State of North Carolina

2023 Hazard Mitigation Plan

December 2022 | FINAL

www.ncdps.gov

TABLE OF CONTENTS

Section 1. INTRODUCTION

1.1 INTRODUCTION TO THE STATE HAZARD MITIGATION PLAN

1.1.1 What is the NC Enhanced Hazard Mitigation Plan?

The North Carolina Enhanced Hazard Mitigation Plan (NCEHMP) is a federally mandated plan that identifies hazards that could potentially affect North Carolina and identifies actions to reduce the loss of life and property from a disaster across the state. The plan is required to have the following components as mandated in the Disaster Mitigation Act of 2000: Planning Process, Risk Assessment, Mitigation Strategies, Coordination of Local Plans; Plan Maintenance; and Plan Adoption and Assurances. All of the requirements for each section are further defined in the 44 CFR §201.4, the FEMA State Plan Review Guide and the FEMA State Plan Review Tool.

The North Carolina Enhanced Hazard Mitigation Plan also serves as the Hazard Identification and Risk Assessment, or HIRA, that informs all other State Emergency Management Plans and planning activities. While the Disaster Mitigation Act of 2000 only requires natural hazards to be identified in the 322 Plan, North Carolina Emergency Management determined that it will be the sole hazard identification and risk assessment source for all hazards. Therefore, the North Carolina Enhanced Hazard Mitigation Plan also includes technological, manmade and human caused hazards.

The main body of the plan is comprised of the following sections: Planning Process, Risk and Vulnerability Assessment, Mitigation Capabilities, Mitigation Strategies, Plan Maintenance, Monitoring, and Implementation. The plan is supplemented with four Appendices that include State Enhanced Plan Review Tool, EMAP Accreditation, Supporting Documentation, Plan Maintenance Records, and Recommendations to the Governor's Cabinet.

The Planning Process section describes how the plan was written and who was involved. This section contains the names of those on the planning teams, the agency they work for and the role each planning team member has for the update and maintenance of the plan. The Risk Management Coordinating Council (RMCC) serves as the advisory committee for the planning process and plan maintenance of the North Carolina Enhanced Hazard Mitigation plan. There is also a North Carolina Emergency Management internal planning team that is responsible for the plan and coordinates its update and maintenance regularly. The Planning Process Section also documents meetings of the planning teams through minutes summaries, meeting attendance summaries and other important information as related to the planning process.

The Risk and Vulnerability Assessment section provides an identification, description and assessment all major natural, technological, manmade and human caused hazards that impact North Carolina. In this context, vulnerability is the extent to which people and property will be adversely affected by a given hazard. The state's degree of vulnerability depends upon the risk of a particular natural hazard occurring (including such factors as scope, frequency, intensity, and destructive potential), as well as the degree to which the population, structures and facilities, economic activity, or environmental resources are exposed. Vulnerability levels are also affected by mitigation policies that are in place to reduce hazard impacts, as well as by policies that may exacerbate the state's vulnerability by facilitating development in hazardous areas. The risk assessment compiles the best available information for use in hazard mitigation policy formulation for the State of North Carolina.

The State of North Carolina continues to make great investments in creating analyses that calculate hazard risks statewide at the building level. This is accomplished through a geospatial approach using multiple GIS datasets and overlaying building data with hazard data. Building footprints are overlayed with the hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve (mathematical model that statistically shows how much damage can be expected due to a particular type of hazard event) is applied to each structure to give the percent damage. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages. The 2018 update of this plan represented the State’s initial attempt to begin integrating risk data into the Enhanced State Hazard Mitigation Plan and that effort has been carried over into this update.

The Capabilities Assessment provides an overview of the State’s capabilities to implement the Mitigation Strategy. It includes: an identification, review, and analysis of the current resources for reducing hazard impacts including an evaluation of State laws, regulations, policies, and other agency programs related to hazard mitigation and development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

The Mitigation Strategy section consists of Goals, Objectives and specific Actions to address mitigation of all hazards making North Carolina as resilient as possible. The goals, objectives and actions are derived after the risk assessment to ensure that they address all hazards. More specific Goals, Objectives. Actions and Measures are identified at a local level in the suite of Regional Hazard Mitigation Plans covering the citizens of all 100 Counties, 552 Municipalities and two Native American Tribes represented in Regional Plans (Eastern Band of Cherokee Indians and the Lumbee Indians statewide.

Coordination of local plans explains how North Carolina Emergency Management provides assistance to local and Tribal governments to update the local hazard mitigation plans, including a description of how the state assists local governments with funding plan updates, the state's review process for local plan updates, and the prioritization process for pursuit of local mitigation grants.

The Plan Maintenance, Monitoring and Implementation section lays out a road map of how the plan will be maintained over the course of the five years cycle. It includes a description of how the process worked in the last five years and how it is changing to improve the process for the next five years. This includes who is responsible, the schedule of maintenance, and template documents to use for maintenance.

The requirements found in 44 CFR §201.4 are embedded into the North Carolina Enhanced Hazard Mitigation Plan as an aid to plan review and maintenance. The North Carolina Enhanced Hazard Mitigation Plan goes above the minimum plan standards to meet the Enhanced Plan requirements as well as all Emergency Management Accreditation Program standards, therefore there are additional sections in the plan that detail additional criteria.

1.1.2 What is the Purpose of the NC Enhanced Hazard Mitigation Plan?

In the year 2000, the 106th United States Congress passed the Disaster Mitigation Act of 2000 (DMA2K) into law to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The purpose of DMA2K is to lessen the vulnerability of citizens to the natural hazards affecting the United States through the strengthening of mitigation efforts at the state and local levels. Section 322 of the DMA2K conditions that each state create a natural hazard mitigation plan to be submitted for approval to the Federal Emergency Management Agency (FEMA). The North Carolina Enhanced Hazard Mitigation Plan has been updated three times since the initial plan was written and approved in 2004. The hazard mitigation plan was initially required by DMA2K to be updated and submitted to FEMA for review and approval every three years. However, in 2014 DMA2K was amended requiring the state plans to be updated and submitted for review and approval every five years.

The hazard mitigation plan ensures that the state remains eligible for Public Assistance Categories C-G and Unified Hazard Mitigation Assistance which consist of the Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities (BRIC) Program, and Flood Mitigation Assistance (FMA) Program. The Hazard Mitigation Grant Program is 15% of the total disaster declaration in additional funds received specifically for mitigation purposes following a Presidential Disaster Declaration. States that maintain "enhanced" hazard mitigation plans are eligible for 20% of the total disaster declaration funds. The Pre-Disaster Mitigation Program and the Flood Mitigation Assistance Program are both non-disaster grants appropriated annually by Congress. All of these funding sources are critical to the State for the purposes of advancing the goals, objectives and actions that comprise the Mitigation Strategy so it is critical that this plan remain a FEMA-approved and meaningful document.

The currently approved plan, the North Carolina Enhanced Hazard Mitigation Plan, was submitted for review to FEMA in 2017 and was approved April 25, 2018 with an April 24, 2023 expiration date. The plan was originally approved in 2005, updated in 2008, 2013, and 2018, this update began in January of 2022 and represents the fifth periodic update of the plan. In addition to addressing the 7 planning components identified in section 201.4 and 201.5 of the 44 Code of Federal Regulations and complying with FEMA mitigation planning policy requirements, this quinquennial update also integrates elements of the State of North Carolina 2020 Climate Risk Assessment and Resilience Plan created under Governor Roy Cooper's October 29, 2018 Executive Order 80.

In anticipation of future FEMA Plan Content Guidance, this plan will include an assessment of the impacts of Global Climate Change on the natural hazards identified in the plan and will begin to assess how issues of social justice and equity will fit into future planning processes, goals and project funding priorities. In addition to these elements, this update also includes, for the first time, an executive summary and a set of recommendations for executive or legislative actions that are beyond the scope and control recognized in the mission of the North Carolina Department of Public Safety's Division of Emergency Management.

1.2 NORTH CAROLINA EMERGENCY MANAGEMENT AS THE RESPONSIBLE AGENCY

1.2.1 Authorities

The North Carolina Emergency Management Act (N.C.G.S. 166A), sets forth the authority and responsibilities of the Governor, state agencies, and local governments in the prevention and mitigation of, preparation for, response to, and recover from natural or manmade disasters.

The North Carolina Emergency Management Act of 1977 (N.C.G.S. 166A-5 (3) (b)), assigns the responsibility for the preparation and maintenance of State's Hazard Mitigation Plan to North Carolina Emergency Management (NCEM).

In June 2001, the North Carolina General Assembly passed Senate Bill 300 (SB 300): An Act to Amend the Laws Regarding Emergency Management (N.C.G.S. 166A) as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, Senate Bill 300 requires that local governments have an approved hazard mitigation plan in place and participate in the National Flood Insurance Program in order to receive State Public Assistance funding.

Following Hurricanes Matthew (2016) and Florence (2018), the North Carolina General Assembly passed significant legislation that committed over $1.4 billion in state funding to disaster recovery, hazard mitigation and resiliency. Through the Disaster Recovery Act of 2016 (over $200 million), the Disaster Recovery Act of 2017 ($100 million), the Hurricane Florence Recovery Act in 2018 (over $850 million) the Storm Recovery Act of 2019 ($258 million) and the state budget of 2021, North Carolina governors Pat McCrory and Roy Cooper and legislators demonstrated their commitment to North Carolina citizens and communities. The policies and programs established through those important pieces of legislation are discussed in more detail in Section 4: Mitigation Capabilities.

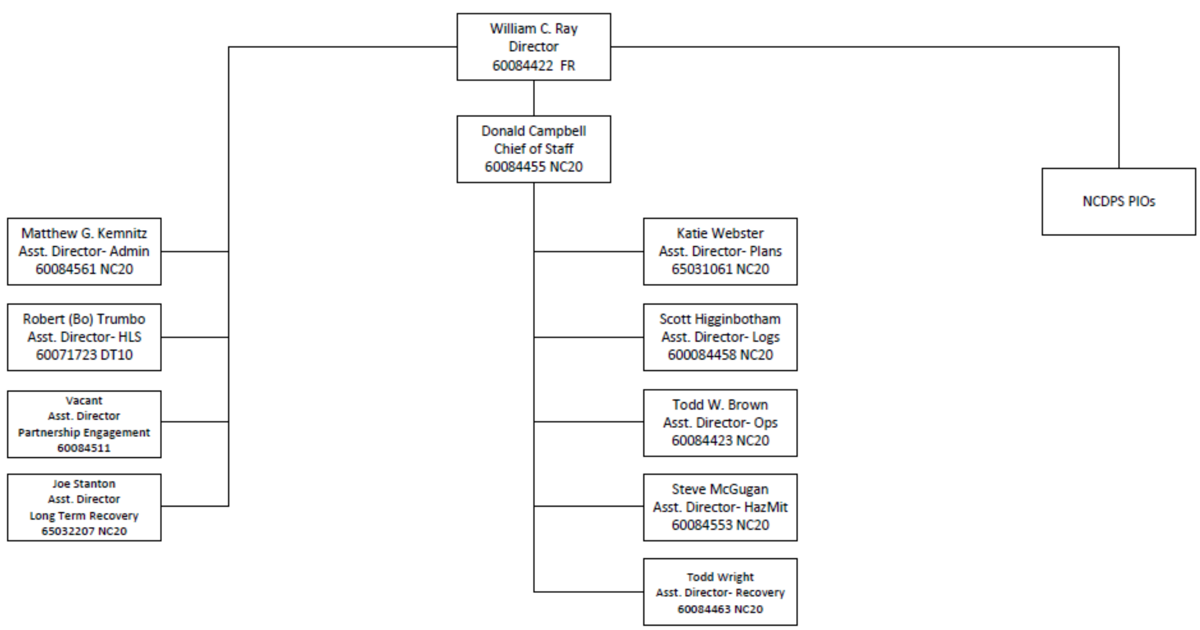
1.2.2 Overview of North Carolina Emergency Management

Organization of North Carolina Emergency Management

North Carolina Emergency Management (NCEM) was created by the Emergency Management Act of 1977 (N.C.G.S. 166-A) and is responsible for protecting the people of North Carolina from the effects of disasters, natural and manmade. NCEM was reorganized in 1997 following Hurricane Fran into functional units, using the national model for managing emergency operations, "Incident Command System" (ICS). This organizational structure mirrors the local incident command structure and the federal Emergency Response Team structure, thus streamlining and simplifying intergovernmental coordination. Since the major reorganization in 1997 following Hurricane Fran, NCEM has undergone several additional reorganizations shaping the agency into the model comprehensive emergency management agency it is today.

The organization chart for NCEM depicting functional branches and programs can be found below:

Figure 1-1 North Carolina Emergency management Organization Chart 2022



The responsibilities and activities of each of these Sections are described in further detail below.

NCEM Responsibilities

The NCEM is responsible for administering many of the disaster assistance programs that are available to states and local governments from the Federal Emergency Management Agency (FEMA), including programs created by the Stafford Act and its amendments. NCEM is responsible for all state department resource coordination before, during and after events as part of the SERT response plan as defined in G.S.166A and furthered detailed in the North Carolina Emergency Operations Plan. NCEM is also the agency charged with administering Homeland Security Grant Program, Emergency Management Preparedness Grant, Recovery Planning and Operations (Individual Assistance and Public Assistance), Mitigation, Floodplain Mapping, National Flood Insurance Program and the Community Development Block Grant – Disaster.

NCEM Branch and Area Offices

In addition to main administrative offices and the State Emergency Operation Center in Raleigh, NCEM operates three Branch Offices which serve as the Regional Coordination Centers during State Emergency Operation Center activations. The Eastern Branch office is in Kinston, the Central Branch operates out of Butner, and the Western Branch is centered in Conover. Each Branch has a manager who has overall responsibility for personnel within the Branch. Each Branch is divided into five Areas, each of which is assigned a coordinator who works directly with the counties within his or her Area to coordinate communication between municipalities, counties and the state, and to provide technical assistance with grants and other aid requests. In addition to the Manager, each Branch Office has a Program Assistant and a two Emergency Management Planners who also assist the counties with Emergency Management Preparedness Grant and Homeland Security Grant Program administration as well as providing technical assistance with maintenance and annual reviews of the local emergency operation plans. The Area Coordinators are capable of providing local emergency operations center overhead support, and are the local government's direct line to mutual aid and state resources upon request.

1.2.2.1 State Emergency Response Team (SERT)

The Division of Emergency Management is also responsible for coordinating the activities of the State Emergency Response Team (SERT). In the event of an emergency, the SERT directs on-site response activities and is capable of directing the total response effort. The SERT provides the technical expertise and coordinates the delivery of the emergency resources used to support local emergency operations. The SERT is composed of representatives of state, local, and federal agencies as well as non-governmental organizations through the North Carolina Voluntary Organization Active in Disasters (NC-VOAD) such as the American Red Cross, Salvation Army, and other groups who coordinate disaster relief and recovery activities. In this way, prompt assistance can be provided to individuals and communities in need following a disaster.

When disaster response and recovery is beyond the capability of local governments and communities, the Governor may use the full resources of the State to support recovery operations. When resource needs are beyond the capabilities of state agencies, mutual aid from other un-impacted local governments and states may be secured using the Statewide Mutual Aid Agreement and/or the Emergency Management Assistance Compact. When the disaster is beyond the capability of both the State and local governments, the Governor may request the President to declare the event a "Major Disaster." This designation authorizes federal financial assistance and resources to supplement state and local response and recovery efforts.

1.2.2.2 State Emergency Response Commission (SERC)

By Executive Order No. 242, dated December 17, 2021, Governor Roy Cooper ordered the continuation of the State Emergency Response Commission (SERC). This Executive Order supersedes and replaces all other executive orders on the subject. It shall remain in effect until December 31, 2023, pursuant to N.C. Gen. Stat.§ 147-16.2 or until rescinded.

The Commission is designated as the State Emergency Response Commission as defined in the Emergency Planning and Community Right-to-Know Act of 1986 enacted by the United States Congress and hereinafter referred to as the "Act." The Department of Public Safety shall provide administrative support and staff to the Commission as may be required. The Commission serves in three roles:

1) The Commission will perform all of the duties required under the Act and other advisory, administrative, regulatory, or legislative actions.
    a. Designate emergency planning districts to facilitate preparation and implementation of emergency plans as required under Section 301(b) of the Act.
    b. Appoint local emergency planning committees described under Section 301(c) of the Act and supervise and coordinate the activities of such committees for each planning district.
    c. Establish procedures for reviewing and processing requests from the public for information under Section 324 of the Act.
    d. Designate additional facilities that may be subject to the Act under Section 302 of the Act.
    e. Review the emergency plans submitted by the local emergency planning committees and recommend revisions of the plans that may be necessary to ensure their coordination with emergency response plans of adjacent districts and state plans.

2) The Commission will act in an advisory capacity to the Homeland Security Advisor to provide input regarding the activities of the North Carolina State Homeland Security Program and the Domestic Preparedness Regions. Specifically, the Commission will:

a. Review the State Homeland Security Strategy to ensure it is aligned with local, state, and federal priorities as required by the United States Department of Homeland Security (DHS), and that its goals and objectives are being met in accordance with program intent.
b. Review applications and subsequent allocations for state and regional homeland security projects funded by DHS grant programs.
c. Review plans for preventing, preparing for, responding to, and recovering from acts of terrorism and all hazards, whether man-made or natural.

3) The Commission will act in an advisory capacity to provide coordinated stakeholder input to the Secretary of the Department of Public Safety/Emergency Management in the preparation, implementation, evaluation, and revision of the North Carolina emergency management program. To this purpose, the Commission will work to:
    a. Increase state and local disaster/emergency response capabilities; and
    b. Coordinate training, education, technical assistance, and outreach activities.

The Secretary of the North Carolina Department of Public Safety shall serve as the Homeland Security Advisor to the Governor and Chairperson of the Commission. The Commission shall consist of not less than 14 members and shall be composed of at least the following persons, or their designee as approved by the Commission Chairperson:

a. Director of Emergency Management, North Carolina Department of Public Safety, who shall serve as the Vice-Chairperson;
b. Director of the State Bureau of Investigation, North Carolina Department of Public Safety;
c. The Adjutant General of the North Carolina National Guard, North Carolina Department of Public Safety;
d. Commander of the State Highway Patrol, North Carolina Department of Public Safety;
e. Secretary of the North Carolina Department of Environmental Quality;
f. Secretary of the North Carolina Department of Transportation;
g. Chief of the Office of Emergency Medical Services, Division of Health Service Regulation, North Carolina Department of Health and Human Services;
h. Assistant State Fire Marshal, Office of the State Fire Marshal, North Carolina Department of Insurance;
i. State Chief Information Risk Officer, North Carolina Department of Information Technology;
j. Director, Division of Public Health, North Carolina Department of Health and Human Services;
k. Assistant Deputy Commissioner of Labor for Occupational Safety and Health, North Carolina Department of Labor;
l. President of the North Carolina Community College System; and
m. Director of the Emergency Programs Division, North Carolina Department of Agriculture and Consumer Services.

In addition to the foregoing, up to eight (8) at-large members from local government, private industry and the public may be appointed by the Governor and serve terms of two (2) years at the pleasure of the Governor. These members may consist of the following persons:

a. A Chief of Police;
b. A Sheriff;
c. A Fire Chief;
d. A representative of emergency medical services in North Carolina;
e. A representative of emergency managers in North Carolina;
f. A representative of medium or large sized public assembly venues in North Carolina;
g. A representative affiliated with the production, storage or transportation of hazardous materials;
h. A private citizen of the state of North Carolina.

In addition, the state is actively involved in critical legislative action in a number of ways. First, high level NCEM staff are in frequent communication with legislators and administrators in the executive branch to ensure that the state's needs are being met with regard to funding and other key resources. This was especially apparent after Hurricane Matthew in 2016 when these relationships resulted in a coordinated effort between NCEM and the legislature to pass the Disaster Recovery Act of 2016. Another way that the state is involved in legislative efforts is through the North Carolina Emergency Management Association which is a key organization in the state that includes many local and state level Emergency Managers and others in the field. In 2017, representatives from the NCEMA traveled to Washington D.C. to visit the offices of North Carolina representatives to discuss national-level emergency management topics and to provide Congressional representatives with opinions and concerns on important issues.

1.2.3 NCEM's Roles and Responsibilities Related to the North Carolina State Enhanced Hazard Mitigation Plan

North Carolina has a long, successful history of implementing hazard mitigation activities. In 1997, the NCEM established a Hazard Mitigation section which had primary responsibility of managing hazard mitigation activities throughout the state including planning and grant development and grant management activities. NCEM's hazard mitigation section was a national leader in pioneering local level hazard mitigation planning through the establishment of the Hazard Mitigation Planning Initiative (HMPI). This program demonstrated success with local hazard mitigation planning and led to the planning requirements found in the DMA2K.

In late 2013 a re-organization occurred within NCEM splitting the Hazard Mitigation Section into two parts. The new organization aligned the Risk Mitigation Planning Branch (formerly known as Hazard Mitigation Planning Branch) and the SHMO under the Risk Management

Section of NCEM. The Risk Management Section housed Floodplain Mapping, National Flood Insurance Program (NFIP), Geographic Information Systems (GIS), Information Technology (IT), North Carolina Geodetic Survey and beginning in 2013, Risk Mitigation Planning. In 2018, the Hazard Mitigation Branch was re-aligned under the Resilience Section of NCEM under the supervision of the Hazard Mitigation Branch Section Manager. In 2022, another reorganization led to NFIP and Risk Management Staff being brought back into the Hazard Mitigation Section.

Under the new organization the SHMO is responsible for Hazard Mitigation Planning. The Hazard Mitigation Plans Supervisor, who is under the SHMO, oversees reviews of local plans and is responsible for leading the development and periodic update of the State's Hazard Mitigation Plan as determined by state and presidential disaster declarations, law, policy changes and innovations in hazard mitigations planning and activities.

Between the years of 2000 and 2014 the State Hazard Mitigation Officer (SHMO) held the responsibility of leading the State Hazard Mitigation Advisory Group (SHMAG) and the update process of the State's Hazard Mitigation Plan. As part of the re-organization of NCEM the SHMAG was dissolved and the duties have been placed on the Risk Management Coordinating Council (RMCC). More details about the RMCC can be found in Section 2, Planning Process.

1.2.4 Plan Adoption and Approval

The State of North Carolina will formally adopt the North Carolina Enhanced Hazard Mitigation Plan upon receipt of Federal Emergency Management Agency's (FEMA) "Approved Pending Adoption" status. The plan will be formally adopted by the Governor or their designee. The FEMA Approval Letter and the formal adoption letter will then be integrated into the NC Enhanced Hazard Mitigation Plan.

1.2.5 Assurances

The NCEHMP update was drafted to meet the requirement for a Standard State Plan under Rule 44 CFR 201.4, and the requirements of the Enhanced State Plan under Rule 44 CFR 201.5 published by the Office of the Federal Register. The State currently meets and will continue to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d). Continuing to meet the requirements of the regulations noted above keeps the state of North Carolina qualified to obtain all disaster assistance including Hazard Mitigation Grant Program funding available through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended, and Unified Hazard Mitigation Assistance (UHMA) which includes the following funding streams: Hazard Mitigation Grant Program funding, Pre-Disaster Mitigation Program funding, and Flood Mitigation Assistance Program funding.

The State of North Carolina assures that it will continue to monitor all applicable Federal statutes and regulations as referred to on FEMA Approval Letters for each respective grant award, to include management cost projects. The State closely monitors federal compliance as it works to develop and implement current projects, and while closing previous disaster as well as non-disaster grants to ensure full programmatic compliance with federal requirements.

Section 2. PLANNING PROCESS

44 CFR Reference

Requirement §201.4(b) Planning process. An effective planning process is essential in developing and maintaining a good plan. The mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, interested groups, and be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives.

Requirement §201.4 (c) Plan content. To be effective the plan must include the following elements: (1) Description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.

2.1 GENERAL DESCRIPTION

This section serves as documentation of the planning process utilized to develop the 2023 update to the State of North Carolina's Enhanced Hazard Mitigation Plan as required for Standard State Mitigation Plans under the Disaster Mitigation Act of 2000 (DMA 2000), Sections 201.4(c)(1) and 201.4(b) of the Standard State Hazard Mitigation Plan criteria, which addresses Documentation of the Planning Process, Coordination Among Agencies, and Program Integration.

The following paragraphs generally summarize the revisions made to this plan during the 2023 update.

Planning Process

The planning process used to conduct the 2023 update built upon the success of the 2018 update which used the Risk Management Coordinating Council and Key State Stakeholder interviews to conduct the process. The Planning Process section has been updated to reflect the most up-to-date membership of the RMCC and the Key State Stakeholder meetings held during the update.

Risk and Vulnerability Assessment

As part of the previous (2018) plan update process, NCEM Hazard Mitigation staff and their consulting team reviewed the existing hazard identification, hazard descriptions, and the risk assessment. Through meetings with natural hazard experts from across the state that provided a comprehensive representation of knowledge across all meteorological and geologic natural hazards that affect North Carolina, the risk and vulnerability assessment was completely reorganized. In coordination with NCEM and these hazard experts, the consulting team collected preliminary information on previous occurrences, projections of future occurrences, and geographic locations of hazard events, which were later revised and supplemented with additional background research. With this information in hand, the planning team of NCEM and their consultants were able to develop a comprehensive analysis of risk across the state on a county-by-county basis.

The 2023 plan update process built upon the 2018 planning efforts and was updated to reflect changes in hazard occurrences and prioritization of the hazards. This included coordinating closely with State agencies such as the State Climate Office, the Department of Environmental Quality, the Department of Health and Human Services and many others that have specialized expertise with particular hazards. Particular care was taken to integrate climate projections from the 2020 North Carolina Climate Science Report and the 2020 North Carolina Climate Risk Assessment and Resilience Plan during this update.

Mitigation Strategy

The implementation of the new format of the North Carolina Enhanced Hazard Mitigation Plan in 2018 changed the section number of the Mitigation Strategy Section of the plan to Section 5. It includes the Goals, Objectives, and Actions of the plan. Some of the changes to the Mitigation Strategy Section made during that update are highlighted below:

- the single goal was revised and additional goals were added;
- the objectives were changed to be the milestones of the goals; and
- actions were reviewed for cost effectiveness, overall feasibility, availability of potential funding, political will, and to meet the SMART action criteria.

SMART is an acronym for Specific, Measurable, Achievable, Relevant, and Time-Bound. This was a new concept to the North Carolina Enhanced Hazard Mitigation Plan for the 2018 update and has been carried over into the 2023 update.

Hazard Mitigation Planning staff reviewed the mitigation actions and made recommendations for revisions to the primary responsible agency through the RMCC members, various subject matter experts, and other stakeholders. After discussion with the responsible agencies, some actions have been identified for deletion and some new actions have been added. The deleted actions have been removed from the “Active” actions and put below in a new sub-section of the Mitigation Strategy Section.

Coordination of Local Mitigation Planning

In 2018, the planning staff made some substantial changes to the part of the plan related to coordinating with local mitigation planning. This was especially notable in the Risk and Vulnerability Assessment which included a new methodology for evaluating local risk assessments (see section 3.4.5.1). That being said, the same basic process remains in place for coordinating local mitigation planning as described in Section 4. The major change over the past five years was that the planning staff became more adept at implementing the process and helping local governments develop their plans.

Plan Maintenance

Hazard Mitigation Planning staff reviewed and made minimal grammatical revisions to this section of the plan. In this review, it made sure the plan maintenance process was still applicable and that it could be easily implemented.

Climate Change Strategy

The 2023 Plan Update aims to integrate climate change considerations into the plan to fully depict the state's present and anticipated climate. North Carolina has already begun to experience the impacts of the changing climate and acknowledges the need to assess potential future effects if conditions continue to follow the current trajectory. Based on findings and supplemental information gathered from the North Carolina Climate Science Report (NCCSR) and included within the Hazard Profiles, climate adaptation and resilience strategies, where relevant and appropriate, will be included to address new or exacerbated vulnerabilities.

In addition to the NCCSR, the 2020 North Carolina Climate Risk Assessment and Resilience Plan was used to guide the narrative on climate change within the 2023 Plan Update. The report offered ample information pertaining to key observations, critical impacts and potential resilience strategies. Strategies proposed within the assessment will be incorporated into the updated hazard mitigation plan to ensure a sense of continuity and correspondence between the state's major planning documents.

2.2 TIMELINE AND MILESTONES

The State of North Carolina developed their first State Hazard Mitigation Plan in 2004. Updates to the plan have been completed in 2007, 2010, 2013 and 2018. Information about the planning processes used to develop previous version of this plan can be found within those plan documents, which are available upon request from NCEM. The process of updating the 2023 version of the plan began in May of 2021 with the first meeting of the RMCC.

Next, planning staff identified specific actions of representative agencies and coordinated with key points of contacts to address the status and validity of mitigation actions and objectives. Once information for various sources was collected, this information was incorporated into the plan and completed by the mitigation planning team members. Each updated section was combined into a complete document for review by the SHMO, the RMCC, and stakeholders. A point of contact was identified for each agency represented in the Capabilities section of the plan, and each agency was contacted and asked to review the material contained within the plan relevant to their agency for currency, accuracy, and continued relevance.

During the plan update, the SHMO and Hazard Mitigation Planning staff participated in numerous conferences, workshops, meetings, and teleconference calls to discuss planning objectives, milestones, and improvements for both state and local plans.

Throughout the update process, important data was collected from a variety of sources, including the National Weather Service, National Centers for Environmental Information, State Climate Office, North Carolina Office of Recovery and Resiliency, North Carolina Department of Environmental Quality, NCEM-Risk Management and many other local, state, and federal partners. This data was analyzed and incorporated into different sections of the plan, including the Risk and Vulnerability Assessment, Mitigation Capabilities, and Mitigation Strategy. New data was included pertaining to population, climate change, economic activities, frequency of hazard events, and mitigation actions. Much of this information was obtained through meetings and communication with identified points of contact described below. Once all necessary new data was collected and integrated into the plan, it was submitted to stakeholders for final approval and then submitted to FEMA for review and approval.

2023 Update

Conversations regarding the 2023 update of this plan began as early as 2019 when Executive Order 80, addressing the State's response to climate change impacts, was passed and initial coordination for the update began between state agencies such as NCEM, newly-established NCORR, and NCDEQ. The Hazard Mitigation Branch, Planning Section applied for funding to conduct the update under DR-4568 (Hurricane Isaias). Staff recognized the need to secure funding in order to hire contractor support with facilitating the planning process and with updating the Risk and Vulnerability Assessment.

The planning process was coordinated through two overlapping processes: 1.) through coordination with the Risk Management Coordinating Council and 2.) through Key State Stakeholder interviews. More detail about specific meetings with the RMCC can be found in Section 2.3 below.

In February of 2022, NCEM selected the consulting team of ESP Associates, Wood, Fernleaf Interactive, Insight Planning and Punchard Consulting to provide consultant support for updating the plan and helping facilitate the planning process. An internal planning team made up of the Hazard Mitigation staff and the consulting team began meeting in February of 2022 and met weekly until the plan draft was completed in late September 2022. Table 2-1 below provides a summary of the meetings held with NCEM Hazard Mitigation staff and the consultant team during the update of this plan.

Table 2-1. Summary of Meetings with NCEM Hazard Mitigation Staff and the Consultant Team

NCEM Hazard Mitigation Staff and Consultant Team Meetings		
Meeting Theme	Date of Meeting	
State Plan Update Kickoff	02/10/22	
NC Enhanced State HM Plan Weekly Meeting	02/17/22 02/24/22 03/03/22 03/10/22 04/01/22 04/07/22 04/21/22 04/28/22 05/19/22 06/02/22	06/08/22 06/16/22 06/23/22 07/07/22 07/13/22 07/21/22 07/28/22 08/04/22 08/18/22 09/01/22 09/15/22
Mitigation Strategy Discussion	09/14/22	

2.3 PLANNING TEAM

The process for coordinating with federal, state, local, and other interested groups involved the Hazard Mitigation staff increasing outreach efforts to develop hazard-specific points of contact and subject matter experts. The SHMO led this effort with the maintenance and update of the RMCC list (Table 2-2) and by attending various conferences, work groups, and community meetings. These meetings allowed the state to highlight the importance of a state and local planning process and comprehensive program management. During the 2023 update, the planning team evaluated the process for coordinating with federal and state agencies and, although some changes to the process were noted, the coordination process remained basically the same.

Table 2-2. Risk Management Coordinating Council Membership (2023)

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
Mike Abraczinskas	NCDEQ – Division of Air Quality		Yes
Klaus Albertin	NCDEQ – Division of Water Resources		Yes
Debora Antley	NC Department of Information Technology		
Darryl Aspey	Department of Homeland Security		
Greg Atchley	NCEM Western Branch		
Carl Baker	NCEM – Hazard Mitigation	Yes	Yes
Ramona Bartos	NC Historic Preservation Office	Yes	Yes
Rishi Bastakoti	NCDEQ – Division of Water		Yes

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
	Resources		
Tim Baumgartner	NC Division of Mitigation Services – Environmental Enhancement Program		
Jacky Bell	FEMA Region IV	Yes	
Meg Benedetti	NCEM – Hazard Mitigation	Yes	
Keith Milly	NCDOT		Yes
Gail Bledsoe	NC Department of Agriculture and Consumer Services	Yes	
John Boland	Johns Hopkins University		
Matthew Booker	NC State University	Yes	
Richard Bolyard	NC Department of Insurance	Yes	
Jacob Boyd	NCDEQ – Division of Marine Fisheries		Yes
Randa Boykin	NCDEQ – Environmental Justice		Yes
Adrienne Burney	NCDCR	Yes	
Scot Brooks	NC Emergency Management Association		
Marlena Byrne	NCORR	Yes	Yes
Julie Casini	NC Department of Health and Human Services		
Julie Coco	NCDEQ – DEMLR – State Sedimentation Control Manager		Yes
Josh Colley	NCDEQ – DEMLR – NC Dam Safety Program		Yes
James Collins	NCEM	Yes	
Adrian Cox	NCDHHS – Public Health and Preparedness		Yes
Lee Cox	NC Department of Health and Human Services		
Chris Crew	NCEM – Risk Management	Yes	Yes
Diane Curtis	NCEM – Eastern Branch		
Todd Davidson	NOAA Coastal Hazards Center		
Cecelia Davis	FEMA Region IV Hazard Mitigation	Yes	
Corey Davis	NC State Climate Office		Yes
Matthew Davis	NCDEQ – State Energy Office	Yes	Yes
Kathie Dello	NC State Climate Office	Yes	
Matthew Dolge	NC Association of Regional Councils of Government		
Ryan Draughn	NC League of Municipalities		
Greg Eades	EPA		
Rebecca Ellin	NC Coastal Reserve & National Estuarine Research Reserve		
Paul Ervin	NCEM		Yes
Laura Fairchild	NCDHHS – Emergency Management Officer		Yes

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
Anna Ferrante	NCEM Planning		Yes
Edward Finley	NC Utilities Commission	Yes	
Brent Fisher	NCEMA President – Nash County		
Matt Flint	USDA		
Richard Flood	FEMA Region IV		
Evelyn Foust	Epidemiologist Section		Yes
James Fox	UNC Asheville, National Environmental Modeling		
Gerald Galloway	University of Maryland		
Rich Gannon	NCDEQ – Division of Water Resources		Yes
Steve Garrett	NC NFIP Coordinator	Yes	Yes
Jason Glazener	USACE – Wilmington	Yes	Yes
Renee Gledhill-Early	NC Department of Cultural Resources		
Shanae Godley	NCDHHS Public Health Preparedness and Response		Yes
Wayne Goodwin	NC Department of Insurance		
Frank Gorham	NC Department of Environment Quality, Coastal Resource Commission		
Virginia Guidry	NCDHHS – Occupational & Environmental Epidemiology		Yes
Dennis Hancock	NCEM Central Region	Yes	
Dot Henderson	NCEM Deputy Recovery Chief	Yes	
Brent Herron	UNC Campus Safety & Emergency Operations		
Greg Hicks	NCAG		
Ginger Holthaus	NC DPS		
John Howard	NC Department of Agriculture & Consumer Services		
Frank Jennings	NCDEQ - Division of Coastal Management		
Corey Johnson	NCEM Planning		Yes
Jimmy Johnson	NCDEQ – Division of Marine Fisheries		Yes
Thomas Johnson	Western Carolina University		
Michael Kelly	NC Association of County Commissioners	Yes	
David Korte	NCDEQ – DEMLR – USGS Geologist		Yes
Renee Kramer	NCDEQ – Environmental Justice		Yes
Josh Krisenski	NCDEQ- DEMLR		Yes
Jamie Kruse	ECU, Center for Natural Hazards Research	Yes	

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
David Lane	NC Department of Agriculture & Consumer Services		
Tom Langan	NCEM		Yes
Matthew Lauffer	NCDOT – Hydraulics		Yes
Steve Lewis	NC Department of Environment Quality		
Autumn Locklear	NCDHHS – Climate and Health Epidemiologist		Yes
Mike Lopazanski	NC Division of Coastal Management		
Rick Luettich	UNC-Marine Sciences		
Dan Madding	NCEM – GIS	Yes	
Edwardine Marrone	FEMA Region IV Mitigation Planning	Yes	Yes
Nancy Marsh	EPA (Region 4) Ground Water		
Amanda Martin	NCORR		Yes
Carl Martin	NC Department of Insurance	Yes	
Sushma Masemore	NCDEQ	Yes	
Steve McGugan	NCEM – Hazard Mitigation	Yes	Yes
Dr. R. Douglas Meckes	NC Department of Agriculture & Consumer Services	Yes	
Megan Mellia	ECU		
John Mello	NCEM – Hazard Mitigation		Yes
Carl Mickolonis	FEMA Region IV – Mitigation Planning		
David Miller	NCDEQ – DEMLR – State Mining Engineer		Yes
Tancred Miller	NC Division of Coastal Management		Yes
Todd Miller	NC Coastal Federation		
Gray Minton	AECOM – Subject Matter Expert		
Jesse Munoz	FEMA Region IV		
Burt Neily	NC Department of Administration - State Construction		
Kelly Nilsson	NCAG	Yes	
Lee Padrick	NC Department of Commerce	Yes	
Louis Panzer	NC 811		
Adam Parr	NCDEQ- DEMLR – State Mining Program		Yes
Nick Petro	NOAA/NWS, Raleigh Weather Forecast Office		
Kevin Phillips	NCEM – Grants Supervisor		
Jason Pleasant	NCEM – Grants Supervisor	Yes	
Brandon Puckett	NC Coastal Reserve & Nat'l Estuarine Research Reserve		
Darrin Punchard	Punchard Consulting	Yes	

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
Terry Quarreles	FEMA Region IV - Public Assistance (406)		
Wayne Randolph	NCDEQ – Division of Waste Management		Yes
Spencer Rogers	NC State – NC Sea Grant	Yes	
MaryCait Russell	NCDHHS – CRI Regional Planning		Yes
Stan Riggs	ECSU		
Linda Rimer	EPA		
Jeanne Robbins	USGS		
Spencer Rogers	NC Sea Grant (NC State)		
Terri Ruch	USDA-NRCS		
Cindy Safrit	NC Department of Ag & Consumer Services		
Beth Schrader	NCDEQ- State Energy Office		Yes
Cory Scheip	NCDEQ USGS		
Mina Shehee	NC Department of Health and Human Services		
Aaron Sims	NC State Climate Office		
Art Singupta	NCDEQ – Dam Safety		
Wesley Sketo	NC Forest Service		Yes
Matt Slagel	NCDCM		
Nathan Slaughter	ESP Associates	Yes	Yes
Danny Smith	NCDEQ – DEMLR – Stormwater Permitting		Yes
Gavin Smith	UNC Chapel Hill		
Johnathon Snell	NCDHHS – Public Health Preparedness and Response		Yes
Jim Stanfill	NCDEQ – Division of Mitigation Services		Yes
Joe Stanton	NCEM Recovery	Yes	
Randy Strait	NCDEQ – Division of Air Quality		Yes
David Stroud	Wood	Yes	Yes
Dianne Suess	NOAA/NWS Space Weather Prediction Center		
Ken Taylor	NC Geologic Survey	Yes	Yes
Gary Thompson	NC Geodetic Survey	Yes	Yes
Hannah Thompson	NC Forest Service	Yes	Yes
Maria Thompson	NC Department of Information Technology		
Mackenzie Todd	NCDEQ – Division of Coastal Management		Yes
Debbie Tomasko	NC Local Government Commission	Yes	
Jay Twisdale	NCDOT - Hydraulics	Yes	
Chris Vaughn	FEMA	Yes	
Toby Vinson	NC Division of Energy, Mineral,	Yes	Yes

Name	Agency	Attended May 11, 2021 RMCC Meeting	Participated in Key State Stakeholder Interviews
	and Land Resources		
Chad Wagner	USGS North Carolina Office		
Ashley Ward	Duke University		
Rebecca Ward	NC State Climate Office		
J Curtis Weaver	USGS South Atlantic Water Science Center		
Andrea Webster	NCORR		Yes
Katy Webster	NCEM Planning	Yes	Yes
Carl Williams	NCDHHS – State Public Health Veterinarian		Yes
Rachael Wolff	NC Division of Energy, Mineral, and Land Resources, NC Dam Safety		Yes
Brian Wrenn	NCDEQ – DEMLR		Yes
Todd Wright	NCEM	Yes	

The first meeting with the RMCC for the 2023 plan update was held virtually on May 11, 2021. The purpose of the meeting was to lay out the vision of the council and to solicit initial feedback on needs for the plan 2023 update.

2.4 KEY STATE STAKEHOLDER INVOLVEMENT

2.4.1 Governmental Agencies

As described above, the RMCC served as the official stakeholder group for coordinating the 2023 plan update process. In addition to the meetings described in Section 2.3, Hazard Mitigation staff and the consulting team held meetings with individual State and Federal agencies that serve on the RMCC to collect feedback on the plan in a more personal setting. Separate meetings were held with representatives from the following governmental agencies:

- United States Army Corps of Engineers
- North Carolina Department of Health and Human Services
    - Division of Public Health
- North Carolina Housing Finance Agency
- North Carolina Department of Agriculture
    - North Carolina Forest Service
- North Carolina Department of Environmental Quality:
    - Division of Air Quality
    - Division of Coastal Management
    - Division of Energy, Mineral and Land Resources
        - NC Dam Safety Program
        - NC Geological Survey

  - Division of Environmental Assistance and Customer Service
  - Division of Environmental Education and Public Affairs
  - Division of Marine Fisheries
  - Division of Mitigation Services
  - Division of Waste Management
  - Division of Water Infrastructure
  - Division of Water Resources
  - State Energy Office
- North Carolina Department of Natural and Cultural Resources
  - North Carolina State Historic Preservation Office
- State Climate Office of North Carolina
- North Carolina Department of Insurance
  - North Carolina Office of State Fire Marshall
- North Carolina Office of Recovery and Resiliency
- North Carolina Department of Transportation

The purpose of the meetings was to review specific information from those stakeholders related to the risk assessment (discussion of data needs and identification of any new data relevant for the plan update), capability assessment (updating existing capability assessment narratives and providing any new relevant information), and mitigation strategy (updating existing actions and providing any new actions). State agency stakeholders were also queried to learn about they are considering and addressing climate resilience and about any recommendations they have for how the State can better address issues of equity and social vulnerability as part of the mitigation strategy.

This process first began during the 2018 update of the plan and was continued for the 2023 update. These meetings were very productive as these stakeholders provided information and led to new data being incorporated into the plan, mitigation action updates and new mitigation actions and updated capability assessment information.

Table 2-3 below provides a summary of these meetings including the stakeholder, main topic discussed at the meetings and the dates of the meetings.

Table 2-3. Summary of Stakeholder Meetings

Summary of Stakeholder Meetings	
Stakeholder (Discussion Topic)	**Date of Meeting**
North Carolina Emergency Management (NCEM) Planning Section	02/28/22
NCEM Risk Management	03/08/22
North Carolina Office of Recovery and Resiliency	03/09/22
Department of Environmental Quality (DEQ) Environmental Justice	04/18/22
DEQ Department of Energy, Mineral and Land Resources	04/27/22
Department of Health and Human Services	05/10/22
State Climate Office	05/24/22
DEQ Division of Air Quality	05/25/22

Summary of Stakeholder Meetings	
DEQ Marine Fisheries	06/08/22
NC Forest Service	06/21/22
Division of Coastal Management	06/23/22
United States Army Corps of Engineers	06/30/22
DEQ Division of Waste Management	07/01/22
NC DHHS Division of Public Health	07/29/22
NC Department of Transportation	08/10/22
NC Department of Agriculture	08/26/22

In addition to regular RMCC representatives, state and local government representatives, emergency management practitioners, and subject matter experts were invited to comment on the plan.

2.5 PUBLIC INVOLVEMENT

For the 2023 update, NCEM provided opportunities for all citizens of North Carolina to provide input into the plan update process and to review the draft plan. This was done to help ensure an open and equitable planning process.

NCEM Hazard Mitigation made the 2018 plan available on their website and requested comments to be considered for the 2023 update.

The draft plan was made available for public review on September 21, 2022 through October 14, 2022 for a period of 24 days.

All comments received were reviewed, considered and integrated into this plan as appropriate. A copy of the comments received, and how they were vetted for the plan can be found in Appendix C.

2.6 REVIEW AND INTEGRATION OF OTHER PLANNING FUNCTIONS

The State of North Carolina continues to be proactive in developing, implementing, and sustaining hazard mitigation planning and activities with federal, tribal, state, local, and nongovernmental agencies and programs. Through partnerships with RMCC members and participation on various panels and work groups, risk mitigation planning efforts have been integrated to provide solutions to hazards identified in the State Enhanced Hazard Mitigation Plan and to become more disaster resilient. To maintain a high level of performance, knowledge of mitigation trends, and technology, the SHMO and Hazard Mitigation Staff attend various trainings, conferences, and local meetings to augment ability to provide technical assistance to customers, RMCC members, and mitigation partners statewide. Hazard Mitigation Staff coordinates with locals through 3 regional branches, with a total of 15 area specific coordinators who serve as intermediaries between local governments and staff in the office.

A summary of how Hazard Mitigation staff works with local, State and Federal agencies to integrate hazard mitigation into other State planning processes and planning initiatives is found below.

2.6.1 Integration with State Planning Programs

Division of Emergency Management Planning Section

The State Hazard Mitigation Branch coordinates regularly and works very closely with the State Planning and Homeland Security Branch. This branch of NCEM is responsible for the State Emergency Operations Plan, THIRA, Radiological Emergency Plans, Strategic Plan, Division Directives, SARA Title III (Emergency Planning Community Right to Know Act), and the Continuity of Operations Plan. While their focus is generally Response and Preparedness statewide, staff works closely with them to ensure all hazards are identified as part of the All-Hazards approach adopted by NCEM. The mitigation plan serves as the single Hazard Identification and Risk Assessment (HIRA) for all plans within NCEM. During review and update of all NCEM Plans and After-Action Reports, staff look at response and vulnerability to population, property, infrastructure, and development which is integrated using the HIRA from the NCHMP. Goals, risk assessments, threat assessments, and hazard identification efforts in local communities and statewide are also utilized in this effort.

State Floodplain Mapping Program

The State Hazard Mitigation Planning Branch coordinates regularly and works very closely with the Floodplain Mapping program. This program is the basis by which many communities assess their flood hazards and how the state, as a whole, looks at flooding vulnerability to existing and future structures and development. Floodplain Mapping works across the state to help communities plan for development and avoid flooding in their communities, which is tied very closely to mitigation planning efforts in local communities and statewide. The efforts made by floodplain administrators have led to changes in the International Building Code to include freeboard for development in floodplains across North Carolina. The risk and vulnerability assessment utilized in this plan identifies areas that are subject to NFIP requirements.

Division of Coastal Management (A Division of NC Department of Environmental Quality)

The SHMO provides courtesy reviews of Coastal Area Management Act (CAMA) Land Use Plan updates for the 20 coastal counties upon request from DEQ. The review is designed to ensure that CAMA plans and hazard mitigation plans are consistent. Also, the State Hazard Mitigation Branch coordinates with the Division of Coastal Management (DCM) when it comes to working in designated CAMA counties. For projects planned in these counties, staff coordinated with DCM to ensure that work will not conflict with an area of Environmental Concern according to CAMA regulations.

North Carolina Department of Transportation Coordination

The State Hazard Mitigation Branch coordinates with NCDOT's Project Development Unit any time there is a potential hazard mitigation project underway. NCEM sends NCDOT information about the location of the project, and they review it against their future plans to ensure no future conflict with deed restricted property and future road projects. Additionally, NCEM and NCDOT coordinate regularly to share data related to hazards and hazard impacts for pre-event and post-event planning purposes.

North Carolina State Geologist

Since the development of the 2004 State Hazard Mitigation Plan, North Carolina has attempted to gain funding to support mapping of landslides. This program gained funding and operation beginning in 2005 and operated through 2011. The program was then defunded through 2018 and regained time-limited funding through 2021. The North Carolina landslide hazards mapping program regained full-time funding in fiscal year 2022. The program created landslide inventory and susceptibility maps for landslide prone western North Carolina and makes this information available to other government agencies, emergency response and the public (landslidesncgs.org)

Other recent work with the State Geologist has included outreach about the earthquake hazards in the western part of NC. The State Hazard Mitigation Branch has worked with the State Geologist to develop a curriculum about earthquake hazards in NC to help communities and the state as a whole plan for earthquakes.

North Carolina Housing Finance Agency

Since its creation in 1973 by the General Assembly, the North Carolina Housing Finance Agency (NCHFA) has financed more than 255,000 affordable homes and apartments for North Carolina citizens. Its mission is to create affordable housing opportunities for North Carolinians whose needs are not met by the market.

NCHFA is a self-supporting public agency. The Agency operates federal and state housing programs including the Low-Income Housing Tax Credit Program and the North Carolina Housing Trust Fund and provides financing through the sale of tax-exempt bonds and mortgage-backed securities. NCHFA also administers the federal HOME program for North Carolina, a block grant from the Department of Housing and Urban Development to finance affordable homes and apartments developed by local governments, nonprofits, and private entities.

Using these and other sources of funds, including its own earnings, the Agency provides a variety of services ranging from low—cost mortgages and down payment assistance for qualified home buyers, helping local governments, non-profit organizations, and private entities develop affordable homes and apartments, financing the development of supportive housing for those with unique housing needs, financing the rehabilitation of substandard owner-occupied homes statewide, and providing foreclosure prevention help in partnership with HUD-approved housing counseling agencies.

In response to damage from Hurricane Matthew and Tropical Storms Julia and Hermine the Essential Single-Family Rehabilitation Loan Pool – Disaster Recovery was created. The source of funds includes specially-appropriated loan funds from the NC General Assembly. The NCHFA is working closely with NCEM and NC Department of Commerce.

Post Hurricane Matthew, Resilient Redevelopment Planning Initiative

In October 2016, Hurricane Matthew caused widespread destruction in the State of North Carolina. At least 26 people lost their lives, and 100,000 homes, businesses, and government buildings sustained damage estimated at $4.8 billion.[1] At the storm's peak, 3,744 individuals fled to 109 shelters across the region. More than 800,000 households lost power and 635 roads were closed, including the major east-west and north-south corridors.

In December 2016, the North Carolina General Assembly established the North Carolina Resilient Redevelopment Planning (NCRRP) program as part of the 2016 Disaster Recovery Act (*Session Law 2016-124*). The purpose of the program is to assist the communities that were damaged by the hurricane by providing a roadmap for community rebuilding and revitalization. The program empowers communities to prepare locally driven recovery plans that identify redevelopment strategies, innovative reconstruction projects, and other necessary actions to allow each community not only to survive, but also to thrive in an era when natural hazards are increasing in severity and frequency. The NCRRP consists of planning and implementation phases and was managed through NCEM.

These planning documents provided a snapshot of the current needs of the impacted counties with regard to holistic recovery and redevelopment. The plans will evolve as the counties analyze the risk to its assets, identify needs and opportunities, determine the potential costs and benefits of projects, and prioritize projects. As projects are more fully defined, the potential impact on neighboring communities and the region may lead to modifications.

Hazard Mitigation Branch staff attended many of the meetings that were held during the development of the Resilient Redevelopment Plans (RRP). They provided input and technical assistance (particularly in how hazard mitigation should be related and integrated into the RRPs) that was used by the stakeholder groups as they developed their plans.

Health and Social Services

The North Carolina Department of Public Health and Human Service, Division of Public Health, Office of Public Health Preparedness and Response provides representation on

---

[1] *State of North Carolina Supplemental Request for Federal Assistance Hurricane Matthew Recovery, https://governor-new.s3.amazonaws.com/s3fs-public/documents/files/Hurricane%20Matthew%20Relief--2017%20Federal%20Request%20%28002%29.pdf.*

the Risk Management Coordinating Council and has contributed their knowledge and expertise to the development of the Enhanced State Hazard Mitigation Plan. Their participation in the RMCC opened new channels of communication between NCEM and the Division of Public Health to address the critical issues of communicable disease and bioterrorism and other public health hazards that are being integrated into this plan.

Coordination with Local Governments

A tool that is used to help the state promote mitigation efforts at the local level is for Hazard Mitigation staff to provide outreach, technical assistance, and guidance to local governments to ensure that information contained in their individual hazard mitigations plans meets the requirements set forth in the 44 CFR and is consistent with the state's mitigation goal.

Our office has adopted an outreach strategy that helps communities to produce viable and relevant hazard mitigation plans and establishes relationships that continue throughout the local and state hazard mitigation plan update cycle.
Through amplified outreach activity, the Hazard Mitigation Branch staff provides technical assistance to community officials through scheduled meetings, conferences, and trainings to provide information on the annually available non-disaster mitigation program funding: the Building Resilient Infrastructure and Communities (BRIC) and Floodplain Mitigation Assistance (FMA) program. The outcome of this effort is the development of mitigation activity that may be funded through these programs, thus making the community more resilient to natural hazards.

NCEM, FEMA, and various state and local government officials work to develop and implement project management efforts based on information from communities that have identified mitigation opportunities. This coordination effort provides an opportunity for the Hazard Mitigation Branch to share information to help expedite the development and implementation of mitigation projects as well as recovery from events.

Other examples of coordinating and integrating mitigation efforts with other State Agencies can be found in Section 4, Mitigation Capabilities.

2.6.2 Integration with FEMA Mitigation Program and Other Federal Initiatives

The State of North Carolina Division of Emergency Management has and will continue to seek federal partners to assist the state improve the overall quality of life for its citizens through administration of mitigation activities. We believe that coordination and planning with our federal partners will heighten state resilience against all hazards. The FEMA and federal programs that we administer and/or provide assistance include:

- Hazard Mitigation Assistance Programs
    - The Hazard Mitigation Grant Program (HMGP)
    - The Flood Mitigation Assistance (FMA) Program
    - The Building Resilient Infrastructure and Communities (BRIC) Program

- Public Assistance (PA)
- Individual Assistance (IA)
- Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program
- Earthquake Consortium Grant
- Emergency Management Performance Grants Program (EMPG)
- Homeland Security Grant
- Disaster Unmet Needs
- Increased Cost of Compliance (ICC)
- National Floodplain Management Program (NFIP)

Given the ever-changing climate, communities are looking for ways to incorporate whole community concepts while maintaining open space property to help reduce vulnerability. As such, we coordinate with FEMA on requests for variances from communities to utilize properties as farms, parks and various other uses allowed under 44 CFR.

Public Assistance, Individual Assistance and Various Stakeholders

After a presidential declaration, NCEM, FEMA, SBA, and various federal, state, and non-profit organizations operate in a Joint Field Office (JFO) setting. The state's Resiliency Section consists of the Public Assistance, and Individual Assistance Branches. The Resiliency Section coordinates closely with FEMA in those situations to cultivate a cooperative approach for outreach, identification, development, and implementation of potential mitigation opportunities.

Potential applicants are briefed on mitigation opportunities that are available under the Hazard Mitigation Program. Hazard Mitigation staff also works with our FEMA, state, and local partners to complete Preliminary Damage Assessments (PDA) as well as mitigation planning and outreach efforts to identify 406 and 404 mitigation opportunities.

Emergency Management Accreditation Program (EMAP)

Developed through the collaboration of the International Association of Emergency Managers (IAEM), National Emergency Management Association (NEMA), Federal Emergency Management Agency (FEMA), and other related agencies, EMAP is a voluntary accreditation process for federal, state, county, and municipal emergency response agencies. The accreditation process was developed to provide a framework for accountability and continuous improvement at the state and local level.

The North Carolina Division of Emergency Management gained EMAP initial accreditation in November of 2008, received re-accreditation 2013, and again in 2018. During the 2018 update, Hazard Mitigation coordinated with the Division's Planning and Homeland Security Section to update the Mitigation Standards required for continued accreditation. Hazard Mitigation was also included in the overall evaluation of the division as a whole and is an integral part of the NCEM EMAP Working Group which is the team that leads the process of developing proof of compliance documentation of the EMAP standards of accreditation. Hazard Mitigation's contribution to the EMAP process was the update of 2 standards and 7 sub-standards of the 73 required for EMAP accreditation. The EMAP process evaluates emergency management program elements compliance based on the NFPA 1600 Standard. Additionally, Hazard Mitigation has improved its information on Mitigation's Standard Operating Procedures and Best Practices.

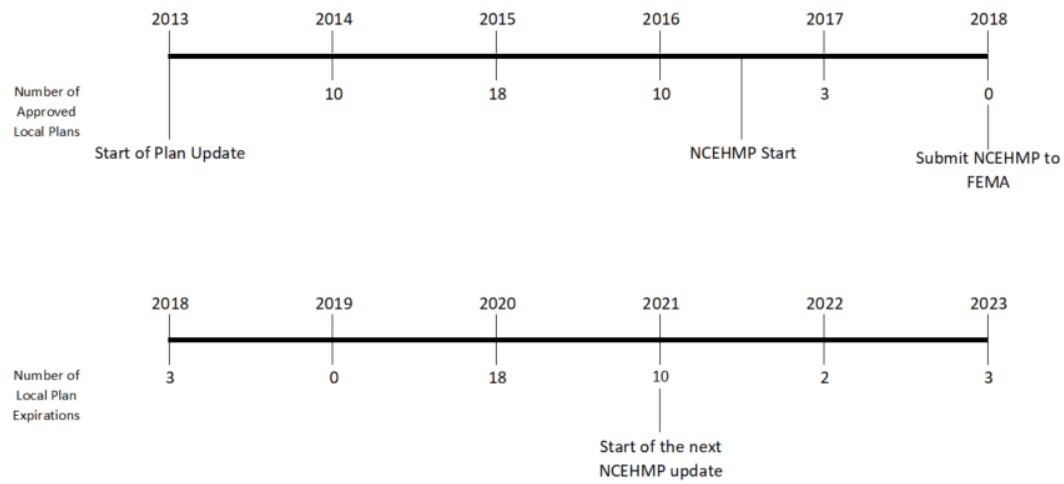
The National Integrated Drought Information System (NIDIS)

Hazard Mitigation staff also participates in workgroups with entities such as the National Drought Mitigation Center (NDMC) to promote the impact of drought on communities and the ecosystem. Our charge is to help develop activities that will help to mitigate the effects of drought on people and property. NIDIS was envisioned to be a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring and the decision support tools needed to better prepare for and mitigate the effects of drought. In this, NIDIS forms the backbone of a national Drought Early Warning System in the U.S.

2.6.3 Integration with Local Planning Functions

Local governments often reference the NCEHMP plan for assistance in identifying hazards, profiling hazards and for vulnerability assessment information to support their local mitigation planning efforts. The local plans and the two Tribal plans in North Carolina are all generally updated early in the five-year cycle of the North Carolina Enhanced Hazard Mitigation Plan. This would be in years one through three of the state plan update cycle. While there are four plans that are in the update process at the time we begin the state plan process, they are far enough into the process for the NCEM and RMCC to review those plans for coordination and linkage purposes. The planning team for the state plan review the local plans to ensure goals, objectives, actions, risk assessment and local capabilities are aligned to the extent necessary. Figure 2-1 below provides a graphical representation of the interconnectedness between NCEHMP update cycle and the local plan update and expiration schedule. More information regarding the linkages between the State Hazard Mitigation Plan and local plans can be found in Section 4.4 (Mitigation Capabilities – Local and Tribal Mitigation Capabilities), Section 4.5 (Mitigation Capabilities - Mitigation Planning) and 3.4.5.1 (Risk and Vulnerability Assessment – General Vulnerability).

Figure 2--1. Local Plan Approvals and Expirations and their Connection with the State Plan Update Cycle



2.7 RISK MANAGEMENT TOOL

The Risk Management Tool (RMT) was developed by NCEM as a tool to simplify hazard mitigation plan development into a single, automated, tool-based format to include geospatially based risk assessment data, also developed by the NCEM-RM. The RMT is a twofold system used to create and/or update a local and state hazard mitigation plan. The two parts of the RMT are a step-by-step system that will prompt a user to input information and narrative as well as upload pictures, documents and other information as needed. The second part of the system is the Risk Tool. The Risk Tool will run a risk assessment at the building level for each hazard selected based on predetermined calculations for each hazard. Some hazards will have a single return period and others have multi-return periods. The availability of multi-returns periods is based on the availability of datasets for each hazard and the degree of detail in each dataset.

The Risk Assessment produced by the Risk Tool will also identify high-risk structures in the planning area and estimate cost by types of mitigation projects (wind retrofits, elevation, acquisition, mitigation reconstruction) and benefit-cost estimates by type of mitigation. The mitigation tool is only meant to begin the process of thinking about problem areas where mitigation may be of interest to the jurisdiction and property owners. It is also designed to drive mitigation actions that are specific, measurable, attainable, realistic and timely.

Once all of the information is input into the system, a hazard mitigation plan can then be exported into multiple document formats. The system will also store the plan so that when it is time to update the plan, the information is already in the system.

The RMT was originally developed as part of the Integrated Hazard Risk Management (IHRM) pilot project which included Durham, Edgecombe, Macon and New Hanover counties. The pilot was successful and it was determined that there is a need and interest in a system designed to be used statewide and potentially nationwide in the future. NCEM is in the final stages of building out Version 2 of the RMT.

For the 2023 update of this plan, NCEM Hazard Mitigation staff worked to develop a Statewide Priority Risk Index based off of information found in local hazard mitigation plans included in the RMT. The PRI is a hazard classification system used to categorize and prioritize all potential hazards that could impact North Carolina as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities to consider as part of the statewide mitigation strategy.

The PRI is a subjective planning tool for classifying and prioritizing hazard risks in North Carolina based on standardized criteria. The PRI is discussed in more detail and presented in Section 3.

Section 3. RISK AND VULNERABILITY ASSESSMENT

44 CFR Reference

Requirement §201.4(c): [The Standard State Plan must include]

(2) Risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments. The risk assessment shall include the following:

(i) An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate;

(ii) An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;

(iii) An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

This section is comprised of two subsections: Natural and Technological Hazard Identification including hazard profiles (found in Sections 3.2-3.3) and the Vulnerability Assessment (found in Section 3.6).

3.1 OVERVIEW OF HAZARDS IDENTIFIED

The hazards considered within this document were selected based on their previous or anticipated impacts on the State of North Carolina. These hazards include natural hazards, technological hazards, manmade hazards, public health hazards, and agricultural hazards. The Disaster Mitigation Act of 2000 only requires states to address natural hazards in the hazard mitigation plan. However, because of the interconnectivity of impacts between all hazard categories, technological hazards are included in this section. This document serves as the Hazard Identification and Risk Assessment (HIRA) for all state-level emergency management planning efforts.

For the 2023 update of the plan, the list of hazards included in the 2018 plan continues as the base list of hazards. The hazard listing was approved by the RMCC and reviewed internally with NCEM staff. Based on these reviews the hazard listing remains the same with the addition of the following hazards: civil disturbance and food emergency. Two additional subhazards were added to the assessment: foreign animal disease as a subhazard of infectious disease and sea level rise as a subhazard of flooding.

Natural Hazards	Technological Hazards
Flooding	Hazardous Substances
- Sea Level Rise	— Hazardous Materials
Hurricanes and Coastal Hazards	— Hazardous Chemicals
Severe Winter Weather	— Oil Spill
Excessive Heat	Radiological Emergency – Fixed Nuclear Facilities
Earthquakes	Terrorism
Wildfires	— Chemical
Dam Failures	— Biological
Drought	— Radiological
Tornadoes/Thunderstorms	— Nuclear
Geological	— Explosive
- Landslides/Rock Fall	Civil Disturbance
- Sinkholes	Cyber
Infectious Disease	Electromagnetic Pulse
- Foreign Animal Disease	Food Emergency

3.1.1 Hazard Identification and Hazard Profiles Methodology

The Hazard Profiles subsections follow the same general format throughout the plan. Each hazard profile is made up of a Description, Extent (as defined by FEMA), Location, Hazard History, Changing Future Conditions, Impact, Future Probability, and Emergency Operation Plan reference. Each subsection gives the user a broad understanding of the hazard and its potential effect on North Carolina.

The hazard description provides a definition or scientific description of the hazard. Hazards often have multiple categories they will fall into depending on where or how they impact North Carolina. These descriptions are examined in detail in the hazard description subsection. Natural hazard definitions were obtained from sources including the National Oceanic and Atmospheric Administration and the National Weather Service.

The extent of a hazard as defined by FEMA is the strength or magnitude of the hazard. This subsection will define the scale by which the hazard is measured (eg:

Saffir-Simpson Scale for Hurricanes) as well as the worst-case historic event to affect North Carolina. Extent is different from the impact of a hazard, Extent is solely based on the scale by which the hazard is measured and not by the impacts of the hazard. The extent subsection will define the various scales used to rate or rank severity of hazards. Natural hazard extent data was obtained from sources including the National Oceanic and Atmospheric Administration and the National Weather Service.

Location is a description of the geographic area that could be affected by a hazard. Every hazard identified in this plan may affect North Carolina, however it may not affect all geographic regions of North Carolina. Landslide is a hazard for the mountainous regions, but it is not a hazard expected to impact the coastal plain due to the topography of the region.

The Hazard History provides a list of previous occurrences statewide. It also goes into detail concerning the more significant events that have affected the state. The section includes a detailed list of previous State and Federal disaster declarations. Information is included for each event describing property losses, economic losses, crop losses, and injuries or deaths attributed to a specific event. Historical data for the hazard profiles is drawn from the National Centers for Environmental Information (NCEI) to capture previous occurrences of the hazards.

Changing Future Conditions is a description of how the hazard's impact, frequency, and magnitude could potentially change in the future as a result of climate change, development, or other forces. As the Earth's climate warms, changing global weather patterns, future development in both the urban and rural areas, and changing local and global environmental conditions are anticipated based on historical trends and future projections. On October 29, 2018, North Carolina Governor Roy Cooper issued Executive Order No. 80, calling for new dialogue and planning efforts concerning climate change within North Carolina, placing it at the forefront of all planning, programs, and policy actions and demonstrating North Carolina's commitment to addressing climate change and transition to a clean energy economy

The report Section 9 of the Executive Order directs North Carolina's cabinet agencies to "integrate climate adaptation and resiliency planning into their policies, programs, and operations to support communities and sectors of the economy that are vulnerable to the effects of climate change and to enhance the agencies' ability to protect human life and health, property, natural and built infrastructure, cultural resources, and other public and private assets of value to North Carolinians." In 2020, an inter-agency team comprised of State agencies from different sectors released the Climate Risk Assessment and Resilience Plan that identified cross-cutting actions to address climate change and its impacts on the state, its citizens and on State operations. One of the recommendations of the CRARP was to integrate climate change science into the Risk Assessment and Goals and Measures section of the State Hazard Mitigation Plan.

Empirical evidence strongly supports the conclusion that North Carolina's climate has changed in recent decades and the State can anticipate sometimes dramatic changes in the future if current trends persist. The North Carolina Climate Science Report is a comprehensive report on the state of climate change science updated by the NC Department of Environmental Quality released in September 2020 and forms the basis of analysis for the impact of climate change on the natural and man-made hazards threatening the state. The projected changes with the highest level of confidence include increases in temperature, summer humidity, sea level, extreme precipitation, and intensity of storms including Hurricanes and Nor'easters… Data and analysis drawn from the NC Climate Science Report will be represented, where applicable throughout the "Changing Future Conditions" sections in the Hazard Profiles. The purpose is to identify, address, and integrate resiliency threats and opportunities into the State Hazard Mitigation Plan.

Links to Executive Order 80, the 2020 Climate Science Report and the Climate Risk Assessment and Resilience Plan are provided below:

Executive Order 80: https://governor.nc.gov/documents/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition

North Carolina Climate Science Report: https://files.nc.gov/ncdeq/climate-change/climate-scinece-report/NC_Climate_Science_Report_Findings_ExecSummary.pdf#:~:text=The%20North%20Carolina%20Climate%20Science%20Report%20is%20a,in%20North%20Carolina%20under%20increased%20greenhouse%20gas%20concentrations.

North Carolina Climate Risk Assessment and Resilience Plan: https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy-plans-and-progress/nc-climate-risk-assessment-and-resilience-plan

Hazard Impact is the description of the potential effects or consequences of the hazard on the state. The description includes the potential effects or consequences of the hazard on state owned assets and the jurisdictions within the state. Effects of the hazard vary greatly depending upon the state and local capability to mitigate, prepare for, respond to, and recover from the event. This section includes a description of the population(s) exposed to hazards.

Future Probability describes the likelihood of a hazard event happening within the geographical boundaries of North Carolina in any given year. This is expressed by a scale that has been determined to be appropriate through the analysis of all hazards.

The scale was developed by reviewing the return periods of all of the hazards assessing historical occurrence data, the geographical area at risk for the hazard, and consideration of changing future conditions. Subject matter experts assigned a general descriptor to each hazard.

The general descriptors are Unlikely, Likely and Highly Likely. The table below shows how these general descriptors correlate to an estimated percentage range of probability. As the descriptors are subjective, there is not a specific percentage assessed for each hazard. It is important to note the methods used to determine the future probability are qualitative, not quantitative. In addition, the impact of a hazard is not factored into future probability. While some hazard impacts are more extensive than others, extent does not increase or decrease the likelihood of a hazard event occurring. Historical data for the hazard profiles is drawn from National Centers for Environmental Information (NCEI) information.

Category of Likelihood	Correlating Percentages of Probability
Unlikely	1% to 33.3%
Likely	33.4% to 66.6%
Highly Likely	66.7% to 100%

While FEMA Guidance does not require the inclusion of or reference to a State Emergency Operations Plan in the Hazard Mitigation Plan, the NCEOP is included by reference here to the NCEOP is included to help insure consistency among various state documents and plans. Planning efforts are coordinated among all staff within NCEM in an effort to support a consistent Risk Assessment and an all-hazards approach using the operating procedures outlined in the NCEOP.

The NCEOP may contain additional annexes that identify operating procedures for cascading hazard impacts. These annexes have been developed in regard to frequency of regional occurrence, potential impact of a hazard, and the need for appropriate response procedures. Conversely, some hazards identified in Section 3.2 of this Hazard Mitigation Plan fall under the response outlined within the Basic Plan or other annexes of the NCEOP. For more information on the NCEOP, please visit the North Carolina Department of Public Safety website.

3.2 NATURAL HAZARD IDENTIFICATION

3.2.1 Flooding

3.2.1.1 Description

Flooding is a localized hazard that generally results from excessive precipitation within a drainage basin. Floods fall in one of two general categories: flash floods, which are the product of heavy localized precipitation that occurs within a short period of time at a given location; and general floods, caused by precipitation that occurs during a longer period of time over a particular river basin.

Flooding is the most common environmental hazard to affect the United States, due to the widespread geographical distribution of river valleys and coastal areas, and the attraction of human settlements to these areas. Most recent presidential major disaster declarations have been associated with flash floods and general flooding.

Flash floods occur shortly after a heavy accumulation of rainfall or may result from a dam or levee failure, or sudden release of water held by an ice jam. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in one local area, or by heavy rains generated by hurricanes and tropical storms.

Although flash flooding occurs often along western mountain streams, it is also common in urban areas throughout the state, especially in areas where much of the ground is covered by impermeable surfaces, as defined in state and local stormwater regulations. Roads and buildings impervious to water infiltration generate greater amounts of runoff than typical forested land. Fixed drainage channels in urban areas may be unable to contain the runoff that is generated by relatively short but intense rainfall events. These events result in localized flooding complaints, but existing NC Stormwater legislation and regulation as in many other states, does not address stormwater quantity or flooding; only water quality.

A combination of river basin physiography, local thunderstorm movement, past and current soil moisture conditions, and the degree of vegetative clearing and creation of impervious surfaces resulting from development determines the severity of a flooding event. Abnormal weather patterns may also contribute to the flooding of a local area. Large-scale climatic events (such as the El Nino-Southern Oscillation in the Pacific Ocean) have been linked to increased storm activity and flooding in the United States.

Nationally, July is the month in which most flash flooding events occur in the United States; nearly 90 percent of flash floods occur during the months of April through September (Frazier, 1979). While flash floods occur within hours of a rain event, general flooding is a longer-term event, and may last for several days or weeks. The primary types of flooding are riverine flooding, coastal flooding, and urban flooding.

The periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal water course, some of the above-normal stream flow spills over onto adjacent lands located within the floodplain.

Floodplains are relatively low-lying areas adjacent to streams, lakes, rivers, or coast commonly prone to flooding. Floodplains are part of the natural hydrologic system, serving the important function of carrying and temporarily storing excess floodwater or dampening the energy of torrential rain or coastal storms. In addition, floodplains are useful for maintaining water quality, preserving groundwater supply, supporting natural vegetation and providing natural habitats, and offering many kinds of recreational and educational activities.

Floodplain boundaries are designated and routinely updated through cooperation between local governments, states and the Federal Emergency Management Agency (FEMA.) Flood Insurance Study (FIS) findings are shown on Flood Insurance Rate Maps (FIRMs) describe various flood hazard zones based on flood height exceedance return periods. Flood hazard zone designations depend on local conditions and map issue dates, but all will show the 100-year or base flood elevation (1-percent annual chance), as well as some areas of the 500-year floodplain (0.2-percent annual chance).

Riverine flooding is a function of precipitation intensity and water runoff volumes within the watershed of a stream or river. The recurrence interval of a flood is defined as the average time interval (in years) expected to take place between the occurrence of one flood of a particular magnitude and the occurrence of a flood of equal or larger magnitude. Generally, flood magnitude (height) increases as recurrence intervals increase.

Coastal flooding is typically a result of storm surge, abnormal tides, wind-driven waves, and heavy rainfall associated with tropical and non-tropical weather systems. These conditions are produced by tropical systems during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push seawater up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forestlands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts.

Another factor to consider when dealing with coastal flooding is sea level rise. Sea level rise is the increase in sea levels as a result of atmospheric and oceanic warming, which causes water expansion and ice melt from ice sheets and glaciers. Due to sea level rise projected throughout the 21st century and beyond, coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion. Sea level rise may cause flooding to occur more frequently and last for longer periods of time. Although considered an onset hazard, sea level rise has already begun to cause “clear sky” or “nuisance” flooding, which is brought on by high tidewaters infiltrating stormwater management systems, rather than storm or rain events.

Urban flooding occurs where there has been development within stream floodplains or in coastal flood hazard areas where there are high levels of development. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities resulting in development of flood hazard areas. The ultimate price of this accessibility was the increased flooding of the built environment. Urbanization increases the magnitude and frequency of floods by increasing the number of impermeable surfaces, increasing the rate of collection and discharge, reducing the carrying capacity of the land and occasionally overwhelming storm water and sanitary sewer systems by infiltration and inflow.

Inflow and Infiltration is a large component of urban flooding. A sanitary sewer or collection system is an underground pipe system used to convey wastewater to a treatment facility and is comprised of conventional gravity lines, pump stations, and force mains. Inflow and infiltration describe water entering a sanitary or storm water system from points other than designed collection points. Inflow refers to the entry of stormwater into the sewage collection system during storm events, whereas infiltration refers to the movement of ground or surface water into the piped system.

There are multiple mechanisms contributing to inflow and infiltration. Gutters connecting to lateral pipes (the pipe from an individual building to the roadside main line), uncapped sewer line cleanouts, faulty sewer manhole covers, and improper cross connections of stormwater lines with sewer lines are all possible ways stormwater can enter sewer lines (Inflow). Groundwater can enter the sewer pipes through cracks, leaky pipe joints, deteriorated manholes, and broken lateral pipes (infiltration).

Together, these two processes increase the volume and overload the sewage collection system, particularly during wet weather, which in turn can cause Sanitary

Sewer Overflows (SSOs) or excessive discharge of tertiary treated waste water. Climate change may further exacerbate the problems with increased rainfall and higher groundwater levels due to saltwater intrusion in coastal areas. Sanitary sewer systems and receiving wastewater facilities in NC are subject to loss of function resulting from inflow and infiltration due to aging infrastructure, proximity to waterways, severe storms, and high ground water levels.

The Division of Energy, Mineral, and Land Resources of the NC Department of Environmental Quality implements three National Pollution Discharge Elimination Systems (NPDES) stormwater permit programs. These include municipal separate storm sewer systems (MS4s), Industrial General Stormwater Permit and Individual Stormwater Permit programs.

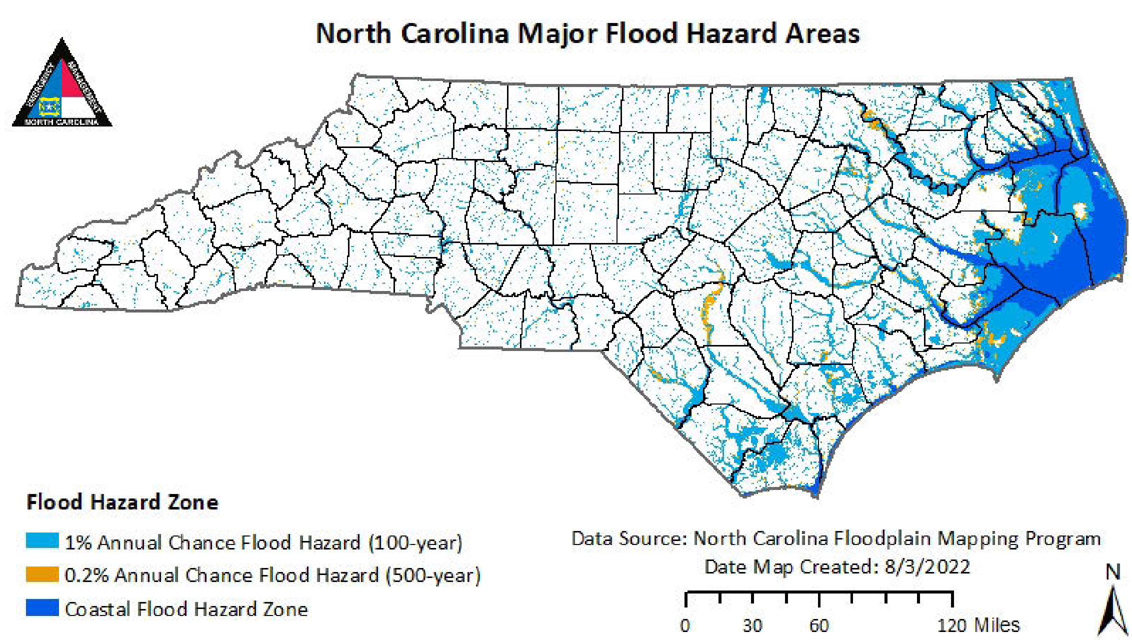
3.2.1.2 Extent

Flood extent can be measured by the amount of land in the floodplain as well as by flood height and velocity. According to the North Carolina Floodplain Mapping Program, the amount of land in the floodplain in North Carolina accounts for about 18.2 % of the total land area in the state.

3.2.1.3 Location/Spatial Extent

The North Carolina Floodplain Mapping Program is a cooperating technical partner with FEMA in the development and periodic update of digital flood hazard data for the entire state of North Carolina. Digital flood hazard data exists for all of the state's 100 counties and has been collected and periodically updated using LiDAR technology since 1999.isFlood hazard areas are summarized in Figure 3-1. Historic Flood Loss Data is depicted in Table 31. The figure also includes the delineation of Coastal High Hazard Areas which are that part of the coastal floodplain where wave heights during the base flood event will be three feet or more above the base flood elevation (also designated by FEMA as "V Zones"). Based on historical events, flooding in some areas of the state could be up to 20 feet in depth and flooding generally could occur in any county in the state.

Figure 3-1 North Carolina Mapped Flood Hazard Areas Through 2022



3.2.1.4 Hazard History

Many North Carolina counties have experienced major catastrophic flooding in recent years, and some have experienced multiple major flooding disasters. Since 1977, North Carolina has received Federal aid from the Small Business Administration (SBA) and/or FEMA for 29 major disasters that produced substantial flood damage to one or more counties. These major disasters are listed in Table 3-1.

Table 3-1 Presidential Flooding Disasters Since 1977

Event	Location	Damages
1977 Floods (11/1977)	Western North Carolina	$14,189,210
1979 Floods	Surry County	$56,084
Hurricane Diana (09/1984)	Coast	$67,000,000
Hurricane Gloria (09/1985)	Coast	$8,500,413
1989 Floods (09/1989)	Fayetteville	$10,000,000
1992 Flood (09/1992)	Swain County	$2,186,000
Hurricane Emily (08/1993)	Dare County	$12,500,000
Hurricane Opal (10/1995)	Mountain Counties	$9,400,000
Western Flooding (01/1998)	Western North Carolina	$7,000,000
Hurricane Bonnie (08/1998)	Eastern North Carolina	$22,000,000
Hurricane Dennis (08/1999)	Eastern North Carolina	$10,000,000
Hurricane Floyd (09/1999)	Mid/East North Carolina	$3,403,839,436
Hurricane Isabel (09/2003)	Mid/East North Carolina	$372,500,000
Tropical Storm Frances (09/2004)	Western North Carolina	$20,500,000
Hurricane Ivan (09/2004)	Western North Carolina	$13,800,00
Hurricane Ophelia (10/2005)	Coastal North Carolina	$70,000,000
Tropical Storm Hanna (10/08/2008)	Beaufort, Brunswick, New Hanover and Person Counties	$10,000,000
Severe Winter Storm and Flooding (02/02/2010)	Western North Carolina	$10,000,000
Tropical Storm Nicole (10/14/2010)	Eastern North Carolina	$5,431,477 (IA only)
Hurricane Irene (08/31/2011)	Eastern and Central North Carolina	$115,431,919 (IA and PA)
Eastern Cherokee Flooding (01/14/2013)	Western North Carolina	$3,161,875
2013 Flooding (07/2013)	Western North Carolina	$14,217,743
Hurricane Matthew (08/07/2016)	Eastern and Central North Carolina	$1,500,000,000

Event	Location	Damages
Hurricane Florence (09/14/2018)	Eastern and Central North Carolina	$1,200,000,000
Hurricane Dorian (09/05-06/2019)	Eastern North Carolina	$77,475,260.21 (PA and HMA)
Tropical Storm Michael (10/10-12/2019	Central North Carolina	$26,752,941.67(PA and HMA)
Severe Storms, Tornadoes, and Flooding (02/2020)	Western North Carolina	$14,532,380.16 (PA and HMA)
Hurricane Isaias (07/2020)	Eastern North Carolina	$31,197,490.03 (PA and HMA)
Tropical Storm Fred (08/16 – 18/2021)	Western North Carolina	$24,547,880.97 (IA, PA, and HMA)

Source: FEMA.gov

Flooding in Western North Carolina

Only five of these disasters were stand-alone flood events, and eleven occurred in the mountains of Western North Carolina. Among these flooding-only disasters was a devastating flood that impacted several counties in early Nov. 1977—the beginning of this documented history. Storms for this event produced 8 to 14 inches of rain in 33 counties; the 17 counties most impacted by these storms were designated in (or later added to) a presidential disaster declaration.

The flood of record for Western North Carolina is the 1916 flood. Back-to-back flood events in July of that year led to the record flooding. From July 15-16, over 20 inches of rain fell on ground and in rivers that were already saturated and full from a tropical system that came through the mountains about a week prior. The French Broad River rose to an estimated 21 feet which is still the record for the river. The rainfall led to numerous landslides, destroyed many roads and bridges and buildings and claimed over 80 lives.[1]

Another significant flood event was the Western Flooding that occurred in January 1998, caused by a weather system that also devastated communities in bordering Tennessee. Heavy rains fell on snow-pack in the higher elevations and the resulting runoff caused flash flooding in streams below. Numerous homes, public buildings, and public and private infrastructure were lost within a very short span of time.

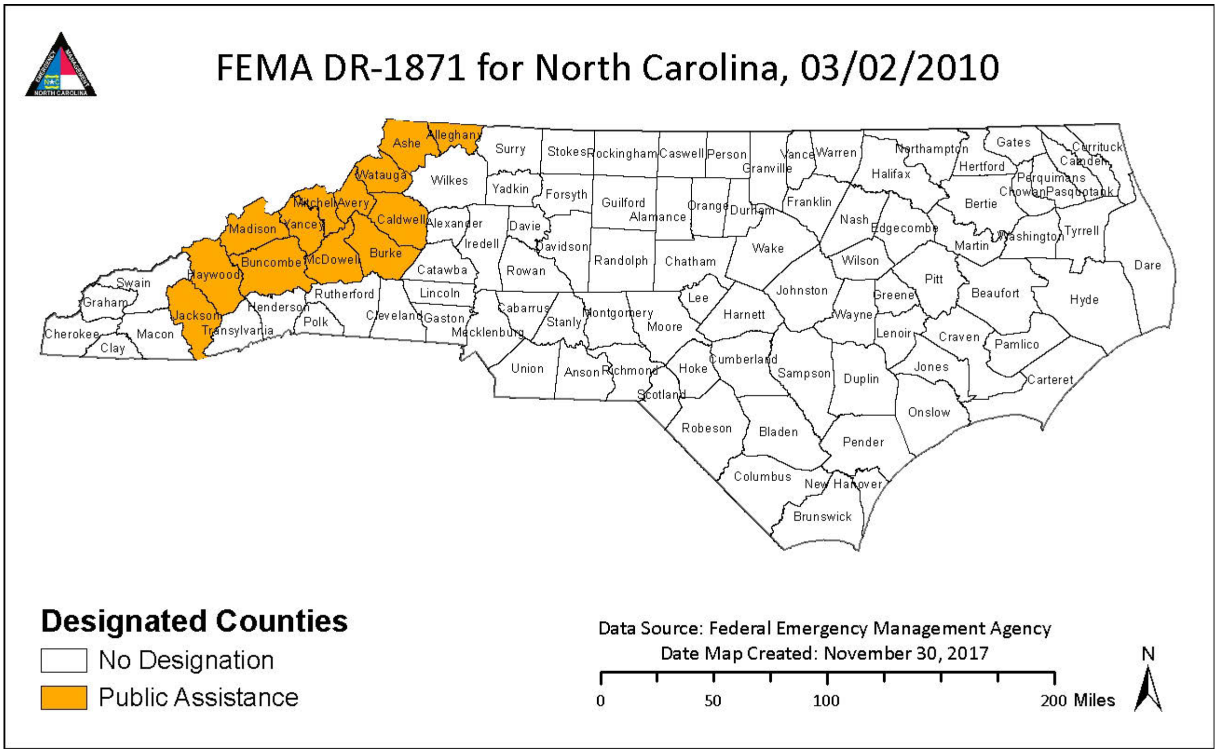
In 2004, the remnants of Tropical Storm Frances and Hurricane Ivan caused major flooding in Western North Carolina, where rainfall estimates from both storms ranged from 6 to 20 inches within a 10-day period. This unprecedented event caused significant flood and debris-flow damages, economic losses, environmental damages, and took 11 lives. The communities of Asheville, Biltmore Village, Brevard, Clyde, Canton, Newland, Morganton, Hendersonville, and Mountain Island Lake were heavily impacted, as well as other rural

[1] *https://climate.ncsu.edu/blog/2015/07/nc-extremes-flood-of-1916-wiped-out-railways-records/*

communities. A losses avoided study related to mitigation activities completed following these events is attached as an appendix to this plan

Two weeks of snow and sleet beginning December 14, 2009 led to runoff and flash flooding in the 13 counties of Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Haywood, Jackson, Madison, McDowell, Mitchell, Watauga, Yancey and the tribal lands of the Eastern Band of Cherokee Indians in Western NC. A preliminary damage assessment conducted in the last two weeks of January, 2010 led to a federal declaration for ice damage and flash flooding. A map of this data is pictured in Figure 3-2 below.

Figure 3-2 Counties Declared in FEMA DR-1871



More recently, Tropical Storm Fred in August of 2021 caused severe flooding in western North Carolina resulting in disaster declarations for eleven North Carolina counties. Heavy precipitation impacts from this storm resulted in devastating flooding and landslides, particularly in Haywood County, that attributed to six deaths and damage to property and farm crops and infrastructure.

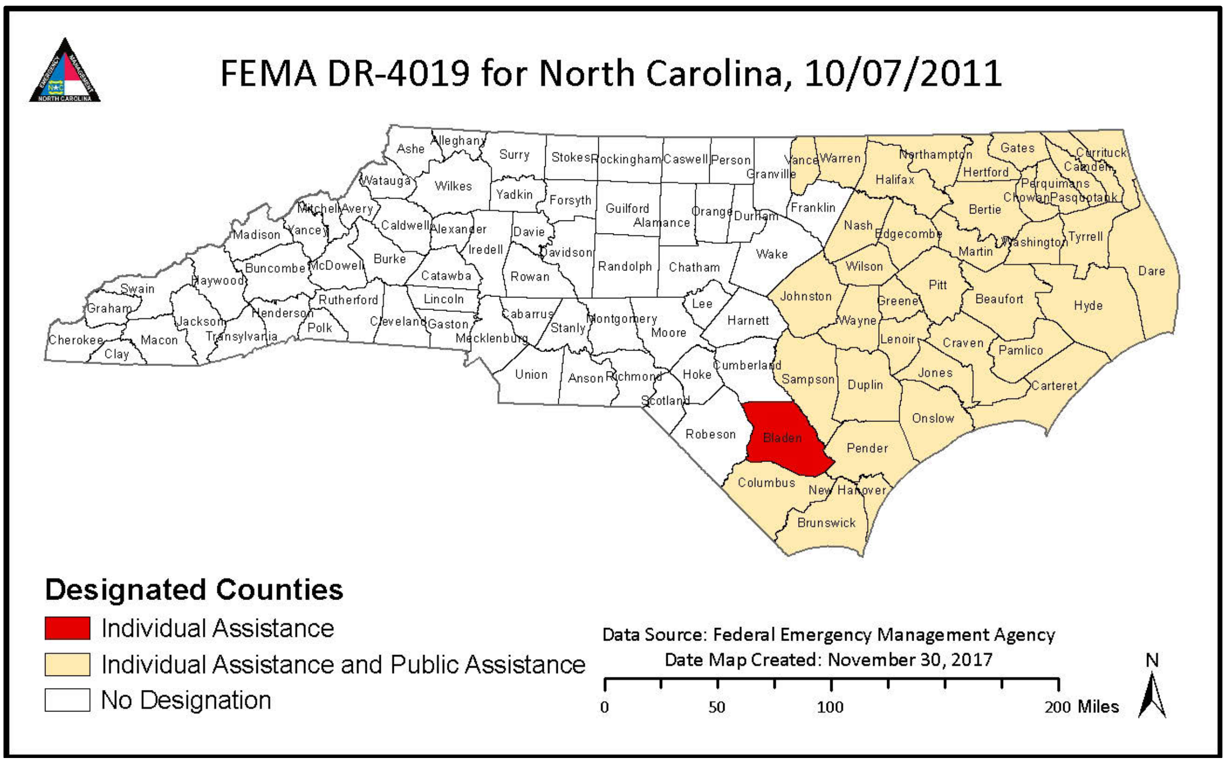
Flooding in Eastern and Central North Carolina

Flooding remains one of the major destructive forces of land-falling tropical storms and hurricanes, which have affected all parts of North Carolina, but have historically caused the largest impacts in the Eastern and Central parts of the state. Fifteen of the listed events are hurricanes or tropical storms that included devastating floods as part of their destructive force. In recent history alone, Hurricanes Irene (2011) and Matthew (2016) brought devastating flooding and heavy winds inland to many communities and counties in Eastern

North Carolina. These events are more thoroughly discussed in the Hurricanes and Coastal Hazards section found later in this risk assessment, but a brief overview of the flooding impacts is warranted here.

In August of 2011, Hurricane Irene caused the worst flooding the state had experienced in nearly a decade. Although the storm was only a category 1 storm when it made landfall and its course did not continue inland, several coastal counties in Eastern North Carolina were hit hard. Counties located on the Pamlico Sound were particularly affected as storm surge and torrential rain caused flooding in many areas located along the sound. In Figure 3-3 below, a map displays all of the counties that were a part of the presidentially declared disaster area.

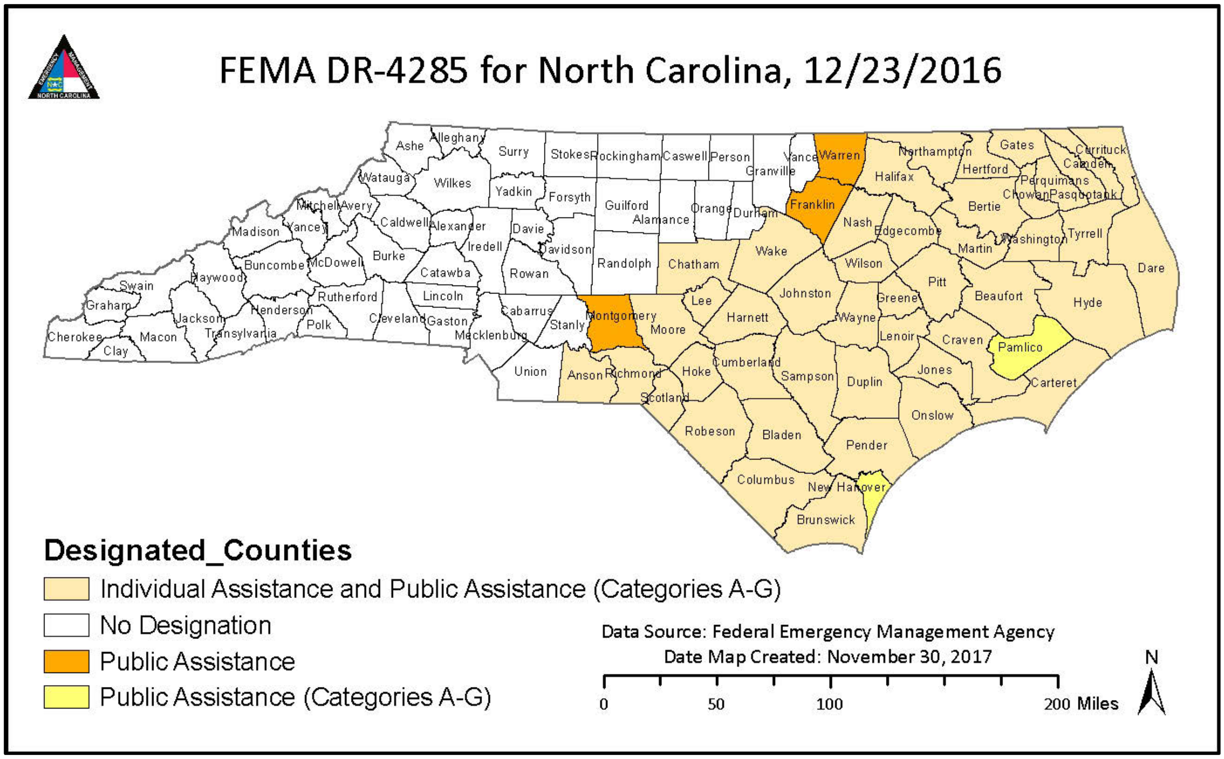
Figure 3-3 Counties Declared in FEMA DR-4019



Hurricane Florence in August and September of 2018 was a long-lived, category 4 hurricane (based on the Saffir-Sampson Hurricane Wind Scale) that made landfall along the southeastern coast of North Carolina near the upper end of category 1. Florence caused devastating freshwater flooding across much of the southeastern United States and significant storm surge flooding in portions of eastern North Carolina. Florence resulted in twenty-two (22) direct deaths and was also associated with thirty (30) indirect fatalities.

Two years prior, in 2016, Hurricane Matthew occurred. Most of the damage was in central and eastern North Carolina from torrential rainfall of 8 to 15 inches. Flooding from this storm directly caused 11 fatalities and caused record-setting river flooding along the Neuse, Cape Fear, and Tar River basins. A presidential disaster was declared on October 10, and a map of the affected counties is pictured in Figure 3-4 below. North Carolina is still in the process of recovering from the Hurricanes Florence and Matthew disaster.

Figure 3-4 Counties Declared in FEMA DR-4285



According to NCEI data, between 1996 and 2021, North Carolina has experienced flooding in every county, resulting in 72 deaths and $ 1,663,464,754 in property and crop damages. A detailed summary of NCEI flooding event data by county is listed in Table 3-12 below. A graphic representation follows the table in Figure 3-5.

Table 3-2 North Carolina Flood Event Summary by County

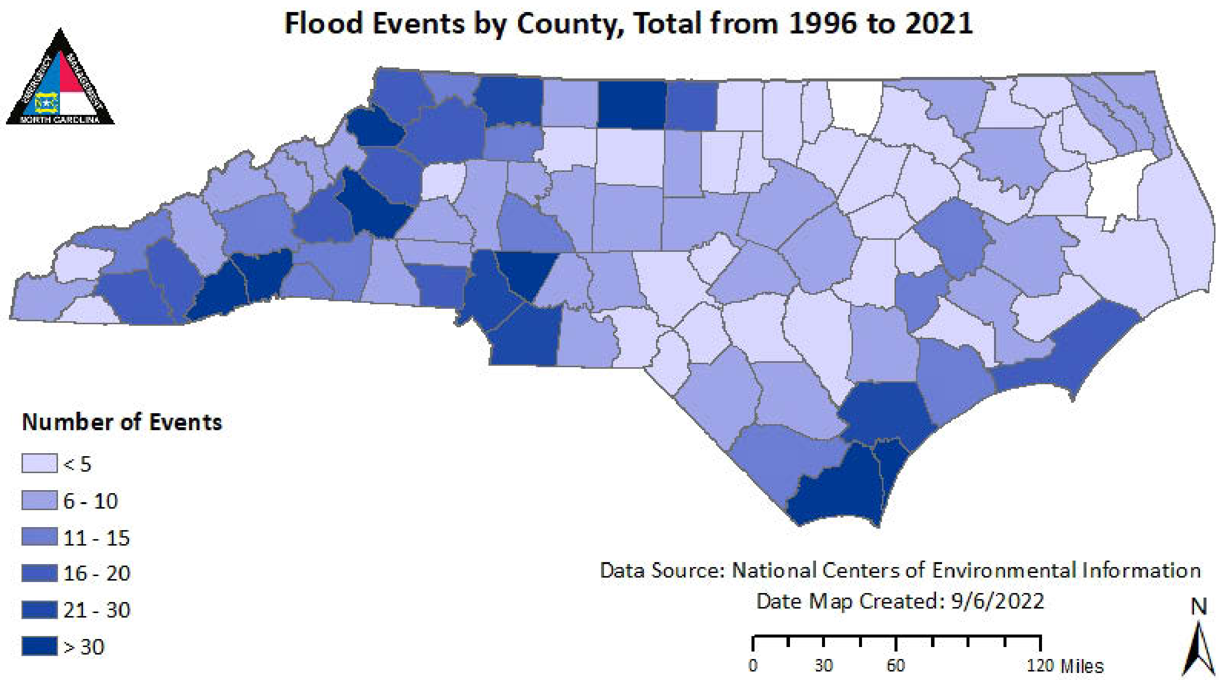
County	Number of events (1996-2021)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Alamance	41	0	0	$3,180,000	$5,000,000
Alexander	14	6	0	$563,000	$0
Alleghany	28	0	0	$641,030	$185,000
Anson	44	1	0	$5,630,000	$30,000,000
Ashe	79	0	0	$1,311,000	$0
Avery	34	0	0	$19,860,000	$7,005,000
Beaufort	30	0	0	$675,000	$55,000,000
Bertie	26	1	0	$10,005,000	$1,000,000
Bladen	50	2	1	$15,210,000	$0
Brunswick	101	0	0	$5,303,000	$0
Buncombe	48	2	1	$86,192,000	$1,000,000
Burke	66	0	0	$367,080	$0

County	Number of events (1996-2021)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Cabarrus	78	1	4	$11,799,000	$2,000,000
Caldwell	69	0	1	$1,188,000	$0
Camden	17	0	0	$505,000	$0
Carteret	54	0	0	$16,000	$0
Caswell	32	0	0	$770,000	$730,000
Catawba	38	0	0	$9,943,000	$0
Chatham	28	0	0	$6,430,00	$20,000,000
Cherokee	17	0	0	$1,720,000	$0
Chowan	12	0	0	$500,000	$0
Clay	9	0	0	$954,000	$0
Cleveland	18	0	0	$1,720,000	$0
Columbus	45	1	1	$32,777,000	$10,200,000
Craven	33	1	0	$602,000	$500,000
Cumberland	60	2	0	$100,664,000	$50,000,000
Currituck	33	0	0	$6,485,000	$0
Dare	40	0	0	$12,900,000	$0
Davidson	66	1	0	$2,181,000	$5,000,000
Davie	13	0	0	$1,080,000	$120,000
Duplin	37	3	0	$175,000	$1,000,000
Durham	70	0	0	$11,495,000	$5,000,000
Edgecombe	41	8	0	$69,130,000	$40,000,000
Forsyth	56	0	0	$575,000	$0
Franklin	32	1	0	$0	$0
Gaston	28	1	0	$4,982,000	$0
Gates	15	1	0	$640,000	$5,900,000
Graham	19	0	0	$370,000	$0
Granville	17	0	0	$25,000	$0
Greene	28	1	0	$0	$0
Guilford	109	1	0	$18,107,000	$5,000,000
Halifax	41	2	0	$74,050,000	$20,000,000
Harnett	36	1	0	$16,705,000	$20,000,000
Haywood	31	9	0	$224,526,000	$2,000,000
Henderson	93	0	1	$6,162,000	$10,230,000
Hertford	17	0	0	$7,250,000	$12,500,000
Hoke	26	0	0	$5,035,000	$30,000,000
Hyde	13	0	0	$0	$0
Iredell	27	0	0	$2,552,000	$0
Jackson	42	0	0	$1,184,000	$14,000
Johnston	71	9	0	$25,011,000	$20,030,000
Jones	18	0	0	$500,000	$6,000,000
Lee	24	0	0	$5,955,000	$20,000,000
Lenoir	38	5	0	$9,150,000	$24,000,000
Lincoln	30	0	0	$2,381,000	$0
Macon	37	0	0	$4,421,000	$1,050,000
Madison	42	1	2	$17,758,000	$12,170,000
Martin	20	0	0	$210,000	$0
McDowell	44	0	0	$1,580,000	$0
Mecklenburg	117	6	4	$24,404,000	$10,000
Mitchell	26	0	0	$6,816,000	$0

County	Number of events (1996-2021)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Montgomery	41	0	0	$617,000	$20,000,000
Moore	44	0	0	$12,545,000	$20,000,000
Nash	35	4	0	$213,425,000	$20,000,000
New Hanover	164	0	2	$7,424,000	$0
Northampton	19	0	0	$1,702,000	$20,300,000
Onslow	46	0	0	$2,230,000	$6,000,000
Orange	36	0	0	$37,333,000	$5,000,000
Pamlico	14	0	0	$10,000	$0
Pasquotank	23	0	0	$255,000	$0
Pender	85	1	0	$6,420,000	$0
Perquimans	16	0	0	$200,000	$0
Person	20	0	0	$310,000	$0
Pitt	49	1	0	$300,000	$100,000
Polk	27	0	0	$557,000	$0
Randolph	59	0	0	$21,090,000	$10,000,000
Richmond	23	0	0	$21,870,000	$30,000,000
Robeson	32	2	0	$4,917,000	$0
Rockingham	90	0	0	$3,764,000	$370,000
Rowan	38	0	0	$607,050	$0
Rutherford	31	0	2	$6,526,000	$0
Sampson	44	0	0	$17,520,000	$55,000,000
Scotland	20	2	0	$8,410,000	$30,000,000
Stanly	81	5	0	$3,905,000	$20,000,000
Stokes	29	0	0	$2,712,000	$0
Surry	81	0	0	$2,554,000	$5,000
Swain	29	0	0	$4,497,000	$12,000
Transylvania	89	0	10	$15,351,000	$6,400,000
Tyrrell	3	0	0	$0	$0
Union	75	3	0	$437,000	$5,000
Vance	11	1	0	$50,000	$0
Wake	186	1	0	$74,722,000	$20,000,000
Warren	25	3	2	$280,000	$0
Washington	9	5	0	$10,000	$1,000,000
Watauga	122	0	0	$20,636,000	$0
Wayne	41	4	0	$141,740,000	$55,000,000
Wilkes	79	0	0	$4,519,000	$0
Wilson	44	2	0	$32,635,000	$45,000,000
Yadkin	33	0	0	$669,000	$0
Yancey	27	0	0	$1,803,000	$900
North Carolina					

Source: NCEI data on event types: Coastal Flood, Flash Flood, Flood, Lakeshore Flood

Figure 3-5 North Carolina Flood Events by County



3.2.1.5 Changing Future Conditions

Changing climate and weather patterns, environmental conditions, and urban and rural development may affect the frequency and intensity of flooding in North Carolina. Although flooding events have been recorded in all parts of the state, North Carolina is highly susceptible to severe coastal flooding, and the Environmental Protection Agency reports that it has the third highest land area vulnerable to changing sea levels. A 2017 report by the US Government Accountability Office also projects tidal flooding to increase in "depth, frequency, and extent this century." The same report also mentions that over the last decade, $90 billion in losses has been incurred by the US government in combined flood and crop insurance payments due to extreme weather. Intensified flooding and increased periods of extreme precipitation would have severe impacts on the North Carolina's economy, public health, and environment.

Additionally, according to the National Climate Assessment, the increased likelihood of extreme precipitation events due to climate change will result in greater risks of flash flooding and impacts from stormwater runoff in the state. Indeed, even though there may be less precipitation overall in the long term (leading to more frequent drought events), the rainfall that does occur will likely be during more intense events that may lead to flash flooding. While overall precipitation may decline, flooding impacts may actually intensify as a result of changing future conditions. This is especially true in the southeastern United States which is located in a middle ground between the southwestern states (which will likely be experiencing significant declines in precipitation) and northeastern states (which will likely be experiencing significant increases in precipitation). The result will be that there are likely to be periods of both drought and substantial precipitation in the southeast going forward.

These changing future conditions, projected impacts with detailed risk and vulnerability are also supported in the 2020 North Carolina Risk Assessment and Resilience Plan published by the Department of Environmental Quality with much detailed input from the other Cabinet Level and Council of State Agencies.

3.2.1.6 Impact

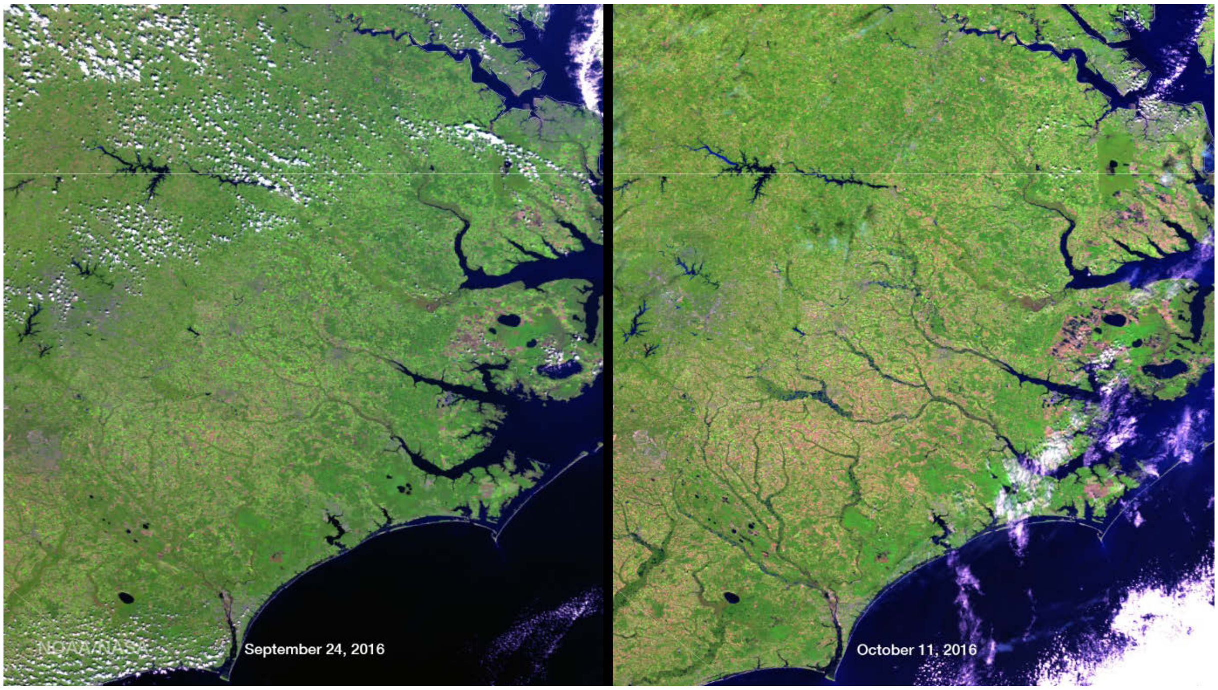
Flooding has the potential to cause critical impacts to the State of North Carolina. During the worst flooding events, such as those experienced during and immediately following major hurricanes that occur in the state, there is the potential for multiple deaths and injuries. It is possible that more than 25% of property in the State could be damaged or destroyed and complete shutdown of critical facilities can sometimes be expected for more than one week.

3.2.1.7 Future Probability

Floods will continue to impact North Carolina in the future. All counties remain vulnerable to flooding as each has identified and mapped Special Flood Hazard Areas (SFHAs)—floodplains with at least a 1-percent annual chance of floods that could potentially cause damage to development lying within those floodplains.

Flooding is the most common environmental hazard to affect North Carolina. The state's varying physiography and rapid growth in urban and extra-urban areas makes it very vulnerable to this type of hazard. Not only does it have many flat and low-lying areas, but it also has 300 miles of coastline in the east and deep and rugged valleys in the western region that are all prone to flooding after heavy rainfall accumulation. Based on historical evidence, it is highly likely (between 66.7 and 100 percent annual probability) that North Carolina will continue to experience flooding events in the future.

According to the North Carolina Climate Risk Assessment and Resilience Plan, inland communities across the state will likely experience increased flooding due to increases in extreme precipitation as well as growth and insufficient stormwater drainage infrastructure. More frequent flooding will negatively impact ecosystems and cultural resources across the state.



3.2.1.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

There is not a separate flood operations or response plan Appendix in the existing NCEOP as there is for other hazards. Rather, flooding EOP procedures are integrated into Annex B, Appendix 1.

3.2.2 **Hurricanes and Coastal Hazards**

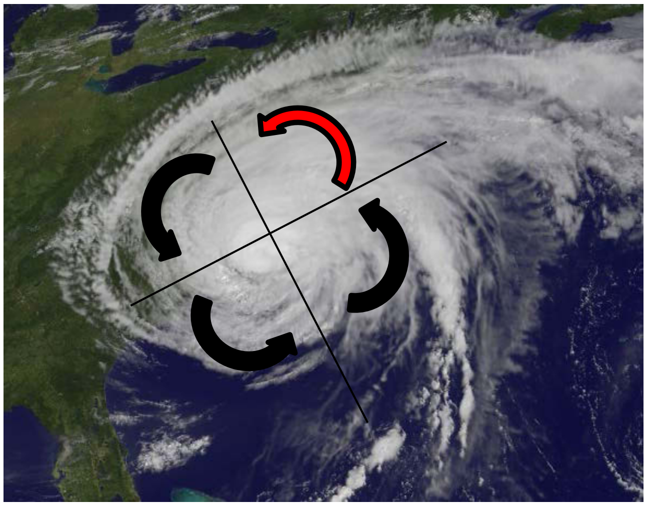
3.2.2.1 Description

Hurricanes are cyclonic storms that originate in tropical ocean waters poleward of about 5 degrees latitude. Hurricanes are heat engines, fueled by the release of latent heat that results from the condensation of warm water. Their formation requires several elements, including, a low-pressure disturbance, sufficiently warm sea surface temperature, rotational force caused by the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. Hurricanes can produce an array of hazardous weather conditions, including storm surge, high winds, torrential rain, and tornadoes.

Hurricanes have the greatest potential to inflict damage as they move from the ocean and cross the coastline. The crossing of the center of the storm's eye is called landfall. Because hurricanes derive their strength from warm ocean waters, hurricanes are generally subject to deterioration once they make landfall. The forward momentum of a hurricane can vary from just a few miles per hour to up to 40 mph. This forward motion (combined with a counterclockwise surface flow) makes the hurricane's right-front quadrant the location of its most potentially damaging winds.

Sea level rise has the potential to amplify the impacted associated with hurricanes and related hazards, such as coastal and sound side storm surge.

Figure 3-6 Quadrant Image of Hurricane Irene August 27, 2011



Source: NASA/NOAA GOES Project

3.2.2.2 Extent

Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic), as shown in Table 3-3 and Table 3-4. The scale categorizes hurricane intensity linearly, based upon maximum sustained winds and minimum barometric pressure. These factors combine to create an estimate of the potential flooding and damage to property, given a hurricane's estimated intensity.

Table 3-3 Saffir-Simpson Hurricane Scale (Simpson and Reihl, 1981)

Saffir-Simpson Scale				
Saffir-Simpson Category	Maximum sustained Wind Speed			Minimum Surface Pressure
	MPH	Meter/Sec	Knots	Millibars
1	74–96	33–42	64–83	Greater than 980
2	97–111	43–49	84–96	979–965
3	112–131	50–58	97–113	964–945
4	132–155	59–69	114–135	944–920
5	156+	70+	136+	Less than 920

Hurricanes with a Saffir-Simpson classification of 3, 4, or 5 are considered major hurricanes (which are the most potentially dangerous).2 These intense hurricanes cause much of the hurricane-related damage in the United States, even though they account for only a small portion of tropical cyclone landfalls.

---

[2] *Saffir-Simpson Hurricane Wind Scale. National Oceanic and Atmospheric Administration: National Hurricane Center. Retrieved on December 14, 2017 from: http://www.nhc.noaa.gov/aboutsshws.php*

Table 3-4 Examples of Hurricane Damage by Saffir-Simpson Category

Hurricane Category Damage Examples			
Category	Level	Description	Example
1	Minimal	Damage primarily to shrubbery, trees, foliage, and unanchored homes. No real damage to other structures. Some damage to poorly constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.	Hurricane Jerry (1989)
2	Moderate	Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Coast roads and low-lying escape routes inland cut by rising water two to four hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying areas required.	Hurricane Bob (1991)
3	Extensive	Foliage torn from trees; large trees blown down. Almost all poorly constructed signs blown down. Some damage to roofing materials of buildings; some wind and door damage. Some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Flat terrain five feet or less above sea level flooded inland eight miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.	Hurricane Gloria (1985)
4	Extreme	Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failures of roofs on many small residences. Complete destruction of mobile homes. Flat terrain 10 feet or less above sea level flooded inland as far as six miles. Major damage to lower floors of structures near shore, due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, as well as the evacuation of single-story residences within two miles of shore.	Hurricane Harvey (2017)
5	Catastrophic	Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Major damage to lower floors of all	Hurricane Camille (1969)

		structures less than 15 feet above sea level and within 500 yards of shore. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.	

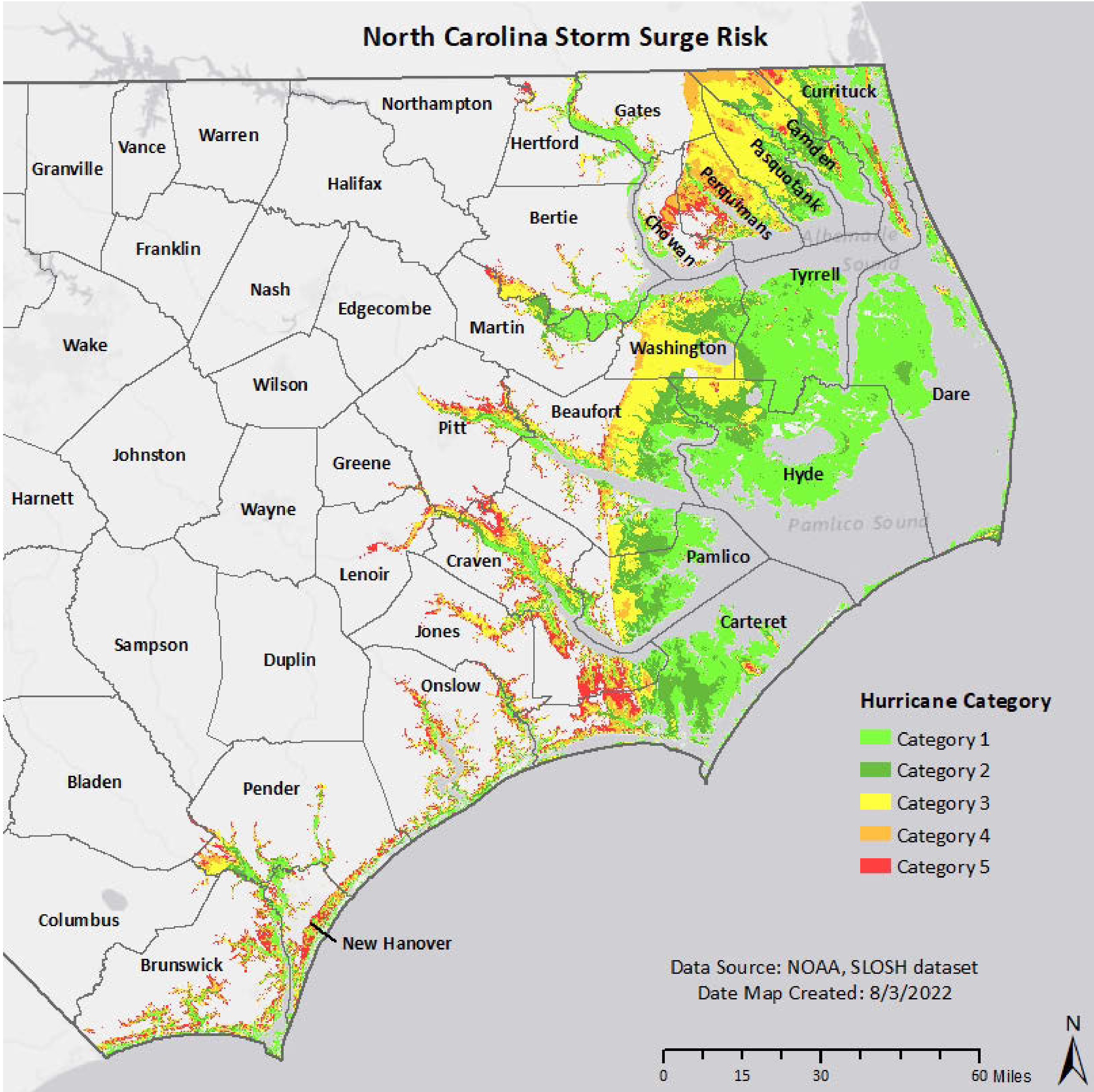
Historically, the state has been impacted by a number of major storms that were categorized as major hurricanes (Category 3, 4, or 5) when they made landfall in the state. Therefore, North Carolina could be impacted by a storm up to a Category 5 based on the Saffir-Simpson Hurricane Scale.

3.2.2.3 Location/Spatial Extent

All of the state's 100 counties are at risk of hurricanes, although the effects are likely to vary. While the eastern part of the state is much more likely to be severely impacted by high winds and storm surge than the mountainous western part of the state, fully fifty percent of hurricane impacts in the state have occurred in Western NC, generally as a result of hurricanes making a Gulf Coast landfall. While flooding is a more general risk in Wester NC, high winds have resulted in considerable damage to forests and other resources.

Storm surge is limited to the coastal counties of North Carolina. Figure 3-7 provides a graphical representation of storm surge risk zones as determined by NOAA. The impacts of sea level rise and climate-driven intensification of coastal storm events are likely to exacerbate storm surge issues in Eastern NC and such impacts will be felt farther inland as the surface levels of our massive estuarine system rise with increasing sea levels.

Figure 3-7 Storm Surge Inundation Areas



3.2.2.4 Hazard History

North Carolina has an extensive hurricane history dating back to colonial times, with notable 19th century storms occurring in 1837, 1846, 1856, 1879, 1883, and 1899. Within the 20th century, the mid-1950s proved to be an exceptionally busy time for hurricanes in North Carolina, including major storms such as Hazel (1954), Connie (1955), Diane (1955), and Ione (1955).

Between 1960 and 1990, a relative lull occurred in the number of major hurricanes that made landfall, with only a few major storms coming ashore including Hurricanes Donna

(1960) and Hugo (1989). Hurricane Donna was a strong Category 2 hurricane when it made landfall on Topsail Island and Hurricane Hugo made landfall in South Carolina as a Category 4 storm and significantly impacted the Charlotte area and the North Carolina mountains. Recent years, however, have witnessed a dramatic change as substantially more storms have impacted the state since 1990 than in the period between 1960 and 1990. The following storms had major impacts on the state since 1990: Emily (1993), Opal (1995), Bertha (1996), Fran (1996), Bonnie (1998), Dennis (1999), Floyd (1999), Irene (1999), Isabel (2003), Ivan (2004), Ophelia (2005), Earl (2010), Irene (2011), Matthew (2016), Florence (2018), Dorian (2019), Michael (2019), Isaias (2020) and Fred (2021).

Table 3-5 lists significant hurricanes from 1879 to 2022 that impacted North Carolina. Each event listing contains detailed information of each hurricane.

Table 3-5 Significant Hurricanes in North Carolina, 1879-2022

Hurricane Category Damage Examples Significant Hurricanes in North Carolina 1879-2022					
Name/Date	Category (in NC)	Maximum Wind	Pressure (in NC) inches Hg	NC Deaths	NC Damage (in millions $)
Aug. 1879	4	168	N/A	40+	N/A
Sept. 1883	3	100+	N/A	53	N/A
Aug. 1899	4	140	N/A	25	N/A
Sept. 1933	3	125	28.26	21	3
Sept. 1944	3	110	27.97	1	1.5
Hazel, 1954	4	150	27.70	19	136
Ione, 1955	3	107	28.00	7	88
Donna, 1960	3	120	28.45	8	25
Diana, 1984	3	115	28.02	3	85
Gloria, 1985	3	100+	27.82	1	8
Hugo, 1989	3	100	28.88	7	1,000
Emily, 1993	3	111	29.00	0	13
Floyd, 1999	2	155	27.2	13	4,500
Ivan, 2004	N/A	<39	26.9	8	13.4
Irene, 2011	1	96	27.82	6	275.2
Arthur, 2014	2	101	27.73	0	2.34
Matthew, 2016	1	97	28.06	26	1,500
Florence, 2018	2	105	28.30	42	1,670
Dorian, 2019	2	110	29.16	3	25
Isaias, 2020	1	85	29.11	2	12.5

Table 3-6 lists the hurricanes that impacted North Carolina between Sept. 31, 1993, and October 8, 2016 according to NCEI data. Each event is described in expanded detail following the table.

Table 3-6 North Carolina Detailed Hurricane History

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Emily	08/31/1993	Hyde, Carteret	Injuries: 1	Property: $85.4 million
Hurricane Gordon	11/17/1994	Carteret, Currituck, Dare, Hyde		Property: $832,722
Hurricane Felix	08/15/1995	Carteret, Currituck, Dare, Hyde, Onslow, Pamlico	Fatalities: 1	Property: $809,773 Crops: $809,700
Hurricane Bertha	07/12/1996	Alamance, Anson, Bertie, Beaufort, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Gates, Granville, Greene, Guilford, Halifax, Harnett, Hertford, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Northampton, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 1 Injuries: 10	Property: $263.4 million Crops: $227.3 million
Hurricane Eduoard	08/29/1996	Carteret, Dare		
Hurricane Fran	09/04/1996–09/05/1996	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Gates, Granville, Greene, Guilford, Halifax, Harnett, Hertford, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Northampton, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 13 Injuries: 6	Property: $1.85 billion Crops: $77 million

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Bonnie	08/26/1998–08/28/1998	Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Cumberland, Currituck, Dare, Duplin, Edgecombe, Franklin, Greene, Harnett, Hoke, Hyde, Johnston, Jones, Lenoir, Martin, Nash, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Sampson, Tyrrell, Wake, Washington, Wayne, Wilson	Fatalities: 1	Property: $139 million Crops: $359 million
Hurricane Dennis	08/30/1999–09/04/1999	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Forsyth, Franklin, Granville, Greene, Guilford, Halifax, Harnett, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson		Property: $162,900 Crops: $4.4 million
Hurricane Floyd	09/14/1999–09/15/1999	Alamance, Anson, Beaufort, Bertie, Brunswick, Camden, Carteret, Chatham, Chowan, Craven, Cumberland, Currituck, Dare, Davidson, Duplin, Durham, Edgecombe, Franklin, Granville, Greene, Guilford, Halifax, Harnett, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Martin, Montgomery, Moore, Nash, New Hanover, Onslow, Orange, Pamlico, Pasquotank, Pender, Perquimans, Person, Pitt, Randolph, Richmond, Sampson, Scotland, Stanly, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 13	Property: $5.2 billion Crops: $1.4 billion
Hurricane Irene	10/16/1999–10/17/1999	Beaufort, Bertie, Camden, Carteret, Chowan, Craven, Currituck, Hyde, Onslow, Pamlico, Pasquotank, Perquimans	Fatalities: 1	Property: $45,923

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Isabel	09/17/2003–09/18/2003	Beaufort, Bertie, Camden, Carteret, Chowan, Craven, Cumberland, Currituck, Dare, Duplin, Durham, Edgecombe, Franklin, Gates, Granville, Greene, Halifax, Hertford, Hyde, Jones, Lenoir, Martin, Nash, Northampton, Onslow, Pamlico, Pasquotank, Perquimans, Person, Pitt, Tyrrell, Vance, Wake, Warren, Washington, Wayne, Wilson	Fatalities: 2	Property: $621.9 million Crops: $19.1 million
Hurricane Alex	08/03/2004	Beaufort, Carteret, Craven, Dare, Hyde, Onslow, Pamlico, Tyrrell, Washington		Property: $9.8 million
Hurricane Charley	08/14/2004	Beaufort, Bladen, Brunswick, Carteret, Columbus, Craven, Dare, Duplin, Greene, Hyde, Jones, Lenoir, Martin, New Hanover, Onslow, Pamlico, Pender, Pitt, Tyrrell, Washington	Injuries: 3	Property: $22.2 million Crops: $6.99 million
Hurricane Ophelia	09/13/2005–09/14/2005	Beaufort, Brunswick, Carteret, Craven, Dare, Duplin, Greene, Hyde, Jones, Lenoir, Martin, New Hanover, Onslow, Pamlico, Pender, Pitt, Tyrrell, Washington	Injuries: 5	Property: $63.9 million Crops: $14.5 million
Hurricane Ivan	9/18/2004	Alamance, Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Caswell, Davidson, Forsyth, Graham, Guilford, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Randolph, Rockingham, Rutherford, Stokes, Swain, Transylvania, Watauga, Wilkes, and Yancey.	Fatalities: 8	Property: $17.5 million
Hurricane Earl	9/01/2010	Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Duplin, Edgecombe, Gates, Greene, Halifax, Hertford, Hyde, Jones, Lenoir, Martin, New Hanover, Northampton, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Tyrrell, and Washington.	Fatalities: 0 Injuries: 0	Property: $430,000 Crops: $2.92 million

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Hurricane Irene	8/27/2011 – 8/28/2011	Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Duplin, Edgecombe, Gates, Greene, Halifax, Hertford, Hyde, Johnston, Jones, Lenoir, Martin, Nash, New Hanover, Northampton, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Sampson, Tyrrell, Vance, Warren, Washington, Wayne, and Wilson.	Fatalities: 6 Injuries: 0	Property: $106.4 million Crops: $95.00 million
Hurricane Arthur	7/3/2014	Hyde, Carteret, Dare	Fatalities: 0 Injuries: 0	Property: $698,500
Hurricane Matthew	10/8/2016	Brunswick, New Hanover, Pender, Dare	Fatalities: Injuries:	Property: Crops:
Hurricane Florence	9/13/2018	Alamance, Anson, Ashe, Beaufort, Bertie, Bladen, Brunswick, Cabarrus, Carteret, Chatham, Columbus, Craven, Cumberland, Craven, Dare, Davidson Duplin, Durham, Duplin, Granville Greene, Guilford, Harnett, Hoke, Hyde, Johnston, Jones, Lee, Lenoir, Madison, McDowell, Montgomery, Moore, New Hanover, Onslow, Orange, Pamlico, Pender, Person, Pitt, Polk, Richmond, Robeson, Rowan, Sampson, Scotland, Stanly, Tyrrell, Union, Wayne, Wilson, Yancey	Fatalities:42 Injuries:	Property: $16.7 billion Crops:
Tropical Storm Michael	10/11/2018	Alamance, Brunswick, Caswell, Chatham, Dare, Davidson, Davie, Forsyth, Granville, Hyde, Iredell, McDowell, Montgomery, Orange, Person, Randolph, Rockingham, Stokes, Surry, Vance, Yadkin	Fatalities: 0 Injuries: 1	Property: $8.67 million Crops: N/A
Hurricane Dorian	9/6/2019	Beaufort, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Duplin, Greene, Hoke, Hyde, Jones, Lenoir, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Robeson, Tyrrell, Washington, Wayne	Fatalities: 0 Injuries: 0	Property: $7.13 million Crops:
Hurricane Isaias	8/4/2020	Beaufort, Bertie, Brunswick, Carteret, Chowan, Columbus, Craven, Hertford, Hyde, Jones, Lenoir, New Hanover, Onslow, Pamlico, Pender, Pitt	Fatalities: 2 Injuries: 14	Property: $12.155 million Crops:

North Carolina Detailed Hurricane History				
Event	Duration	Location	Severity	Extent of Damages (2017 dollars)
Tropical Storm Eta	11/12/2020	Alexander, Alleghany, Ashe, Beaufort, Burke, Caldwell, Davidson, Davie, Duplin, Edgecombe, Hertford, Iredell, Robeson, Rowan, Sampson, Stokes, Wilkes, Wilson, Yadkin	Fatalities: 9 Injuries:	Property: $20.4 million Crops: N/A
Tropical Storm Fred	8/16/2021	Buncombe, Cherokee, Clay, Haywood, Henderson, Jackson, McDowell, Macon, Madison, Mitchell, Transylvania, Yancey, Avery, Burke, Graham, Polk, Rutherford, Swain	Fatalities: 6 Injuries:	

Source: NCEI

Significant North Carolina Hurricane Event Overviews

Hurricane Fran (09/04/1996–09/05/1996)

Hurricane Fran moved onshore near Cape Fear on the evening of Sept. 6, 1996, and raced north toward Raleigh, cutting a swath of destruction as it traveled. The Category 3 hurricane destroyed or damaged 90 percent of the homes located in North Topsail Beach. The town hall and police station were destroyed. A 15-foot storm surge cut a 100-foot-wide inlet through the middle of the island. A Camp Lejeune-based Marine lost his life when he and two others mistakenly drove onto the island at the height of the storm. State Route 1568 was washed out and NC 210 was covered with sand. Damages in North Topsail Beach and Onslow County alone exceeded $500 million, as 6,688 structures were either destroyed or damaged.

In Carteret County, Emerald Isle reported 67 homes destroyed and 409 that had experienced major damage. Thirty-three mobile homes were destroyed. The Emerald Isle fishing pier was destroyed, and Bogue Sound Pier lost 150 feet. Dune elevation was reduced by 5 to 20 feet due to erosion. Winds gusted up to 100 mph at Atlantic Beach. Storm surge in Swansboro was measured at 10 feet. Several businesses along the waterfront were destroyed and water covered Main Street. Storm surges approaching 9 feet flooded portions of Washington and Belhaven. The storm surge in Washington was the highest recorded since the unnamed hurricane that occurred on Sept. 3, 1912.

New Bern experienced a storm surge of 10 feet on the Neuse River. One bridge was closed when an approach road collapsed. Other bridges were washed out near Stella and Swansboro. One motorist was killed near Greenville when his car struck a tree. In Duplin County (near Rose Hill), a resident perished when the chimney in her home collapsed. Another resident died when a tree fell through her trailer, located in Catherine Lake in Onslow County. Measured wind gusts approached speeds of 94 mph at the New River Marine Corps Air Station in Jacksonville, and 92 mph at Duke Marine Labs in Beaufort.

Hurricane Fran was the worst natural disaster in terms of economics in North Carolina history. In the Raleigh, NC area alone, the damage exceeded $2 billion. Damage to crops, livestock, and farm equipment/buildings was more than $400 million. The agricultural damage was the greatest in Sampson, Johnston, and Wayne counties. Several hundred thousand trees were uprooted or broken. Tens of thousands of homes were damaged by falling trees. Almost every neighborhood in the path of the storm's center was affected. The copious rainfall produced many severe flash floods and river floods. The flooding experienced by the Haw River (at the town of Haw River), the Neuse River (at Smithfield and Goldsboro), and the Tar River (at Louisburg and Rocky Mount) approached or exceeded the highest floods on record.

Many homes located in the floodplain had to be evacuated. The most massive evacuation occurred in Goldsboro, where residents of 550 homes had to be relocated to public shelters. Hundreds of cars in Goldsboro were damaged by water; many of these vehicles were so deeply submerged beneath floodwater that only the tops of their radio antenna were visible from the surface. Many homes and businesses incurred heavy losses. Along the Crabtree Creek in Raleigh, which crested at its highest peak since 1973, hundreds of new cars from local auto dealerships floated in 6 feet of water. Scores of businesses reported heavy damage at the area's largest shopping center. Basic living necessities were unavailable for several days, including milk, bread, drinking water, power, and telephone service. It took more than 10 days for power to be restored to many areas. Schools were closed for a week in the hardest-hit counties. Automobile travel was hazardous for days after the storm, due to fallen and falling trees. A full 12 days after the event, 150 secondary roads remained closed.

Spiral bands associated with Hurricane Fran affected northeast North Carolina from the evening of Sept. 5 through the morning of Sept. 6. The highest sustained wind speed recorded at the Elizabeth City Coast Guard Station (ECG) was 43 mph, with the highest gust recorded at 55 mph. There were no confirmed tornadoes, but numerous trees and power lines were blown down across northeast North Carolina, resulting in assorted structural damage and power outages. Coastal Pasquotank and Camden counties experienced approximately a 6-foot storm surge in the Albemarle Sound, flooding coastal sections of these counties, including the business district of downtown Elizabeth City. Chowan County experienced a 4-foot surge from the Albemarle Sound, causing some flooding in Edenton. Currituck County received only minor flooding from the Currituck Sound. The heaviest rain fell across the inland counties of northeast North Carolina, where amounts generally ranged from 1.5 to 3.5 inches. Some roads were flooded due to the rainfall.

The eye of Hurricane Fran passed over eastern Brunswick County with winds measured as high as 109 mph at Long Beach. The storm surge was approximately 6 feet, with beach erosion around 15 feet on the eastern islands. Seven beach houses on the east end of Holden Beach were damaged or destroyed. Emergency shelters housed 1,750 residents and vacationers.

The center of Fran's eye (which measured approximately 25 miles across), passed up the Cape Fear River during the evening, with winds gusting around 110 mph, storm surge recorded at 12 feet Mean Sea Level (MSL), and 40-foot beach erosion, which destroyed most docks and piers. County infrastructure suffered $5 million in damage. Schools experienced $2 million in damage. Power outages lasted for more than a week in some areas. Pleasure Island was hit hard, as 25 homes were carried off their foundations and many others were badly damaged. Wrightsville Beach was not hit as hard, but 15 homes suffered at least 75 percent damage. In Wilmington, 14 homes were destroyed and 385 homes suffered major damage. The 197-foot-tall steeple of the 130-year-old First Baptist Church fell. Shelters housed 880 evacuees.

Fran's eye then moved across Pender County. On Topsail Island, a 12-foot storm surge caused 40 feet of beach erosion and wiped-out dunes as over wash destroyed most of the first row of beach houses and heavily damaged the rest. Damage to Surfside Beach and Topsail Beach was $112 million. The rest of the county experienced more than $50 million in structural damage, with 161 buildings destroyed and 585 more sustaining major damage (including the roof being blown off the county courthouse). Marketable timber loss was $37 million. Two people died: a woman found on a mattress in the marsh and a man floating in the Scotts Hill Marina Boat Basin. Shelters housed more than 600 evacuees.

Hurricane Floyd (09/14/1999–09/15/1999)

Hurricane Floyd caused the largest peacetime evacuation in the history of the United States up to that point in time. The storm also caused massive record flooding across inland sections of eastern North Carolina. At one time, Floyd was classified as a Category 4 hurricane on the Saffir-Simpson scale, and will likely be categorized as one of the costliest hurricanes to strike the United States during the 20th century.

Tropical Depression 8 (Hurricane Floyd's initial designation) was detected by the National Hurricane Center at 4 p.m. EST on Sept. 7. The broad center was located nearly 1,000 miles west of the Lesser Antilles. At that time, the depression was moving toward the west at 14 mph, with maximum sustained winds of 30 mph. Within 12 hours, the depression gained strength, became a tropical storm, and was named Floyd. As it neared the Virgin Islands on the afternoon of Sept. 10 (just 415 miles west of San Juan), Floyd was officially designated as a hurricane. Hurricane Floyd rapidly intensified and by the evening of Sept. 12 was classified as a Category 4 hurricane. The hurricane continued to intensify. At its peak on the morning of Sept. 13, the winds increased to 155 mph and the central pressure bottomed-out at 921 mb. The position was 525 miles east-southeast of Miami and moving west at 14 mph. Fortunately for Floridians, Hurricane Floyd soon made an expected turn to the north. By 5 p.m. EST on Sept. 14, the entire North Carolina coast was under a hurricane watch, which at midnight was upgraded to a hurricane warning.

That same night, the first outer rain bands began affecting eastern North Carolina and, in turn, reports of flooding began filtering into the National Weather Service office in Morehead City/Newport (MHX). At least 40 official shelters were opened across the county warning area. Severe weather and rainfall preceded landfall. By the night of Sept. 16, 20 tornado warnings had been issued, with over half of the possible tornado occurrences being verified. The greatest rainfall estimates from the MHX Doppler radar were over Duplin, Jones, Lenoir, Greene, Pitt, Martin, Craven, and Onslow counties. Estimates were near 6 to 10 inches of rain, with isolated areas receiving 12 to 15 inches. The greatest amount of rainfall (15.48 inches) was reported by a Cooperative observer in Washington. Tyrrell, eastern Carteret, eastern Pamlico, Hyde, and Dare counties all reported estimates of less than 3 inches.

Hurricane Floyd made landfall on the morning of Sept. 16 near North Topsail Beach, as a Category 2 hurricane. The eye moved northeast over Jacksonville, New Bern, Washington, Plymouth and continued over the eastern shores of Virginia. As the hurricane moved over the eastern coast of North Carolina, it accelerated and weakened. It lost its tropical characteristics early on Sept. 17. The University of Oklahoma Doppler-On-Wheels (DOW) team was positioned at Topsail Beach. Around 2 a.m. EST, the DOW recorded a sustained wind of 81 mph with gusts of up to 105 mph. The peak inland report in the MHX 15-county warning area was 82 mph at Cherry Point Marine Corp Air Station (NKT). The peak offshore report was 96 mph at Duck Pier.

Similar to rainfall, the strongest ocean storm surges occurred west and northwest of the eye. Ocean storm surges were about 4 to 6 feet above normal, generally affecting Onslow, Carteret, and Hyde counties. This caused extensive beach erosion on the south facing beaches. Ocracoke Island officials reported at least 10 new dune breaks along Highway 12. In Carteret County, Pine Knoll Shores lost some 50 feet of beach. Emerald Isle lost an average of 14 feet and 52 public beach access walkways. The Oceana Pier on Atlantic Beach lost a 200-foot section and the remaining 200-foot section of Iron Steamer Pier that Hurricane Bonnie spared was also wiped out. Along the Albemarle Sound, storm tides were about 5 to 6 feet above normal. The Pamlico River storm tides ranged between 6 to 8 feet above normal. Water levels were especially high in Hyde County, Sladesville, and Scranton. Along the Neuse River, storm tides were also near 6 to 8 feet above normal, especially in the Core Creek area.

Extreme flooding was experienced across most counties. Inland flooding exceeded that generated by hurricanes Bertha, Fran, Bonnie, and Dennis combined. Most counties reported their worst flooding ever. The Tar River in Greenville and the Neuse River in Kinston were nearly 15 feet above their flood stages of 13 and 14 feet, respectively. The Tar River remained above flood stage for nearly two weeks, while the Neuse River remained above flood stage for more than a month. The Northeast Cape Fear River in Chinquapin was 8 to 10 feet above the flood stage of 13 feet. The Roanoke River in Williamston rose to nearly 3 feet above its flood stage. Unbelievable numbers of homes were covered with water and over half a million customers throughout the county warning area were left without power. In Greenville alone, a 100-acre parcel of land would be needed to store all the mobile homes that were destroyed due to flooding.

Unofficially, the flooding from Hurricane Floyd has been compared to that of a 500-year flood. At least 13 fatalities have been reported during the event in the 15-county warning area. Unfortunately, a majority of the deaths could have been avoided had the victims not tried to drive on flooded roadways. As with most hurricanes, inland flooding is now responsible for the largest percentage of fatalities.

Floyd also produced more human misery and environmental impact on North Carolina than any disaster in memory. The 15 to 20 inches of rain that fell across the eastern half of the state caused every river and stream to flood. Many rivers set new flooding records. Whole communities were submerged for days, and some areas remained underwater for weeks. Thousands of homes were lost. Crop damage was extensive. The infrastructure of the eastern counties (composed mainly of roads, bridges, water plants, etc.) was heavily damaged. By the end of 1999, $1.5 billion of emergency funding had already been spent, with estimates that the cost would ultimately reach $3 to $4 billion. The counties within the Raleigh County warning area probably sustained more than half of the state total. Even worse was the loss of life, which occurred mainly due to flooding. Many North Carolinians did not heed the call to evacuate and many more attempted to drive through flooded areas. In the central part of the state, 21 people lost their lives. Also, a significant loss of livestock occurred, mainly involving swine and poultry.

Floyd, with wind gusts around 90 mph caused the widespread occurrences of downed trees and power outages. In Brunswick County, power was lost by 95 percent of the county. The wind did major damage to the roof of Brunswick Community Hospital. Storm surge was 7 to 9 feet on the east side of the county and 3 to 6 feet further west. Ocean Crest Pier, Long Beach Pier, and Sunset Beach Pier were hit hard. Ocean over wash was worst at Oak Island, where 4 miles of beach containing 100 oceanfront homes sustained $23 million in damage. Holden Beach sustained $8.8 million in damage, and 46 homes were condemned—many due to exposed septic tanks. Ocean Isle Beach suffered $6 million in damage: two houses were knocked off their foundations; 500 feet of roadway was lost; and 28 homes were declared unsafe. Sunset Beach experienced $1.25 million in damage and lost half its dune and a road, thus isolating 75 homes. However, it was the heavy rains that accumulated around 20 inches which caused the worst flooding in history. High water closed most roads (including US 17), isolating many areas. A dam broke at Boiling Springs Lakes, inundating the area. In New Hanover County, housing losses approached $25 million: eight homes were destroyed and more than 200 sustained major damage. Ocean storm surge was 9 to 10 feet, inundating barrier islands and causing extensive dune erosion.

Record rainfall distinguished Floyd—the most rain ever in 24 hours at ILM Airport (14.84 inches) and a storm total 19.06 inches, causing widespread flooding. In Pender County, a 7- to 9-foot storm surge at the beach damaged the barrier islands, eroding half the dune. However, it was record rainfall with ensuing ponding and flooding of rivers that caused the most serious damage. The Northeast Cape Fear had the worst flood of the 20th Century, while the Black River flood was the worst experienced since 1945. Largely due to flooding, more than 1,000 homes suffered major damage and 200 more were condemned. More than 3,000 hogs, 90,000 turkeys, and 200 cows were lost due to drowning. Animal waste and septic tanks added pollution to the flooding. Two human fatalities occurred as motorists drove into flooded parts of highways. In Columbus and Bladen counties, wind gusts approached 75 mph in the eastern parts of the counties, downing trees and power lines. More than 15 inches of rain caused widespread flooding. In Robeson County, Hurricane Floyd caused wind gusts near 70 mph in eastern portions of the county, downing trees and power lines. Rainfall around 10 inches caused widespread flooding.

Floyd was a Category 1 hurricane as it crossed the Wakefield WFO County warning area. Sustained tropical-storm-force winds with gusts up to near hurricane force occurred over the northwest quadrant of the storm, over interior portions of northeast North Carolina and along the coastal waters of the Wakefield marina area. The center of the storm crossed the county warning area along Elizabeth City to Currituck County, to Sandbridge Virginia Beach axis. The highest sustained wind speed recorded at the Elizabeth City Coast Guard Station (ECG) was 39 mph, with gusts to 64 mph. Two confirmed tornadoes occurred in association with Floyd, both in northeast North Carolina. Several thousand persons were evacuated and housed in several shelters from coastal jurisdictions. Hundreds of trees and power lines were blown down across northeast North Carolina, resulting in widespread power outages. Coastal Pasquotank and Camden counties experienced approximately a 5- to 6-foot surge in the Albemarle Sound, flooding coastal sections of those counties, including the business district of downtown Elizabeth City. Chowan County experienced a 5- to 6-foot surge from the Albemarle Sound, causing some flooding in Edenton. The lowest sea level pressure recorded at the ECG was 968.5 mb.

Hurricane Irene (08/27/2011–08/28/2011)

Hurricane Irene moving northward over the outer banks of North Carolina and just off the Virginia coast produced hurricane force wind gusts across portions of coastal northeast North Carolina from early Saturday morning, August 27th into Sunday morning, August 28th. Announcing itself with howling winds and hammering rains, Hurricane Irene made landfall at Cape Lookout, on the Outer Banks of North Carolina, at about 7:30 a.m. on Saturday, August 27, 2011. However, tropical-storm-force winds began to affect the Outer Banks hours before landfall, producing waves of 6–9 ft (1.8–2.7 m). During Irene, some of the state’s worst flooding happened along the Pamlico and Albemarle sounds, in the state’s Inner Banks. Rescue crews fanned out late Saturday, August 27th and Sunday, August 28th in search of people trapped by the rising waters. Boats that were once docked in the Albemarle Sound were washed up on the side of N.C. 158 in Nags Head about a half mile down from the causeway bridge.

The large hurricane left extensive damage in its wake and there were reports that tornadoes may have leveled homes and overturned vehicles. Following the touch down of a potent tornado, at least four homes were demolished in Columbia, while up to three others sustained significant damage. Preliminary assessment indicated multiple flooded areas and uprooted trees along coastlines; in Nash County, a snatched tree limb struck and killed one person. Prior to the storm, a resident in Onslow County suffered a fatal heart attack while applying plywood to his house. Two people in Pitt and Sampson Counties were additionally killed by falling trees, as were two others in Goldsboro and Pitt County in traffic accidents. A man also drowned in the flooded Cape Fear River. In all, over 1,100 homes were destroyed. The estimated $71 million in damage did not include agricultural losses.

Hurricane Irene left downed and denuded trees, impassable roadways, damaged municipal buildings, and widespread flooding on its way. In Bay Drive in Kill Devil Hills, debris from the Albemarle Sound covered the street after overflowing with overnight rainfall. Storm surge from Hurricane Irene spilled over Kitty Hawk Bay in Albemarle Sound and Roanoke Island, Hatteras Island, Collington, Duck, and other parts of the islands were simply inundated by the Albemarle and Pamlico Sounds. In addition, heavy rains contributed to minor crop damage. Storm total rainfall generally ranged from ten to fourteen inches.

Hurricane Matthew (10/8/2016-10/9/2016)

Hurricane Matthew was an extraordinarily severe and sustained event that brought record-level flooding to many areas in eastern North Carolina's coastal plain, sound, and coastal communities. Hurricane Matthew hit North Carolina on October 8, 2016, as a Category 1 storm. Communities were devastated by this slow-moving storm primarily by widespread rainfall. During a 36-hour period, up to 18 inches of heavy rainfall inundated areas in central and eastern North Carolina.

Riverine flooding began several days after Hurricane Matthew passed and lasted for more than two weeks. New rainfall records were set in 17 counties in the Tar, Cape Fear, Cashie, Lumber, and Neuse River watersheds. Entire towns were flooded as water levels throughout eastern North Carolina crested well above previously seen stages.

During the peak of the hurricane, 800,000 households lost power and 635 roads were closed, including a section of I-40 West in Johnston County that was closed for seven days, and sections of I-95 North and South in Robeson and Cumberland Counties that were closed for 10 days.

Approximately 88,000 homes were damaged and 4,424 residences were completely destroyed. Losses totaled more than $967 million, representing an economic loss as high as 68 percent of the damages, or $659 million, not expected to be covered by insurance or FEMA assistance.

North Carolina Governor McCrory requested FEMA assistance on October 9, 2016, and FEMA subsequently declared a major disaster (DR-4285) for North Carolina on October 10, 2016, for 48 counties encompassing approximately 325 cities, towns, townships, and villages. Preliminary estimates indicate that more than 30,000 businesses suffered physical or economic damage, and 400,000 employees were affected as a result. Hurricane Matthew also had a significant impact on the agriculture and agribusiness economy in eastern North Carolina. The nearly 33,000 agricultural workers and 5,000 agriculture-support workers hit by the storm account for more than half of the state's agricultural and agriculture-support workforce.

Initial economic analysis of the impacts of crop and livestock losses caused by Hurricane Matthew estimated that there was a loss of more than 1,200 jobs and roughly $10 million in state and local income and sales tax revenue.3

North Carolina's response to Hurricane Matthew included 2,300 swift-water rescues using 79 boats, and more than 90 air rescues. North Carolina also deployed more than 1,000 National Guard and State Highway Patrol to assist with rescue and sheltering missions. There were 3,744 individuals transported to 109 shelters across central and eastern North Carolina during the storm's peak.

FEMA's disaster declaration made 50 counties eligible for FEMA assistance, 45 of which are eligible for Individual Assistance and Public Assistance and five of which are eligible for Public Assistance only. There were 81,832 individuals registered for FEMA/state assistance. Federal/state financial assistance in the amount of $92.5 million was approved to help flood survivors recover. Small Business Administration (SBA) loans approved for individuals after Hurricane Matthew totaled $65.6 million. SBA loans approved for businesses after Hurricane Matthew totaled $23.2 million.

Hurricane Florence (September 14, 2018)

Hurricane Florence, was a long-lived Cape Verde hurricane and the wettest tropical cyclone on record in the Carolinas. The storm produced record level flooding along the Cape Fear, Northeast Cape Fear, Lumberton and Waccamaw Rivers, destroying roads and damaging thousands of homes and businesses. A USGS report indicated nine river gauges reported floods exceeding their 1 in 500 year expected flood intervals. Florence also produced wind gusts over 100 mph which caused significant damage to buildings, trees, and electrical services across the Cape Fear area, and storm surge of over four feet eroded beaches and damaged property between Cape Fear and Point Lookout.

Despite making landfall as a weakened Category 1 hurricane, Florence still produced 40 to 70 mph wind gusts. Most major roads and highways in the Piedmont experienced some flooding, with large stretches of I-40 and I-95 remaining impassible for days after the storm has passed. The storm also spawned tornadoes in several places along its path.

North Carolina reported 42 fatalities due to the hurricane and preliminary damage estimates of $16.7 billion. An estimated 74,563 structures were flooded and 5,125 people were reportedly rescued from flooding. Nearly 140,000 North Carolinians registered for disaster assistance after the storm.

Hurricane Dorian (September 5-6, 2019)

Hurricane Dorian caused severe flooding and hurricane force winds over parts of the coastal Carolinas during early September 2019. After stalling over the Bahamas for three days as a

---

[3] *Governor McCrory's Request for Federal Assistance for Hurricane Matthew Recovery, November 14, 2016*

Category 5 Hurricane, Dorian proceeded generally to the northwest, before moving along the Atlantic Coast, striking the town of Buxton, North Carolina, on September 6th.

The effects of Hurricane Dorian were extensive in North Carolina, but not as severe as 2019's Hurricane Florence. During the event, 22 tornadoes were confirmed across coastal sections of North Carolina, most short-lived and weak. However, two longer-lived tornadoes of EF2 intensity were confirmed in Sunset Beach and Emerald Isle, causing severe damage to multiple structures, inflicting at least $2 million in property damage.

In Brunswick County, heavy rainfall led to flash flooding that inundated neighborhoods near Leland, Small creeks flooded areas near Varnamtown and closed roads, U.S. Route 17 near Ocean Isle Beach was closed due to overflow throughout the morning hours of September 6th. In Oak Island, 86 properties sustained damage, though only 3 of those were substantially damaged. In New Hanover County, sand dunes reconstructed after Hurricane Florence protected Carolina Beach from significant impacts, with only minor beach erosion noted. High water covered Route 117 in Castle Hayne with 2 ft of water, with lesser values elsewhere. Severe neighborhood streets in Wilmington were inundated, and the downtown area was flooded as portions of the Cape Fear River overflowed its banks.

After a lull in heavy rainfall, a second bout of precipitation late on September 5th forced the closure of roadways throughout Castle Hayne, Wrightsboro, Wilmington, and Ogden. Only a few trees were toppled in this area; however, a 54-year-old man was killed while cutting a fallen tree on September 7th.

Effects were minimal in neighboring Pender County, were come county roads were closed due to flooding but water receded quickly. Farther inland, flash flooding resulted in the closure of severe roads throughout Washington, Wilson, Johnston, Sampson. And Craven counties; some roads throughout these communities were washed out. Across Sampson County in particular, 15 roads were closed and a section of road was washed out near Clinton. In Robeson County, a firefighter was injured when a tree fell on his vehicle. Two minor injuries were also reported in Johnston County when a vehicle struck a fallen tree.

At the height of the power outages, about 5,000 people lost electricity in Johnston County, and an additional 2,445 people lost electricity in Wake County.

On September 14th, Governor Roy Cooper sought a disaster declaration for the state; an additional request for federal assistance was sent one week later. The North Carolina Department of Transportation reported that Dorian inflicted $40 – 50 million in damage to roads, with $25 – 30 million to primary roads and $16 – 20 million to secondary roads, including $4 – 5 million to Highway 12 alone. Duke Energy reported that 288,000 customers had their power restored in the wake of the storm. Coastal assessments found at least 54 new inlets cutting from the Atlantic into the Core sound throughout the Outer Banks. At least 20 – 25% of the state's crop industry was destroyed, particularly the tobacco crop.

Hurricane Isaias (August 3, 2020)

Hurricane Isaias was a category one hurricane that made landfall at Ocean Isle Beach, NC during the evening of August 3, 2020 with a maximum sustained wind near 85 mph. The storm's rapid movement limited rainfall amounts, however significant storm surge flooding and multiple tornado touchdowns occurred across portions of coastal North Carolina.

A damaging storm surge occurred along the Horry County coastline during the evening high tide on August 3. Homes in low lying areas near the beach were flooded and dune erosion was severe. Damaging storm surge flooding continued northward along the south-facing coastline of Brunswick County including Holden Beach, Ocean Isle Beach, Oak Island, and Southport. Up to three feet of storm surge flooding caused heavy damage to waterfront shops in Southport. On Oak Island storm surge flooding damage or destroyed an estimated 75 – 100 vehicles. Sand dunes were washed onto the streets up to three blocks inland. Town officials estimated damage around $40 million.

The highest wind gusts occurred at the beaches near and east of the landfall point across Brunswick, New Hanover, and Pender counties in southeastern North Carolina. Brunswick County reported 53,000 customers without power at the height of the storm. Across New Hanover County downed trees and power lines knocked out electrical service to 85,000 residents. Pender County officials reported 27,500 residents lost electrical power.

Hurricane Isaias produced six confirmed tornado touchdowns across our portion of the Carolinas. The strongest was an EF2 tornado that was on the ground for over eight miles from Bald Head Island to Southport. A short-lived tornado at Garden City Beach injured one person and damage several homes. In Bertie County, a deadly EF3 tornado killed two and injured 14 near the town of Windsor. Isaias indirectly led to the heath of two people in Wilmington, North Carolina on August 5th. Both men were clearing debris when lightning from a thunderstorm struck and killed them.

Heavy damage was inflicted to multiple homes in Oak Island and Ocean Isle Beach, North Carolina, including three that were destroyed in the latter community by a large fire. Damage to Holden Beach along exceeded $40 million.

3.2.2.5 Changing Future Conditions

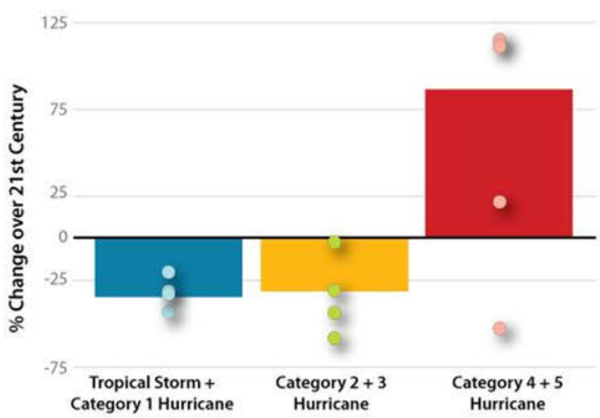
North Carolina's coastal location makes it a prime target for hurricane landfalls, and changing climate and weather conditions may increase the number and frequency of future hurricane events. Hurricanes and other coastal storms may result in increased flooding, injuries, deaths, and extreme property loss. According to the US Government Accountability Office, national storm losses from changing frequency and intensity of storms is projected to increase anywhere from $4-6 billion in the near future.

According to the North Carolina Climate Science Report, a recent assessment has supported the conclusion that the intensity of the strongest hurricanes is likely to increase as the Earth continues to warm. This also holds true for the State of North Carolina. On a global scale, confidence is high for tropical cyclone changes. From the state perspective, individual regions for North Carolina receive a medium confidence level. Although less than the entire globe, this potential risk should be considered in risk assessments.

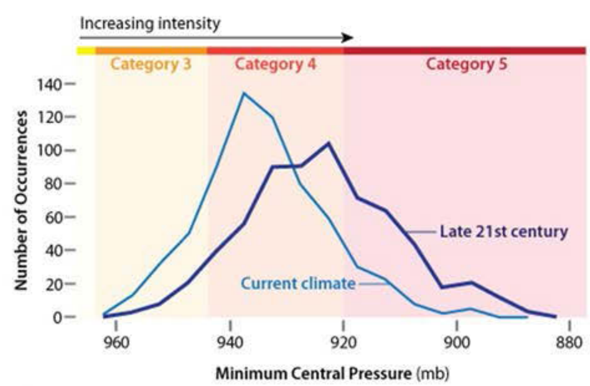
On the other hand, it is virtually certain that rising sea level and increasing intensity of coastal hurricanes, will result in storm surge flooding in coastal North Carolina. Overall, there is low confidence pertaining to the total number of hurricanes.

Additionally, as NOAA reports in Figure 3-8, weather extremes will likely cause more frequent, stronger storms in the future due to rising surface temperatures. That is to say, NOAA models predict that while there may be less frequent, low-category storm events (Tropical Storms, Category 1 Hurricanes), there will be more, high-category storm events (Category 4 and 5 Hurricanes) in the future. This means that there may be fewer hurricanes overall in any given year, but when hurricanes do form, it is more likely that they will become large storms that can create massive damage.

Figure 3-8: National Oceanic and Atmospheric Administration Climate Models Projection for Future Hurricanes



Climate models project there will be fewer weak to moderate-strength Atlantic hurricanes as surface temperatures rise this century. However, the models predict that a greater number of the hurricanes that do form will tend to strengthen to category 4 and 5 hurricanes. The bars in this graph show the average results from 18 different models. The dots on each bar show a range of results from 4 of the 18 different models. Graph courtesy of Gabriel Vecchi, NOAA GFDL.



Models project there will be an increase in hurricane intensities as the climate warms over the course of this century. Though there will likely be fewer Atlantic hurricanes overall, wind speeds for the ones that do form will be about 4 percent stronger for every 1°C increase in sea surface temperature. Graph courtesy of Tom Knutson, NOAA GFDL.

Source: National Oceanic and Atmospheric Administration GFDL

3.2.2.6 Impact

North Carolina is susceptible to potentially catastrophic impacts from hurricane. While not highly likely, a Category 5 hurricane could strike North Carolina causing a high number of deaths/injuries possible and damaging or destroying more than 50% of the property in the State. It is not out of the realm of possibility that a major could hurricane could cause complete shutdown of some critical facilities for 30 days or more.

3.2.2.7 Future Probability

North Carolina has an extensive hurricane history due to its coastal location. Because large hurricanes can impact large areas at one time, all parts of the state are vulnerable to impact. Historical occurrences of hurricanes and coastal hazards show that North Carolina is likely (between 33.4 and 66.6 percent annual probability) to experience these types of events in the future. Additionally, intensity of the strongest hurricanes is likely to increase with warming, causing greater losses to people, communities, the economy, and natural resources.

It is virtually certain that sea level along the North Carolina coast will continue to rise due to expansion from ocean warming and melting of ice caps on land. Similarly, it is virtually certain that rising sea levels and increasing intensity of coastal storms will result in an increase in storm surge flooding in coastal North Carolina. Increased storm surge will, in time, lead to eroded shorelines. This loss of land and natural buffer will ultimately leave properties further at risk of flooding and storm damage.

3.2.2.8 NCEOP Reference

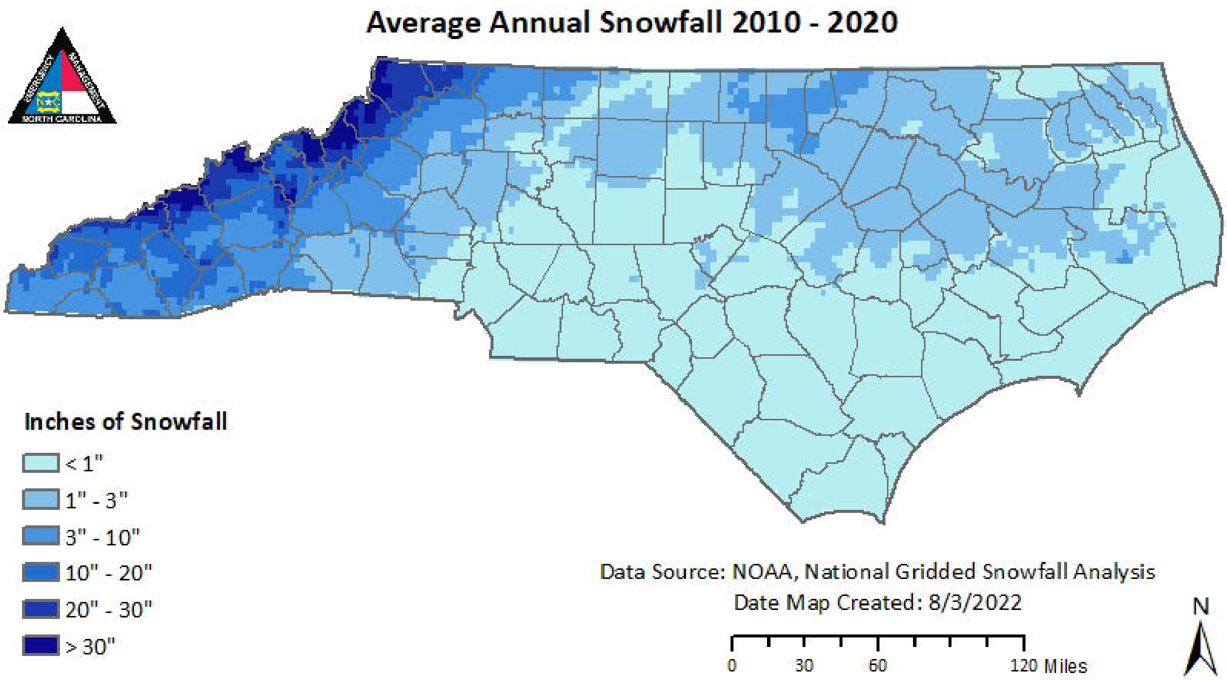
Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 1, Hurricane Operations Plan

3.2.3 Severe Winter Weather

3.2.3.1 Description

The winter storms that typically impact North Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. The entire state has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal areas typically face their greatest weather threat from nor'easters and other severe winter coastal storms. These storms can contain strong waves and often result in extensive beach erosion and flooding. Freezing rain and ice storms typically occur once every several years at coastal locations and severe snowstorms have been recorded occasionally in coastal areas. Rising global temperatures may reduce the number of frozen precipitation events in North Carolina, but may also increase the likelihood of non-freezing storm events in the winter months.

Figure 3-9 Average Normal Annual Snowfall 2010-2020



3.2.3.2 Extent

The extent of winter storms can be measured by the amount of snowfall received (in inches). The greatest 24-hour snowfall (36 inches) and single storm snowfall (50 inches) in North Carolina was recorded on March 1993 at Mount Mitchell.[4]

When reviewing historical snowfall information provided by NOAA and NCEI information, the mountains of North Carolina are more prone to snowfall events, but the Piedmont, and even coastal counties can experience ice storms that often cause major disruption.

[4] *Weather Extremes. North Carolina State Climate Office. Retrieved on December 14, 2017 from: https://climate.ncsu.edu/nc_extremes*

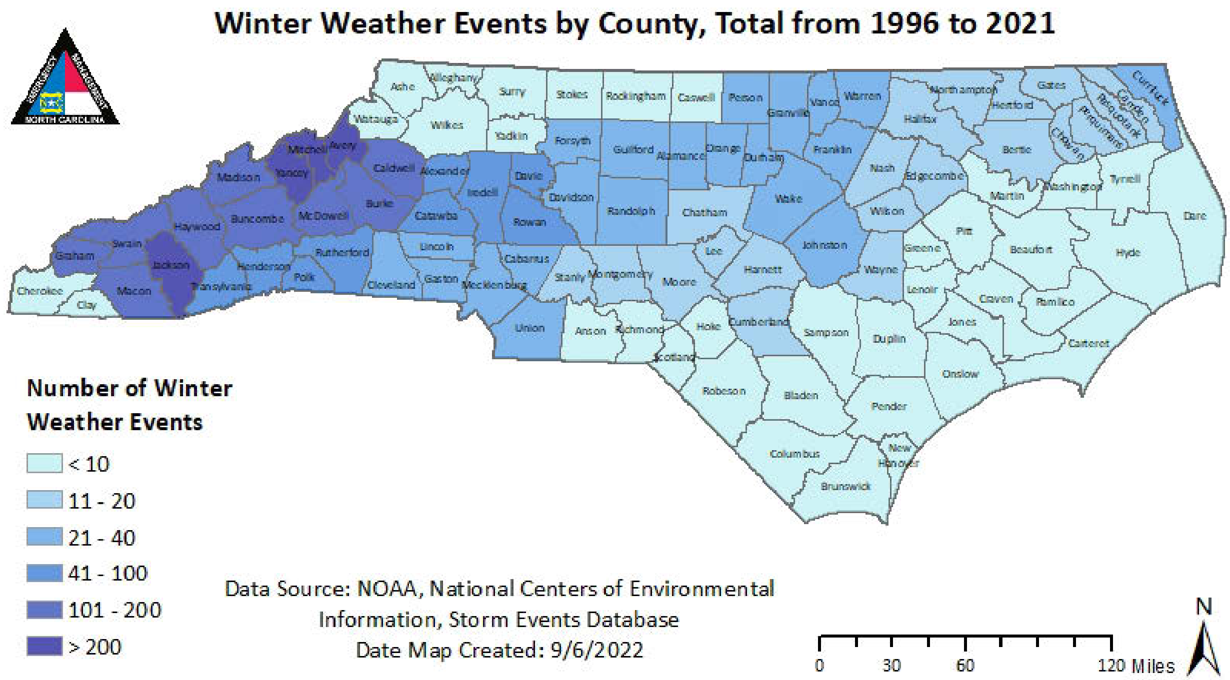
3.2.3.3 Location/Spatial Extent

Nearly the entire continental United States is susceptible to winter storm and freeze events. Some ice and winter storms may be large enough to affect several states, while others might affect limited, localized areas. The degree of exposure typically depends on the normal expected severity of local winter weather. The State of North Carolina is accustomed to severe winter weather conditions, and frequently receives adverse weather during the winter months. This is especially true in the western part of the state which receives severe winter weather much more frequently and in higher precipitation amounts than the eastern part of the state.

3.2.3.4 Hazard History

In recent years, presidential disasters have been declared in North Carolina for severe winter weather in January/February 1996, January 2000, December 2002, March 2003, and March 2014. Since January 1996, 34 deaths and 191 injuries have been attributed to snow and ice events that have occurred in the state. Total property damage for those events is estimated at $471.9 million. Table 3-7 lists severe winter storms and the impacted counties. FEMA Public Assistance data is listed when available. Detailed information about two of these severe winter weather events follows the table.

Figure 3-10 Severe Winter Weather Events for North Carolina



All counties in North Carolina have been affected by winter weather events at least once between 1996 and 2022 Western counties, such as Avery and Mitchell, reported having 384 and 362 occurrences, respectively. Over these years, there have also been 34 fatalities and 177 injuries due to severe winter weather. Table 3-7 summarizes the winter weather events by county, as listed in the NCEI's Storm Events Database.

Table 3-7 Detailed Severe Winter Weather History of North Carolina

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Alamance	76	0	0	$520,000	$0
Alexander	1	0	0	$11,007,425	$1,190,395
Alleghany	74	0	1	$138,000	$3,000
Anson	35	0	0	$0	$0
Ashe	106	0	0	$243,800	$3,000
Avery	393	1	0	$50,026,000	$1,000,000
Beaufort	31	4	13	$45,000	$0
Bertie	46	0	0	$25,000	$0
Bladen	25	0	0	$3,530,000	$0
Brunswick	6	0	0	$0	$0
Buncombe	263	0	0	$75,250	$10,000,000
Burke	160	0	0	$0	$2,000,000
Cabarrus	70	0	0	$12,050,000	$1,000,000
Caldwell	164	0	0	$0	$2,000,000
Camden	39	0	0	$0	$0
Carteret	23	4	4	$220,000	$0
Caswell	42	0	0	$73,000	$183,000
Catawba	117	0	0	$9,053,000	$1,000,000
Chatham	52	0	0	$520,000	$0
Cherokee	42	0	0	$1,000	$0
Chowan	40	0	0	$0	$0
Clay	25	0	0	$0	$0
Cleveland	86	0	0	$9,103,000	$2,000,000
Columbus	17	0	0	$6,005,000	$0
Craven	30	0	0	$0	$0
Cumberland	37	1	0	$10,000	$0
Currituck	63	0	0	$0	$0
Dare	40	0	0	$22,500,000	$0
Davidson	72	0	0	$ 6,200,000	$25,000
Davie	115	0	0	$9,025,000	$0
Duplin	32	1	5	$0	$0
Durham	63	0	0	$1,430,000	$0
Edgecombe	47	0	0	$20,000	$0
Forsyth	81	0	0	$570,000	$100,000
Franklin	60	0	0	$535,000	$0
Gaston	73	0	0	$18,150,000	$1,000,000
Gates	46	0	0	$0	$0
Graham	218	0	0	$0	$1,000,000
Granville	66	1	3	$912,000	$0
Greene	29	1	4	$20,000	$0
Guilford	79	0	0	$8,770,000	$75,000
Halifax	53	0	0	$640,000	$0
Harnett	53	0	0	$25,000	$0
Haywood	282	0	0	$0	$2,000,000

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Henderson	167	2	0	$1,156,000	$10,000,000
Hertford	47	0	0	$0	$0
Hoke	32	0	0	$0	$0
Hyde	41	0	0	$0	$350,000
Iredell	120	0	0	$10,031,000	$1,000,000
Jackson	366	0	0	$3,000,000	$1,000,000
Johnston	55	0	0	$570,000	$0
Jones	26	0	0	$0	$0
Lee	49	0	0	$0	$0
Lenoir	33	1	10	$40,000	$0
Lincoln	85	0	0	$9,052,000	$1,000,000
Macon	172	0	0	$0	$2,000,000
Madison	305	0	0	$0	$3,000,000
Martin	35	1	14	$40,000	$0
McDowell	150	0	0	$0	$2,000,000
Mecklenburg	74	2	0	$42,600,000	$1,000,000
Mitchell	375	0	0	$26,250	$1,000,000
Montgomery	44	0	0	$0	$0
Moore	43	0	0	$10,000	$0
Nash	57	0	0	$530,000	$0
New Hanover	10	0	0	$0	$0
Northampton	50	0	0	$515,000	$0
Onslow	28	1	35	$145,000	$0
Orange	72	0	0	$3,730,000	$0
Pamlico	23	0	2	$15,000	$0
Pasquotank	37	0	0	$0	$0
Pender	12	2	0	$40,000	$0
Perquimans	41	0	0	$0	$0
Person	77	0	0	$1,169,000	$25,000
Pitt	35	0	92	$75,000	$0
Polk	106	0	0	$0	$1,000,000
Randolph	64	0	0	$3,615,000	$0
Richmond	37	0	0	$0	$0
Robeson	27	0	1	$4,550,000	$0
Rockingham	49	0	0	$278,000	$180,000
Rowan	101	5	0	$10,030,000	$1,000,000
Rutherford	104	0	0	$0	$2,380,791
Sampson	34	0	0	$0	$0
Scotland	33	0	0	$0	$0
Stanly	43	0	0	$0	$0
Stokes	48	2	0	$253,000	$30,000
Surry	60	4	5	$889,000	$242,000
Swain	251	0	0	$0	$1,000,000
Transylvania	164	1	0	$7,050,000	$3,000,000
Tyrrell	26	0	0	$0	$0
Union	53	0	0	$11,500,000	$500,000
Vance	63	0	0	$900,000	$0
Wake	62	0	0	$1,040,000	$0

County	Number of events (1996-2017)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Warren	58	0	0	$880,000	$0
Washington	33	0	2	$15,000	$0
Watauga	113	0	0	$413,000	$3,000
Wayne	37	0	0	$10,000	$0
Wilkes	58	0	0	$797,800	$1,720,000
Wilson	49	0	0	$530,000	$0
Yadkin	41	0	0	$143,000	$548,000
Yancey	370	0	0	$26,250	$1,000,000
North Carolina	**7500**	**34**	**177**	**$330,416,008**	**$65,039,781**

Source: NCEI

Significant North Carolina Severe Winter Weather Events
The following overview provides a synopsis of two notable severe winter weather events that have impacted North Carolina during this decade:

Ice Storm (02/27/2003)
Another round of frozen precipitation moved into the area on the heels of a previous storm, bringing more freezing rain and sleet to areas that already had more than a quarter inch of ice frozen on trees. The total ice accumulations ranged from a trace near the coast to as much as three quarters of an inch of ice over interior sections. The weight of the ice caused major power outages from falling tree limbs, as well as significant structural damage to many residential structures. Some ice accumulations occurred on the roads, especially on bridges and overpasses, with numerous traffic accidents reported. Many residences were left without power for more than a week. Monetary damages totaled more than a million dollars per county in some parts of the state, due to the costs of debris cleanup, utility expenses, and home repair.

Ice Storm (02/03/2005)
Ice accretion began to cause damage across the southern mountains and foothills of North Carolina just prior to sunrise. By late morning, the ice storm had become severe, as thousands of trees fell across the area, and power outages became widespread. Numerous trees and large limbs fell on and damaged homes and vehicles. It was estimated that three-quarters of Henderson County's residents lost power. Most who lost power went without it for at least 24 hours. In some areas, it took as much as five days to restore electricity. Despite the devastation, road problems occurred only rarely, as temperatures hovered right around the freezing mark for most of the event. Duke Power estimated costs for labor overtime and line repair at $72 million for the event, thought these costs are not reflected in the property damage values for the event. In Henderson County, two deaths occurred as an indirect result of the ice storm. One resident died of carbon monoxide poisoning after running an unventilated generator inside a garage. Another resident died of carbon monoxide poisoning due to a malfunctioning gas stove. Ice accumulation ranged from more than a half-inch along the Blue Ridge to one-eighth-of-an-inch or less along the Tennessee border. Several trees and large limbs fell on and damaged homes and vehicles. Numerous slick spots also

developed on roadways, primarily in the North Carolina mountains, where a number of accidents occurred.

Severe Winter Storm (02/11 – 12/2014)

A very damaging winter storm affected eastern North Carolina. This event produced devastating amounts of freezing rain along and east of Interstate 95 all the way down to the coast. In Wilmington this was the second largest ice storm on record since 1947 with over half an inch of ice measured at the Wilmington International Airport. Although substantial amounts of snow and sleet feel across interior portions of eastern North Carolina, damage from this storm is primarily attributed to a heavy accumulation of freezing rain that fell across the Pee Dee region of South Carolina into coastal North Carolina. Widespread damage occurred to trees and power lines, with electric service not fully restored to some areas for a week across coastal North Carolina. In North Carolina along, there were 1,800 traffic accidents reported to the NC Highway Patrol, with upwards of 100,000 residents without power during the worst of the storm. Packed sleet over area roadways and other surfaces became the most significant impact as cold and cloudy conditions for the next couple of days severely limited the melting process.

An ice storm of this magnitude is estimated to occur only once every 30-35 years (on average) in this part of the country. This was actually the second significant winter storm to affect the eastern Carolinas within a few weeks; an earlier winter storm on January 28-29, 2014 dumped 2 to 4 inches of sleet and snow across southeaster North Carolina and the Pee Dee Region of South Carolina.

In addition to these profiled events, Figure 3-11 displays a map of declared disaster counties impacted by a blizzard that occurred in Jan. 2000. Likewise, Figure 3-12 shows a map of declared disaster counties impacted by an ice storm that occurred in Dec. 2002.

Figure 3-11 Severe Winter Weather Event #2: Map of Declared Disaster Counties

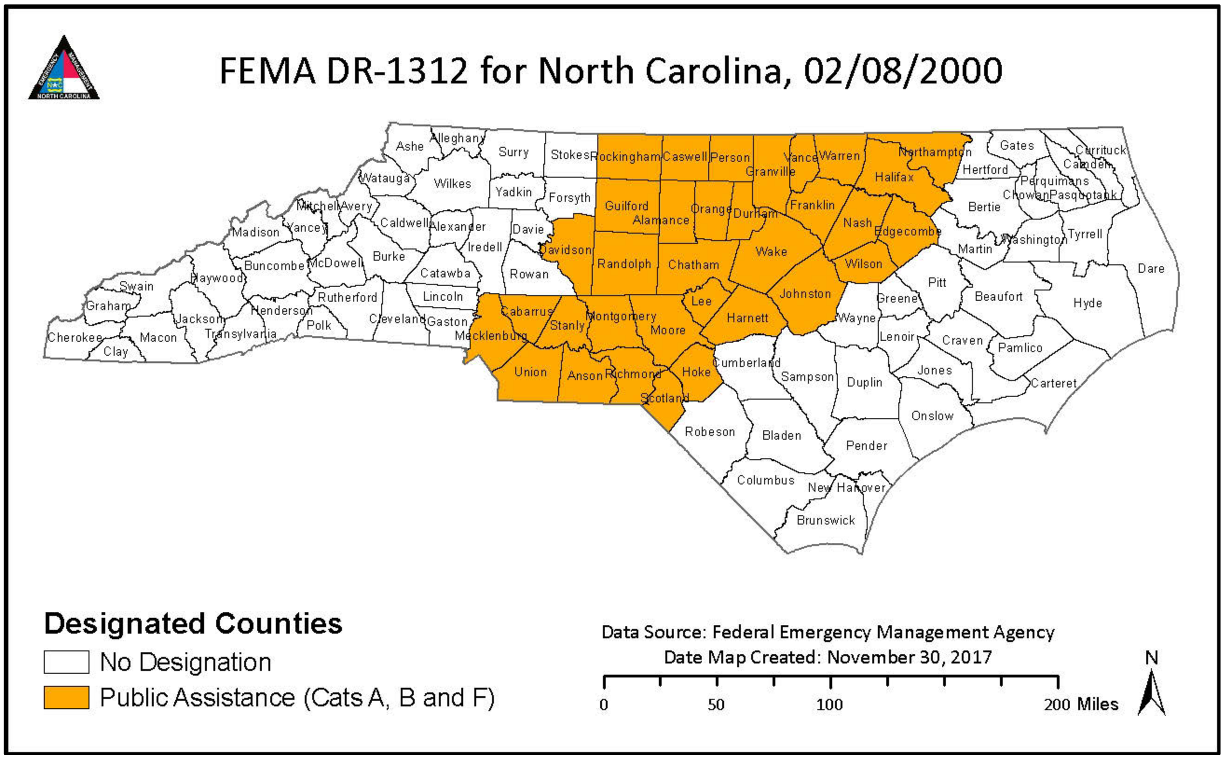
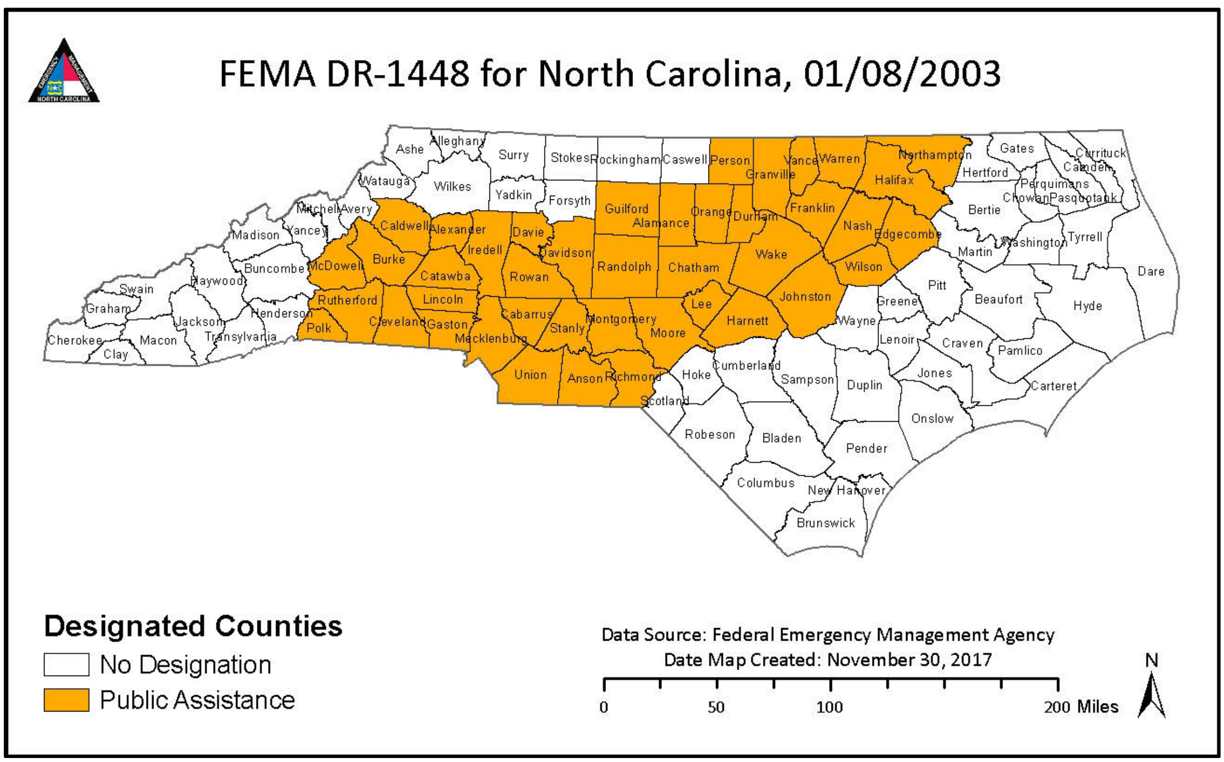


Figure 3-12 Severe Winter Weather Event #3: Map of Declared Disaster Counties



3.2.3.5 Changing Future Conditions

The uncertainty associated with potentially changing climate conditions creates unpredictability for future severe winter storms. If it is determined that global temperatures are indeed rising, this could cause shorter and warmer winters in many areas; however, the likelihood of dangerously low temperatures may increase due to continuing trends of temperature extremes. Warmer winters, however, mean that precipitation that would normally fall as snow may begin to fall as rain or freezing rain instead.

3.2.3.6 Impact

North Carolina has experienced and will continue to experience dangerous winter storms. However, because the state is not prone to winter weather events like more northern states, rare winter storms have more of an impact. Roads easily become covered by snow and ice, making driving more dangerous. According to the North Carolina State University Climate Office, 70% of winter weather related injuries are from vehicle accidents. Winter weather can also cause power outages when ice accrues on power lines, and widespread outages may occur.

3.2.3.7 Future Probability

Although North Carolina typically experiences a warmer climate, it still has been affected by severe winter weather. According to historical evidence, the state experiences on average 21 winter storm events per year. All parts of the state are vulnerable to winter storms, but they are more likely to occur in the western counties. Winter storm events will remain a likely (between 33.4 and 66.6 percent annual probability) occurrence, and the probability of future occurrences is certain. Fortunately, large-scale property damages and/or threats to human life and safety are rare with these events.

3.2.3.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 2, Winter Storm Operations Plan

3.2.4 Excessive Heat

3.2.4.1 Description

Excessive heat is a dangerous and deadly occurrence in North Carolina. According to the National Weather Service, heat is one of the leading weather-related causes of loss of life in the United States.[5] The Centers for Disease Control and Prevention (CDC) indicates that 618 people on average in the United States are killed by extreme heat every year.[6] That number represents more deaths than hurricanes, lightning, tornadoes, earthquakes and floods combined.[7] The CDC defines extreme heat as "summertime temperatures that are much hotter and/or more humid than average." The National Weather Service defines a heat wave as "a period of abnormally and uncomfortably hot and unusually humid weather, typically lasting two or more days."[8] The NCDEQ 2020 Climate Science Report suggests that the average number of high heat/humidity days in North Carolina will increase over the coming decades resulting in additional stresses on populations, certain industries, infrastructure and healthcare systems.

As the population of urban areas continue to grow in North Carolina, these areas will increasingly become affected by the urban heat island effect. According to the U.S. Environmental Protection Agency (EPA), heat islands are urbanized areas that experience higher temperatures than outlying areas.[9] Structures such as buildings, roads, and other infrastructure absorb heat more than natural landscapes. Areas where structures are highly concentrated and open greenspace is limited may become "heat islands" recording higher temperatures than surrounding area. Heat waves often lead to poor air quality. According to the University Corporation for Atmospheric Research (UCAR) Center for Science Education on Air Quality, extreme heat and stagnant air during a heat wave increase the amount of ozone pollution and particulate pollution. Additionally, there is some evidence that the heat island effect can impact summer rainfall patterns, particularly in densely populated and developed urban areas.

---

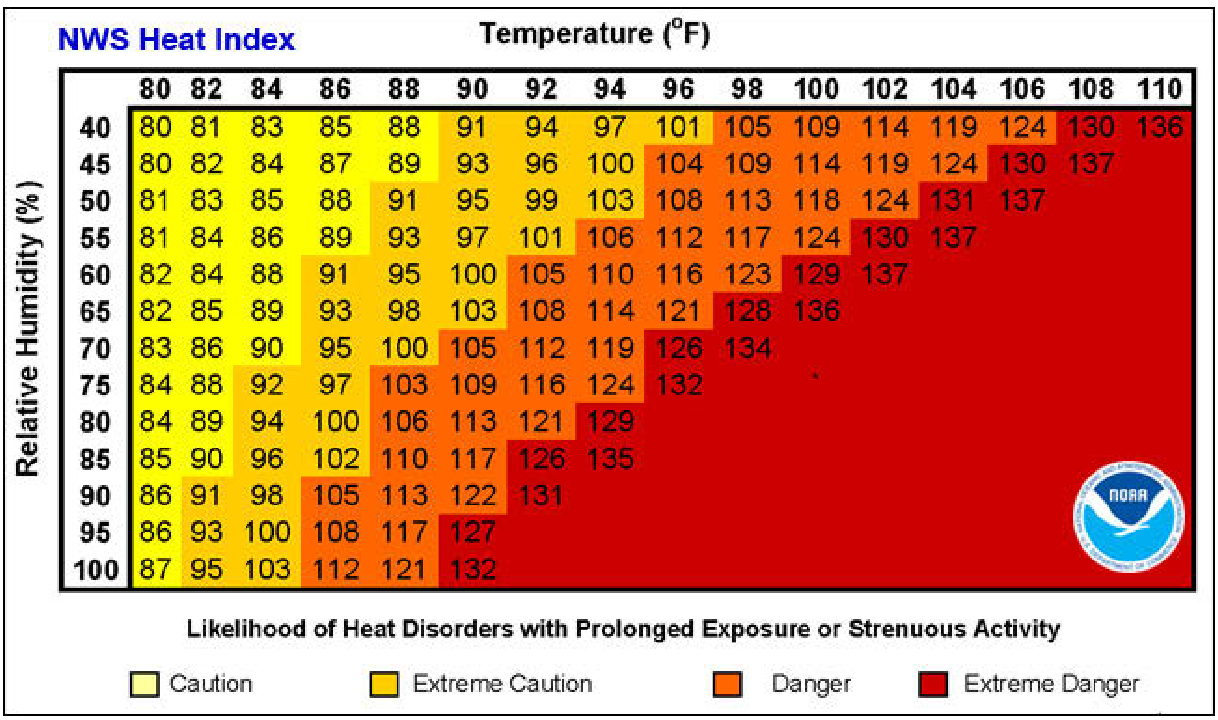
[5] *Heat Safety Tips and Resources. National Oceanic and Atmospheric Administration: National Weather Service. Retrieved on December 14, 2017 from: http://www.nws.noaa.gov/os/heat/*
[6] *Natural Disasters and Severe Weather. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.cdc.gov/disasters/extremeheat/heat_guide.html*
[7] *Extreme Heat. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.weather.gov/images/rah/heat/CDCInfographic.jpg*
[8] *Historic Heat Waves in the Carolinas. National Oceanic and Atmospheric Administration: National Weather Service. Retrieved on December 14, 2017 from: http://www.weather.gov/ilm/heatwaves*
[9] *Heat Island Effect. Environmental Protection Agency. Retrieved on August 30, 2022 from: https://www.epa.gov/heatislands*

3.2.4.2 Extent

According to a study from the UNC Gillings School of Global Public Health, mortality rates from excessively hot nights caused by climate change are predicted to increase up to 60% across the United States by the end of the century. Ambient heat during the night may interrupt the normal physiology of sleep. Less sleep can then lead to immune system damage and a higher risk of cardiovascular disease, chronic illness, inflammation, and mental health conditions. Additionally, the study from the UNC Gillings School, found that occurrences of hot night excess are projected to occur more rapidly than the daily mean temperature changes – the frequency and mean intensity of hot nights will likely increase more than 30% to 60% by the 2100s. The study also found that regional differences in temperature accounted for many of the variances in nighttime temperature, and areas with the lowest average temperature were projected to have the largest warming potential.[10]

The National Weather Service devised the Heat Index as a mechanism to better inform the public of heat dangers. The Heat Index Chart, shown in Figure 3-13, uses air temperature and humidity to determine the heat index or apparent temperature.

Figure 3-13 NOAA Heat Index



NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: NOAA, National Weather Service

[10] *Risk of Death Rises as Climate Change Causes Nighttime Temperatures to Climb. UNC Gillings School of Public Health. Retrieved on August 2, 2022 from https://sph.unc.edu/sph-news/risk-of-death-rises-as-climate-change-causes-nighttime-temperatures-to-climb/.*

It should also be noted that the highest temperature ever recorded in the state by the State Climate Office was 110 degrees Fahrenheit in Fayetteville in August of 1983.[11]

3.2.4.3 Location/Spatial Extent

Excessive heat can have an impact in any location throughout the state as temperatures in all parts of the state have been high enough historically to cause heat disorders in the population. It is especially notable that high humidity rates across the state often exacerbate already high temperatures and lead to greater incidences of heat-related illness. An urban heat island effect results when vegetated surfaces are converted to structures and paved urban and suburban landscapes, increasing the amount of heat retained in darker, paved surfaces as compared to natural land cover.[12]

NCDHHS conducts syndromic surveillance for heat illness across the state and develops weekly heat reports during summer months from May 1st – September 30th. Reports are disseminated to a variety of stakeholders, including interagency heat-related illness (HRI) working group and heat-health prevention specialist partners. Some communities, such as those in the Sandhills region of the state, are already experiencing the cumulative impacts of climate and social stressors, such as an increase in warmer night-time temperatures and inadequate access to cooling in lower income communities. Thus, Bladen, Hoke, Robeson, Sampson, and Scotland counties are prioritized for some climate and health adaptations including a heat-health alert system through the North Carolina Building Resilience Against Climate Effects (NC BRACE) program funded by the Centers for Disease Control and Prevention (CDC).

The NC BRACE heat-health alert system is tailored to different vulnerable populations in each of these Sandhill counties, including low-income communities, farmworkers, youth in sports and elderly communities. Partners disseminate alerts using a variety of media, including social media, radio and printed materials, and at varying heat thresholds that best suit the needs of target populations. The heat alert system is accompanied by an educational component and HRI syndromic surveillance data. Together, these interventions aim to increase the number of high heat days where health protective skills are used and actions are taken to reduce dehydration and heat illness.

The North Carolina Farmworker Health Program (NCFHP), administered by the Office of Rural Health within DHSS, provides funding, training and technical assistance to outreach and health providers to improve the health of migrant and seasonal farmworkers across the state. Migrant and seasonal farmworkers face a high burden of occupational risks, including illness resulting from excessive heat exposure. Farmworkers and their families are also one of the most underserved populations due to significant barriers to care they face, such as isolation, cost, and transportation. NCFHP provides education and training across the state

---

[11] *Weather Extremes. North Carolina State Climate Office. Retrieved on December 14, 2017 from: https://climate.ncsu.edu/nc_extremes*

[12] *North Carolina Climate Science Report. North Carolina Institute for Climate Studies. Retrieved on May 5, 2022 from https://ncics.org/programs/nccsr/*

to protect migrant and seasonal farmworkers from heat illness. In 2020, NCFHP outreach workers reached 7,362 farmworkers with heat illness education.[13]

3.2.4.4 Hazard History

NCEI data indicates 32 unique heat/excessive heat events that have occurred in North Carolina since 1996 through 2021. Impacts have been recorded in 70 counties and have resulted in 16 fatalities and 17 injuries. These events are listed in Table 3-8 below, and a graphic representation of the data follows the table in Figure 3-14. These heat events are only inclusive of those reported by the National Centers for Environmental Information.

Table 3-8 North Carolina Excessive Heat Event Summary by County

North Carolina Excessive Heat Events					
County	Number of Events (1996-2021)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Alamance	1	0	0	$0	$0
Alexander	2	0	0	$0	$0
Alleghany	1	0	0	$0	$0
Anson	1	0	0	$0	$0
Ashe	0	0	0	$0	$0
Avery	0	0	0	$0	$0
Beaufort	2	0	0	$0	$0
Bertie	3	0	0	$0	$0
Bladen	4	0	0	$0	$0
Brunswick	7	0	0	$0	$0
Buncombe	0	0	0	$0	$0
Burke	0	0	0	$0	$0
Cabarrus	3	0	0	$0	$0
Caldwell	0	0	0	$0	$0
Camden	3	0	0	$0	$0
Carteret	4	0	0	$0	$0
Caswell	0	0	0	$0	$0
Catawba	2	0	0	$0	$0
Chatham	1	0	0	$0	$0
Cherokee	0	0	0	$0	$0
Chowan	4	0	1	$0	$0
Clay	0	0	0	$0	$0
Cleveland	2	0	0	$0	$0
Columbus	5	15	1	$0	$0
Craven	5	0	0	$0	$0
Cumberland	2	0	1	$0	$0
Currituck	6	0	0	$0	$0
Dare	1	0	0	$0	$0
Davidson	1	0	0	$0	$0
Davie	2	0	0	$0	$0
Duplin	0	0	0	$0	$0

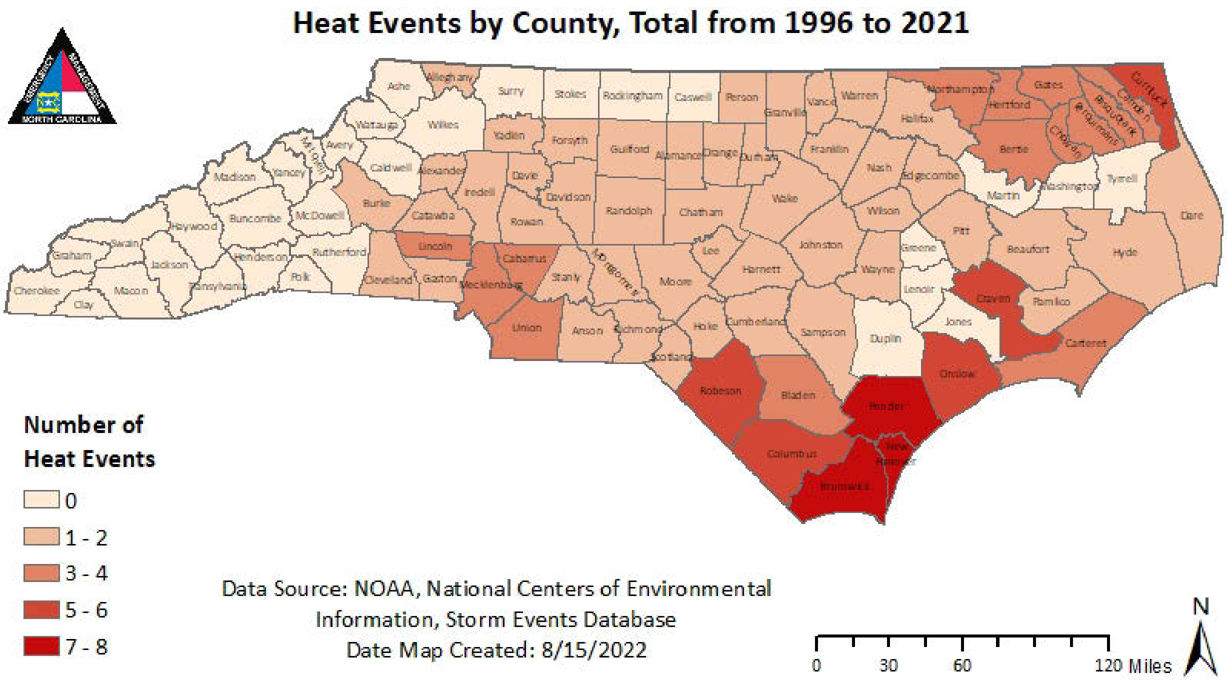
[13] *NCFHP 2021 Profile; https://www.ncdhhs.gov/media/9345/download*

North Carolina Excessive Heat Events					
County	Number of Events (1996-2021)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Durham	1	0	0	$0	$0
Edgecombe	2	0	1	$0	$0
Forsyth	1	0	0	$0	$0
Franklin	1	0	0	$0	$0
Gaston	2	0	0	$0	$0
Gates	3	0	0	$0	$0
Graham	0	0	0	$0	$0
Granville	1	0	0	$0	$0
Greene	0	0	0	$0	$0
Guilford	2	0	1	$0	$0
Halifax	1	0	0	$0	$0
Harnett	2	0	1	$0	$0
Haywood	0	0	0	$0	$0
Henderson	0	0	0	$0	$0
Hertford	3	0	0	$0	$0
Hoke	1	0	0	$0	$0
Hyde	2	0	0	$0	$0
Iredell	2	0	0	$0	$0
Jackson	0	0	0	$0	$0
Johnston	2	0	1	$0	$0
Jones	0	0	0	$0	$0
Lee	1	0	0	$0	$0
Lenoir	0	0	0	$0	$0
Lincoln	3	1	0	$0	$0
Macon	0	0	0	$0	$0
Madison	0	0	0	$0	$0
Martin	0	0	0	$0	$0
McDowell	0	0	0	$0	$0
Mecklenburg	4	0	2	$0	$0
Mitchell	0	0	0	$0	$0
Montgomery	1	0	0	$0	$0
Moore	1	0	0	$0	$0
Nash	1	0	0	$0	$0
New Hanover	7	0	0	$0	$0
Northampton	3	0	0	$0	$0
Onslow	5	0	0	$0	$0
Orange	1	0	0	$0	$0
Pamlico	1	0	0	$0	$0
Pasquotank	3	0	0	$0	$0
Pender	7	0	0	$0	$0
Perquimans	3	0	0	$0	$0
Person	2	0	1	$0	$0
Pitt	2	0	3	$0	$0
Polk	0	0	0	$0	$0
Randolph	1	0	0	$0	$0
Richmond	1	0	0	$0	$0
Robeson	5	0	1	$0	$0
Rockingham	0	0	0	$0	$0

North Carolina Excessive Heat Events					
County	Number of Events (1996-2021)	Injuries	Fatalities	Property Damage (Inflated to 2017 Dollars)	Crops Damage (Inflated to 2017 Dollars)
Rowan	2	0	0	$0	$0
Rutherford	0	0	0	$0	$0
Sampson	1	0	0	$0	$0
Scotland	2	0	1	$0	$0
Stanly	1	0	0	$0	$0
Stokes	0	0	0	$0	$0
Surry	0	0	0	$0	$0
Swain	0	0	0	$0	$0
Transylvania	0	0	0	$0	$0
Tyrrell	0	0	0	$0	$0
Union	3	0	0	$0	$0
Vance	1	0	0	$0	$0
Wake	2	1	0	$0	$0
Warren	1	0	0	$0	$0
Washington	0	0	0	$0	$0
Watauga	0	0	0	$0	$0
Wayne	1	0	0	$0	$0
Wilkes	0	0	0	$0	$0
Wilson	1	0	0	$0	$0
Yadkin	1	0	0	$0	$0
Yancey	0	0	0	$0	$0
North Carolina	125	17	16	$0	$0

Source: NCEI

Figure 3-14 NC Excessive Heat Events by County, 1996-2021



Details for Selected Excessive Heat Events

July 22, 1998–July 23, 1998

Excessive heat plagued central North Carolina during July 22 through July 23. Maximum temperatures reached the 98 to 103-degree range combined with dew points in the 78 to 80-degree range with little wind to give heat index values of around 110 degrees for several hours each afternoon. To make matters worse, the minimum temperatures did not fall below 80°F at several locations and those that did achieved that feat for only an hour or two. Strong thunderstorms ended the two-day excessive heat ordeal when rain cooled the environment enough to send temperatures into the lower 70s at most locations.

July 20, 1999–July 31, 1999

A heat wave caused many to require hospital treatment in Columbus County and in neighboring counties in southeast NC. A farm worker died of heat stroke after hospitalization.

July 23, 1999–July 25, 1999

A farm worker was overcome by heat exhaustion. He was taken to the local hospital where his body temperature was measured at 108 degrees. A three-year-old boy died after he apparently entered his parents' car and could not get out.

Aug. 7, 2001–Aug. 9, 2001

High humidity and temperatures in the mid-90s caused afternoon heat indices between 105 and 110 degrees (measured by Automated Surface Observing Systems) in New Hanover County. A heat index of 108 was also reported at Lumberton.

July 21, 2011

Excessive heat advisories and warnings were issued for a large portion of eastern North Carolina for several days toward the end of July. The heat and humidity combined to push heat indices near 110 degrees at times during the afternoon.

June 29, 2012 – Jul1 1, 2012

A very hot and humid airmass that spent several days building west of the Appalachians finally made it east of the mountains, bringing very hot conditions to foothills and Piedmont of North Carolina. The high temperature at Charlotte-Douglas International Airport hit 104 degrees on both the 29th and 30th, tying the all-time high. The heat index hit 105 degrees. Excessive heat affected areas east of Charlotte. The ASOS at Monroe, NC reported a heat index value of 110 degrees on 30th. Lower dewpoints over the foothills resulted in sub-advisory and warning level heat index values. The heat lasted through July 1st, before thunderstorms brought somewhat cooler conditions.

July 28, 2016

Hot and humid conditions with high temperatures in the mid-90s and heat index values between 105 and 109 degrees resulted in the death of a man in Chowan County in northeast North Carolina.

In addition to data from NCEI on historic excessive heat incident tracking, the NCDHHS NC DETECT data indicates 45,869 heat-related illness emergency department visits that have occurred in North Carolina since 2010 through 2021. Annual aggregate counts are displayed in Table 3-9 below. A graphical representation of the proportion of emergency department visits for heat-related illness follows in Figure 3-14. These heat events are only inclusive of those reported by NC DETECT.

Table 3-9 - Heat-Related Illness in Emergency Departments and Heat Index Data in North Carolina (May 2010 - September 2021)

Heat Related Illness in North Carolina			
Year	Number Heat-Related Illness Emergency Department Visits	Maximum Heat Index	Average Heat Index
2010	4355	*	*
2011	4219	*	*
2012	3664	*	*
2013	2382	*	*
2014	2813	100	84
2015	3656	103	88
2016	5057	100	84
2017	3582	101	84
2018	4922	97	86
2019	4919	100	86
2020	3099	103	84
2021	3201	105	88

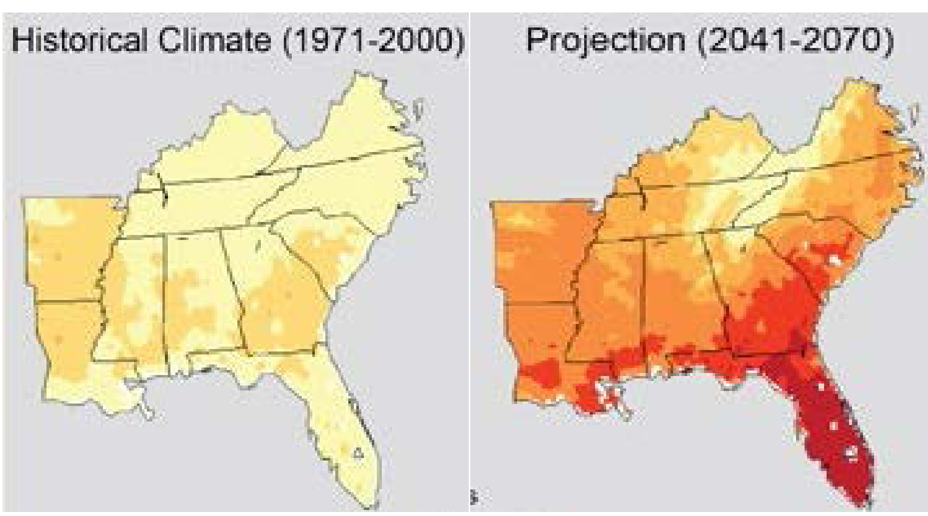
3.2.4.5 Changing Future Conditions

Changing climate patterns may affect North Carolina's likelihood of experiencing days with extreme heat. As global surface temperatures rise, so does the probability of excessive heat. In the US Global Change Research Program's 2017 Climate Science Special Report, researchers predict the frequency and intensity of extreme high temperature events are virtually certain to surge. More intense heat waves may further affect agricultural production and species diversity. Occasionally, destructive wildfires may also spread in dry conditions during heat waves.

Additionally, according to the National Climate Assessment, the increase in the number of days over 95°F is likely to increase over the next 30 to 50 years when compared to a baseline over the last 30 years of the 20th century. Figure 3-15 shows both the baseline, historical number of days over 95°F from 1971 to 2000 and the projection for the 2041 to 2070 period. Figure 3-16 shows the projected change in number of days between the historic data and the projected data. This increase in days of extreme heat due to weather extremes will likely result in a higher number of rolling brown/blackouts and decreased air quality in the state.

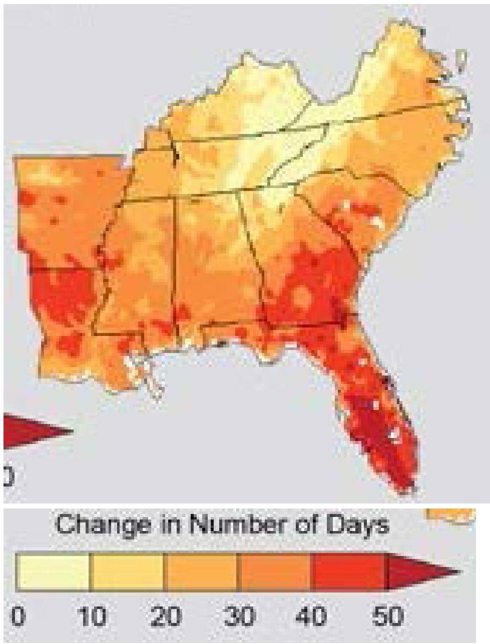
The recent North Carolina Climate Science Report projects little to no change between 2021 and 2040 in the number of very hot days or very warm nights in the Mountains. However, across much of the Piedmont and Coastal Plain, the number of very hot days is projected to increase by ten (10) to twenty (20) days per year as compared to the 1996-2015 average. Extreme temperatures above the average threshold are far more common in the Piedmont and Coastal Region than in the Western Mountains. The number of very warm nights is projected to increase by three (3) to fifteen (15) per year across the Piedmont and Coastal Plain. Additionally, some areas within those regions are anticipating an increase by eighteen (18) or more per year when compared to the 1996-2015 average.

Figure 3-15: Number of Days Over 95 Degrees Fahrenheit



Source: National Climate Assessment

Figure 3-16: Projected Change in Number of Days Over 95 Degrees Fahrenheit



Source: National Climate Assessment

3.2.4.6 Impact

Extreme heat can have devastating effects on public health. The primary impacts are heat related illnesses such as dehydration and heat-stroke and even death. Some populations, such as outdoor workers and those who cannot afford adequate cooling are at an increased risk for heat exposures. Rising heat and poor air quality have disproportionate impact on the maternal and infant mortality, young children and older adults. Urban heat islands, combined with an aging population to heat-related health impacts in the future[14]. The impacts of extreme heat events are higher in underserved communities, especially those living in mobile homes which are poorly insulated and those whose residents have limited means to adapt to warming temperatures and already experience disparate asthma and cardiovascular disease burden (Figure 3-16). DEQ defines an underserved community by the following criteria: The share of nonwhites and Hispanic or Latino in a census block group is over 50 percent, and the share of the population experiencing poverty is over 20 percent[15].

[14] *Temperature Extremes. Centers for Disease Control and Prevention. Retrieved on May 5, 2022 from https://www.cdc.gov/climateandhealth/effects/temperature_extremes.htm*

[15] *North Carolina Community Mapping System: Glossary of Terms and Definitions. The North Carolina Department of Environmental Quality. Retrieved on September 19, 2022 https://deq.nc.gov/media/26866/download?attachment*

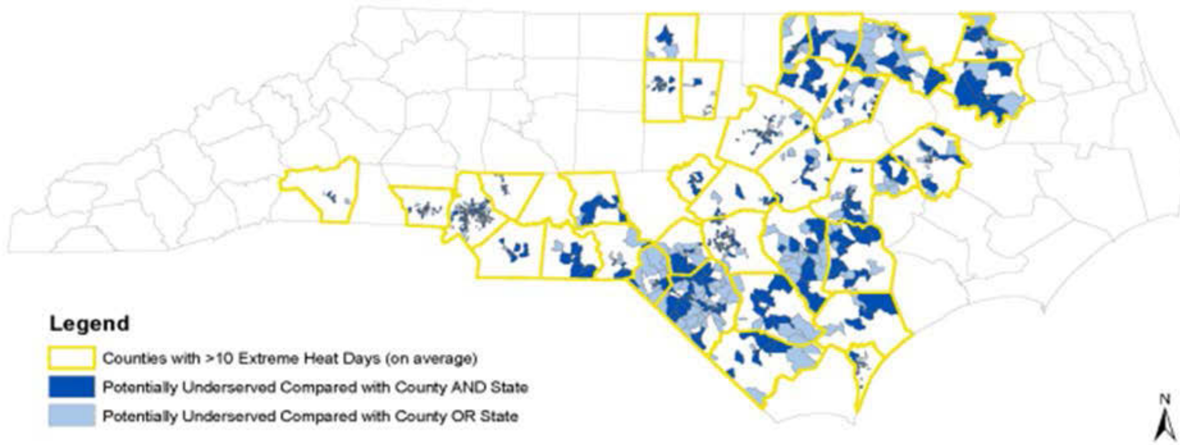


Figure 3-3-17

3.2.4.7 Future Probability

Although regional changes in temperature can vary from global changes, it is very likely that North Carolina temperatures will increase substantially in all seasons. The major urban areas of the state have expanded substantially over the past few decades and it is likely that future warming in urban areas will be enhanced by future growth of those areas. The 2020 North Carolina Climate Science Report projects two hypothetical futures: a higher scenario in which greenhouse gas emissions continue to increase through the end of the century, and a lower scenario in which emissions increase at a slower rate, peak around the middle of the century, and then begin to decrease. Annual average temperature increases related to the recent climate (1996 – 2015) for North Carolina are projected to be on the order of 2°–5°F under the higher scenario and 2°–4°F under the lower scenario. By the end of this century, annual average temperatures increase relative to the recent climate (1996 – 2015) for North Carolina are projected to be on the order of 6°–10°F under a higher scenario. Under the lowest emissions scenario, most parts of North Carolina are projected to see at least 2-3 additional weeks of very hot days (maximum temperature of 95°F or higher) for 2021-2040.[16]

It is likely that the number of hot and very hot days will increase while it is very likely the number of warmer nights will increase. Changing future conditions create concern regarding extreme heat occurrences. Due to the fact that weather extremes may cause more extreme temperatures and based on historical evidence, it is unlikely likely (between 1 33.4 and 66.633.3 percent annual probability) that North Carolina will continue to experience excessive heat events in the near future. Extreme heat events will become more frequent, longer lasting, and more intense. According to the NC State Climate Office, North Carolina

[16] *North Carolina Climate Science Report. North Carolina Institute for Climate Studies. Retrieved on May 5, 2022 from https://ncics.org/programs/nccsr/*

currently averages about 10 excessive heat days a year; by 2050, the state is projected to see almost 60 excessive days a year.

3.2.4.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 9, Heat Emergency Response Plan

3.2.5 Earthquakes

3.2.5.1 Description

An earthquake is a vibration or shaking of Earth's surface due to an underground release of energy. They can be caused by various conditions, such as sudden movements along geological faults or volcanic activity. Earthquake magnitudes, or severity, are recorded on the Richter scale with seismographs. Some may be so small that they are virtually unnoticed, while others can destroy entire cities. Seismology, the study of earthquakes, helps scientists understand what areas are more prone to experiencing earthquakes, such as along the Ring of Fire located around the Pacific Ocean; however, earthquakes are generally unpredictable. According to the USGS, there around 500,000 earthquakes reported each year, but only around 100,000 are strong enough to be felt.

Sometimes earthquakes have foreshocks, which are smaller earthquakes that occur in the same location where a larger earthquake follows. The largest quake, or the mainshock, may also be followed by smaller tremors called aftershocks. The exact location where the earthquake begins is referred to as the hypocenter, and the epicenter is the location directly above the hypocenter on earth's surface. Major destruction generally occurs near the epicenter because it is the area of maximum intensity.

Historical seismicity is an indicator of where earthquakes have happened. Paleo seismicity (the study of earthquake-induced ground failures during prehistoric times) provides further evidence as to the size and frequency of earthquakes. Since 1735, North Carolina has experienced 24 earthquakes, each of which caused at least architectural damage. From historical data, scientists from the U.S. Geological Survey (USGS) and several university research centers have produced maps that project the expected ground motion for various return periods. The last recorded damaging earthquake in which the epicenter was located in North Carolina occurred in the vicinity of the Town of Sparta in 2020. The epicenter for the last recorded damaging event that affected the state was in Mineral Springs, Virginia in 2011.

Figure 3-18 NC Earthquake Events Since 1990

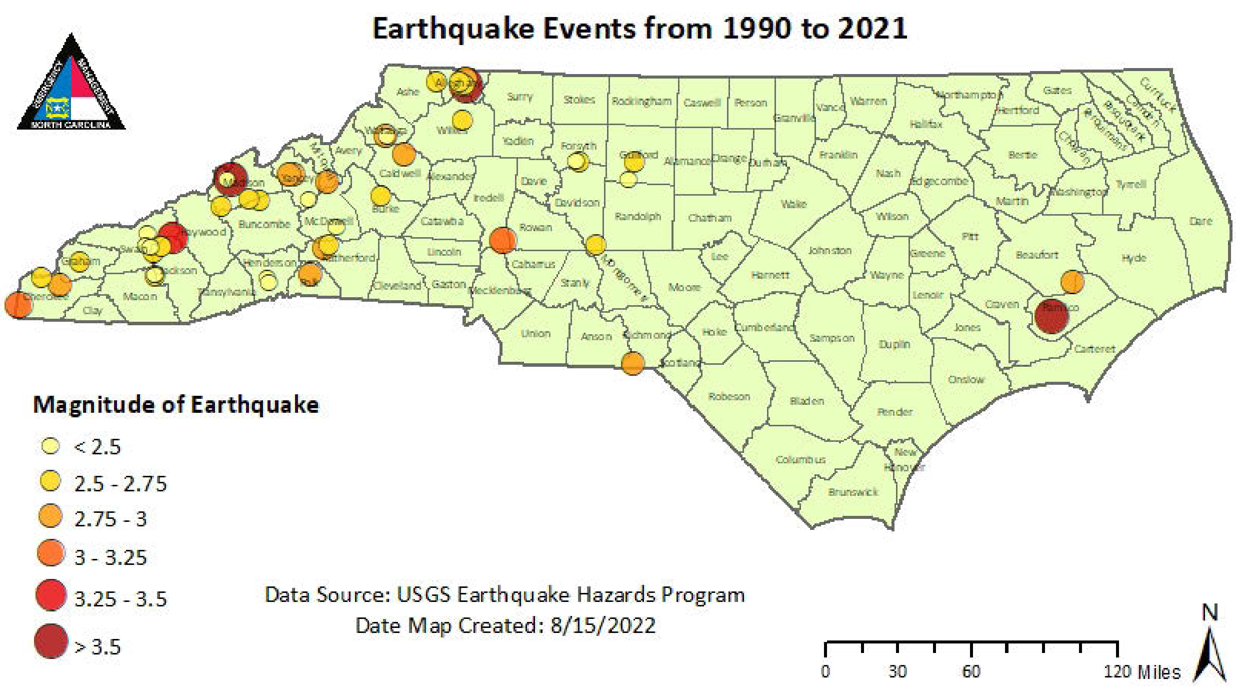


Figure 3-19 Western North Carolina Earthquake Events Since 1990

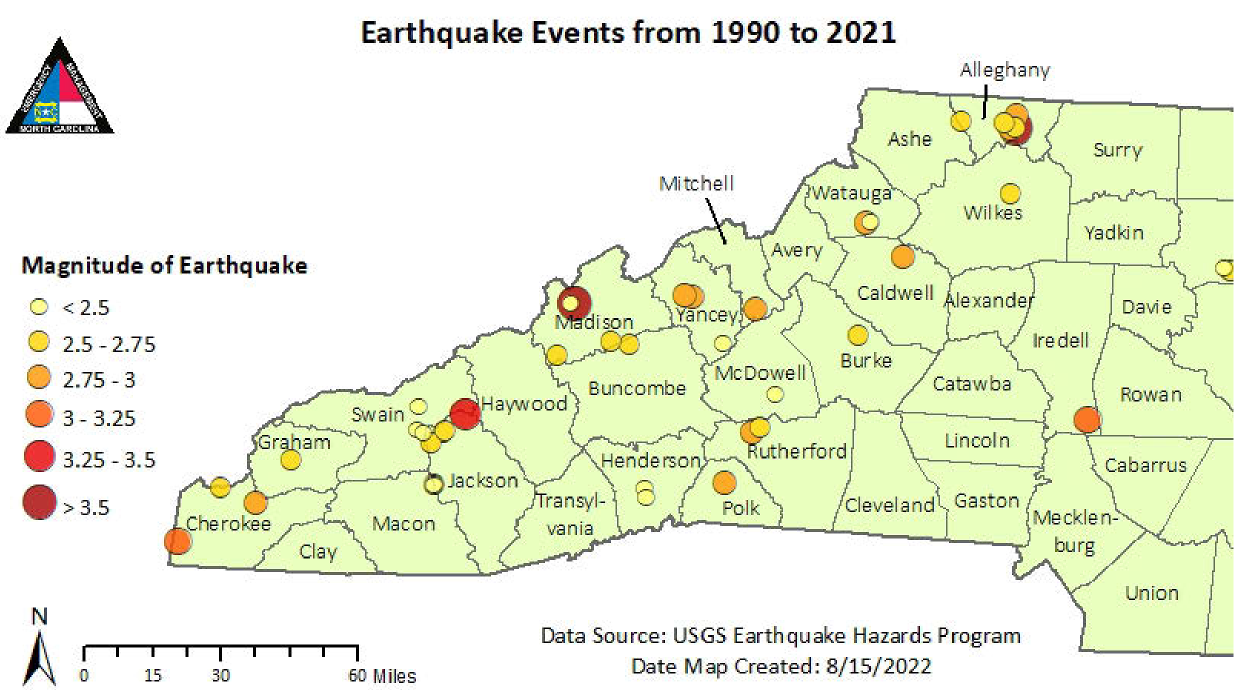
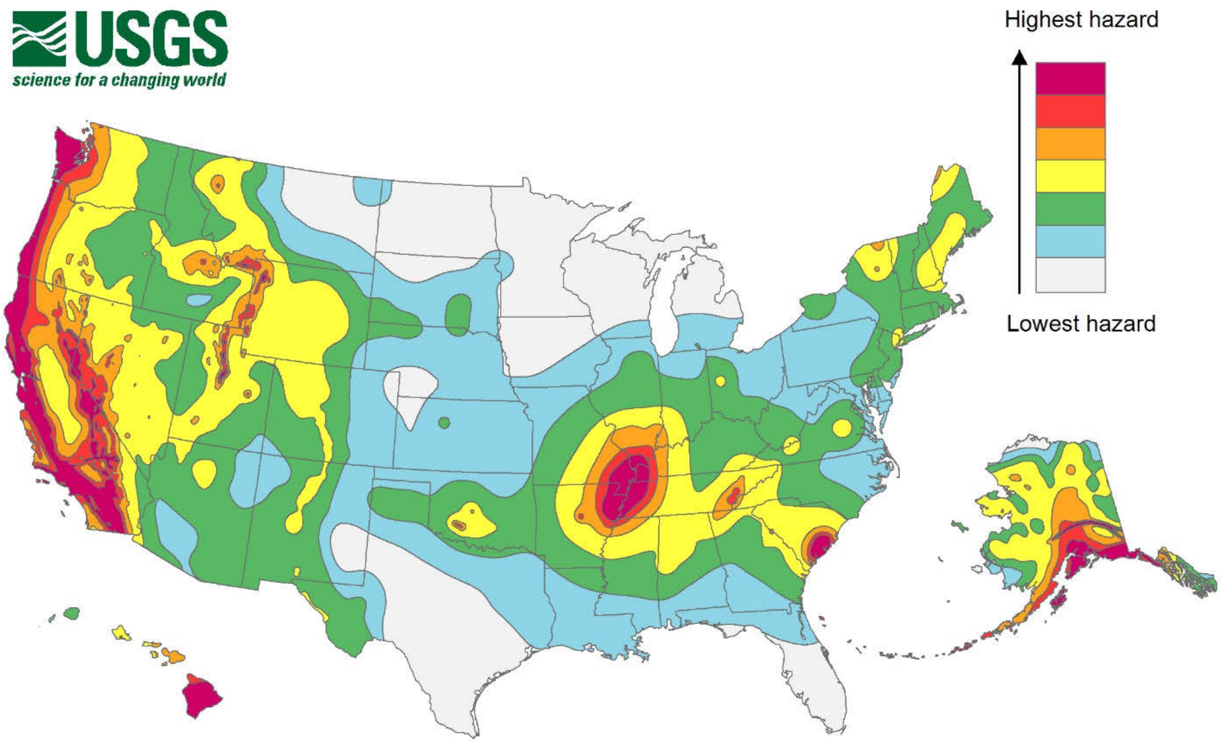
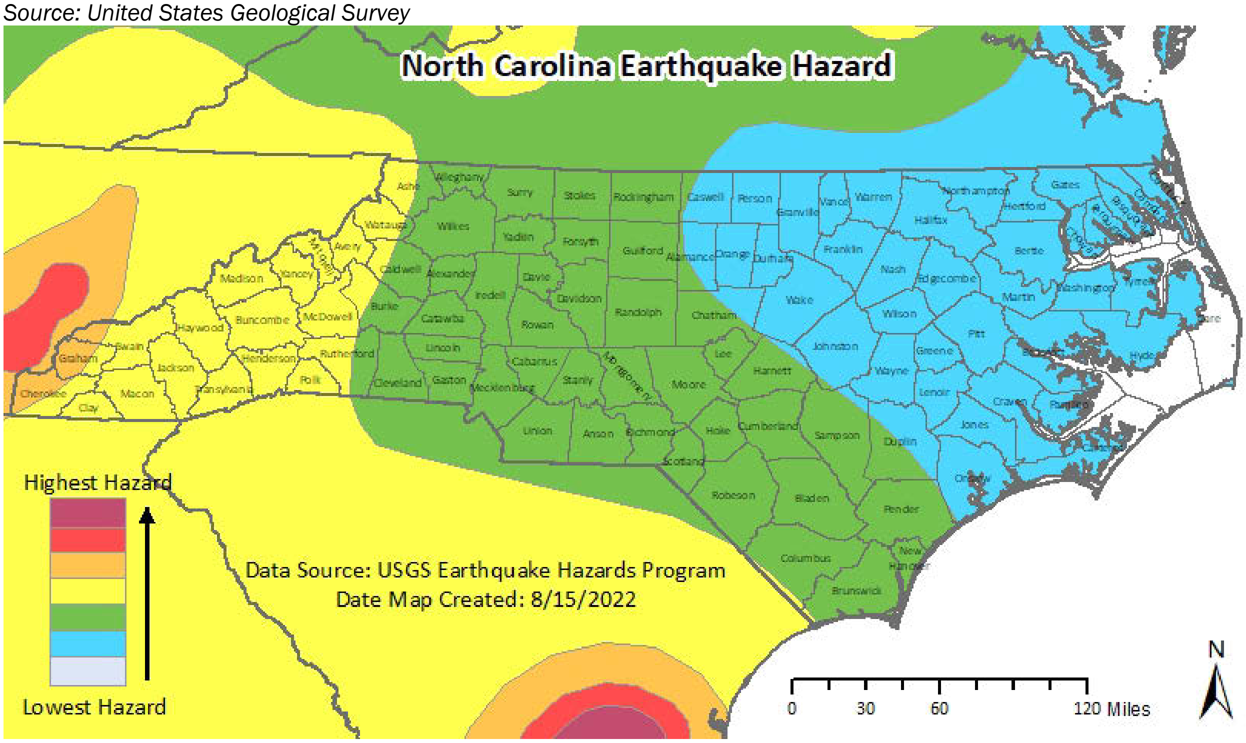


Figure 3-20 United States Earthquake Hazard Map



Source: United States Geological Survey



3.2.5.2 Extent

Earthquakes capable of producing structural damage or structural collapse are typically events with magnitudes greater than 5.5 on the Richter Scale. Seismologists use two terms to describe earthquakes and their effects. The oldest term is intensity, and this describes the extent of shaking and the damages caused by the earthquake (i.e., the effects of the event on human populations and the built environment). The Modified Mercalli Intensity Scale (Table 3-10) lists the effects of earthquakes, ranging from slightly felt (I), to waking people (V), to complete devastation (XII). Roman numerals are used to indicate the rated intensity. For most widely felt events, intensity maps are prepared to document the extent of various intensities. From these maps, seismologists can relate the maximum shaking (highest intensity), as well as the felt area (spatial area in which the earthquake was observed).

Table 3-10 Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	INSTRUMENTAL	Detected only on seismographs.	
II	FEEBLE	Some people feel it.	< 4.2
III	SLIGHT	Felt by people resting; like a truck rumbling by.	
IV	MODERATE	Felt by people walking.	
V	SLIGHTLY STRONG	Sleepers awake; church bells ring.	< 4.8
VI	STRONG	Trees sway; suspended objects swing, objects fall off shelves.	< 5.4
VII	VERY STRONG	Mild alarm; walls crack; plaster falls.	< 6.1
VIII	DESTRUCTIVE	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged.	
IX	RUINOUS	Some houses collapse; ground cracks; pipes break open.	< 6.9
X	DISASTROUS	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	< 7.3
XI	VERY DISASTROUS	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	< 8.1

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
XII	CATASTROPHIC	Total destruction; trees fall; ground rises and falls in waves.	> 8.1

Source: Federal Emergency Management Agency

A second indicator was invented in 1935 to describe earthquakes in which no felt data was available. At that time, Charles Richter (working at the California Institute of Technology) demonstrated that the amplitude of ground motion—as recorded on a seismograph for earthquakes at the same distance from the seismograph—could be characterized. Richter proposed that each time the ground motion increased tenfold, the magnitude or size of the event increased by 1 unit of magnitude. The magnitude scale, therefore, relates the amplitude of ground motion. As the scale (Table 3-11) was improved to correct for wave attenuation (decreases in the height of a wave over distance), seismographs could be used to estimate an earthquake's magnitude and arrive at the same value. A magnitude 6 earthquake, therefore, will possess 10 times (10x) greater ground motion than a magnitude 5 earthquake and 100 times (or 100x) greater ground motion than a magnitude 4 earthquake.

Table 3-11 Richter Scale for Earthquakes

Richter Magnitudes	Earthquake Effects
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

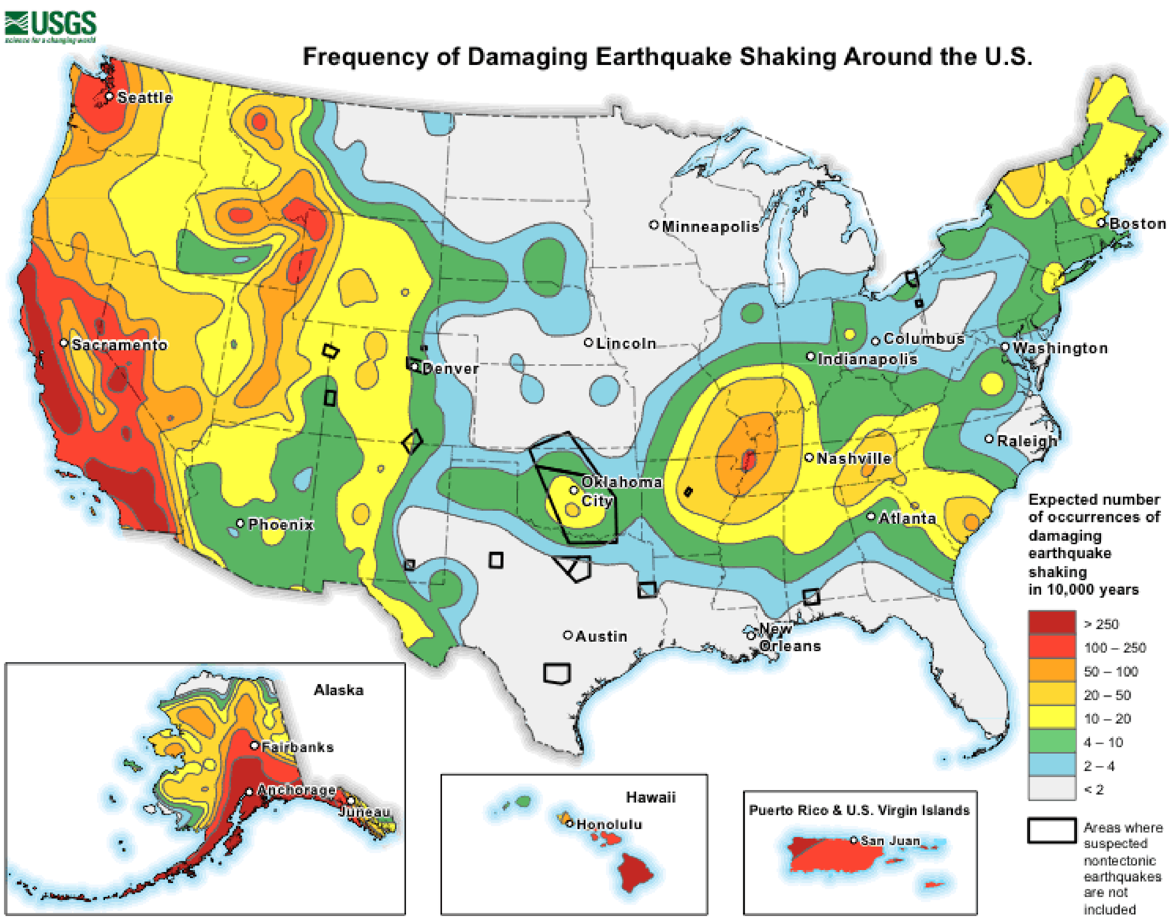
Decades later, seismologists found that an earthquake's magnitude could be related directly to the energy released in ground motion. For each tenfold increase in ground motion, there is a 30-fold increase in energy. Therefore, a magnitude 5 earthquake releases 30 times more energy than a magnitude 4 event. A magnitude 7 earthquake is 900 times larger (30 multiplied by itself) than a magnitude 5 earthquake, and 27,000 times (30 multiplied by 30 multiplied by 30) larger than a magnitude 4 earthquake.

By using observations related to magnitude, ground motion amplitude and duration (as well as wave attenuation), seismologists have been able to estimate earthquake magnitudes for historical earthquakes. In addition, by using the relationships developed through the study of large recent events, prehistoric earthquakes have also been characterized. Although it is possible that the state could experience an earthquake rated as high as a 10 on the Richter scale, the most likely high-level event is a 6 or 7. Likewise, Modified Mercalli intensity for a high-level event is likely to be around 8 or 9.

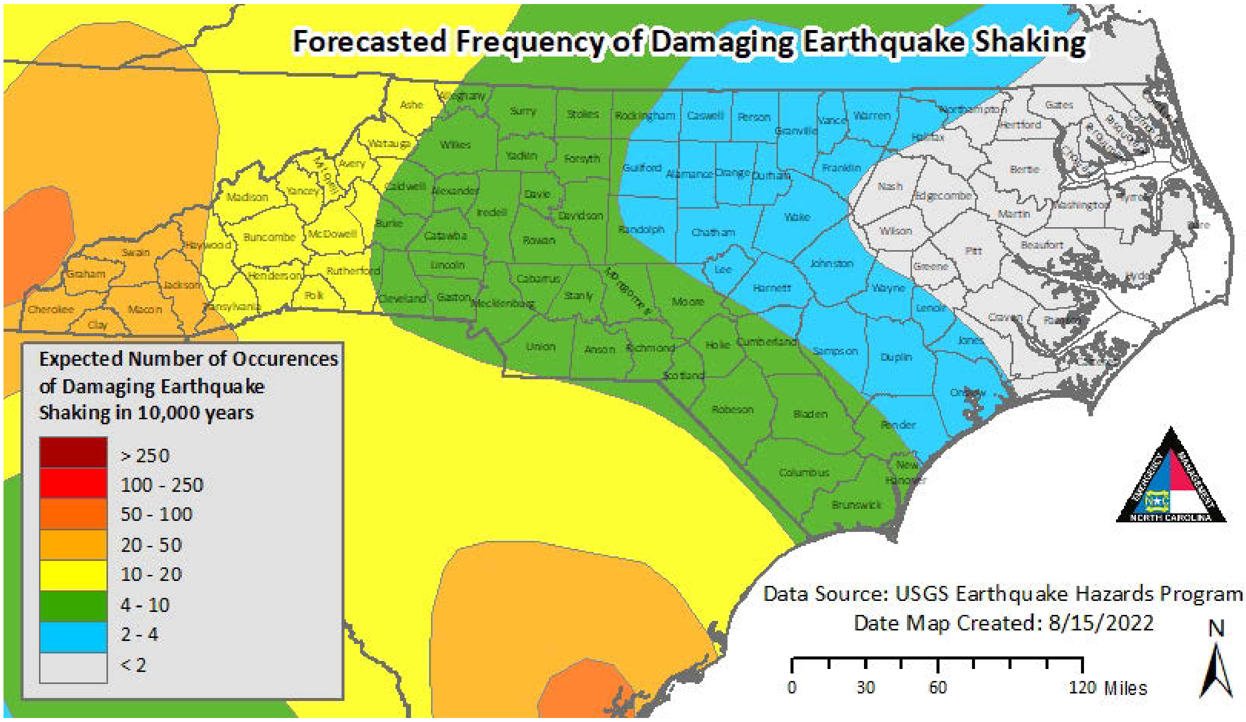
3.2.5.3 Location/Spatial Extent

Earthquakes could potentially affect any geographic location in North Carolina; however, they are far more likely in the western and southern parts of the state. The northeastern part of the state rarely experiences significant earthquakes. This is apparent in Figure 3-21, which shows that the probability of significant, damaging earthquake events affecting North Carolina is generally medium. The forecasted frequency of an earthquake that would result in shaking capable of causing damage is fairly low in the northeast and gets higher moving west and south from there. It is possible that future earthquakes resulting in moderate to strong perceived shaking and damages that are substantial will affect the state, especially in the western and southern parts of the state.

Figure 3-21: Forecasted Frequency of Earthquake Shaking Capable of Causing Damage within the United States



Source: National Geophysical Data Center



3.2.5.4 Hazard History

North Carolina is located in "earthquake country." Since 1735, when the state's first reported earthquake was felt in Bath, seismologists have compiled catalogs of felt events. Later, when seismographs became available, earthquake magnitude and hypocenter (earthquake location within the earth) parameters were compiled on a regional basis. The Southeastern United States Earthquake Catalog (SEUSEC) is one such compilation and represents the combination of the U.S. Geological Survey "United States Earthquake Data File," compiled by C.W. Stover, B.G. Reager, and S.T. Algermissen in 1984 (USGS Open File report 84-225) with more than 25 years of instrument-measured activity. Since 1977, earthquake magnitudes and hypocenters have been compiled by seismic network operators based in the southeastern United States and documented in a series of publications titled, "Southeastern United States Seismic Network Bulletin"—July 1977 to December 2002 (SEUSEC). The combination of these two datasets provides the best and most complete catalog of seismicity for the region.

A SEUSEC list of earthquakes that have caused damage in North Carolina is shown on Table 3-12. The table charts the date, magnitude, location, and felt intensity for the 24 earthquakes that have caused at least architectural damage in North Carolina. Of the 24 events, eight were located in North Carolina, primarily in the western region. One can determine from the data in the table that seven of these events were centered in North Carolina. The average time span between damaging events is 22 years, with the longest "quiet" interval lasting 40 years.

Table 3-12 Historic Earthquakes Registered in North Carolina

Date	Location	Magnitude	Max MMI*	MMI in NC**
12/16/1811	Northeast AK	8.5	XI	VI
12/16/1811	Northeast AK	8.0	XI	VI
12/16/1811	Northeast AK	8.0	XI	VI
1/23/1812	New Madrid, MO	8.4	XI	VI
2/7/1812	New Madrid, MO	8.7	XII	VI
4/29/1852	Wytheville, VA	5.0	VI	VI
8/31/1861	Wilkesboro, NC	5.1	VII	VII
12/23/1875	Central VA	5.0	VII	VI
8/31/1886	Charleston, SC	7.3	X	VII
5/31/1897	Giles County, VA	5.8	VIII	VI
1/1/1913	Union County, SC	4.8	VII	VI
2/21/1916	Asheville, NC	5.5	VII	VII
7/8/1926	Mitchell County, NC	5.2	VII	VII
11/3/1928	Newport, TN	4.5	VI	VI
5/13/1957	McDowell County, NC	4.1	VI	VI
7/2/1957	Buncombe County, NC	3.7	VI	VI
11/24/1957	Jackson County, NC	4.0	VI	VI
10/27/1959	Chesterfield, SC	4.0	VI	VI
7/13/1971	Newry, SC	3.8	VI	VI
11/30/1973	Alcoa, TN	4.6	VI	VI
9/13/1976	Southwest VA	4.1	VI	VI
5/5/1981	Henderson County, NC	3.5	VI	VI
8/23/2011	Mineral Springs, VA	5.8	VIII	V
8/9/2020	Sparta, NC	5.1	VII	VII

*Maximum Modified Mercalli Intensity experienced in the event
**Modified Mercalli Intensity experienced in North Carolina

Table 3-13 North Carolina Earthquakes 2021

Date	Region	Magnitude
2/3/2021	Virginia/North Carolina Border	2.6
2/8/2021	Virginia/North Carolina Border	1.8
2/21/2021	Tennessee/North Carolina border region	2.4
2/25/2021	Virginia/North Carolina Border	2.2
2/26/2021	Western North Carolina	1.6
3/04/2021	Virginia/North Carolina Border	2
3/7/2021	Western North Carolina	1.6
4/7/2021	Tennessee/North Carolina Border	1.6
4/17/2021	Western North Carolina	2.0
4/20/2021	Virginia/North Carolina Border	1.7
4/21/2021	Virginia/North Carolina Border	2.3
4/28/2021	Virginia/North Carolina Border	1.9
6/9/2021	Virginia/North Carolina Border	1.9
6/21/2021	Virginia/North Carolina Border	1.8
7/27/2021	Western North Carolina	2.7
7/30/2021	Virginia/North Carolina Border	1.7
8/17/2021	Western North Carolina	2.7
8/23/2021	Virginia/North Carolina Border	1.8
8/23/2021	Virginia/North Carolina Border	1.5
8/24/2021	Western North Carolina	2.1
9/25/2021	Western North Carolina	2.5
11/5/2021	Virginia/North Carolina border region	2.0
11/21/2021	Western North Carolina	2.4
11/24/2021	Western North Carolina	2.0
12/5/2021	Western North Carolina	2.3

Source: Southeast US Seismic Network, USGS

Details for Selected Earthquake Events

Sparta Earthquake – August 9, 2020

The 2020 Sparta Earthquake occurred about two (2) miles southeast of the Town of Sparta, North Carolina, on August 9, 2020. Seismic instruments indicate the earthquake originated at a depth of about 2.3 miles. The earthquake had a magnitude 5.1, and a shallow depth of 7.6 kilometers. Shaking was reported throughout the Southeastern, Midwestern, and Northeastern United States. It was the strongest earthquake recorded in North Carolina in 104 years, the second strongest in the state's history.

Widespread damage occurred in Sparta. Damages included collapsed ceilings, chimneys, and masonry; damaged water mains; cracked and deformed roads; uprooted headstones; and displaced appliances and items. The town mayor issued a state of emergency to apply for FEMA and state financial aid. Damage was worse than initially thought, with at least 525 structures being damaged, and 60 with major damage. Governor Roy Cooper sent $24 million in relief funds to help the town. According to local officials, 67% of the relief funds have been approved for various projects and anticipate completion within the next two (2) years. An additional $9 million was requested from the Office of State Budget and Management for Disaster Recovery.

There were no fatalities reported with the event and only one injury. The strongest aftershock of the sequence was a magnitude 2.9 that struck 2 days after the mainshock. In total, there were 20 recorded aftershocks as of August 27, 2020. As of August 2021, Mayor Wes Brinegar reported over 300 aftershocks indicating the residual effects and extent of the massive event.

3.2.5.5 Changing Future Conditions

Although North Carolina does not fall on any major fault lines, it is still susceptible to earthquakes, particularly in the western region. According to the NC Department of Environmental Quality, large, damaging seismic events are infrequent in the State diminishing the confidence level of future projections. One of the most prone areas to earthquakes in this region stretches along the border of North Carolina, Tennessee, and northern Georgia. This area is known as the Eastern Tennessee seismic zone.

3.2.5.6 Impact

Earthquakes capable of causing structural damage or failure (Mercalli Intensity VII or greater) are usually magnitude 5.5 or greater. This means that most of the historical catalog (large events) has great importance, since much of the accurate characterization of the earthquake hazard depends upon those events. By studying the relationship that exists between the number of earthquakes of various magnitudes, it has been shown that the number of small events (magnitude 3 or less) is directly related to the number of large events. This relationship is called the Gutenberg/Richter law. Put simply, a location in which numerous earthquakes occur is called a seismic source zone. Inside these zones, there are 100 magnitude 3 events for every 10 magnitude 4 events and for every one magnitude 5 event during a particular length of time. This allows seismologists to use current observations to predict or estimate the largest possible earthquake in a seismic source zone. High-activity source zones, such as those found in California, experience many more earthquakes over a given period of time, so it stands to reason damaging earthquakes occur more often, as well. Other seismic source zones experience fewer earthquakes and will experience damaging earthquakes less often. The size of the source zone gives a direct indication of the largest possible earthquake that could occur within that zone.

For example, the great earthquakes that struck California in 1857 and 1906 broke the entire San Andreas fault from Mexico to the offshore areas around San Francisco. These events were estimated to register more than 8.3 on the Richter Scale. The seismic source zone for the San Andreas fault system runs for hundreds of miles and experiences approximately 3,000 earthquakes per quarter (12,000 per year). Based on the maximum possible earthquake that could occur inside a source zone and observed activity (based on a combination of historical data and current observations), seismologists have produced ground motion maps, which relate the expected level of ground shaking to occur during a given period of time. In 1977, the National Earthquake Hazards Reduction Program (NEHRP) was established in order to coordinate the production of ground motion maps and to provide guidance on the interpretation and use of these maps to the emergency management, risk assessment, design, and governmental communities.

The NEHRP maps show an expected level of ground shaking in terms of acceleration (as a percent of "g" or gravity, which exerts a downward force of 9.8 meters/second/second or 32 feet/second/second), which would not be exceeded at the 90-percent and 98-percent confidence levels. Mathematically, the 90-percent and 98-percent levels of non-exceedance relate to the 425-year and 2,500-year return period earthquake. For a given location, the level of ground shaking in "g" (3 percent, 5 percent, or 10 percent), which has a 90-percent chance of not being exceeded in 50 years, is plotted on the map. A higher level of ground shaking (which has a 98-percent probability of not being exceeded in 50 years) is also plotted to demonstrate the upper bounds of potential impact. Taken together, these two maps provide two measures of the expected ground motion. For example, seismologists estimate that within the next 50 years in North Carolina, there is a 98 percent chance that ground shaking could equal a level of shaking in which structural failure would occur. By knowing the level of shaking, engineers can design structures and infrastructure to withstand that level of shaking, or at least reduce significantly the level of resulting damage.

HAZUS Applications in North Carolina

The North Carolina Division of Emergency Management, including its Hazard Mitigation Section, has been using HAZUS (FEMA's loss estimation software) since 1997. During the last several years, many analyses have been conducted with this software in order to estimate losses. An example of this application is documented in the report "Earthquake Planning Scenarios for Henderson County, North Carolina—Using HAZUS, the FEMA Software Tool for Estimating Earthquake Losses," which was prepared for the Henderson County Local Emergency Planning Committee (LEPC) and dated July 10, 1997. This early analysis used HAZUS97 and was the first study undertaken by any state outside of California. Later applications included three regional analyses: one for the 35 jurisdictions that compose the Western NCEM Branch (34 counties and the Eastern Band of the Cherokee); a second analysis for the 33 counties in the Central NCEM Branch; and a third analysis of the 33 counties in the Eastern NCEM Branch. Those analyses were completed in Aug. 1998 and are the first statewide HAZUS analyses performed outside the state of California.

The earthquake analysis completed by State Hazard Mitigation Officer Kenneth B. Taylor (now State Geologist, NC Department of Environment and Natural Resources) was applicable to the more academic planning side of the house as an upper bound estimate of expected damages for earthquake in North Carolina, and on the practical, project development and management side of the mitigation house. The study aggregated anticipated damages from an earthquake event rating approximately VI on the Mercalli Intensity Scale (or <5.4 on the Richter Scale) for three geographic regions of NC. The analysis was run on a regional basis as the vagaries of strength and associated damages across the scale of earthquake intensities NC is likely to experience, coupled with the random nature of any particular assigned earthquake epicenter could result in vastly differing estimated damages. Placing the epicenter a few miles closer to or farther from, say the international banking center of Charlotte, NC, could result in millions of dollars of difference in estimated damages. Therefore, a broader brush stroke was employed to give a reasonable, if softly focused, idea of loss potential. This study was aggregated by building type (residential, commercial, government) and represented the first known attempt in NC to complete an aggregate look at all buildings in the state. Because earthquake activity seems to be fairly stable over geologic timeframes, and thus certainly over the periodic life of a hazard mitigation plan, the risk is deemed to be fairly stable in NC and no further updates to the analysis have been completed.

The analysis suggested that non-structural earthquake retrofits for critical public facilities including schools, emergency operations centers, hospitals and other critical, high value targets would be selected for mitigation projects. As of the 2023 update of the NCEHMP plan, a dozen or more individual Earthquake mitigation projects have been completed in western NC including: application of ballistic window films to plate glass windows in schools; anchoring of tall/heavy shelving and light fixtures; provision of segregated chemical storage in science labs; anchoring of expensive/delicate equipment in hospitals; and delivery of earth quake education, outreach and training of local emergency managers in assessment of non-structural earthquake mitigation opportunities. These projects have been funded through the HMGP and the NEHRP Earthquake Consortia Grant program.

HAZUS and updates of previous HAZUS runs have not been given much attention since 1998 for a variety of reasons, including staffing, occupation with implementation of massive HMGP and non-disaster appropriations, and due to the limited utility of HAZUS given its gross scale. The tool is well-suited for county level general assessments but doesn't provide the level of detail necessary to address specific issues or individual projects. The benefit and advantage of HAZUS is that it replaced guesswork with modeling based on aggregate data, the downside, as referenced above, is a lack of focus. NCEM is currently directing it hazard assessment efforts toward collection of building-specific data through the IHRM so that county-level and local level assessments can be done at the individual building level. As these assessments will be done on the same basis across the state, we anticipate being able to collect and utilize a much finer risk analysis than we have been able to use in the past.

3.2.5.7 Future Probability

Using the SEUSEC, two seismologists from the Virginia Tech Seismological Observatory proposed a map of the 10 seismic source zones which have affected the southeastern United States. These are:

1. Giles County, Virginia;
2. Central Virginia;
3. Eastern Tennessee;

4. Southern Appalachians;
5. Northern Virginia and Maryland;
6. Central Appalachians;
7. Piedmont-Coastal Plain;
8. Charleston, South Carolina;
9. Appalachian Foreland; and,
10. The New Madrid Seismic Zone.

Using SEUSEC data, a formula was developed to express the relationship that exists between the expected earthquake magnitude in each seismic source zone and the return period (i.e., how long a time interval exists between events) for that magnitude. Only one earthquake with a magnitude greater than 6 has been located in the southeast: the 7.3 magnitude earthquake that struck Charleston, S.C., on Aug. 31, 1886. That quake caused damage that can still be seen at the Old Cotton Exchange in Wilmington, N.C. Earthquake bolts were placed across the front side of the building to shore up the un-reinforced masonry building.

The two other most active zones that affect North Carolina are the Eastern Tennessee Seismic Zone (ETSZ) and the Southern Appalachian Seismic Zone (SASZ). Recurrence rates for the two zones are very similar. For the ETSZ, a magnitude 2 earthquake occurs about every 1.4 months with a similar size event occurring within the SASZ about every two months. Larger events (such as magnitude 5 quakes) typically occur in the ETSZ once every 60 years and once every 59 years in the SASZ. For magnitude 6 events, the return period is 476 years (for ETSZ) and 417 years (SASZ).

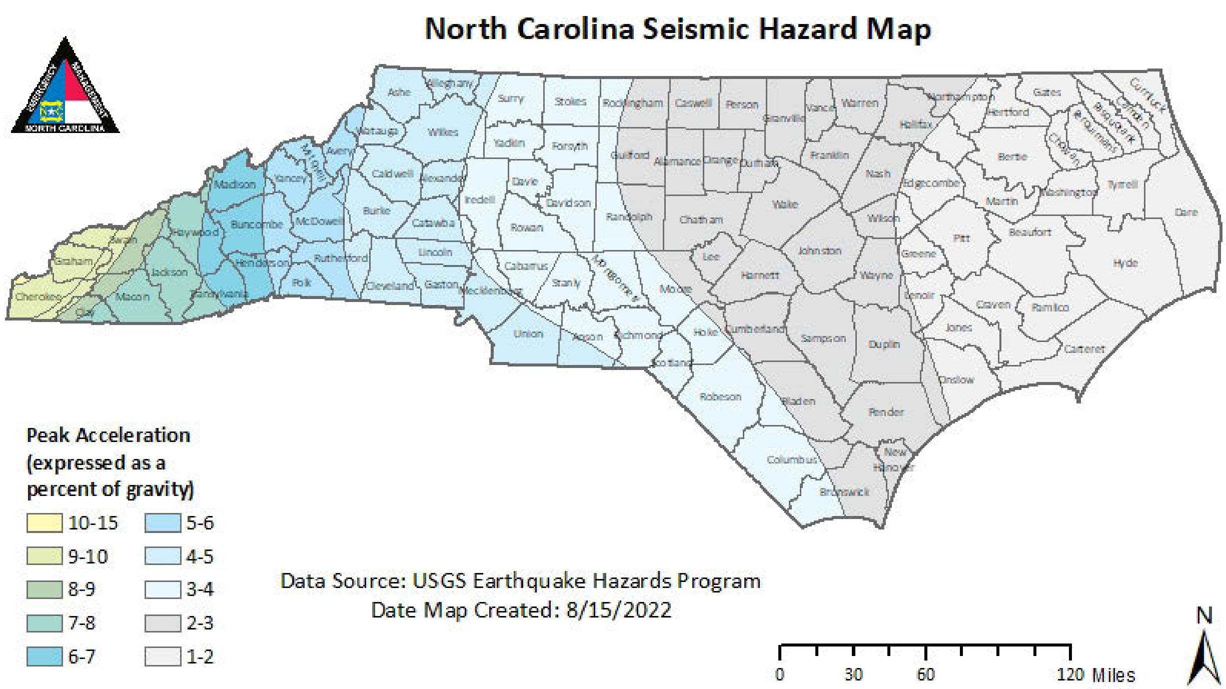
The ETSZ is the second most-active seismic zone east of the Rocky Mountains. One troubling finding presented by seismologists in 1994 argues that the ETSZ's seismicity clusters along a 185-mile line that exists in the middle of the zone. Should that entire line break at once, the estimated magnitude of such an event would register at least 7 on the Richter Scale.

The largest earthquake to be centered in North Carolina occurred in 1916 in western North Carolina. That event was felt in seven states. Based on historical events, the state could experience an earthquake as large as a magnitude 8 or 9; however, the likelihood of such an event is relatively low. That being said, an earthquake of magnitude 6 is a highly likely event over the next 50 years and would cause significant damage in the state. An earthquake could affect any part of the state, though it is much more likely in the west and in the southeast.

Using historical catalogs such as SEUSEC, the USGS has compiled two NEHRP maps that display 90 percent probability of non-exceedance and 98 percent probability of non-exceedance, as recorded during a 50-year time interval. There is a 90-percent chance that ground accelerations would equal or exceed 6 percent to 9 percent g (percent g is a measure of the forces caused by the shaking caused by an earthquake). This level of shaking is above the threshold of architectural damage that would occur in the western third of the state. Considering the greatest possible level of shaking (98 percent non-exceedance), ground accelerations could equal or exceed 12 percent to nearly 30 percent g. Those levels of shaking would lead to structural damage or structural failure in western North Carolina. Figure 3-22 shows the earthquake acceleration percentages for the state.

In interpreting the NEHRP maps, ground accelerations of 3 percent to 6 percent g can cause architectural damage (non-load-bearing building ornaments). Ground accelerations of 6 percent to 12 percent g can cause architectural failure. Even greater accelerations (12 percent to 24 percent g) can result in structural damage (cracks in load-bearing walls), and accelerations of 25 percent to 48 percent g can result in structural collapse. The expected level of damage for these levels of shaking is based on a comparison of observed ground motion and the performance of un-reinforced masonry buildings, which are the structurally weakest and most damage-prone type of building.

Figure 3-22 Seismic Hazard Map for North Carolina



Although the western side of the state is more prone to experience earthquakes on a regular basis, most earthquakes are not of high magnitudes, and many are virtually unnoticeable. However, based on historical evidence, in the entire state of North Carolina, it is unlikely (between 1 and 33.3 percent annual probability) that there will be more earthquakes in the near future.

3.2.5.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 8, Earthquake Operations Plan

3.2.6 Wildfire

3.2.6.1 Description

A wildfire is an uncontrolled burning of grasslands, brush or woodlands. The potential for wildfire depends upon surface fuel characteristics, recent climate conditions, current meteorological conditions, and fire behavior. Hot, dry summers and dry vegetation increase susceptibility to fire in the fall—a particularly dangerous time of year for wildfire.

Southern forest landscapes have had a long history of wildfire. Wildfires have taken place as a natural process for many thousands of years, playing an important role in the ecological integrity of our natural environment. Human settlement has significantly influenced changes in the spatial and temporal pattern of wildfire occurrence, as well as the risks associated with them for human life and property. The fire regimes of the Southeast can be categorized into five time periods, as described in Table 3-14.[17]

Table 3-14 Southeast Fire Regime Time Periods

Time Period	Fire Description
14,000 to 500 years ago	American Indians used fire for swidden agriculture, better hunting visibility, reduction of wildfire fuel, and maintenance of trails.
500 to 100 years ago	European settlers used fire to maintain large amounts of permanent agricultural fields at a much greater scale than previously done.
Late 1800s to early 1900s	Forests were extensively logged, creating conditions that exacerbated the common occurrence of wildfires.
1900 to 1950s	Response to wildfires was widespread fire suppression.
1950 to Present	Active management; the natural role of fire is incorporated through prescribed burning.

Natural wildfires still take place on a regular basis in the Southeast. They can be caused by human carelessness, arson, or from lightning strikes. Other natural disturbances (such as tornadoes, droughts, and hurricanes) can influence the structure and fuel distribution of forests, leading to a change in wildfire intensity and risk. The occurrence and frequency of wildfires also depends greatly upon the type of forests, ranging from longleaf pine forest in the coastal plain to oak-hickory forests in the mountains.[18]

The current scale of wildfire risk conditions is measured with the Keetch-Byram Drought Index (KBDI). The KBDI estimates the potential risk for wildfire conditions based on daily temperatures, daily precipitation, and annual precipitation levels on an index of 0 (no

[17] *Stanturf, John A., Wade, Dale D., Waltrop, Thomas A., Kennard, Deborah K., and Achtemeier, Gary L. 2002. Southern Forest Resource Assessment: Background Paper Chapter 25: Fire in Southern Forest Landscapes. Southern Research Station, United States Department of Agriculture Forest Service, pp 607-630. Retrieved on December 14, 2017 from: http://www.srs.fs.usda.gov/sustain/report/pdf/chapter_25e.pdf*

[18] *Stanturf, John A., Wade, Dale D., Waltrop, Thomas A., Kennard, Deborah K., and Achtemeier, Gary L. 2002. Southern Forest Resource Assessment: Background Paper Chapter 25: Fire in Southern Forest Landscapes. Southern Research Station, United States Department of Agriculture Forest Service, pp 607-630. Retrieved on December 14, 2017 from: http://www.srs.fs.usda.gov/sustain/report/pdf/chapter_25e.pdf*

drought) to 800 (extreme drought).[19] The daily KBDI for the state of North Carolina can be found on the North Carolina Forest Service Division of Forest Resource website.[20]

3.2.6.2 Extent

Although North Carolina has not experienced wildfires as large as some areas in the western United States, it has still been impacted by several large fires historically that have had a significant impact on the state.

Wildfire data was provided by the North Carolina Forest Service and is reported annually by county from 1970 to 2017. The greatest number of acres to burn in a single year occurred in 2000 in Mitchell County when 2,794 acres were burned in 24 fires. The greatest crop damage from wildfires occurred in 2016 in Brunswick County that resulted in $2.33 million in losses.

3.2.6.3 Location/Spatial Extent

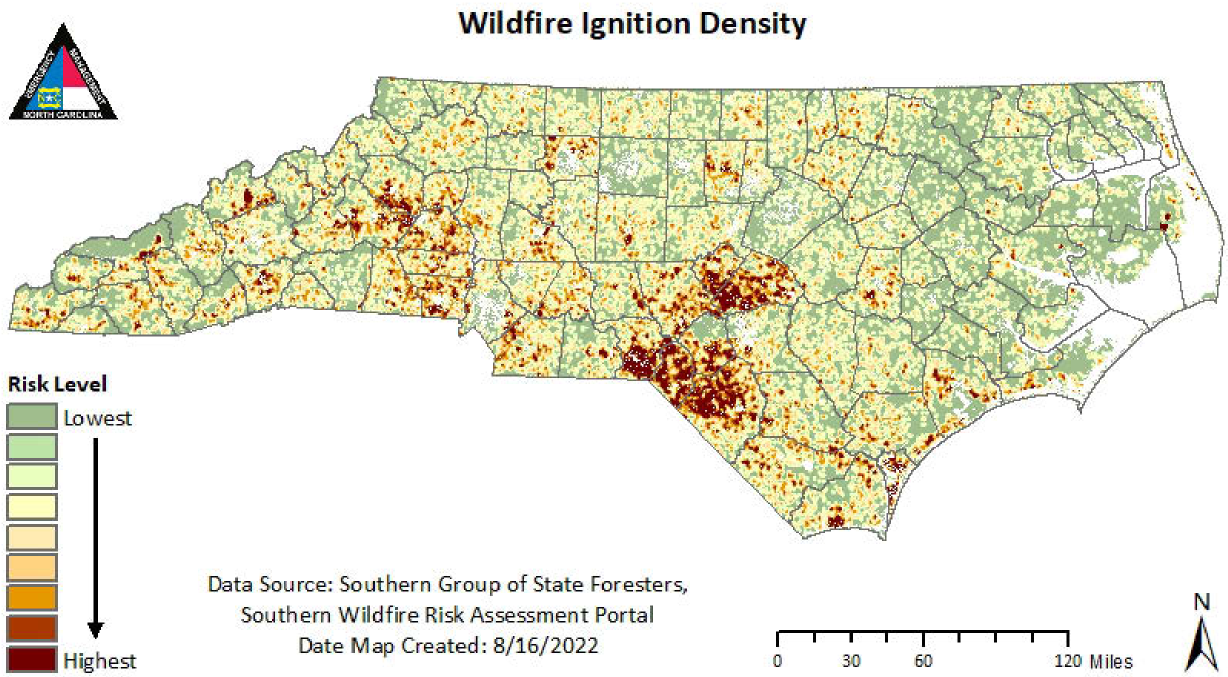
The entire state is at risk to a wildfire. In fact, North Carolina has the highest number of acres of land located in the Wildland Urban Interface in the United States[21]. However, several factors such as drought conditions or high levels of fuel on the forest floor may make a wildfire more likely in certain areas. Furthermore, areas in the urban-wildland interface are particularly susceptible to fire hazard where populations and development abut formerly undeveloped areas. That is to say that more rural areas where some development is just starting to take place tend to be at highest risk to a wildfire.

[19] *Keetch-Byram Drought Index. United States Forest Services: Wildland Fire Assessment System. Retrieved on December 14, 2017 from: https://www.wfas.net/index.php/keetch-byram-index-moisture--drought-49*
[20] *Fire Weather Intelligence Portal. State Climate Office of North Carolina. Retrieved on December 14, 2017 from: http://climate.ncsu.edu/fwip/?tab=curr&state=NC&map_bg=ter&point_curr=kbdi*
[21] *https://www.resistwildfirenc.org/*

3.2.6.4 Hazard History

The Wildfire Ignition Density data shown in below gives an indication of historic location of wildfires in North Carolina based on data from the Southern Wildfire Risk Assessment. This data is based on historical fire ignitions and the likelihood of a wildfire igniting in an area. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. This is measured in the number of fires per year per 1,000 acres.[22]

Figure 3-23 North Carolina Wildfire Ignition Density



[22] *Southern Wildfire Risk Assessment, 2016.*

Figure 3-24 Number of Wildfires Per Year

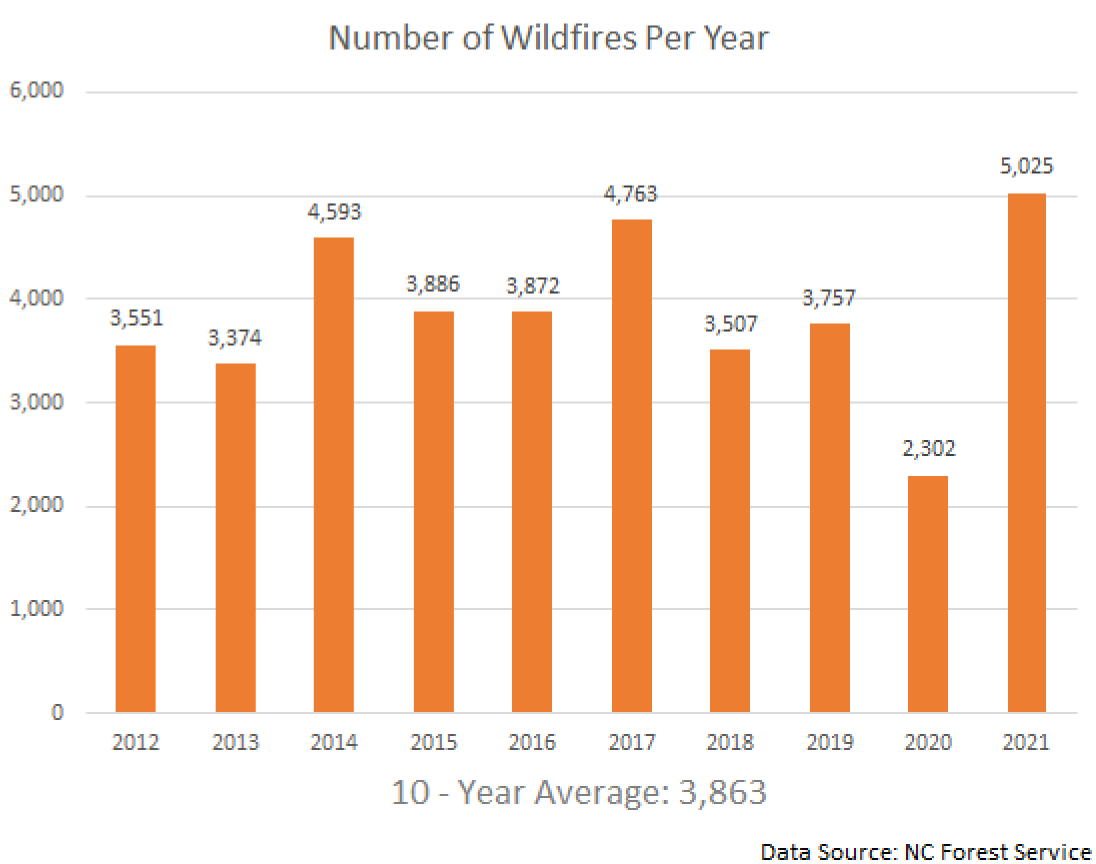


Table 3-15 describes wildfire events that occurred in North Carolina between 1998 and 2021, as listed in the NCEI's Storm Events Database. Detailed information for selected events follows the table. Figure 3-25 provides a visual representation of these events.

Table 3-15 Detailed Wildfire History

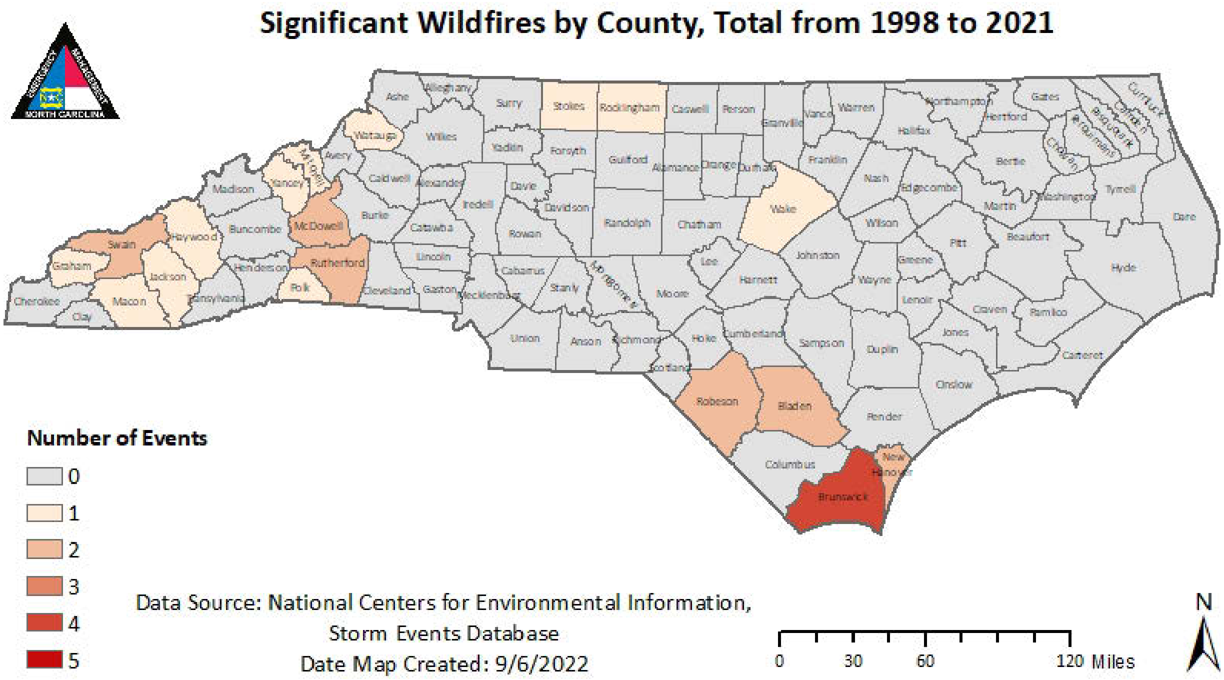
North Carolina Wildfire Events					
#	Event	Duration	Location (County)	Severity	Extent of Damages
1	Wild/Forest Fire	06/03/1998–06/05/1998	Pender (12 miles NE of Rocky Point)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
2	Wild/Forest Fire	10/28/2000–10/31/2000	McDowell (4 miles N of Ashford)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
3	Wild/Forest Fire	11/01/2000–11/02/2000	McDowell (4 miles N of Ashford)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
4	Wild/Forest Fire	11/01/2000–11/02/2000	Yancey (8 Miles SW of Burnsville, Celo)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
5	Wild/Forest Fire	11/01/2000-11/02/2000	Mitchell (5 miles SE of Spruce Pine)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0

North Carolina Wildfire Events					
#	Event	Duration	Location (County)	Severity	Extent of Damages
6	Wild/Forest Fire	11/01/2000–11/02/2000	Haywood (Waterville)	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
7	Wild/Forest Fire	03/11– 12/2007	Swain County --Grassy Ridge community	Fatalities: 0 Injuries: 0	Property: $1,190,395 Crops: $0
8	Wild/Forest Fire	9/25– 28/2007	Brunswick County - Hale Swamp Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
9	Wild/Forest Fire	11/05/2007	Robeson County -- Jackson Swamp area	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
10	Wild/Forest Fire	12/01/2007	Robeson County	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
11	Wild/Forest Fire	3/26-27/2008	New Hanover east of I-40 between Sidbury and Holly Shelter Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
12	Wild/Forest Fire	3/28-28/2008	Brunswick County -- Highway 133 and Funston Road	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
13	Wild/Forest Fire	4/19-21/2008	Pender Shiloh Road west of Highway 421 near Atkinson	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
14	Evans Road Fire	3/23/2010	Wake County – Highland Creek Community	Fatalities 0 Injuries 4	Property: $1,131,906 Crops: $0
15	Wild/Forest Fire	04/7/2010	Northern Jackson County --Bradley Branch Rd	Fatalities: 0 Injuries: 0	Property: $113,190 Crops: $0
16	Wild/Forest Fire	2/12– 20/2011	Rutherford County - Chimney Rock State Park	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
17	Wild/Forest Fire	2/12– 20/2011	Polk County -- Chimney Rock State Park	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
18	Wild/Forest Fire	2/14/2011	Rockingham County – Near Ruffin	Fatalities: 0 Injuries: 0	Property: $5,486 Crops: $0
19	Wild/Forest Fire	2/14/2011	Watauga County – Green Briar/Rocky Knob area	Fatalities: 0 Injuries: 0	Property: $0 Crops: $0
20	Simmons Road Wildfire	6/18-7/30/2011	Bladen County --NC Hwy 53 and Simmons Road	Fatalities: 0 Injuries: 0	Property: $548,635 Crops: $0
21	Juniper Road Wildfire	6/18-7/30/2011	Pender County – Holly Shelter Game Land	Fatalities 0 Injuries 0	Property: $0 Crops: $0

North Carolina Wildfire Events					
#	Event	Duration	Location (County)	Severity	Extent of Damages
22	Wild/Forest Fire	7/1/2011	Inland Pender County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
23	Wild/Forest Fire	7/1/2011	Bladen County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
24	Wild/Forest Fire	4/14/2012	Inland Pender County - Hampstead	Fatalities 0 Injuries 0	Property: $2,150 Crops: $0
25	Wild/Forest Fire	4/16/2012	Inland New Hanover County - Cameron Art Museum Property, Wilmington	Fatalities 0 Injuries 0	Property: $2,687 Crops: $0
26	Wild/Forest Fire	4/4-4/5/2014	Inland Pender County - Holly Shelter Game Land	Fatalities 0 Injuries 0	Property: $47,437 Crops: $0
27	Wild/Forest Fire	4/6-4/16/2015	Inland Brunswick County – Compass Point Subdivision	Fatalities 0 Injuries 0	Property: $208,871 Crops: $0
28	Wild/Forest Fire	4/19/2016	Inland Brunswick County - Clemmons Rd	Fatalities 0 Injuries 0	Property: $2,570 Crops: $2.39M
29	Tellico Fire	11/3-11/30/2016	Macon County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
30	Tellico Fire	11/3-11/30/2016	Swain County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
31	Maple Springs Fire	11/4-11/30/2016	Graham County	Fatalities 0 Injuries 0	Property: $0 Crops: $0
32	Party Rock Fire	11/5-11/30/2016	Rutherford County Mountains	Fatalities 0 Injuries 0	Property: $0 Crops: $0
33	Grindstone Fire	12/1-12/3/2021	Stokes County Pilot Mountain	Fatalities 0 Injuries 0	Property: $364,000 Crops: $0

Source: NCEI

Figure 3-25 Wildfire Events in North Carolina



Significant North Carolina Wildfire Events

June 3, 1998–June 5, 1998

Lightning sparked a forest fire just east of Shaw Highway (north of Highway 210) that burned 695 acres on the western edge of Holly Shelter Game Land.

Oct. 28, 2000–Nov. 2, 2000

A wildfire was started in the Linville Gorge area and eventually burned hundreds of acres. Extremely dry conditions had persisted across the area; rainfall had not been measured for 50 days. Wildfires that started in late October continued to burn out of control into early November. Several thousand acres were burned with the largest burn area occurring in the Linville Gorge.

June 1, 2008- January 5, 2009

A wildfire sparked by lightning in Hyde County NC burned 40,704 acres of private, state owned and federally managed land in three counties. 60% of the damage was contained on the federal Pocosin Lakes Wildlife Refuge. Due to ongoing drought in the region, the peat soil caught fire and the fire spread underground over a large area. At the height of the response, over 400 local, county, state and federal agents participated. Over 2 billion gallons of water was pumped over 35 miles from Lake Phelps, New Lake and the Alligator River and used to flood the local canal system in an effort to raise the water table and extinguish the underground fires. Heavy smoke led to air quality warnings as far as 150 miles away in Piedmont NC. Three mobile homes used as hunt camps were the only structures destroyed by the blaze. The last hot spots from the fire were identified and extinguished on January 5, 2009. Suppression of the blaze cost just under $20 million.

March 23, 2010

Dry conditions in Wake County along with above normal temperatures during the week preceding the fire likely contributed to a decrease in fuel moisture and an increased potential for fires. Strong gusty westerly winds developed during the afternoon and in advance of a surface trough. These gusty winds and the close proximity of the homes were factors in the rapid spread of the fire. Three homes were destroyed and 4 homes were damaged in the Highland Creek Home Community in north Raleigh when a fire spread from a grass, pine straw area directly behind one of the homes

June 18, 2011-July 30, 2011

Lightning sparked a wildfire near the intersection of NC Hwy 53 and Simmons Road, in the Live Oak community in Bladen County. Against the backdrop of an ongoing severe drought and 100-degree heat, strong and erratic winds caused the fire to cross containment lines on June 20-21. The fire destroyed three homes and eleven outbuildings. The fire spread to all or parts of several bays containing dense vegetation and organic soil. Evacuations were ordered on two occasions, but all residents were able to return home. The fire grew to 5600 acres and continued to burn into July.

Party Rock Fire, Rutherford County, November 5 – November 30, 2016

An extended period of abnormally dry weather and drought conditions that began in late winter of 2016, and continued through the year resulted in very dry vegetation across western North Carolina by mid-autumn. This was exacerbated by an unusually warm late summer and fall, when temperatures averaged as much as 5 degrees above normal. In these conditions, multiple wildfires ignited and spread during the first week of November, culminating in one of the worst wildfire episodes in recent western North Carolina history. Multiple large fires burned, mainly across the southern mountains, and most of these fires were not completely contained until a cold front brought much-needed rain to the area at the end of the month.

The Party Rock fire burned more than 7,000 acres in the Lake Lure/Chimney Rock/Bat Cave area. Chimney Rock State Park was closed throughout much of the month, while Chimney Rock village was evacuated multiple times during adverse fire weather conditions. The Maple Springs Fire burned around 8000 acres in an area just north and northwest of Lake Santeetlah. The Tellico fire burned more than 13,000 acres in the Nantahala area along the Macon/Swain County line.

Grindstone Fire, Stokes County, December 1 – December 3, 2021

Abnormally low precipitation totals during December 2021, combined with unusually warm average temperatures (6 – 8 degrees F above normal) through the month across the Piedmont and foothills of northern North Carolina, allowed Severe Drought conditions to persist since its onset in late November. While not as dry as November, less than half of the normal monthly precipitation for December fell across this region, cementing the dryness that was already in place during much of autumn. Streamflows and soil moisture continued to range from below-normal to well below-normal for early winter. Agricultural concerns were minimal due to winter dormancy, however slow/poor growth of cover crops, which are meant to reduce soil erosion, were noted, as well as to winter wheat. Conversely, some farmers welcomed the dryness as it allowed them to work in their fields without contending with the mud. Concerns for increased wildfire activity were present, burn bans already in place at the start of the month for the entire state of North Carolina.

As of December 4th, 2021, the cost of containing the Grindstone Fire on Pilot Mountain had increased to at least $364,000 dollars and had burned an estimated 1050 acres of state park land, The fire was not 100% contained. The fire was caused by a campfire that escaped containment during unusually dry conditions and high winds favorable for allowing the fire to quickly spread.

A historical record of the number of wildfires and acreage burned in North Carolina from 1928 to 2021 can be found at the North Carolina Forest Service website. Official records of wildfire under jurisdiction of the NCFS are entered by county personnel and compiled in a statewide database of fire information. Also available on the website is a listing of the causes of wildfire in North Carolina from 1970 to 2018, as shown in Table 3-16.[23]

Table 3-16 Causes of Wildfire in North Carolina (1970–2021)

Year	Fires	Acres	Lightning	Camping	Smoking	Debris Burning	Incendiary	Mach. Use	Rail-Road	Children	Misc.
1970	5,291	72,747	64	45	722	1,752	1,084	191	454	265	714
1971	4,015	79,864	26	40	528	1,208	784	105	410	241	673
1972	2,524	37,715	16	22	261	886	601	81	193	189	275
1973	3,649	29,658	17	55	540	1,218	743	156	154	227	539
1974	3,407	33,836	8	35	433	1,198	749	111	220	244	409
1975	2,710	16,321	24	38	332	852	591	88	139	253	393
1976	6,355	69,805	26	60	736	2,007	1,705	233	342	447	799
1977	5,836	38,295	129	48	627	2,141	1,177	208	409	385	712
1978	4,865	36,137	29	50	604	1,735	1,093	175	326	329	524
1979	3,563	30,767	12	41	403	1,433	809	127	244	237	257
1980	4,420	62,785	107	52	492	1,513	1,072	225	301	281	377
1981	8,746	108,253	58	122	996	3,023	2,231	352	444	572	948

[23] *Wildfire Statistics. North Carolina Forest Service. Retrieved on December 14, 2017 from: http://www.ncforestservice.gov/fire_control/wildfire_statistics.htm*

Year	Fires	Acres	Lightning	Camping	Smoking	Debris Burning	Incendiary	Mach. Use	Rail-Road	Children	Misc.
1982	3,734	74,269	23	40	349	1,557	817	163	179	228	378
1983	2,900	12,579	99	24	276	1,001	648	270	128	195	259
1984	3,569	19,771	30	53	317	1,453	829	216	95	236	340
1985	7,318	99,473	92	80	832	2,861	1,674	345	172	487	775
1986	5,580	113,479	188	66	652	1,794	1,366	318	92	458	646
1987	3,908	17,834	89	55	374	1,517	880	239	62	266	426
1988	4,581	23,795	151	48	496	1,636	1159	216	74	313	488
1989	2,660	14,440	32	32	260	1,008	664	134	47	188	295
1990	4,037	26,193	129	41	354	1,352	1,199	251	36	291	384
1991	5,051	24,336	49	60	483	1,945	1,178	282	51	394	609
1992	5,721	23,952	54	52	622	2,322	1,237	340	57	444	593
1993	4,793	25,334	204	59	397	1,690	1,086	303	56	430	568
1994	5,809	19,359	99	73	474	2,472	1,188	302	61	525	615
1995	5,296	21,253	48	58	457	2,165	1,134	277	49	559	549
1996	4,272	15,963	49	35	300	1,838	807	222	81	428	512
1997	4,539	16,274	127	50	273	1,890	929	226	86	477	481
1998	4,317	15,699	80	40	297	1,755	944	258	63	387	493
1999	6,244	28,298	110	75	439	2,629	1,195	325	107	598	776
2000	4,949	25,146	57	60	358	2,049	955	282	119	443	626
2001	8,129	28,733	82	110	708	3,226	1593	524	121	749	1,015
2002	5,618	28,216	261	73	370	2,250	975	360	65	501	764
2003	1,994	5,841.4	10	21	121	864	355	140	15	154	314
2004	4,364	14,722.8	29	49	255	2,046	693	295	36	335	626
2005	4,057	15,235.8	49	47	278	1,697	764	325	45	311	541
2006	5,096	21,924.0	97	52	333	2,111	943	430	49	393	690
2007	7,260	38,065	215	105	503	2,461	1,476	614	98	614	1,174
2008	4,381	50,646	197	36	246	1,567	758	384	58	332	802
2009	3,291	12,322	56	38	186	1,309	618	283	26	246	469
2010	4,053	14,703	71	36	166	1,642	801	435	24	268	602
2011	5,265	63,547	200	28	216	2102	1012	522	40	298	803
2012	3,550	11,992	129	46	91	1,221	715	384	36	228	668
2013	3,374	9,451	20	37	102	1,492	580	344	14	200	583

Year	Fires	Acres	Lightning	Camping	Smoking	Debris Burning	Incendiary	Mach. Use	Rail-Road	Children	Misc.
2014	4,593	13,327	53	41	90	2,237	706	460	30	210	766
2015	3,886	10,558	77	32	82	1,671	444	416	0	223	941
2016	3,872	77,741	48	65	78	1,566	402	438	18	175	1,405
2017	5,153	20,479	60	40	79	2.413	322	485	36	159	1,559
2018	3,597	10,994	43	29	35	1,601	191	364	22	140	1,172

Source: North Carolina Forest Service

3.2.6.5 Changing Future Conditions Changing Future Conditions

According to the North Carolina Climate Science Report, higher average temperatures and more severe droughts will lead to an increased likelihood of conditions conducive to wildfires. Increases in wildfire will pose a major risk for human health and emergency services, putting more lives at risk of fire related injuries, fatalities, and property losses. It is likely that future droughts in their multiple forms in North Carolina will be more frequent and intense due to higher temperatures leading to increased evaporation, therefore, it is likely the frequency of climate conditions conducive to wildfires in North Carolina will increase.

Wildfire risk is greatest among potentially underserved communities in the southern and western regions of the state due to large wildland areas and limited warning and response capabilities. Some of the most affected counties include Robeson, Hoke, Brunswick, in the southern region of the state, and Henderson, Buncombe, Cleveland, Burke, Catawba and Iredell counties in the western region of the state.

3.2.6.6 Impact

Wildfires are a key part of nature's cycle that renews many ecosystems; however, they can also be dangerous and deadly when uncontrolled. Smoke from wildfires can cause health risks, and carbon dioxide is also released into the atmosphere during burns.

There have been several notable incidents that caused significant damage in North Carolina's recorded history of wildfires that can be used as a basis for the impacts that a wildfire might have in the state. For example, Fayetteville experienced a devastating fire on May 29, 1831. The fire was considered to be more destructive than the Great Fire of Chicago in 1871. Fayetteville lost 600 homes, 100 businesses, and several churches, among other structures.[24] In recent years, North Carolina has also experienced significant wildfires, including on June 3, 1998, when lightning sparked a forest fire just east of Shaw Highway (north of Highway 210 in Pender County) that burned 695 acres on the western edge of Holly

[24] *Citywide Fire in Fayetteville, 1831. North Carolina Department of Natural and Cultural Resources. Retrieved on December 14, 2017 from: https://www.ncdcr.gov/blog/2015/05/29/citywide-fire-in-fayetteville-1831*

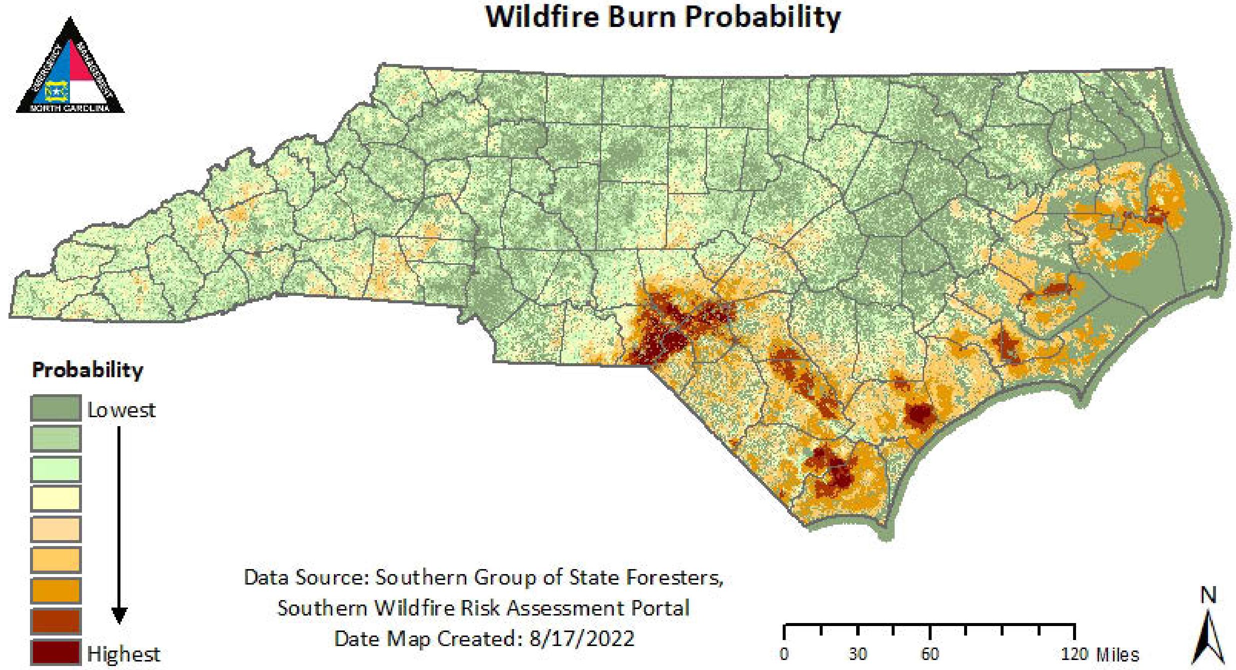
Shelter Game Land. The event lasted 45 hours. A major wildfire occurred in Brunswick County in April 2016 when burning debris caught fire. The wildfire covered 1,578 acres and destroyed a travel trailer and mobile home. Over $2 million was lost in property and crop damages. The Party Rock and Chestnut Knob Fires in 2016 were the most recent major wildfires in the state.

3.2.6.7 Future Probability

There is a high probability of future wildfire events in the State of North Carolina. Higher average temperatures and more severe droughts associated with a changing climate will lead to an increase likelihood of conditions conducive to wildfires. More intense wildfires will negatively impact air quality because of more fine particles in the air, exacerbating health issues such as asthma. In addition, increased development throughout the State leads to increased vulnerability by increasing structure and infrastructure exposure at the Urban Wildland Interface.

Figure 3-26 shows areas of the state that have a high probability of experiencing a wildfire according to the Southern Wildfire Risk Assessment's Burn Probability Index.

Figure 3-26 Wildfire Probability



North Carolina has an extensive history of wildfires in recent years, many of which were sparked by burning debris in hotter and dryer months. North Carolina also has a larger percentage of structures at the Urban/Wildland Interface than any state in the nation. Extreme heat, drought, wind and continued development of the UWI may make the probability of experiencing wildfires even higher. Therefore, according to historical evidence and changing future conditions, it is likely (between 33.4 and 66.6 percent annual probability) that North Carolina will continue to experience wildfires in the future.

3.2.6.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.7 Dam Failures

3.2.7.1 Description

Dams store water in reservoirs during times of excess flow, so that water can be released from the reservoir during other times, when natural flows are inadequate to meet the needs of water users.[25] Dams can pose risks to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing the loss of life and considerable property damage downstream from the dam.[26] Many dam failures have resulted because of design flaws leading to an inability to safely pass flood flows. Failures caused by hydrologic conditions can range from sudden (with complete breaching or collapse), to gradual (with progressive erosion and partial breaching). The most common modes of failure associated with hydrologic conditions include overtopping, the erosion of earth spillways, and overstressing the dam or its structural components.[27] In addition, the 2023 update of this hazard analysis includes FEMA's June 2020 guidance on High Hazard Potential Dams Program which can be viewed here: https://www.fema.gov/sites/default/files/2020-08/fema_hhpd_grant-guidance.pdf

Like all constructed infrastructure, dams deteriorate. Lack of maintenance can cause dams to be more susceptible to failure. For example, corrugated metal piping used in some historical and current dam construction projects has a relatively short design life, often shorter than the intended overall design life of the dam itself. This can lead to expensive replacement and/or replacement projects to avoid further deterioration and potential impacts to the overall dam. In the United States since January 2000 more than 900 dam incidents (including 307 dam failures) were reported and collected in joint efforts by the Department of Homeland Security (DHS) and the Association of State Dam Safety Officials (ASDSO). ASDSO collects and archives information on dam performance as reported by state and federal regulatory agencies and dam owners.

Since 2015 and Hurricane Matthew, North Carolina has seen failure of more than 27 dams and weather-related damage to over 60 dams[28]. Dam incidents are events resulting from

---

[25] Storing and Moving Water. National Drought Mitigation Center: University of Nebraska. Retrieved on December 14, 2017 from: http://drought.unl.edu/DroughtforKids/HowCanWeProtectOurselves/StoringandMovingWater.aspx
[26] Dams Sector: Crisis Management Overview Course. Federal Emergency Management Agency. Retrieved on December 14, 2017 from: https://emilms.fema.gov/IS0870a/DCM01summary.htm
[27] Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams. April 2004. Retrieved on December 14, 2017 from: https://www.ferc.gov/industries/hydropower/safety/guidelines/fema-94.pdf
[28] *This data taken from ASDSO at Incidents Search | Association of State Dam Safety and internal DEQ data.*

heavy precipitation, large floods, landslides or earthquakes that alert dam safety engineers to deficiencies that threaten the safety of a dam which often require emergency response by the State. Due to limited State resources, it is not possible to monitor and inspect the more than 6,000 dams in North Carolina on a timely basis. The inventory of North Carolina Dams is located online here:
https://northcarolinadeptofenvandnat.sharefile.com/share/view/s5bc5eb354fa54907b0d903b2de0c447a/fo90c5d4-716c-47a3-8521-c8b4280ce3ea
The inventory includes information about location and hazard potential description in addition to many other details about the dams. North Carolina regulates approximately 2,500 of these dams. 1,500 of these dams are classified as High Hazard and the State Dam Safety Program inspects these on a one to two-year rotation. Appendix D provides a listing of the High Hazard Dams in North Carolina. All other regulated Intermediate and Low-Hazard dams are inspected on five-year rotations. The majority of incidents are self-reported by the dam owner or a member of the public. However, many incidents go unreported as they are unnoticed (e.g., dams located in rural, unpopulated areas) and are therefore not discovered until the State Dam Safety Program performs its scheduled inspections. The actual number of incidents is likely to be much higher.

Communities continue to develop along the state's rivers, creeks and streams, many in potential dam-failure inundation zones. Further exacerbating the potential risk to citizens is the deficient condition and lack of maintenance of dams and the lack of approved plans to complete the necessary modifications and/or repairs. A compounding factor is the lack of warning systems to alert the public in the event of a dam failure.

Other hazards can impact dam failures as well such as earthquakes, landslides and wildfires. Earthquakes can cause structural damages to dams which can lead to failures. Landslides can also cause structural damages to dams and/or cause increased sediment loads flowing into the storage areas of the dams, decreasing storage capacity and increasing water tables. Wildfires cause increased flows from rain events and increased sedimentation in the water flowing into dam storage areas. This can also lead to decreasing storage capacity and increasing water tables. These hazards can also limit access to dams which can be problematic in times of disaster.

3.2.7.2 Extent

The hazard potential is the possible adverse incremental consequences that result from the release of water or stored contents, due to the failure of the dam or disoperation of the dam or appurtenances. Dams can be grouped into three categories based on the anticipated consequences of failure: low-, intermediate- (significant-), and high-hazard. It should be noted that hazard classification does not reflect the condition of the dam itself, only the magnitude of the consequences if a failure should occur. The hazard classification assigned to a dam is based on consideration of the effects of a failure during both normal (sunny day) and flood-flow (rainy day) conditions.[29] Table 3-17 (below) provides a description and guidelines for the three dam hazard classification categories used by the Dam Safety Program within the North Carolina Division of Energy, Mineral, and Land Resources (DEMLR).

Table 3-17 Dam Hazard Classifications

Dam Hazard Classification[30]		
Hazard Classification	Description	Quantitative Guidelines
Low	Interruption of road service, low volume roads; economic damage	Less than 25 vehicles per day; less than $30,000
Intermediate (Significant)	Damage to highways, interruption of service; economic damage	25 to less than 250 vehicles per day; $30,000 to less than $200,000
High	Loss of human life; economic damage *Probable loss of human life due to breached roadway or bridge on or below the dam	Probable loss of one or more human lives; more than $200,000 * 250 Vehicles per day at 1000-ft. visibility;100 Vehicles per day at 500-ft. visibility; 25 Vehicles per day at 200-ft. visibility

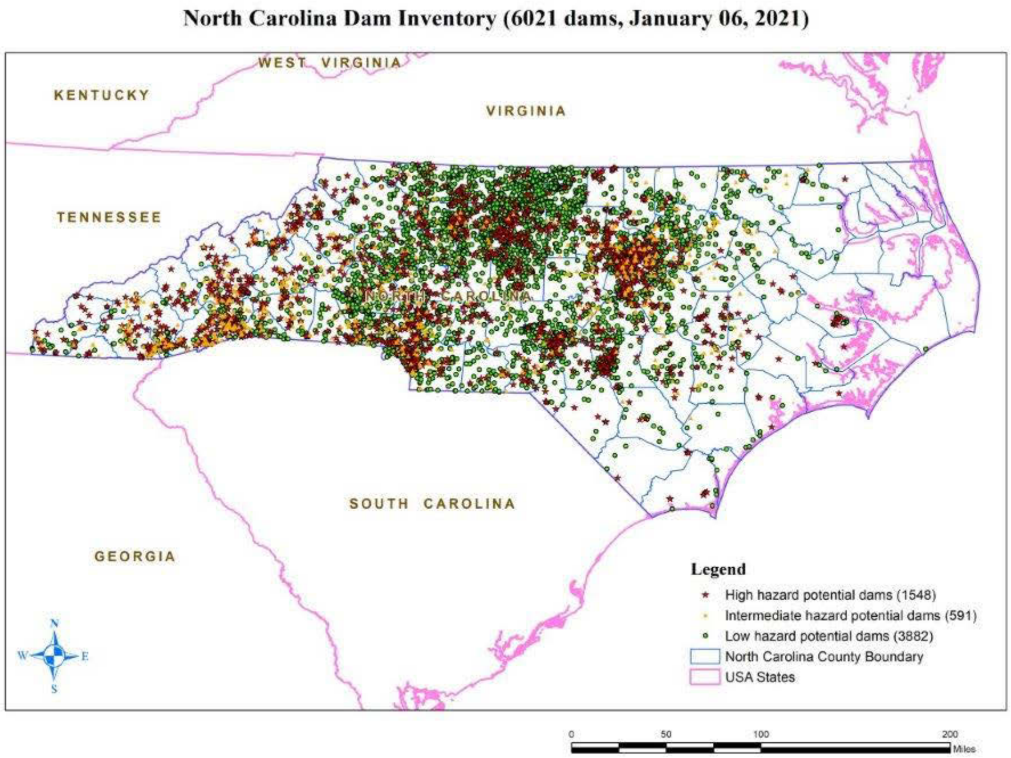
3.2.7.3 Location/Spatial Extent

In North Carolina, dams exist throughout the state and have played an important role in its economic development. Dams are relied upon to generate power, provide communities with drinking water, and provide flood mitigation. As of June 2022, there are more than 6,041 dams in North Carolina. According to the State's Dam Safety Office, there are 1,567 high hazard dams that would pose a risk to public safety and property if a dam failure were to occur. The number of high hazard dams in North Carolina is expected to increase as North Carolina grows and further development continues. Additionally, improved data collection and reporting has resulted in increased number of dams in the National Dam Inventory. In 1998, North Carolina had 874 high hazard dams. In 2015 that number had increased to 1,235. The number of North Carolina dams that were identified as potentially being eligible for National Rehabilitation Funds in 2017 was reported to be 44.[31] According to a 2012 study from the Association of State Dam Safety Officials, the cost of rehabilitating all non-federal high hazard potential dams in North Carolina would be $1.9 billion.[32]

---

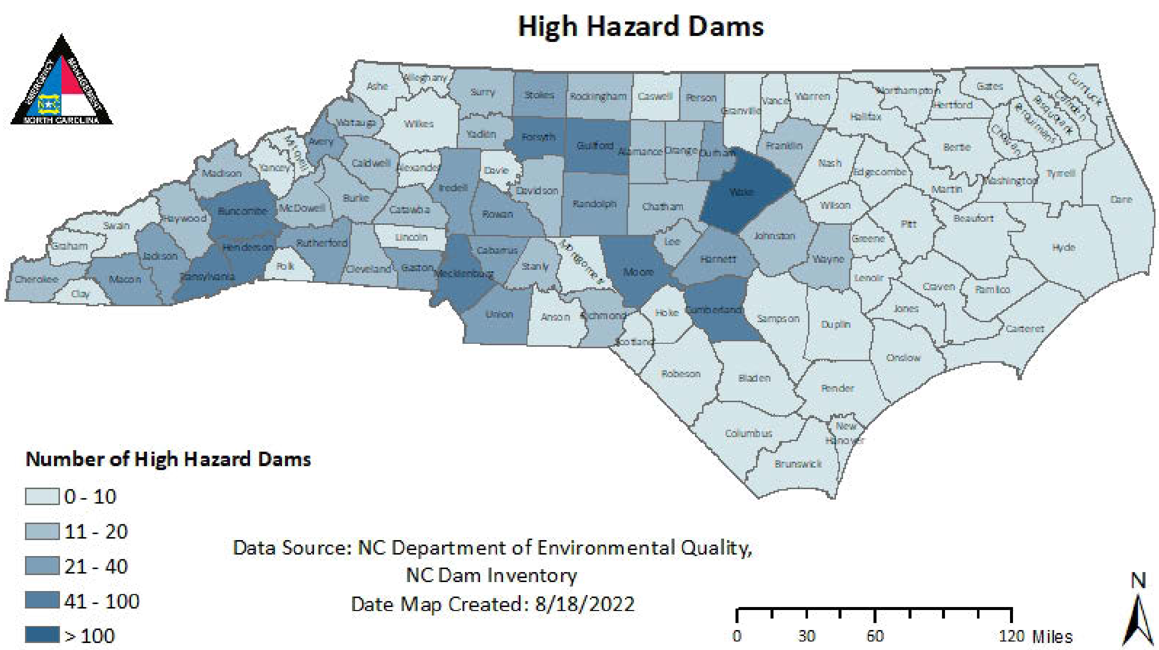
[29] *Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams. April 2004. Retrieved on December 14, 2017 from: https://www.ferc.gov/industries/hydropower/safety/guidelines/fema-94.pdf*
[30] *NC Dam Safety Program website: https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/dam-safety*
[31] *2017 Infrastructure Report Card. American Society of Civil Engineers. Retrieved on December 14, 2017 from: https://www.infrastructurereportcard.org/dams/funding-future-need/#dams-infographic*
[32] *The Cost of Rehabilitating our Nation's Dams. Retrieved on September 12, 2022 from: https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/Cost%20of%20Rehab%20Report-2022%20FINAL.pdf*

Figure 3-27: Dam Locations in North Carolina



Source: NC Dam Safety Office

Figure 3-28 NC Potential High Hazard Dams by County



3.2.7.4 Hazard History

Table 3-18 lists the historical occurrences of dam failure that have impacted North Carolina.

Table 3-18 Detailed Dam Failure History

North Carolina Dam Break Events					
#	Event	Year	Location	Severity	Extent of Damages
1	Lake Toxaway Dam Burst	1916	Lake Toxaway, NC	Overtopping	Unknown
2	Bearwallow Lake Dam Break	1976	Bearwallow Lake, N.C.	Sliding	Unknown
3	Potato Hill Lake Dam Break	1977	Potato Hill Lake, N.C.	Overtopping	Unknown
4	Winston Dam Break	1912	Winston, N.C.	Overtopping	Unknown
5	Hurricane Fran	1996	Eastern N.C.	3 major and 12 minor breaks	Private facilities
6	Hurricane Floyd	1999	44 Counties of N.C.	36 failures	100 dams damaged; hog lagoon overflow
7	Hope Mills	2003	Hoke and Cumberland Counties, N.C.	5 failures and 11 damaged dams	No injuries
8	Hurricane Matthew	2016	Cumberland, Duplin, Harnett, Hoke, Lenoir, Sampson, Wayne and Wilson Counties	12 state-regulated dams breached; 8 other, non-regulated dams breached	400 inspections conducted after the event
9	Hurricane Florence	2018	Brunswick and Cumberland Counties	6 state-regulated dams breached	436 inspections conducted after the event

The conditions with which dam failure occurred in these cases share similar attributes:

- Persistent precipitation from severe weather events (heavy rainfall, hurricanes, and tropical storms) beyond the capacity for which the original structures were ever built to withstand;
- Existing structural faults, such as small cracks and leaks which were not addressed through regular maintenance: and
- Piping which does not properly filter, and soil particles continuously progress and form sinkholes in dams.

According to the Association of Dam Safety Officials, overtopping of a dam due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately 34% of all U.S. dam failures.[33]

[33] *Understanding Dam Failure. Association of State Dam Safety Officials. Retrieved on September 13, 2022 from https://damsafety.org/dam-failures#:~:text=National%20statistics%20show%20that%20overtopping,of%20all%20U.S.%20dam%20failures.&text=2.,30%25%20of%20all%20dam%20failures.*

3.2.7.5 Changing Future Conditions

It is recognized in the 2020 North Carolina Risk Assessment and Resilience Plan that climate and weather pattern changes are expected to lead to more frequent and more severe storm events, which are likely to increase the risk of dam overtopping, structural damage, or other failures. In addition, hydraulic structures designed to current standards may not be sufficient to handle future climate change-driven conditions of more intense rainfall. The North Carolina Department of Environmental Quality (DEQ) has efforts under way to update the study for Probable Maximum Precipitation (PMP) in NC. This information will be valuable not only for dam design criteria, but to also provide this information to other State and Local Government Agencies for their use in flood and dam failure planning, design, and resilience activities.

3.2.7.6 Impact

Dam failures have the potential to cause critical impacts in many parts of the state. This means that multiple deaths/injuries are possible and that more than 25% of property in an affected area is likely to be damaged or destroyed. In some parts of the state, a major dam failure has the potential to cause complete shutdown of critical facilities for more than one week. This was witnessed during Hurricane Florence with the failure of the Sutton Lake Dam, which is one of the cooling pond dams for a major power plant in eastern North Carolina.

3.2.7.7 Future Probability

Although construction of dams in North Carolina is increasing, according to the NC Dam Safety Office, historical occurrences of dam failures have been infrequent. It is relatively unlikely (between 1 and 33.3 percent annual probability) that dam failures will occur in North Carolina without a precipitating event such as a hurricane or flood; however, since dam failures often create widespread impacts beyond their surrounding location, they should still be properly monitored and maintained to prevent this hazard from happening.

3.2.7.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.8 Drought

3.2.8.1 Description

Drought refers to an extended period of deficient rainfall relative to the statistical mean established for a region. Drought can be defined according to meteorological, hydrological, and agricultural criteria. Meteorological drought uses long-term precipitation data to measure present precipitation levels against departures from normal precipitation levels. Hydrological drought is defined by surface and subsurface water supply deficiencies based on stream flow, lake, reservoir, and ground water levels. Agricultural drought occurs when there is insufficient soil moisture to satisfy the water budget of a specific crop, leading to destroyed or underdeveloped crops with greatly depleted yields.

Table 3-19 Drought Classification Definitions

Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually crops.
Socioeconomic Drought	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

A drought is a prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. Human demands and actions have the ability to hasten or mitigate drought-related impacts on local communities.

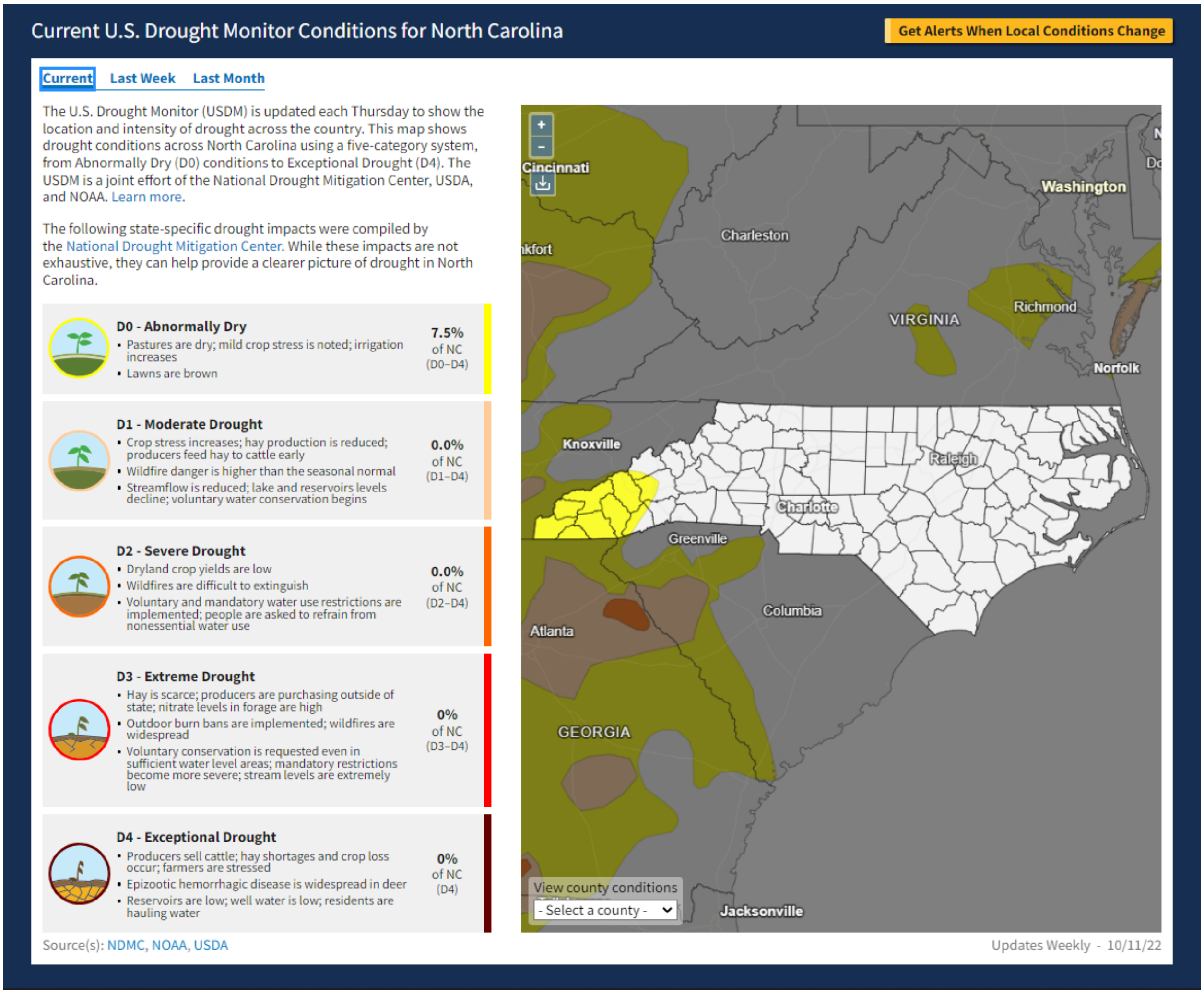
Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. Because drought is progressive in nature, and develops slowly, it is often not recognized until it reaches a severe level.

The underlying cause of most droughts can be related to variations in large-scale atmospheric circulation patterns and the locations of anticyclones, or high-pressure systems. Sometimes, whirling masses of air separate from the main westerly airflow (analogous to whirlpools that form in rapidly flowing rivers) and effectively prevent the usual west-to-east progression of weather systems. When these “blocking systems” persist for extended periods of time, weather extremes (such as drought, floods, heat waves, and cold snaps) can occur.

Extent

One way of assessing drought extent is through the drought classifications provided by the U.S. Drought Monitor, an example of which can be found in Table 3-19.
.

Figure 3-29 US Drought Monitor of North Carolina

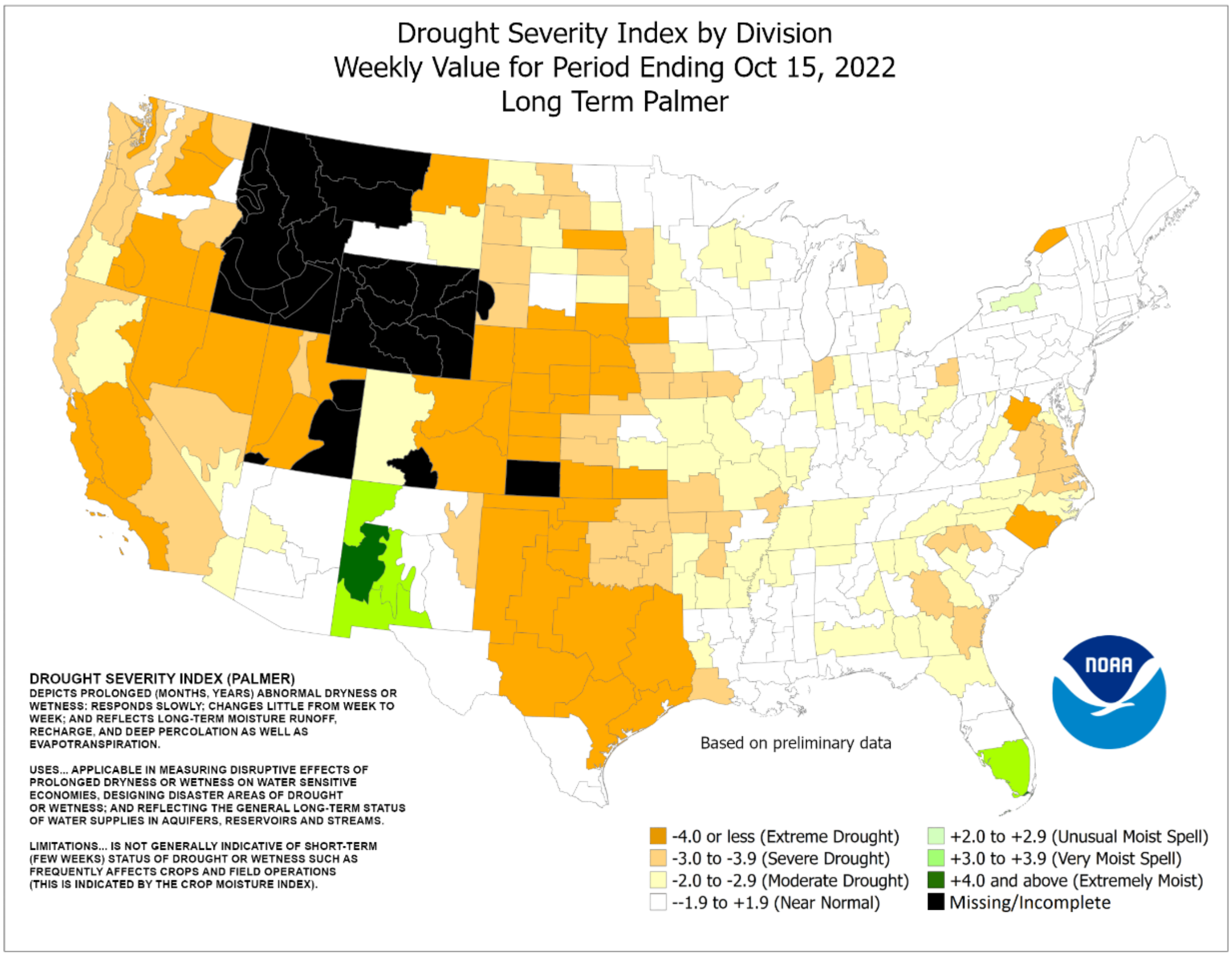


Source: US Drought Monitor of North Carolina

The N.C. Drought Management Advisory Council (DMAC), created as required by North Carolina General Statute 143-355.1, coordinates drought monitoring, assessment, and response activities between State and Federal agencies, public water systems, and water users. Drought conditions in North Carolina are updated weekly through an audio-video teleconference with a Technical Drought Advisory Team, which is a sub-group of the N.C. DMAC. The team consists of experts on climate, weather, hydrology, water supply, forestry, and agriculture that report each week on streams flows, groundwater levels, reservoirs levels, wildfire activity, water supplies, and crop conditions. Based on this information, the team makes a recommendation to the U.S. Drought Monitor author on the state's drought conditions for that week. Those recommendations are used to draw the national drought map (https://droughtmonitor.unl.edu/CurrentMap.aspx) each Thursday.

The Palmer Drought Severity Index (PDSI) is one measure of drought that is widely used in the United States for tracking moisture conditions. The PDSI is defined as "an interval of time, generally in months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of the climatically expected or climatically appropriate moisture supply." The range of PDSI is from –4.0 (extremely dry) to +4.0 (excessively wet), with the central half (–2.0 to +2.0) representing the normal or near normal conditions. The PDSI is best used for long-term measurements of drought. For short-term (week-to-week) measurements, it is more useful to use the Crop Moisture Index (CMI), also developed by Wayne Palmer.[34] Drought has ranged from "Abnormal" (D0) to "Exceptional" (D4) in North Carolina and all areas have experienced Exceptional levels of drought historically.

Figure 3-30 Palmer Drought Severity Index Summary Map for the United States



Source: NOAA

[34] *How Do I Measure Drought? National Drought Mitigation Center: University of Nebraska. Retrieved on December 14, 2017 from: http://drought.unl.edu/ranchplan/DroughtBasics/WeatherDrought/MeasuringDrought.aspx*

Table 3-20 Drought Severity Classification

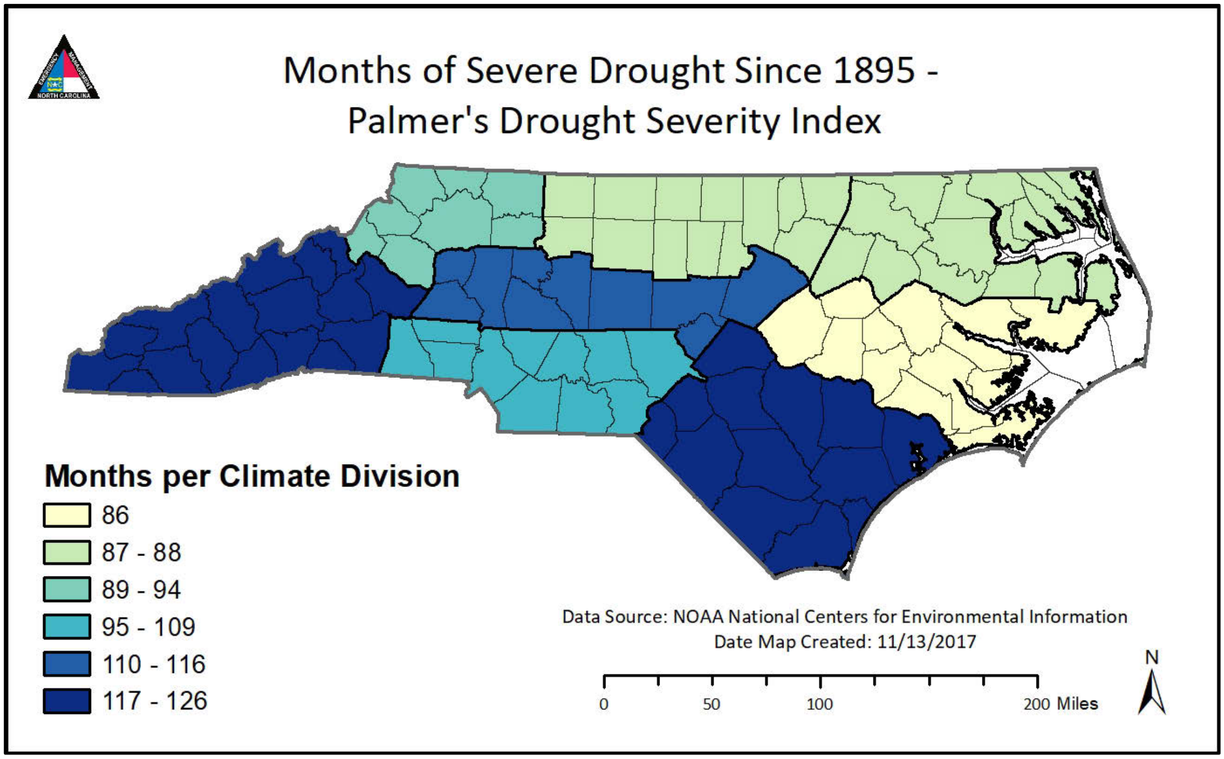
			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures Coming out of drought: some lingering water deficits pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	Some damage to crops, pastures Streams, reservoirs, or wells low, some water shortages developing or imminent Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	Crop or pasture losses likely Water shortages common Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	Major crop/pasture losses Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Source: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

3.2.8.2 Location/Spatial Extent

Drought is a common hazard across the entire state. "Severe" drought is a good indicator of the areas of the state that may experience more drought than others. As Figure 3-31 illustrates, the southeastern and western parts of the state have spent the most months in severe drought since 1895.

Figure 3-31 Palmer's Drought Severity Index Months of Severe Drought Since 1895



3.2.8.3 Hazard History

In the recent past, many areas of North Carolina have been affected by drought, to varying degrees. Table 3-21 lists historical drought events that occurred between July 1998 and December 2021; detailed descriptions about selected events follow the table. It is worth noting that any geographic area of the state is susceptible to a drought. Figure 3-32 provides a graphical depiction of the events recorded in the NCEI event database.

Table 3-21 Detailed Drought History

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage ()	Crop Damage ()
Alamance	0	0	0	0	0
Alexander	35	0	0	$0	$0
Alleghany	17	0	0	$0	$10,285,000
Anson	0	0	0	$0	$0
Ashe	23	0	0	$0	$10,277,000
Avery	33	0	0	$0	$0

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage ()	Crop Damage ()
Beaufort	3	0	0	$0	$0
Bertie	0	0	0	$0	$0
Bladen	10	0	0	$0	$0
Brunswick	4	0	0	$0	$0
Buncombe	33	0	0	$0	$0
Burke	30	0	0	$0	$0
Cabarrus	33	0	0	$0	$0
Caldwell	30	0	0	$0	$0
Camden	0	0	0	$0	$0
Carteret	3	0	0	$0	$0
Caswell	20	0	0	$0	$13,350,000
Catawba	35	0	0	$0	$0
Chatham	0	0	0	$0	$0
Cherokee	0	0	0	$0	$0
Chowan	0	0	0	$0	$0
Clay	0	0	0	$0	$0
Cleveland	35	0	0	$0	$0
Columbus	11	0	0	$0	$0
Craven	3	0	0	$0	$0
Cumberland	0	0	0	$0	$0
Currituck	0	0	0	$0	$0
Dare	6	0	0	$0	$0
Davidson	0	0	0	$0	$0
Davie	33	0	0	$0	$0
Duplin	3	0	0	$0	$0
Durham	0	0	0	$0	$0
Edgecombe	0	0	0	$0	$0
Forsyth	0	0	0	$0	$0
Franklin	0	0	0	$0	$0
Gaston	33	0	0	$0	$0
Gates	0	0	0	$0	$0
Graham	35	0	0	$0	$0
Granville	0	0	0	$0	$0
Greene	3	0	0	$0	$0
Guilford	0	0	0	$0	$0
Halifax	0	0	0	$0	$0
Harnett	0	0	0	$0	$0
Haywood	35	0	0	$0	$0
Henderson	34	0	0	$0	$0
Hertford	0	0	0	$0	$0
Hoke	0	0	0	$0	$0
Hyde	6	0	0	$0	$0
Iredell	33	0	0	$0	$0
Jackson	70	0	0	$0	$0
Johnston	0	0	0	$0	$0
Jones	3	0	0	$0	$0
Lee	0	0	0	$0	$0
Lenoir	3	0	0	$0	$0

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage ()	Crop Damage ()
Lincoln	35	0	0	$0	$0
Macon	35	0	0	$0	$0
Madison	32	0	0	$0	$0
Martin	2	0	0	$0	$0
McDowell	30	0	0	$0	$0
Mecklenburg	332	0	0	$0	$0
Mitchell	33	0	0	$0	$0
Montgomery	0	0	0	$0	$0
Moore	0	0	0	$0	$0
Nash	0	0	0	$0	$0
New Hanover	49	0	0	$0	$0
Northampton	0	0	0	$0	$0
Onslow	3	0	0	$0	$0
Orange	0	0	0	$0	$0
Pamlico	3	0	0	$0	$0
Pasquotank	0	0	0	$0	$0
Pender	4	0	0	$0	$0
Perquimans	0	0	0	$0	$0
Person	0	0	0	$0	$0
Pitt	3	0	0	$0	$0
Polk	32	0	0	$0	$0
Randolph	0	0	0	$0	$0
Richmond	0	0	0	$0	$0
Robeson	12	0	0	$0	$0
Rockingham	18	0	0	$0	$10, 940,000
Rowan	33	0	0	$0	$0
Rutherford	32	0	0	$0	$0
Sampson	0	0	0	$0	$0
Scotland	0	0	0	$0	$0
Stanly	0	0	0	$0	$0
Stokes	18	0	0	$0	$10,330,000
Surry	19	0	0	$0	$10,325,000
Swain	35	0	0	$0	$0
Transylvania	34	0	0	$0	$0
Tyrrell	3	0	0	$0	$0
Union	33	0	0	$0	$0
Vance	0	0	0	$0	$0
Wake	0	0	0	$0	$0
Warren	0	0	0	$0	$0
Washington	3	0	0	$0	$0
Watauga	26	0	0	$0	$10,670,000
Wayne	0	0	0	$0	$0
Wilkes	23	0	0	$0	$8,280,000
Wilson	0	0	0	$0	$0
Yadkin	22	0	0	$0	$12,320,000
Yancey	33	0	0	$0	$0
North Carolina	**1496**	**0**	**0**	**$0**	**$111,238,174**

Source: NCEI

North Carolina Selected Drought Detailed Event Information

July 1, 1998–July 31, 1998

Dry weather continued through much of the month of July 1998, affecting crops during the critical part of the growing season. Corn and other vegetables sustained the most damage, but a dollar amount related to the crop losses was not available.

Oct. 1, 1998–Oct. 31, 1998

The drought which began during the summer of 1998 continued through October. The only significant rainfall during the month occurred on Oct. 7 and Oct. 8. Cities and counties began to restrict water usage, and stream flows for several mountain locations were reduced to the lowest amounts seen in 50 years.

Aug. 25, 1999–Sept. 5, 1999

In 1999, Brunswick, Columbus, and Robeson Counties were declared Federal Disaster Areas due to hot and dry conditions which had continued since July. Dry conditions that began in July 1998, subsided for several months during the latter part of 1998 and the first part of 1999, then returned in June 1999 and continued in many areas through early September. In many areas, crops were either damaged or destroyed. Water levels in creeks, streams, and rivers remained very low. The drought ended in most areas with the arrival of heavy rain from the remnants of Hurricane Dennis, which occurred on Sept. 4 and Sept. 5.

Feb. 1, 2001–May 31, 2001

Effects of the 2001 drought intensified as many areas received absolutely no rain during the month, setting records in several locations for the longest stretch endured without any measurable rainfall. Wells and mountain streams continued to dry up and lake levels continued to drop. Despite beneficial rain during March, the drought continued to grip most of the area. Severe water restrictions were implemented in parts of the North Carolina Piedmont, where reservoirs dropped to all-time low levels. In Concord, food establishments were asked to use paper and plastic products in order to conserve water. Some rivers and lakes reached record-low levels. Well-drilling companies in the North Carolina Piedmont recorded twice as much business as usual.

Nov. 1, 2001–Nov. 30, 2001

The National Weather Service declared North Carolina to be in a moderate drought in Nov. 2001. Between Jan. 2001 and Nov. 2001, the weather office in Wilmington NC recorded only 35.84 inches of precipitation, an amount approximately 14 inches below normal. Similar rainfall deficits were experienced around the state. Many areas in North Carolina participating in either voluntary or mandatory water-conservation measures. The Charlotte area recorded an all-time record dry calendar year with just 26.23 inches of rainfall occurring during 2001. (Records have been kept in the area since 1878.) Many communities initiated either mandatory or voluntary water restrictions. At Kings Mountain, a new pump was required at Lake Moss because the water level dropped below two of the three existing pumps. Record low ground water supplies, lake levels, and stream flows were reported across all of western North Carolina.

Aug. 1, 2002–Aug. 31, 2002

The 2002 water supply situation reached crisis levels in some communities, as the effects of a long-term drought continued to plague western North Carolina. Particularly hard hit were several Piedmont communities along the Interstate-77 corridor. The city of Shelby was forced to buy water from surrounding communities, and even from private companies and citizens. In Statesville, emergency construction of wells and a dam was necessary to prevent the city from running out of water as the nearby South Yadkin River reached historically low levels. Water levels on area lakes fell as much as 10 feet below full pond levels. Most of the larger towns and cities along the I-77 corridor had imposed mandatory water restrictions by the end of the month, including the Charlotte metro area.

Aug. 1, 2003–May 1, 2004

A period of dry weather that began in Aug. 2003 resulted in moderate drought conditions across portions of western North Carolina by late spring of 2004. Streamflow and lake levels began to run below normal, and a few communities instituted water restrictions.

2007-2008

The drought in 2007 was the worst for North Carolina since record keeping began in the state in 1895. In 2007 conditions in the state went from no drought to record drought in less than one year. The year 2007 was recorded by the National Weather Service as the driest year in more than 100 years in North Carolina. Records were set in many areas for number of days of low humidity and number of days with temperatures above 90 F. Forest landowners and many residents in wildfire-prone areas were impacted by the drought. Soil moisture was not a grave problem during the planting season of 2008. However, the lack of rains throughout the spring and summer months stunted or prohibited crop growth in some areas. Some areas had record low yields while some other areas seemed to make it through the drought because of isolated showers which doused fields at the right times of the growing season. At one point as many as 30 cities and towns were forced to confront the realization that they may run out of water or have to ration water. Many of those were within 100 days of running out of water. In Siler City, officials had to ship in water supplies by truck. Rocky Mount sought and received the state's permission to extend a pipeline to Wilson to keep from running out of water.

January 13, 2009–March 17, 2009

Extreme drought (D3) began impacting Western North Carolina in January 2009 after several months of the region experiencing a severe drought (D2). The most severely impacted were the Southwestern counties, from Rutherford to Cherokee County (from East to West).

July 05, 2011–August 23, 2011

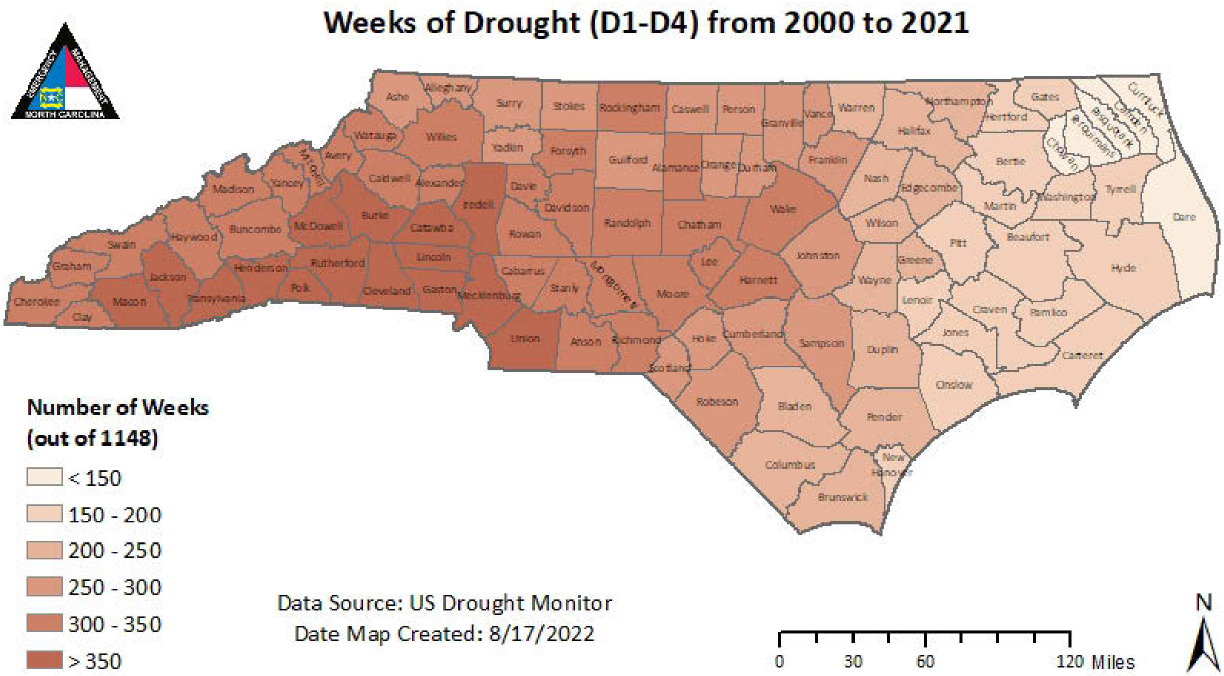
Severe drought (D2) began impacting Eastern North Carolina in early June and worsened to extreme drought (D3) by early July for several Eastern North Carolina counties. Since the winter of 2010, the region received well below normal precipitation. Stream flows over Eastern North Carolina were well below normal with several sites showing less than ten percentile range of streamflow. Groundwater conditions were listed as much below to record low levels across the region. As of July 8th, Local Climatological Data Sites New Bern and Cape Hatteras observed fifty-four and seventy-six percent of normal precipitation, respectively. As a result of these conditions, the North Carolina Department of Environment and Natural Resources banned open burning in Eastern North Carolina.

January 17, 2012–February 28, 2012

A severe drought (D2) started in January 2012 after several months of diminished precipitation. The conditions continued until the end of February. The affected counties were located in the Southeastern part of the state. As a result, some public supply systems enacted mandatory conservation statuses.

Much of North Carolina was abnormally dry in early 2016. While central and eastern North Carolina received need rains in late spring, western North Carolina saw moderate drought begin by early May 2016. Far western North Carolina saw drought conditions continue to worsen with Haywood, Jackson, Macon, and Transylvania being classified as in severe drought by late June 2016. Conditions worsened with the western tip of North Carolina reaching the Extreme Drought stage by October 18, 2016 and Exceptional Drought by November 8, 2016. Fortunately, the period of Exceptional Drought only lasted a few weeks and conditions gradually improved until the Severe Drought classification was lifted in late March 2017. Row crops are well past harvest and municipal demands are low in the winter so the drought impacts were fairly minor. Pastures and winter grains were affected as was recreation such as skiing.

Figure 3-32 Drought Events in North Carolina



Source: National Centers for Environmental Information

3.2.8.4 Changing Future Conditions

Changes in weather patterns and climate may have effects on North Carolina's vulnerability to the drought hazard. These changes could impact the probability of drought occurrences, as well as the extent or location of droughts. Lasting drought conditions may be experienced in some areas more frequently. Changing future conditions could also trigger more notable flooding occurrences from infrequent and intense rainstorms in areas where flooding does not usually occur.

The North Carolina Climate Science Report predicts future droughts to be warmer than historical events with a high level of confidence. The warmer conditions will result in more rapid drying through increases in potential evapotranspiration. Model simulations indicate the extension of the Bermuda High northwestward will occur more frequently in the future. It was determined within the report that given the changing conditions of the climate, it is likely that future droughts will become more severe in terms of soil moisture deficits as well as impacts on rainfed agriculture and natural vegetation.

3.2.8.5 Impact

Drought is an atmospheric hazard and it has the potential to impact all existing and future assets, critical facilities and populations. Droughts tend to have greater economic, environmental, and social impacts than they have on the built environment. Droughts may result in the following impacts:

Economic

- Temporary closure of business and essential facilities (for example: restaurants cannot operate safely without water)
- Increase in food prices
- Increased wildfires
- Loss of incomes
- Loss of hydroelectric power

Environmental

- Crop damage
- Stress on wildlife
- Increased wildfires
- Wind erosion
- Loss of wetlands
- Drying ponds/lakes

Social

- Water conservation requirements
- Reduced quality of life
- Food shortages
- Political conflicts over water rights
- Stress

3.2.8.6 Future Probability

The future incidence of drought is highly unpredictable. Conditions may be localized or widespread, and not much historical data is available, making it difficult to determine the future probability of drought conditions with any accuracy. However, based on historical data, future occurrences are still infrequent (between 1 and 33.3 percent annual probability).

3.2.8.7 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats
Annex B, Appendix 3, Drought Assessment and Response Plan

3.2.9 Tornadoes/Thunderstorms

3.2.9.1 Description

Tornadoes

A tornado is a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. A condensation funnel does not need to reach to the ground for a tornado to be present; a debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado, even in the total absence of a condensation funnel.

Tornadoes are spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris.

Thunderstorms

Thunderstorms can produce a variety of accompanying hazards including wind, hail, and lightning. Although thunderstorms generally affect a small area, they are very dangerous and may cause substantial property damage.

Three conditions need to occur for a thunderstorm to form. First, it needs moisture to form clouds and rain. Second, it needs unstable air, such as warm air that can rise rapidly (this is often referred to as the "engine" of the storm). Third, thunderstorms need lift, which comes in the form of cold or warm fronts, sea breezes, mountains, or the sun's heat. When these conditions occur simultaneously, air masses of varying temperatures meet, and a thunderstorm is formed. These storm events can occur singularly, in lines, or in clusters. Furthermore, they can move through an area very quickly or linger for several hours.

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as "severe." Thunderstorm events have the capability of producing straight-line winds that can cause severe destruction to communities and threaten the safety of a population.

High winds can form due to pressure off the Northeast coast that combines with strong pressure moving through the Ohio Valley. This creates a tight pressure gradient across the region, resulting in high winds which increase with elevation. It is common for gusts of 30 to 60 miles per hour during the winter months.

Downbursts are also possible with thunderstorm events. Such events are a burst of wind in excess of 125 miles per hour. They are often confused with tornadoes. Downbursts are caused by downdrafts from the base of a convective thunderstorm cloud. It occurs when rain-cooled air within the cloud becomes heavier than its surroundings. Thus, air rushes towards the ground in a destructive yet isolated manner. There are two types of downbursts. Downbursts less than 2.5 miles wide with a duration of less than 5 minutes and winds up to 168 miles per hour are called "microbursts." Larger events greater than 2.5 miles at the surface and longer than 5 minutes with winds up to 130 miles per hour are referred to as "macrobursts."

3.2.9.2 Extent

Tornadoes

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings (particularly mobile homes). Tornadic magnitude is reported according to the Fujita and Enhanced Fujita Scales. Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (**Error! Reference source not found.**21). Tornado magnitudes that were determined in 2005 and later were determined using the Enhanced Fujita Scale (**Error! Reference source not found.**22). The greatest magnitude reported in North Carolina was an F2 (last reported on May 8, 2009).

Table 3-22 The Fujita Scale (Effective Prior to 2005)

F-Scale Number	Intensity	Wind Speed	Type of Damage Done
F0	GALE TORNADO	40–72 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	MODERATE TORNADO	73–112 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	SIGNIFICANT TORNADO	113–157 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	SEVERE TORNADO	158–206 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	DEVASTATING TORNADO	207–260 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	INCREDIBLE TORNADO	261–318 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	INCONCEIVABLE TORNADO	319–379 MPH	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Source: National Weather Service

Table 3-23 The Enhanced Fujita Scale (Effective 2005 and Later)

Ef-Scale Number	Intensity Phrase	3 Second Gust (Mph)	Type Of Damage Done
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	INCREDIBLE	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Source: National Weather Service

Thunderstorms

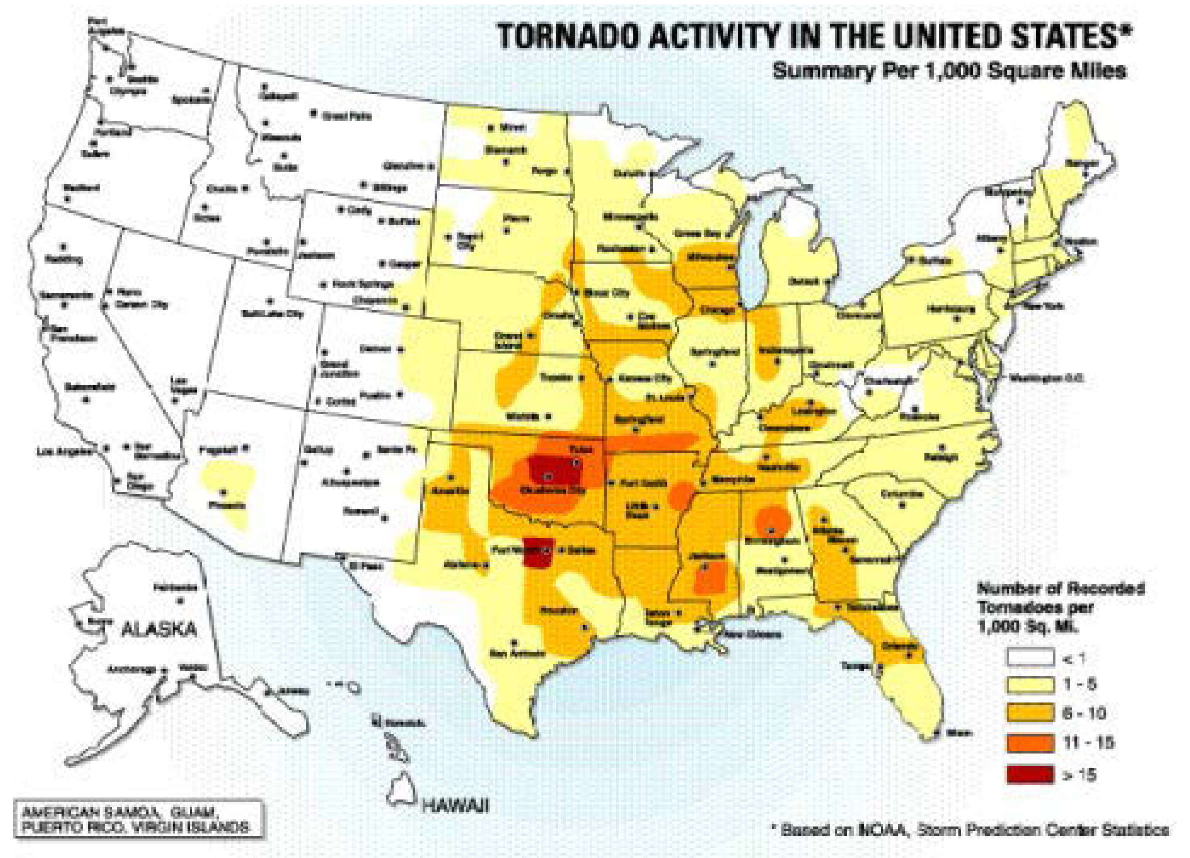
Thunderstorm extent is defined by the wind speeds reported. According to a 60-year history from the NCEI, the strongest recorded wind event in North Carolina was reported in Robeson County on May 11, 2009 at 109 knots (approximately 125 mph). It should be noted that future events may exceed these historical occurrences.

3.2.9.3 Location/Spatial Extent

Tornadoes

Tornadoes occur throughout the State of North Carolina. Tornadoes typically impact a relatively small area, but damage may be extensive. Event locations are completely random and it is not possible to predict specific areas that are more susceptible to tornado strikes over time. It is assumed that the entire State of North Carolina is uniformly exposed to this hazard; however, based on historical data, many of the eastern counties have experienced tornadoes more frequently. Historically, tornadoes are also more common in the Spring and Fall months in North Carolina. As Figure 3-33 illustrates, North Carolina is in an area of the United States that experiences moderate tornadic activity compared to the rest of the country.

Figure 3-33 Tornado Activity in the United States

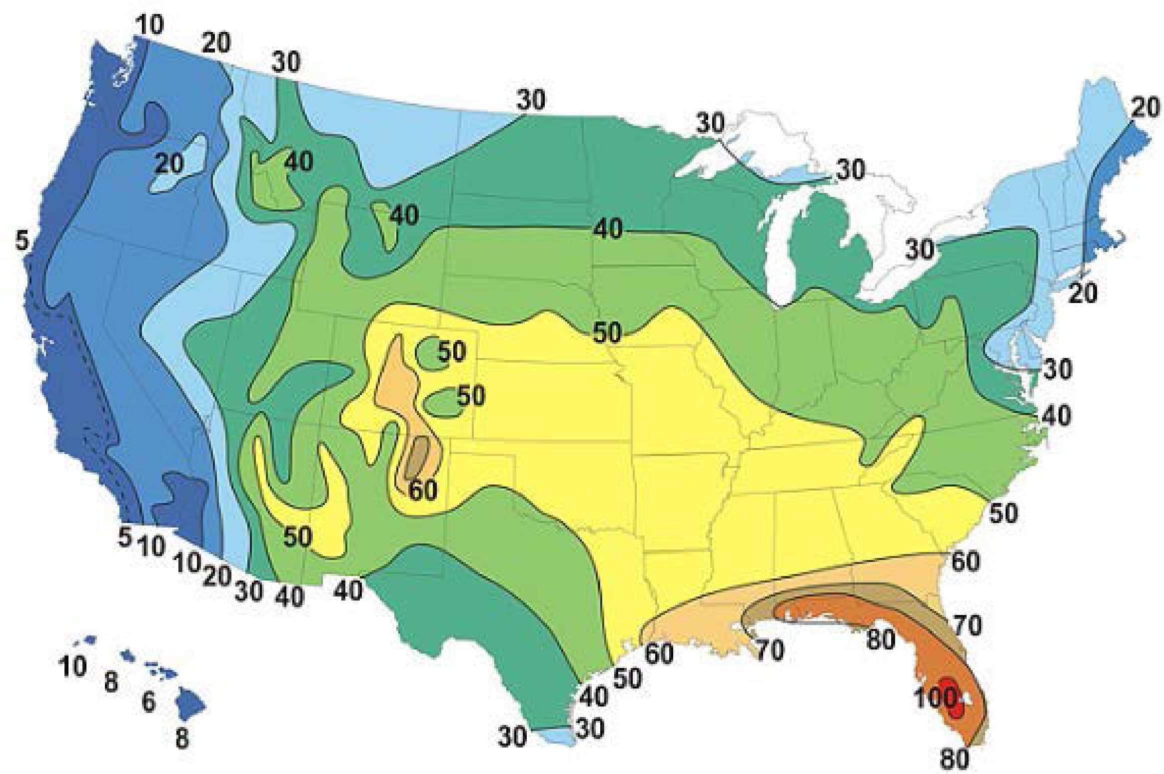


Source: Federal Emergency Management Agency

Thunderstorms

Much like tornadoes, thunderstorms can occur anywhere in North Carolina and risk to thunderstorm activity is more or less the same across the state. Figure 3-34 depicts the average number of thunderstorm days each year throughout the United States. North Carolina generally falls within the range of 40-60 thunderstorm days a year.

Figure 3-34 Average Number of Thunderstorm Days Per Year



Source: National Weather Services

3.2.9.4 Hazard History

Tornadoes

Between January 1950 and August 2021, 1,492 tornadoes were reported in North Carolina which resulted in 127 fatalities, 2,415 injuries, and $1,720,489,840 dollars in property damage. 5 (.33%) were not classified on the scale or missing a scale value, 630 (42%) were classified F0, 562 (37%) were classified F1, 226 (15%) were classified as F2, 46 (4%) were classified as F3, and 23 (3%) were classified as F4. There have been no recorded F5 tornadoes. The counties with the most reported tornadoes are Carteret (77), Onslow (46), Robeson (45), Pender (44), Brunswick (39), Dare (39), Duplin (38), and Wake (29) Counties.

Table 3-24 summarizes the tornado events by F Scale by county, as listed in the NCEI's Storm Events Database. A graphic representation of the table follows in Figure 3-35.

Figure 3-35Table 3-24 Tornado Events of F Scale by County

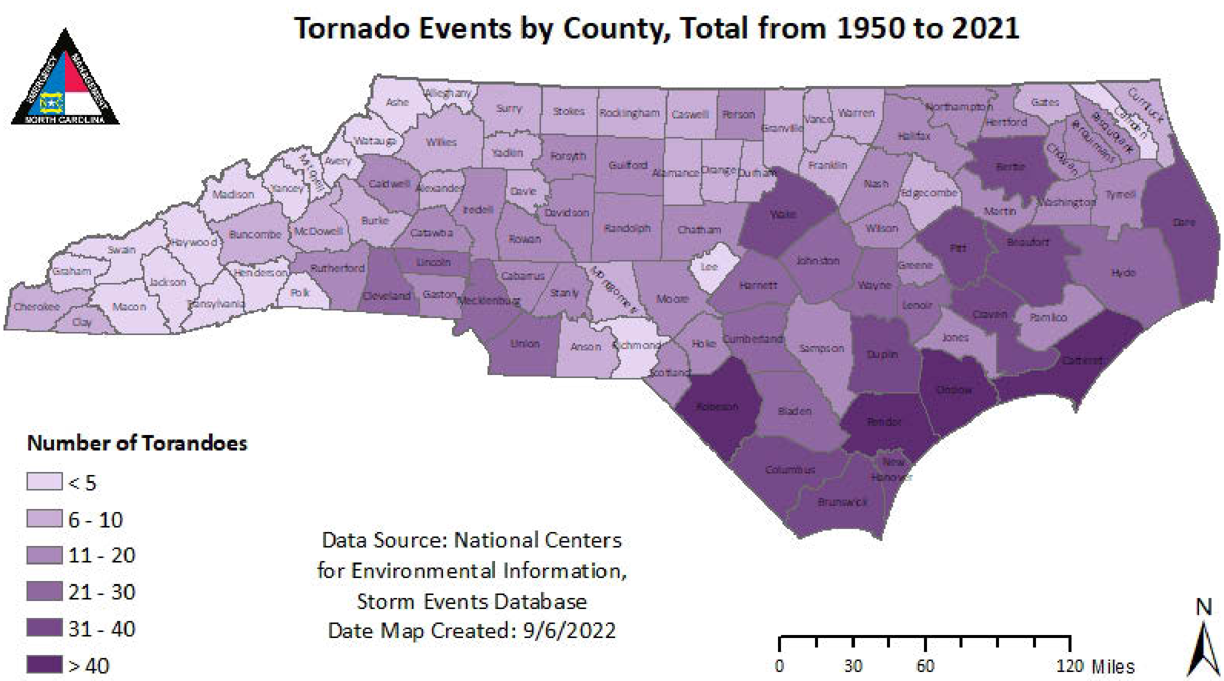
County	Number of Events (1950-2021)	Magnitude (Fujita Scale)						Maximum F Scale	Fatalities	Injuries	Damage ()
		0	1	2	3	4	5				
Alamance	8	1	7					1		1	$2,930,000
Alexander	10	4	5	1				2		0	$1,824,402
Alleghany	3		2	1				2		7	$1,625,592
Anson	6	1	3	2				2		5	$8,684,633
Ashe	1	1						0			$11,729
Avery	1		1					2		1	$195,888
Beaufort	36	13	13	9	1			3	1	46	$38,485,798
Bertie	31	11	9	7	6			3	20	108	$79,419,155
Bladen	24	11	6	6	1			3	5	8	$505,523
Brunswick	39	16	8	1				2	3	11	$2,114,000
Buncombe	6	1	5					1	0	0	$3,599,723
Burke	10	4	3	3				2	0	8	$17,841,310
Cabarrus	14	5	7	2				2	0	3	$9,098,189
Caldwell	11	4	4	2		1		4	0	3	$4,102,558
Camden	5	4		1				2	0	0	$139,259
Carteret	77	40	29	8				2	0	11	$24,968,233
Caswell	7	3	3	1				2	0	3	$5,236,897
Catawba	18	6	7	4		1		4	0	6	$61,227,244
Chatham	11	5	4	2				2	0	0	$1,039,669
Cherokee	9	4	3	1		1		4	4	26	$127,919,567
Chowan	14	5	5	3	1			3	1	1	$1,849,254
Clay	6	2	4					1	0	0	$293,299
Cleveland	25	11	10	2	1	1		4	0	36	$54,222,070
Columbus	31	13	12	4	2			3	8	40	$16,710,643
Craven	37	25	8	3	1			2	0	48	$28,933,635
Cumberland	23	7	7	4	3	2		4	5	169	$99,079,510
Currituck	10	7	3					1	0	2	$620,510
Dare	39	23	11	4	1			3	1	22	$11,017,654
Davidson	16	6	8	2				2	2	22	$27,078,966
Davie	7	6		1				2	0	1	$386,202
Duplin	38	9	13	13	2	1		4	0	86	$90,248,666
Durham	8	2	3	3				2	0	5	$57,023,685
Edgecombe	8	1	4		3			3	0	8	$2,901,074
Forsyth	16	4	4	4	4			3	0	58	$146,274,409
Franklin	10	2	5	2		1		4	0	24	$57,068,796

County	Number of Events (1950-2021)	Magnitude (Fujita Scale)						Maximum F Scale	Fatalities	Injuries	Damage ()
		0	1	2	3	4	5				
Gaston	16	5	10	1		2		4	1	12	$16,504,049
Gates	6	4	1		1			3	2	10	$6,164,991
Graham	1			1				2	2	11	$1,251,617
Granville	9	1	4	4				2	0	2	$9,131,161
Greene	17	7	5	2	2	1		4	7	33	$97,860,532
Guilford	16	1	11	3	1			3	1	5	$96,130,473
Halifax	14	3	7	3		1		4	0	12	$9,250,037
Harnett	25	10	10	4	1			3	1	34	$23,201,527
Haywood	2		2					1	0	1	$1,084,442
Henderson	3		3					1	0	0	$1,197,734
Hertford	18	6	6	6				2	1	14	$71,546,475
Hoke	11	6	3	2				2	1	6	$1,742,083
Hyde	21	11	8	2				2	0	4	$3,276,962
Iredell	19	6	11	2				2	1	4	$8,281,410
Jackson	3	2		1				2	0	0	$1,139,340
Johnston	24	11	10	2	1			3	1	81	$33,888,680
Jones	20	12	2	4	1			3	1	13	$29,474,562
Lee	5	1	2	1	1			3	2	36	$62,797,326
Lenoir	29	12	12	2	1	1		4	0	49	$139,502,044
Lincoln	22	6	9	3		1		4	4	30	$53,383,727
Macon	4	3	1					1	0	0	$1,095,286
Madison	4	1	3					1	0	5	$2,138,283
Martin	20	9	9	1	1			3	0	9	$4,312,761
McDowell	6	5		1				2	0	0	$788.854
Mecklenburg	24	6	12	6				2	0	23	$11,815,778
Mitchell											
Montgomery	7	3	3	1				2	0	7	$12,489,155
Moore	16	6	7	2				2	0	3	$9,717,858
Nash	16	5	6	3	1	1		4	2	23	$19,717,778
New Hanover	31	17	14					1	0	8	$4,865,127
Northampton	17	10	3	3		1		4	0	18	$13,738,043
Onslow	46	28	12	4	1			3	3	59	$23,649,127
Orange	10	4	3	2	1			3	2	11	$3,142,541
Pamlico	17	10	4	2	1			3	1	45	$26,160,194
Pasquotank	20	9	3	7	1			3	0	30	$10,890,898
Pender	44	24	14	4				2	3	31	$6,668,554
Perquimans	12	4	4	4				2	1	1	$3,382,576

County	Number of Events (1950-2021)	Magnitude (Fujita Scale)						Maximum F Scale	Fatalities	Injuries	Damage ()
		0	1	2	3	4	5				
Person	11	4	4	3				2	0	2	$4,008,412
Pitt	33	16	12	3	1	1		4	9	158	$81,470,045
Polk	2		1					1	0	0	$215,013
Randolph	16	3	8	4	1			3	1	6	$12,278,912
Richmond	4	1	2		1			3	0	0	$1,497,487
Robeson	45	16	18	6		3		4	6	334	$22,278,431
Rockingham	10	2	7		1			3	2	31	$69,602,129
Rowan	11	2	8	1				2	0	3	$4,679,254
Rutherford	11	5	3	2		1		4	0	10	$710,454
Sampson	21	5	7	3	3	2		4	14	203	$139,428,176
Scotland	11	2	3	1	2	3		4	0	24	$19,342,737
Stanly	14	3	7	4				2	0	1	$15,634,888
Stokes	9	1	7	1				2	0	15	$21,870,452
Surry	7	1	6					1	0	3	$4,226,014
Swain	3	1	1	1				2	0	0	$1,096,958
Transylvania	3	1	1	1				2	0	0	$833,740
Tyrrell	14	5	6	3				2	0	2	$2,560,877
Union	21	5	9	5	1	1		4	1	26	$62,068,232
Vance	6		4		2			2	0	0	$17,722,875
Wake	38	19	9	7	1	1		4	7	213	$659,527,347
Warren	6	4		2				2	0	0	$3,657,534
Washington	12	7	2	3				2	0	6	$3,745,769
Watauga	2	1	1					1	0	2	$108,939
Wayne	28	14	8	3	1	1		4	4	159	$126,082,175
Wilkes	10	3	7					1	0	0	$3,682,039
Wilson	19	7	3	4	4			3	1	20	$14,395,984
Yadkin	9		8	1				2	0	1	$10,735,616
Yancey	2		2					1	0	0	$1,018,230
North Carolina	**1,560**	**632**	**577**	**237**	**59**	**29**			**132**	**2,617**	**$3,106,808,652**

Source: NCEI

Figure 3-35 NC Tornadoes by County from 1950 to 2021



Historical Tornado Events in North Carolina

March 28, 1984: The tornado outbreak on March 28, 1984 was one of the deadliest and most destructive outbreaks in history for North Carolina. There were eleven confirmed tornado touchdowns in North Carolina. There were 799 people injured and 42 people were killed. Impacted counties included Bertie, Bladen, Chowan, Columbus, Cumberland, Duplin, Gates, Greene, Hertford, Lenoir, Nash, Perquimans, Pitt, Robeson, Sampson, Scotland, Union, and Wayne.

August 13, 2004: The remnants of Tropical Storm Bonnie produced a tornado that touched down just south of Rocky Point and moved northeast, causing F0-F2 damage in the amount of $1.3 million, three deaths and 29 injuries. Damage (F0) was first observed near West Strawberry Lane, with roof damage to a couple of structures. The tornado crossed I-40, just southeast of Rocky Point. It then tracked across Martin Marietta Access Road, causing F0-F1 tree damage. The tornado intensified to F1-F2 as it moved into a small community along Hwy 210. Significant damage occurred on Clayton Lane, Nixon Avenue, and Pickett Road. The tornado reached peak intensity as it moved across Cart Wheel Road, where several homes were completely leveled. It continued to track northeast, with F1 tree damage. The tornado crossed the Northeast Cape Fear River and finally dissipated near Shaw Highway, approximately one mile north of Hwy 210. The following is a summary of damage from Pender County Emergency Management. 17 homes destroyed 25 other homes suffered major damage, 34 other homes suffered minor damage, two businesses suffered major damage, and one business suffered minor damage. Also, in Bath, an emergency manager reported 24 homes and a church sustained damage from a weak tornado which was on the ground for two miles.

August 14, 2004: Twenty structures were damaged in Nags Head on the Outer Banks. Tropical Storm Charley moved northeast across the Coastal Plains of Eastern North Carolina during the afternoon hours causing $225,000 in property damage. Five weak tornadoes were reported across the area associated with Charley with damage reported. The most significant damage related to a tornado occurred along the Outer Banks in Nags Head.

September 7, 2004: Tornadoes impacted three counties causing over $1 million in damage. At 12:38 p.m. a tornado touched down near Old Steak Rd and moved north through Evergreen. The tornado caused spotty damage as it continued to Boardman, and then crossed into Robeson County. Three homes/businesses were destroyed and four others were damaged, totaling $700,000 in damage. At 2:53pm a tornado downed many trees and caused damage to four homes, with one shed destroyed, resulting in $200,000 in damage two miles North West of Marietta in Robeson County. At 10:48 a.m. a tornado moved north from South Carolina and produced widespread damage to trees and power lines along its two-mile path across the southwest corner of Mecklenburg County resulting in $150,000 in damage. The roof of a well-constructed home was blown off, and several other homes incurred shingle damage. A sheet of wallboard was torn off a garage wall and blown away. There was additional damage to automobiles and homes due to fallen trees.

November 19, 2006: At approximately 6:30 a.m., an F3 tornado with up to 200 mph winds impacted a mobile home park in the Riegelwood area in Columbus County. There were eight fatalities, 19 injuries, at least 13 destroyed homes, roughly 100 people displaced from their homes, and over $500,000 in property damage.

May 27, 2008: Tornadoes impacted Bertie and Onslow Counties destroying over a dozen homes.

November 17, 2008: Tornadoes impacted Wilson and Johnston Counties.

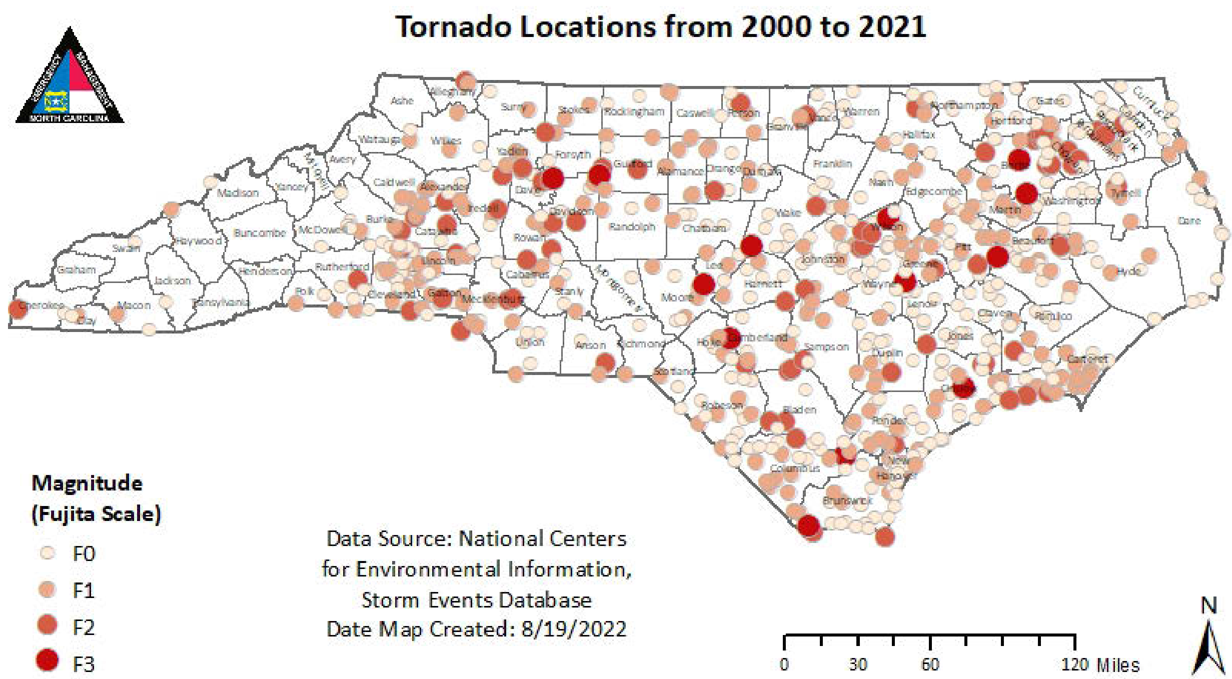
March 28, 2010: Tornadoes impacted Guilford and Davidson Counties resulting in a state disaster declaration and a Small Business Administration (SBA) declaration.

April 16, 2011 Southeast Tornado Outbreak: The largest tornado outbreak ever observed across eastern North Carolina occurred during the afternoon and evening of April 16th 2011. Several powerful super-cell thunderstorms developed ahead of an approaching cold front as a squall line that earlier descended the Blue Ridge, rapidly intensifying as it moved east into the central Piedmont of North Carolina. Conditions ahead of the front were favorable for tornadoes with a moderately unstable atmosphere combined with strong winds that veered with height and produced four long live tornadic supercells that evolved from the linear convective segment. These tornadic supercells went on to produce damage in 38 counties.

The tornadoes left 24 dead with approximately 442 injuries. These tornadoes combined to produce over $1.5 billion dollars in damages statewide.

Based on state tornado statistics, North Carolina experiences an average of 39 injuries per year as a result of tornadoes, and the maximum number of tornadoes in any year was 66 in 1998.[35] Figure 3-36 and Figure 3-37 show the historical tornado locations for North Carolina according to their recorded maximum intensity.

Figure 3-36 Historical F0 – F3 Tornado Locations in North Carolina Since 1950



[35] *Tornadoes of North Carolina. Southeast Regional Climate Center. Retrieved on December 14, 2017 from: https://www.sercc.com/education_files/tornadoes_nc.pdf*

Figure 3-37 Historical F3 – F4 Tornado Locations in North Carolina Since 1950

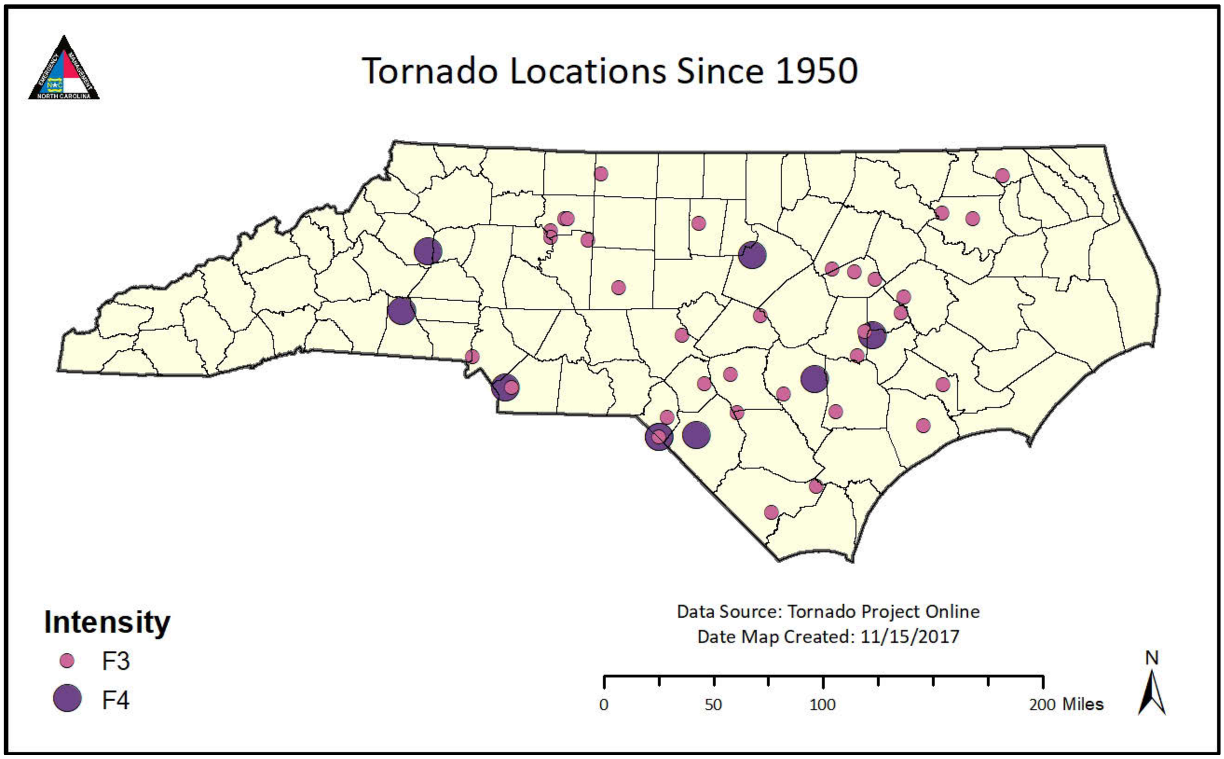


Table 3-25 summarizes thunderstorms that have impacted North Carolina from 1996 to 2017, as listed in the NCEI's Storm Events Database. A graphic representation of the table follows in Figure 3-38.

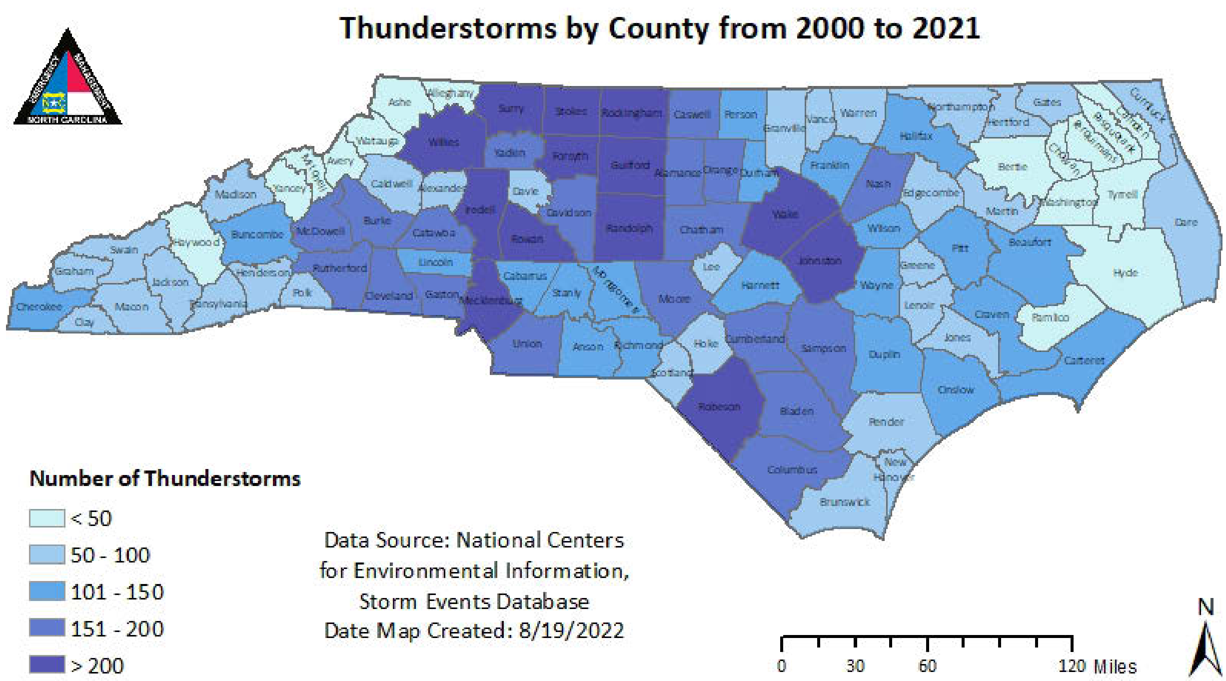
Table 3-25 North Carolina Thunderstorm Summary of Events by County Since 1996

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Alamance	165	0	3	$1,070,943	$199,853
Alexander	103	0	2	$1,338,000	$0
Alleghany	33	0	0	$143,080	$2,194
Anson	139	1	2	$182,499	$46,067
Ashe	54	0	0	$267,872	$0
Avery	43	0	0	$22,759	$0
Beaufort	123	2	41	$357,617	$0
Bertie	77	0	2	$428,462	$0
Bladen	234	0	6	$2,682,417	$2,263
Brunswick	130	0	1	$793,684	$16,195
Buncombe	158	1	9	$553,040	$0
Burke	193	0	2	$664,979	$10,425
Cabarrus	182	0	0	$782,460	$10,425
Caldwell	121	0	0	$505293	$0
Camden	31	0	0	$75958	$0
Carteret	139	0	1	$ 2141410	$0
Caswell	186	0	0	$ 1631940	$32,390

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Catawba	239	0	2	$ 2956742	$10,425
Chatham	176	0	3	$680,888	$0
Cherokee	136	0	0	$919,180	$212,400
Chowan	52	1	0	$755,931	$0
Clay	64	0	0	$535,350	$69,942
Cleveland	223	0	6	$923,021	$1,042
Columbus	214	0	7	$9,601,817	$7,571
Craven	179	0	2	$363,632	$3,395
Cumberland	229	0	8	$1,749,515	$0
Currituck	45	0	0	$117,530	$0
Dare	114	0	12	$1,008,964	$0
Davidson	192	1	3	$1,959,505	$1,028
Davie	117	0	0	$207,019	$0
Duplin	198	0	6	$1,410,170	$39,327
Durham	174	2	3	$1,103,896	$0
Edgecombe	118	0	1	$1,494,863	$0
Forsyth	229	1	3	$993,204	$1,631
Franklin	168	0	4	$6,405,303	$3,085
Gaston	211	2	4	$773,856	$0
Gates	56	1	2	$108,792	$0
Graham	75	0	3	$55,752	$0
Granville	113	0	0	$306,017	$0
Greene	86	0	1	$381,572	$1,131
Guilford	282	2	2	$1,204,004	$1,131
Halifax	158	0	1	$711,218	$1,028
Harnett	183	1	6	$1,314,125	$13,433
Haywood	59	0	0	$205,551	$0
Henderson	128	0	4	$234,456	$0
Hertford	59	0	1	$214,938	$0
Hoke	101	0	4	$504,494	$0
Hyde	69	0	1	$95,459	$0
Iredell	241	2	0	$1,073,976	$0
Jackson	86	0	2	$662,214	$0
Johnston	308	0	1	$1,175,790	$5,141
Jones	65	0	3	$145,531	$0
Lee	103	0	1	$425,038	$0
Lenoir	136	0	0	$905,017	$809
Lincoln	136	1	1	$551,959	$0
Macon	70	0	1	$539,158	$0
Madison	88	0	0	$52,800	$0
Martin	78	0	0	$521,848	$0
McDowell	150	0	0	$795,800	$0
Mecklenburg	348	0	0	$1,950,903	$0
Mitchell	320	0	0	$2,682	$0
Montgomery	98	0	0	$2,475,520	$0
Moore	205	0	4	$1,490,149	$4,113
Nash	180	0	1	$732,560	$99,527
New Hanover	133	0	5	$2,430,684	$0
Northampton	91	0	0	$614,478	$0

County	Number of events (1996-2022)	Fatalities	Injuries	Property Damage (Inflated to 2017 Dollars)	Crop Damage (Inflated to 2017 Dollars)
Onslow	169	0	0	$398,613	$0
Orange	174	1	3	$337,536	$2,000
Pamlico	35	0	0	$95,863	$0
Pasquotank	75	0	0	$790,776	$0
Pender	125	0	7	$3,567,920	$16,195
Perquimans	45	1	0	$171,881	$0
Person	138	0	0	$313,608	$3,028
Pitt	197	1	9	$1,106,637	$0
Polk	87	0	2	$40,168	$0
Randolph	258	0	3	$777,880	$7,698
Richmond	114	0	0	$685,543	$2,528
Robeson	309	0	8	$5,469,324	$14,244
Rockingham	341	0	0	$3,576,485	$0
Rowan	261	0	11	$2,075,756	$0
Rutherford	195	4	3	$1,577,437	$0
Sampson	222	0	17	$4,224,936	$49,098
Scotland	96	0	4	$851,930	$0
Stanly	153	0	3	$2,838,029	$10,000
Stokes	253	0	0	$1,178,810	$0
Surry	319	0	11	$2,879,310	$0
Swain	62	1	1	$69,630	$0
Transylvania	67	0	0	$121,119	$0
Tyrrell	34	4	0	$108,953	$0
Union	215	0	1	$1,813,030	$0
Vance	90	0	0	$255,185	$514
Wake	434	1	19	$3,809,146	$4,206
Warren	101	0	0	$397,478	$2,082
Washington	61	0	0	$125,764	$0
Watauga	46	0	1	$246,555	$0
Wayne	207	1	9	$4,710,463	$477,136
Wilkes	255	1	1	$1,350,531	$68,041
Wilson	136	0	6	$263,383	$2,056
Yadkin	143	0	0	$1,555,294	$153,781
Yancey	33	0	0	$59,956	$37,037
North Carolina	14,845	31	226	$101,524,742	$1,645,615

Figure 3-38 NC Thunderstorms by County from 1955 to 2021



3.2.9.5 Changing Future Conditions

Climate is more than a measure of average conditions; it also is the range of weather variability, which can include the frequency and severity of extreme events like tornadoes and storms. Changing weather patterns may result in more frequent and more severe tornadoes in North Carolina. A US Government Accountability Report in 2017 states that $350 billion has been incurred by the US Government from extreme weather, and these costs are expected to increase as rare events become more common.

Additionally, according to the National Aeronautics and Space Administration (NASA), tornado and thunderstorm events in the future are likely to become more frequent in the southeast as a result of weather extremes. Thunderstorm/tornado potential is measured by an index that NASA created called the Convective Available Potential Energy (CAPE) index. This measures how warm and moist the air is, which is a major contributing factor in thunderstorm/tornado formation. NASA projects that by the period of 2072-2099 the CAPE in the southeastern United States will increase dramatically. Indeed, as Figure 3-39 shows, parts of North Carolina are in an area that will likely experience the greatest increase in CAPE in the United States, and all of the state is likely to experience at least some increase. This indicates that there will potentially be even more frequent thunderstorms/tornadoes in the state going forward.

Overall, there is a challenge in quantifying the number and intensity of tornado and thunderstorm events as these are confirmed by visual sightings as opposed to standard measurement. NASA data identifies important information concerning tornado events. Based on observations dating back to the 1970s, the United States has experienced a decrease in the number of days per year that tornado events occur, but the frequency of tornado outbreaks (clusters of tornadoes) and the number of extremely powerful tornado events have been increasing over nearly the past half-century in the United States[36]. The total number of U.S. tornadoes observed each year roughly doubled from the 1950s to the 1990s with the advent of more storm spotters and more sophisticated weather tracking software like doppler radar[37]. The number of annual days of which weather conditions were favorable for tornadoes decreased across the southern parts of the traditional Tornado Alley (which covers the roughly the central U.S. states of Texas, Louisiana, Oklahoma, Kansas, South Dakota, Iowa, and Nebraska) from 1979 to 2020, while increasing from the Mississippi Valley across much of the Southeast.

On the other hand, tornado outbreaks and length of tornado season appear to be increasing. Generally speaking, there is more interannual variability and volatility in tornado occurrence. This interannual variability may be linked to strong multidecadal warming observed across the Southeast. The increased heat of sea surface temperatures across the Guld of Mexico are increasing, which helps to generate warm, humid surface air feeding into severe thunderstorms across the southeast US[38].

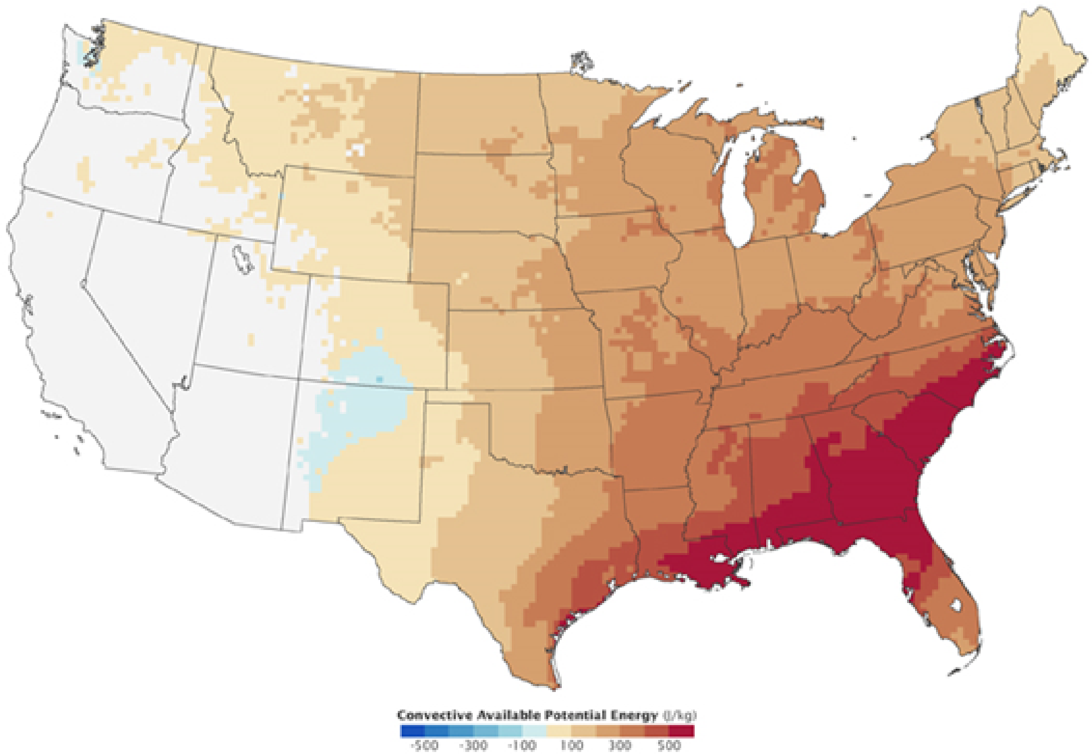
The North Carolina Climate Science Report suggests that, albeit remaining scientific uncertainties, the occurrence of severe thunderstorms will likely increase due to Global Warming. Global climate models consistently project an increase in the frequency of severe thunderstorm events environments across the United States over the mid-to late 21st century. Based on the increased frequency of very high Convective Available Potential Energy (CAPE), increases in storm intensity are also projected over this same period.

The North Carolina Climate Science Report suggests that, the occurrence of severe thunderstorms will likely increase. Global climate models consistently project an increase in the frequency of severe thunderstorm events across the United States over the mid-to late 21st century. Based on the increased frequency of very high Convective Available Potential Energy, increases in storm intensity are also projected over this same period.

---

[36] *More Tornadoes in the Most Extreme U.S. Tornado Outbreaks. Science.org. Retrieved on October 18. 2022 from: https://www.science.org/doi/10.1126/science.aah7393.*
[37] *Climate Change and Tornadoes: Any Connection? Yale Climate Connections. Retrieved on October 18, 200 from: https://yaleclimateconnections.org/2021/07/climate-change-and-tornadoes-any-connection/.*
[38] *Tornado Warning: Twisters are hitting more frequently and dealing more deaths in the South. USA Today. Retrieved on October 18, 2022 from: https://www.usatoday.com/in-depth/news/nation/2021/06/16/tornado-season-changing-spreading-across-south-deaths-and-destruction/5134403001/.*

Figure 3-39: Convective Available Potential Energy Projected Increase by 2072-2099



Source: National Aeronautics and Space Administration

3.2.9.6 Impact

Tornadoes and severe thunderstorms both have the potential to cause critical impacts in parts of North Carolina. That means that multiple deaths/injuries are possible and more than 25% of property in affected area could be damaged or destroyed. Also, complete shutdown of critical facilities for more than one week could occur.

3.2.9.7 Future Probability

Tornadoes

Historic records demonstrate that tornado events are becoming annual occurrences for the State of North Carolina. The probability of future tornado occurrences affecting the State is likely (between 36 and 75 percent annual probability). Based on previous data showing that tornadoes often occur in the central and eastern parts of North Carolina, it may be expected they are more probable in these zones as well.

Thunderstorms

Thunderstorms are also common occurrences throughout the state, especially in summer months. Historical data shows that these types of hazards tend to be more common in the central and eastern part of the state as well, so it is possible that they will continue to take place more frequently in these areas. Based on historical evidence, it is highly likely (66.7 to 100 percent annual probability) that North Carolina will continue to experience thunderstorms in the future.

3.2.9.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.2.10 Geological

3.2.10.1 Description

For the purposes of this plan, geological hazards refer to landslides, sinkholes and coastal erosion because they are the primary geological hazards that have the ability to cause damage to property and potential loss of life. Other geological hazards not included in this plan: ground collapse caused by old mines and prospects, rippable vs. non-rippable earth material, expansive soils (shrink swell clays), acid-producing rock, radon in air and groundwater (linked to geology), arsenic in groundwater (linked to geology).

Landslides

A landslide is a downward movement of earth or rock driven by gravity. Landslides can be triggered by natural or man-made circumstances, such as heavy rains, earthquakes, rapid snow melt, erosion, or slope modification.

Every landslide, or slope movement, is different and unpredictable. However, they are typically associated with periods of heavy rainfall and can worsen the impact of storm, flood and wildfire events. Some move slowly, while others may move in excess of 45 mph. Some geological areas are more prone to landslides, such as bases of steep slopes or hillsides. Flatter areas away from slope changes tend to be safer from landslides. Trees and other vegetative cover and soil composition also influence slope stability indices. Severe wildfires damage the forest canopy, the plants below, as well as the soil. This can result in runoff after intense rainfall or rapid snowmelt, which can put homes and other structures below a burned area at risk of localized floods and landslides.

Sinkholes

According to the United States Geological Survey (USGS), a sinkhole is an area of ground that has no natural external surface drainage. When it rains, all of the water stays inside the sinkhole and typically drains into the subsurface. Sinkholes can vary in size from a few feet to hundreds of acres, and from less than 1 to more than 100 feet deep. Some are shaped like shallow bowls or saucers whereas others have vertical or concave walls.

Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by circulating groundwater. As the rock dissolves, spaces and caverns develop underground. Sinkholes are dramatic because the surface land usually stays intact until the underground spaces deteriorate. Once there is not enough support for the land above the void a sudden collapse can occur. These collapses can be small, or, as the picture below shows, they can be huge and cause significant damage to nearby structures and infrastructure.[39]

[39] *Sinkholes. United States Geological Survey. Retrieved on December 14, 2017 from: https://water.usgs.gov/edu/sinkholes.html*

Sinkholes may also be caused by failures of culverts and other components of drainage systems, or improper compaction of soil during construction activities.

Coastal Erosion

Coastal or beach erosion is the wearing away of the beach and dune sediments due to winds, tidal currents, or wave action. Erosion is typically event-driven and tends to happen during periods of strong winds, high tides and waves, such as a storm; however, continued erosion wears away the coastal profile and can create imbalance on shorelines. An eroding beach may lose feet of sand per year.

Erosion clearly affects the environment, but it also is problematic for homes and businesses that are constructed on or near beaches. Severe erosion can cause extreme property loss or damage. Many beaches rely on sandbags placed in front of homes and dunes to protect them from hazard erosion.

3.2.10.2 Extent

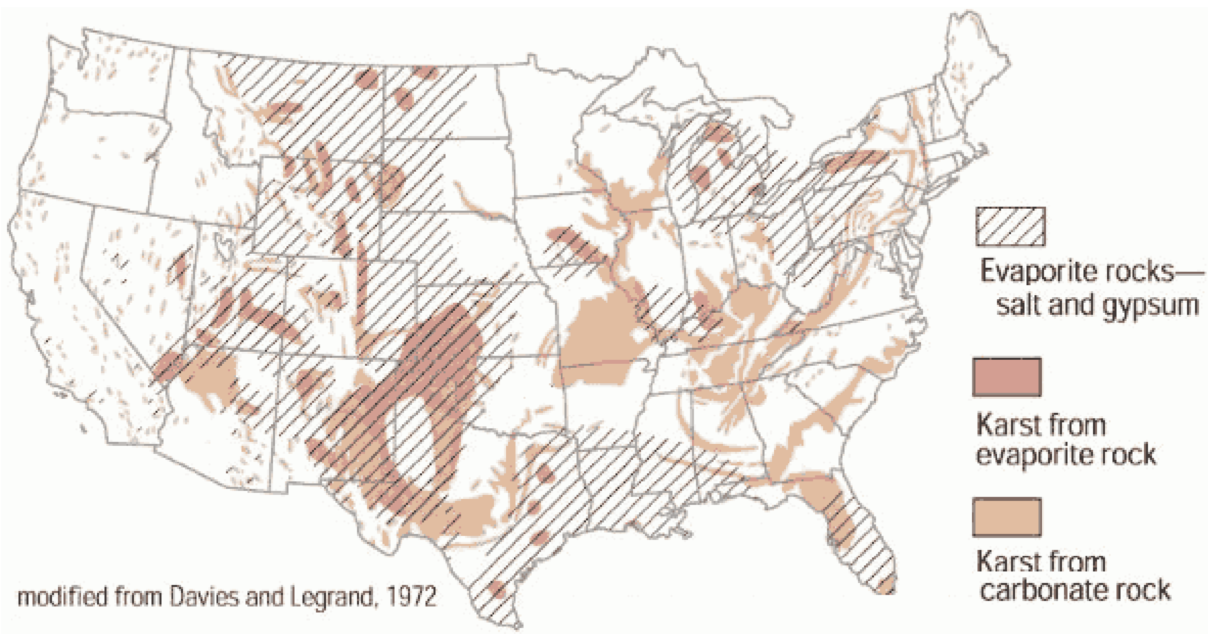
Landslides

Landslide extent can be measured using the size/volume of the debris moved during a landslide event. In the western areas of the state where landslides are most prevalent and largest, some landslides have displaced boulders as large as 60 feet in length and 900 tons in weight. Many times, the outflow from these landslide events has moved at upwards of 50 miles per hour, damaging homes and other structures along the way.[40]

Sinkholes

Figure 3-40 below shows areas of the United States where certain rock types that are susceptible to dissolution in water occur. In these areas, the formation of underground cavities can result in catastrophic sinkholes. These rock types are evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). Evaporite rocks underlie about 35 to 40 percent of the United States, though in many areas they are buried at great depths. In some cases, sinkholes in North Carolina have been measured at up to 20 to 25 feet in depth, with similar widths. Recent mapping work by the Eastern Office of the North Carolina Geological Survey indicates previously unrecognized areas with natural sinkhole activity in the northeastern part of the state.

Figure 3-40: United States Geological Survey of Karst Modified from Davies and Legrand, 1972[41]



Coastal Erosion

In North Carolina, the NC Division of Coastal Management and the NC Geological Survey (both part of NCDEQ) study and calculate shoreline change rates. These rates vary along the NC coast, but it is notable that, on average, the state is experiencing 1.6 feet per year of

---

[40] *Historical NC Landslide Events. North Carolina Department of Environmental Quality. Retrieved on December 14, 2017 from: https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/geologic-hazards/historical-nc-landslide-events*
[41] *Sinkholes. United States Geological Survey. Retrieved on December 14, 2017 from: https://water.usgs.gov/edu/sinkholes.html*

erosion based on studies at multiple locations conducted by the NC Department of Environmental Quality. More details on specific locations can be found in study, which is located at the following URL: https://files.nc.gov/ncdeq/Coastal%20Management/documents/PDF/erosion%20rates/Erosion_Rate_Data_Summary_2011.pdf[42].

Figure 3-41 Severe Beach Erosion on North Carolina Outer Banks resulting in structural collapse

Source: FEMA

3.2.10.3 Location/Spatial Extent

Landslides

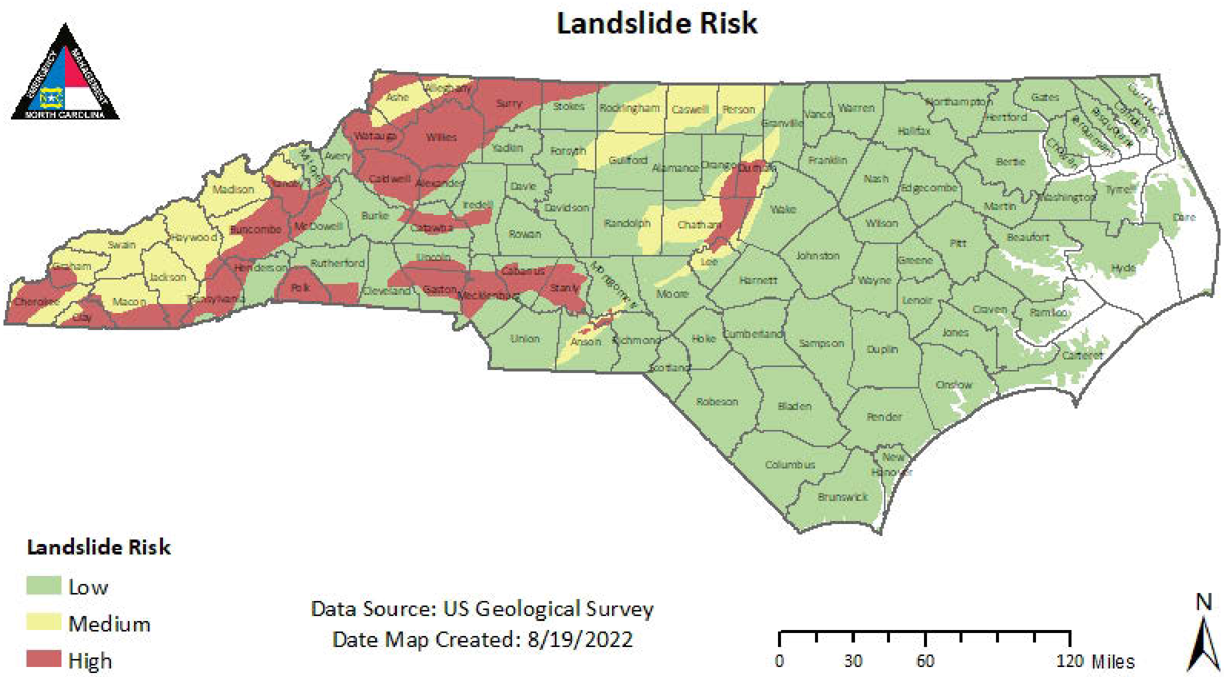
Three common types of landslides that affect North Carolina are: debris flows, debris and earth slides, and rockslides. Most recorded landslides in the state have been recorded in the western region, due to steep slopes, intense rainfall and slope modification.

Figure 3-42 below shows areas of landslide risk according to the United States Geological Survey.

---

[42] More details on specific locations can be found in that study, which is located at the following url: https://files.nc.gov/ncdeq/Coastal%20Management/documents/PDF/erosion%20rates/Erosion_Rate_Data_Summary_2011.pdf

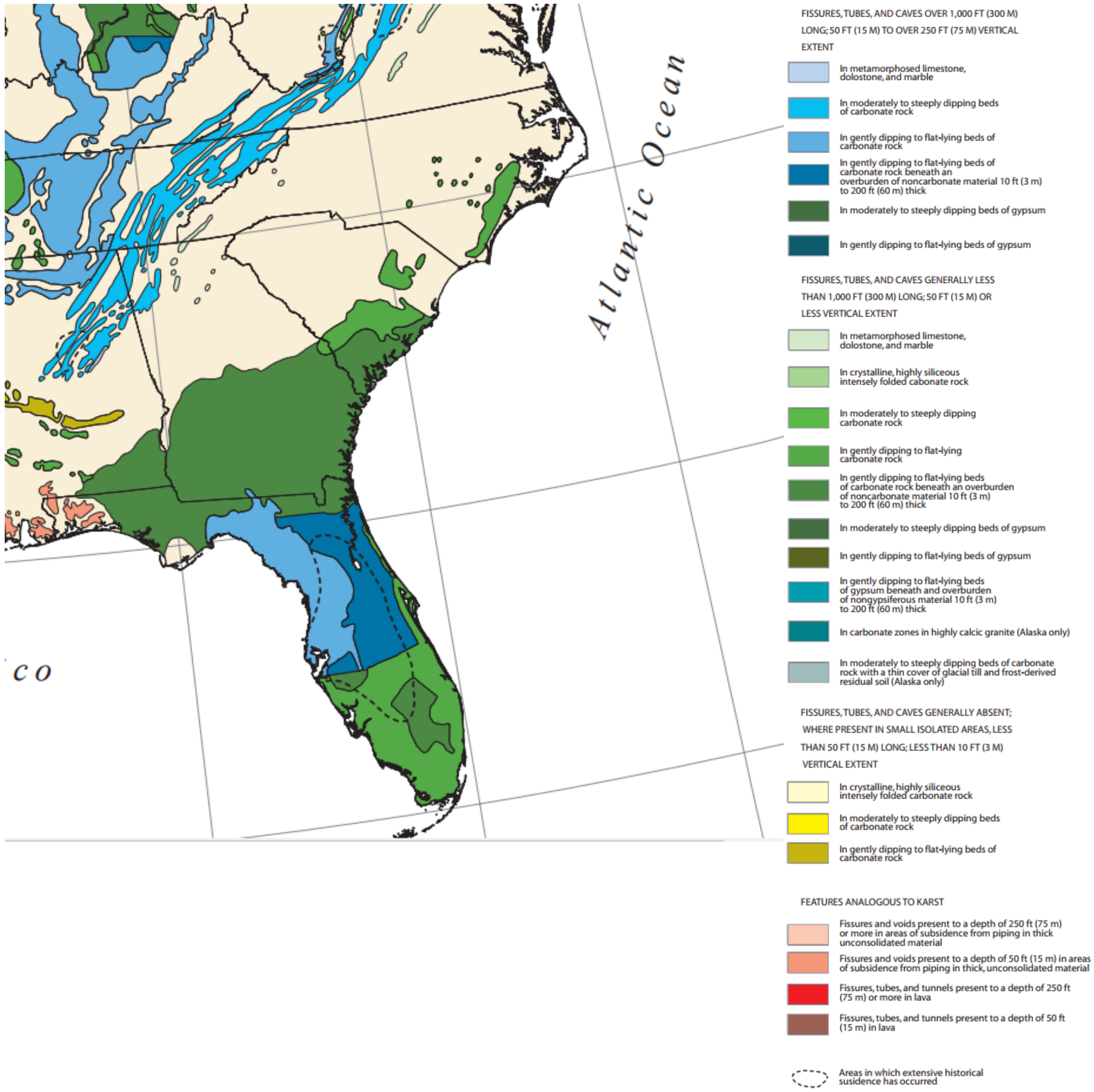
Figure 3-42 North Carolina Landslide Risk Areas



Sinkholes

Figure 3-43 below shows a more recent mapping of the karst features of soil types that have been documented by the USGS and which indicate some susceptibility to sinkholes due to the erodibility of the karst soil type. Although this is not the only indicator, and should not be used as the sole means for determining sinkhole risk, this information does give some indication as to areas that might be more likely to experience sinkholes in the state.

Figure 3-43: United States Geological Survey of Karst Soils from Davies, et al, 1984[43]



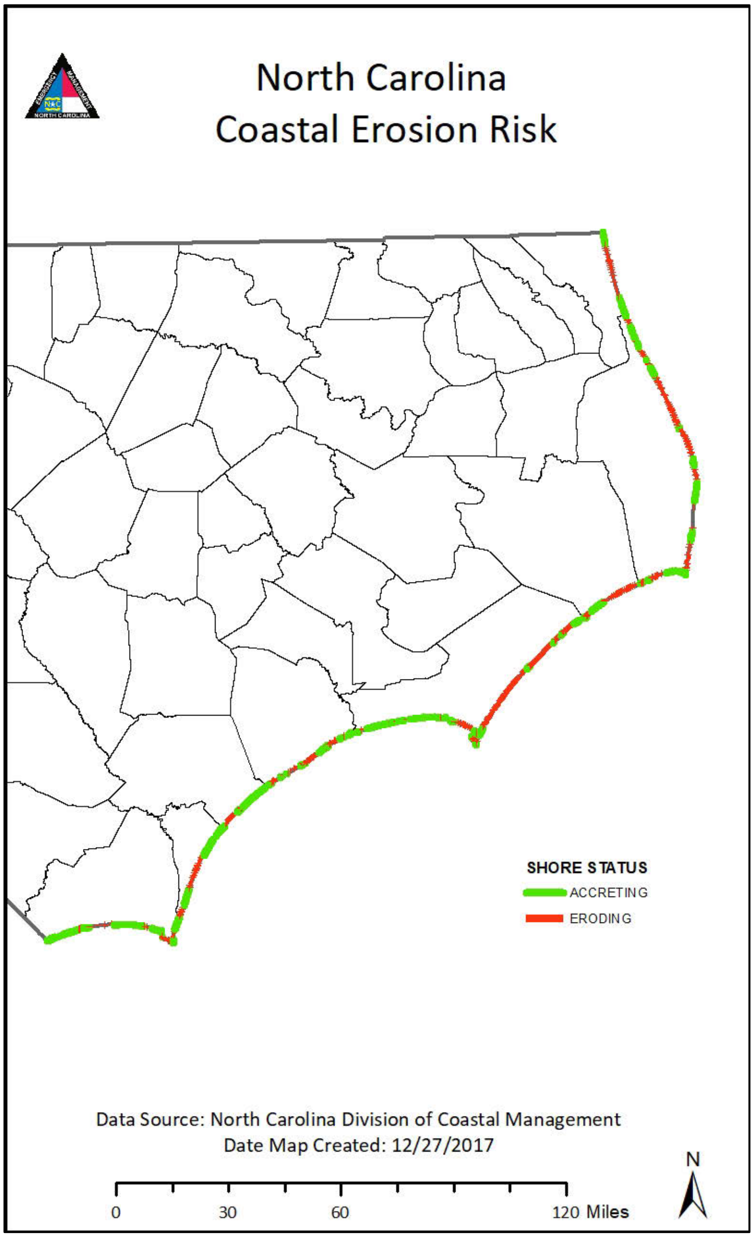
Coastal Erosion

By definition, coastal erosion is unique to the communities on North Carolina's coastline. However, a unique feature of North Carolina's coastline is its barrier islands that often experience erosion along their entire shoreline to some degree. Counties along North Carolina's coast must deal with erosion on both these barrier islands and along their mainland shorelines. These communities often face erosion and accretion in close proximity within a community as erosion in one area often leads to accretion of sediment in another. Figure 3-44 presents a depiction of the North Carolina coastline and shows segments of the shoreline that are either eroding or accreting.

---

[43] *Digital Engineering Aspects of Karst Map. A GIS Version of Davies, W.E., Simpson, J.H., Ohlmacher, G.C., Kirk, W.S., and Newton, E.G. 1984. Bret D. Tobin and David J. Weary. United States Geological Survey, 2004.*

Figure 3-44 Areas of Coastal Erosion



3.2.10.4 Hazard History

Landslides

North Carolina has experienced landslide events that have directly caused deaths and property damage. Table 3-26 lists recent landslide events and a brief summary of each event.

Table 3-26 North Carolina Landslide Events 1990-2021

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Lands Creek I	12/23/1990	Swain	debris flow			Mobile home and chlorinator building for Bryson City Municipal water system destroyed. Utility lines downed. Roads heavily damaged by debris.
Oconeechee Mountain, Eno River State Park	2/18/2001	Orange	rock slide			
Bald Mountain Debris Flow 1996	9/4/1996	Rutherford	debris flows			Home destroyed by debris flow triggered by high intensity rainstorm
Spruce Pine Rock Slide I	1/28/2002	Mitchell	rock slide			Building planned for use as Chamber of Commerce destroyed
Maggie Valley Debris Flow Dogwood-Wildcat Run	12/13/2003	Haywood	debris flow	1	1	I home destroyed; sedimentation
Mountain Air DS-DF	3-4/x/2004	Yancey	debris slide			Damage to road and golf learning center - expensive repair
Lands Creek II	5/5-7/2003	Swain	debris flow			Sedimentation and large woody debris into drinking water reservoir
Charley Branch (Glory Mtn) 1-5	5/5-7/2003	Swain	debris flow			Damage to private driveway and yard, sedimentation into local water supply
SoHi Trail	5/5-7/2003	Swain	debris flow			Damage to road and property below; sedimentation
Midnight Trail Embankment Failure	5/5-7/2003	Swain	debris flow			Damage to road and property below; sedimentation
Timber Estates Slide	5/5-7/2003	Swain	weathered rock slide			Damage to road and cut slope relatively minor
Tory Lane Debris Slide	5/5-7/2004	Swain	debris slide			Minor damage to house siding, blocked drive way
Nantahala Cabins	5/5-7/2003	Swain	debris slide			Cabin knocked off foundation, damage repaired, retaining wall built
Alarka Creek	5/5-7/2004	Swain	debris flow			Damage to road and property down slope
Bear Rock Estates	9/8/2004	Henderson	debris flow			1 home damaged; sedimentation

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
White Laurel	9/8/2004	Watauga	debris flows			1 home destroyed; 6 condemned until site stabilized; sedimentation
Old CCC Road	9/6-8/2004	Henderson	debris slide-flow			
Elijay Creek	9/16-17/2004	Macon	rock fall, debris flow			Minor damage to house from rockfall; property damage from embankment failure-debris flow
Little Pine	9/16-17/2004	Madison	debris flow			Barn destroyed
Peeks Creek	9/17/2004	Macon	debris flow	5	2	15 homes destroyed; 2 homes damaged; bridge destroyed; road damaged; sedimentation
Fishhawk Mtn Rd PC EF1, EF2	9/16-17/2004	Macon	debris flows			Damage to outer road embankments, sedimentation into Peeks Creek
Wayah I	9/17/2004	Macon	debris flow			Barn destroyed; temporarily blocked Wayah Road
Wayah 2	9/17/2004	Macon	debris flow			Wayah Road temporarily blocked
Nickajack Creek Blowout	2004/09/16-17	Macon	debris blowout			Minor vegetation removal and sedimentation
Starns Cove	9/16-17/2004	Buncombe	debris flows			Arrowood home destroyed; damage to home further down the track.
Bat Cave 1	9/4/1996	Henderson	debris flow			Old cabin destroyed
Hebo Mountain 1, 2	9/6-17/2004	Haywood	debris flow; debris slide			Failed retaining wall, cracks in ground near home
Jonas Ridge	9/6-8/2004	Burke	debris flow			Home destroyed
Honeycutt Mtn. - McNutt	9/6-8/2004	McDowell	debris flow			Home threatened by further movement; scrap and ground cracks near home.
Bear Lake - Setzer	9/16-17/2004	Jackson	debris flow			
Glenville Quad	9/6-17/2004	Jackson	debris flow			Workshop destroyed; road damaged; Two debris flow tracks
Glenville Business Park	9/6-17/2004	Jackson	debris flow			
Glenville DFs	9/6-17/2004	Jackson	debris flow			Destroyed workshop, road heavily damaged.

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Spruce Pine Rock Slide II Toe River Tire	5/11/2005; 12/3/2015	Mitchell	rock slide			Garage and storage building damaged in first slide; main building damaged in second slide in the same cut slope
Bills Mountain	2005; 12/24-26/2015	Rutherford	weathered rock-debris slide			Slide remained periodically active from 2005 to 2016; continued excavation at slide toe likely contributed to slide movement
Broad River Fire Department	7/7/2005	Buncombe	rock slide			Severely damaged Broad River Fire Dept.
Campbell Mountain Estates	7/7-11/2005	Haywood	weathered rock slide			
Old U.S. 64 (Whetstone Ridge)	7/14/2005	Transylvania	debris flow			Modular home pushed off foundation with major structural damage
Bear Lake Preserve	07/x/2005	Jackson	weathered rock slide			Damage to road, and unbuilt lot above road
Cooperhead Ridge	2003, 09/06-06/2004	McDowell	weathered rock slide			
Lake Logan	9/6-17/2004	Haywood	weathered rock slide			Sedimentation into West Fork Pigeon River
Jackson County Airport	8/22/2005	Jackson	debris flows			Sedimentation damage to two properties
Hunters Crossing	9/xx/2005	Haywood	weathered-rock slide			2 homes condemned; 2 damaged and abandoned; water line broken; road damaged; 1-3 homes threatened
Gator Ridge I	9/6-17/2004	Macon	debris flow			Road damage; damage to fish hatchery water source
Black Bear Ridge - Cub Trail	5/x/2006	Haywood	debris slide			Road damaged; 1 home threatened
105 River Roar Rd	9/6-17/2004	Macon	debris slide			foundation cracks; deck and supports sag and lean
Eaglenest Ridge	8/31/2006	Haywood	debris flow			
Triska Court - Conestee Falls	8/17/1994 1/1/2007	Transylvania	debris slide/flow			damage to road and properties below; movement reported in 1994, and 2007
White	2007	Mitchell	debris slide			Septic system compromised
Bear Trail	1/7/2009	Haywood	debris flow		2	1 home destroyed; road damaged; sedimentation
Rising Sun	1/7/2009	Haywood	debris flow			Sedimentation

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Blossomtown 1, 2	2006 02/10/2010	Macon	weathered rock slide			Road access to home blocked by scarp; landslide movement into developed area down slope.
Moody Debris Flow Bear Creek Road	1/x/2009	Haywood	debris flow			Property condemned, scarp near garage, cracks in deck foundation
Waynesville Quarry	3/13/2009	Haywood	rock slide			Buried drill rig; major remediation effort required for stabilization and regaining access to quarry floor
Tanner Trail	2009	Haywood	debris slide			Scarps, toe bulge
Serentity Forest	2009	Buncombe	debris slides			Damage to development roads
Fulcher Vistas	9/16-17/2004	Macon	debris slides			Development roads and private property damaged in two locations; private property damaged at 1 location
Watauga Road BSM	1970	Macon	earth slide			Older home destroyed; damage to newer home
Sagee Mtn	10/x/2009	Macon	debris flow			Erosion, sedimentation on USFS land below initiation zone
Wildflower	11/14-16/2009	Macon	debris slide-flow			Road damaged; 1 home threatened; sedimentation
Thomas Slide	12/x/2009	Madison	weathered rock slide			Driveway damaged, home threatened
Skyland Drive	12/2009 thru 01/2013	Jackson	debris slide			Bulge in Skyland Drive, scarps in North Fork Rd; scarps damaging private drive and affecting septic system
Waterdance EF-DF	02/06-07/2010	Jackson	debris flow			Damage to road and sedimentation into river
Chocolate Drop	2009	Polk	debris slides			Sedimentation into creeks, road damage, and damage to unbuilt lots below road; no homes threatened
Basswood Drive DS	2/5/2010	Rutherford	debris slide			Damage to road
Cosmus	1/25/2010	Rutherford	rock slide-rock fall			Damaged corner of house and roof
Ghost Town - Rich Cove	2/5/2010	Haywood	debris slide-flow			3 homes damaged; 18 homes threatened; sedimentation; reactivated on 1/17/2013 with minor damage

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Ghost Town Cracks	06/x/2011	Haywood	subsidence			Extensive asphalt cracking, MV Sheriff's Dept. noted expanded cracking in 5/2011; cracking in concrete in foundation area of amusement ride
Logan Slide	08/x/2009	Jackson	debris slide			Damage to outbuilding
Taylor - 2730 Silvermine Rd.	2/5/2010	Swain	debris slide			Relatively minor damage to home
Dove Landing Echoing Ridge Road	12/25/2009	Buncombe	debris flow			Damage to development roads
Holiday Drive	12/1/2010	Henderson	debris flow			
Barnes	12/x/2009	Jackson	weathered rock slide			Property damage, utility pole damage. Potential for damage to mobile home from slide.
Reinold	3/6/2011	Swain	debris slide			Damage to porch, driveway; slope behind house needed stabilization
Sneed-EBCI	10/xx/2008	Jackson	weathered rock slide			Minor damage to yard and outbuilding
Wadsworth/Zerelli Glenville	9/16-17/2004	Jackson	debris flow			Corner of house severely damaged
Bear Lake - 281	pre-2011	Jackson	debris slide			
Gunter Fork	7/14-15/2011	Haywood	debris flows			Damage to Gunter Fork Trail
Saluda RR	9/6-17/2004	Polk	debris flow; debris slide			Damage to inactive Railroad line; embankment gone beneath tracks; sedimentation into Pacolet River
Balsam Corner	7/14-15/2011	Swain	debris flows			Debris flows probably triggered flood damage to Cherokee Hatchery 13 km downstream
Indian Creek	7/19/2012	Haywood	debris flow			Damage to roads and slope below house; sedimentation
Chimney Rock State Park Rockfall, Debris Slide	11/14/2012	Rutherford	rock fall - debris slide			Segment of trail severely damaged; segment of timber and steel beam walkway destroyed
Cornerstone Drive	2010	Haywood	debris slide			Scarps on adjacent field. Property damage, slide probably still active

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Mountain Heritage	1/14-17/2013	Jackson	debris flow			Damage to development road, and community property; unstable slope remained
Watauga Vista Stacy	1/14-17-/2013	Macon	debris flow			Damage to garage, driveway and slopes above; unstable slope remained
Hinton	01/14-17/2013	Madison	debris slide			Damage to outer edge of driveway; driveway threatened
Hopkins	1/17/2013	Watauga	debris flow			Property damage, and damaged outbuilding
343 Skyline Drive	1/14-17-2013	Haywood	debris flow			Severe damage to home
Gator Ridge 2	1/14-17/2013	Macon	debris flow			Road damage; damage to fish hatchery water source
Moore Little Choga	1/14-17/2013	Macon	debris flow			Property damage; unstable slope remained
Villages of Plott Creek - Hertwig	1/14-17/2013	Haywood	debris flow			Damage to development roads; damage to vacant lot
Wren Way Waynesville	2/4/2013	Haywood	debris slide - flow			Damage to home; Litigation over Waynesville water line leak
Spring Valley (Weaver Bethel)	5/6/2013	Haywood	debris slide			Property damage and damage to development roads
Evergreen Farm Trail	5/8/2013	Haywood	debris slide			Property damage; cut slope in debris deposit
Dandelion Drive	5/23/2013	Jackson	earth-debris slide			Community access road threatened
Baker Wilderness Trail	2004, 2013	Buncombe	earth-debris slide residuum			Property damage; back yard subsiding; unstable slope remained
Herron Branch	7/4-6/2013	Jackson	debris flow			Development road damaged; property damage; debris dams remained in stream channel
Jump Cove	4/1/2013	Buncombe	debris slide			Severe damage to home
Roberts Hill Road	4/27-28/2013	Madison	debris slide			Mobile home destroyed and property damage
Norfolk Southern RR	5/6/2013	McDowell	debris slide-flow	1		1 fatality after reports of landslide in area
Blue Ridge Parkway Tanbark	2013	Buncombe	debris slide			Business temporarily closed
Shadow Lane	7/18/2013	Haywood	debris slide residuum			Driveway damaged; community road inaccessible

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Bills Mountain II	2006, 2013(?)	Rutherford	debris flow			Road, lots damaged in Bills Mtn.; failed onto existing weathered rock slide downslope
Bills Mountain III	05/04-06/2013	Rutherford	debris flow			Road, lot damaged in Bills Mtn. Damage to drinking water source of downstream owner
Bills Mountain IV	201?	Rutherford	debris flow			Road, lots damaged in Bills Mtn.
Bills Mountain V	2013	Rutherford	debris flow			Road, lots damaged in Bills Mtn.
Bills Mountain VI	05/04-06/2103	Rutherford	debris flow			Road, lots damaged in Bills Mtn.; Cut failure in toe of active weathered rock slide
Hawks Ridge 1, 2, 3	1/14-17-2013	Jackson	debris flow			Property damage; development road damaged; unstable slope remained
145 Black Oak Drive	7/5/2013	Buncombe	debris slide-flow			Condemned home demolished; road blocked and unstable slope remained
194 Embankment Failure	7/4-6/2013	Avery	debris slide-flow			Major damage to U.S. 194, home reported destroyed, other properties damaged
Kelley - Esmeralda Inn	5/5/2013	Rutherford	debris flow			Road embankment failure in Cliffside development; paved area not damaged; sedimentation into creek and property of the Esmeralda Inn
Hidden Meadows Helton	xx/xx/2013	Henderson	debris slide			embankment failure resulted I 110-foot-long crack in pavement with approx. 2 inches of vertical displacement
Blue Ridge Parkway, NC Segment	09/06-08/2004	McDowell	debris flow			Parkway closed for extended period for major repairs of embankment and cut slope failures
Blue Ridge Parkway, NC Segment	09/06-08/2004	Transylvania, McDowell	weathered rock slide, debris slide			Parkway closed for extended period for major repairs of embankment and cut slope failures

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Blue Ridge Parkway, NC Segment DMR-007	x/x/2006 x/x/2009		weathered rock slide			Slide movement in 2002, and noted again in 2004. 2009 -Bulge in pavement, unstable slopes above BRP at tunnel portal
Bateman	xx/xx/2013	Buncombe	subsidence-debris slide			Subsidence and scarps in embankment; some affecting deck supports; homeowner reported previous failure in 2004 below current area of subsidence
Dry Falls	various	Macon	rockfall			numerous small rockfall boulders in area of overhang, no known damage to trail, no known injuries
Bridal Veil Falls	12/xx/2003	Macon	rockfall			2003 rockfall blocked and damage to road beneath Bridal Veil Falls; later rockfall did not hit road, fell on inside shoulder beneath overhang
187 Settacoo	01/14-17/2013	Swain	debris slide			Foundation and porch damage
John Bull	01/14-17/2013	Jackson	debris slide			Slope damage below driveway
Long View	01/14-17/2013	Jackson	debris slide			Retaining wall to repair initial embankment failure was cracked
Parrot Cut Slope	x/x/2014	Macon	rockfall			Minor rockfall and ravel behind retaining wall
High Cliffs - Old Fort Road	01/14-17/2013	Buncombe	debris flow			debris flow deposited material onto property; previous property owner reported damaged RV camper; damage to High Cliffs road, and material deposited onto Old Fort Road.
Spruce Pine - Toe River Tire 2	12/3/2015	Mitchell	rockslide			Damage to west side of main building, wall collapse; Owner reported to have decided to relocate business
Rhododendron Drive	08/xx/2014	Buncombe	debris slide			Slide scarps along edge of driveway; potential damage to properties down slope

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Mill Creek	12/24/2015	Macon	debris flow			Backyard with landscaping and deck damaged; sediment onto road and properties below; building inspector issued a no-occupancy order for home where failure originated.
Azalea Ridge	12/24/2015	Macon	debris flow			Damage to development road and downslope property
Florida Hills	12/24/2108	Macon	blowout - debris flow			Sediment against house, but no major structural damage; damage to private road
The Ridges	12/24/2015	Clay	debris flow			Development roads damaged in three locations; access to private residence blocked for several months
Mill Creek Road	10/3/2015	McDowell	weathered rock slide			Cut slope failure with debris slide and minor debris flow activity;
Smoky Mountain Country Club	7/5/2013	Swain	debris slides			Sedimentation into downslope properties; retaining wall constructed at site 4
Ridgehaven	7/4/2013	Buncombe	debris slide			Scarp propagated upslope from initial 07/04/2016 cut slope failure: smaller debris slide upslope beneath deck foundation pier
Hiddenite Mine Collapse	9/17/2014	Alexander	weathered rock slide	1		1 person killed in open pit mine wall collapse
Stonegate Coleman	2007, 2016	Buncombe	debris slide subsidence			Minor property damage to landscaped area; no threat to home; sinkhole may be related to buried woody debris
Harahan Train Tracks Trail	2006-2016	Cherokee	subsidence (1); debris slides (3)			Fill (unlikely mine-related) subsidence in driveway; small debris slides in embankments; porch foundation posts tilted
West Jefferson	1/17/2017	Ashe	weathered rock slide			Moisture and impact damage to three businesses in shopping center
AVL CCR Fill	9/7/2017	Buncombe	earth slide-flow			Damage to embankment slope of CCR fill - 40-foot-long scarp, and seepage from embankment

Landslide Event	Date	County	Type of Event	Fatalities	Injuries	Damage Description
Skyview Place	10/23/2017	Buncombe	debris slide - flow			Road embankment failure on Skyview Place Rd (City of Asheville jurisdiction). Sedimentation onto road below; No immediate threat to residences observed
Chimney Rock SP Parking Lot Retaining Wall	10/23/2017	Rutherford	debris flow			60-foot-wide section of stone retaining wall collapsed; slide debris onto CRSP access road below. CRSP temporarily closed. Settlement and pavement cracks in the area
Valhalla	5/18/2018	Polk	Debris flow	1		Two debris flows converged and destroyed home with occupant inside
Cruso	8/18/2021	Haywood	Earth slide-debris flow	1		Translational slide transitioned to debris blow that destroyed 2 homes.

Source: NC Department of Environmental Quality

Historically, landslides tend to occur in the same general area where previous landslides have occurred. Therefore, areas that have experienced landslides in North Carolina are prone to experiencing landslides in the future. The Department of Environmental Quality's North Carolina Geological Survey (NCGS) has a landslide website and GIS-based mapping tool to better inform communities about landslide hazards. The website allows users to explore current and historical information about landslides in North Carolina.

The NCGS landslide hazard maps website link is provided here: https://experience.arcgis.com/experience/b55c8497d115400aa09d9cb7a27f5dc8/page/page_7/.

Sinkholes

In North Carolina, most sinkholes occur in the southern coastal plain. This is due to the high concentration of limestone in the southern half of the state compared to the relatively sandy soil in the north. Sinkholes are also common in Western North Carolina, and according to a search of local media outlets across the state, the area has experienced more than 40 sinkholes over the past 20 years. The two types of sinkholes discussed in this plan are technical and geological sinkholes. Technical sinkholes are human-caused; and they are caused by activities like groundwater pumping and construction and development practices, when natural water-drainage patterns are changed and new water-diversion systems are developed, or when industrial and runoff-storage ponds are created. On the other hand, geological sinkholes are caused by dissolution, where surface rick that are soluble to weak acids are dissolved, and suffusion, where cavities form below the land surface. Geological sinkholes tend to develop gradually and are usually not noticeable. Whereas technical sinkholes can develop quickly when an underground collapse of supporting material gives way. The following are some examples of historical sinkhole events that have occurred in North Carolina, damaging roads and buildings.

May 27, 2009 – Torrential tropical rains resulted in a technical sinkhole on a stretch of U.S. 421 in Wilkesboro (Wilkes County), greatly affecting traffic flow in the Triad.

September 14, 2011 – A geological sinkhole appeared near two homes in Jacksonville (Onslow County) during the heavy rains from Hurricane Irene

August 10, 2012 – A large technical sinkhole closed a small road in Wadesboro (Anson County) near Highway 74 and Highway 52. As a result, three buildings in the area had to close, including a local homeless shelter which required finding temporary housing for the people staying at the shelter.

August 9, 2014 – Heavy rains produced a technical sinkhole in Hampstead (Pender County) near Azalea and Country Club Road.

August 1, 2016 – A man drove into a weather-related sinkhole on Glenn Road between Club Boulevard and Bundy Avenue in Durham (Durham County). The man was rescued but sustained injuries. The sinkhole stretched from one side of the road to the other and was estimated to be 10 to 15 feet deep.

October 11, 2016 – Rain from Hurricane Matthew created a technical sinkhole at least one quarter of a mile wide across Bingham Drive in Fayetteville (Cumberland County).

November 27, 2016 – A man was rescued after being stranded in a 12-foot sinkhole in Durham (Durham County). The victim sustained undisclosed injuries after being stuck for hours.

October 27, 2017 – A technical sinkhole formed in a restaurant parking lot in Woodfin (Buncombe County), swallowing part of a small tanker truck. By the next day, the hole had grown to about 20 feet deep, making a large part of the parking lot unusable.

Coastal Erosion

In recent history, North Carolina has experienced many events that have led to beach erosion. In 1996, more than $2 billion worth of property damage was caused by Hurricane Fran, and most of the dunes were wiped out on Topsail Island. Later in September 2003, Hurricane Isabel eroded the beach and caused a 1,700-foot gap in Hatteras Island. The new inlet that was formed cut NC Highway 12 in half and was 24 feet deep in some spots. In 2005, Hurricane Ophelia eroded the beach in the Outer Banks, and parts of Surf City lost 25 feet of beach. A damage assessment reported that 90 percent of beach access stairs in Topsail beach were damaged or destroyed. The same storm caused a new inlet to be formed near Cape Lookout.

3.2.10.5 Changing Future Conditions

Landslides

Landslides may affect large areas at one time, and they can be slow or quick moving. In North Carolina, landslides have tended to impact the western side of the state more often and have caused 5 injuries and 8 fatalities in the recent past. The biggest impact caused by landslides is property damage and loss. In severe cases, landslides have caused damages to roads, impacting transportation. Although they are not easily predictable, landslides have harsher impacts after periods of severe rainfall. The increasing intensity of rainfall events anticipated as a consequence of climate change will likely lead to an increase in the number and extent of landslide occurrences. In addition, increasing development pressure in Western NC, if not accompanied by more stringent development codes, ordinances and practices regarding slope modifications may lead to an increase in prevalence and extent of landslides.

Sinkholes

Similar to landslides, sinkholes can be triggered by heavy rains and flooding. An increase in the number and intensity of severe storms, and resulting heavy rains and flooding, may also result in sinkholes developing more frequently. Occurrence of technical sinkholes associated with the failure of drainage systems and other infrastructure will be a likely consequence of the increased rainfall intensity associated with climate change.

Coastal Erosion

Weather extremes may negatively affect coastal erosion rates. If continuing extreme storms occur as predicted, shoreline imbalances may happen more frequently. Rising global sea levels also erosion rates both globally and locally through increased tide and storm surge heights and loss of protective coastal marshes and reefs Increased storm surges will erode shorelines, which in turn, will leave properties further at risk of flooding and storm damage. Furthermore, as population increases and more people move to coasts, erosion rates are likely to quicken.

3.2.10.6 Impact

Landslides

Landslides may occur over a large geographic area simultaneously due to the impact of weather systems and events. Slides can be slow- or fast-moving taking place in the span of minutes, or over many days depending on local soil and terrain conditions. Landslides in North Carolina tend to impact the western side of the state most often and have resulted in property destruction, road closures, serious injuries and deaths in the recent past. The most widespread impact of landslides is property damage and loss of function of roadways and highway systems. Although they are not easily predictable, landslide activity shows a positive correlation to slope steepness, soil type and periods of intense rainfall. Research by the NC Geological Survey indicates that slope modification during construction is also a leading indicator of slope failure hazards.

Sinkholes
While generally confined to known hazard areas, geological sinkholes are fairly unpredictable and may occur suddenly, enhancing the risk and impact. Geological sinkholes are typically confined to the karstic soils of the extreme Southeastern portion of the state, but recent mapping efforts by the NC Geological Survey have identified some new areas of risk in the northern Coastal Plan. Sinkholes resulting from infrastructure failure (generally collapse of stormwater, water or sewer lines or poor construction site preparation may occur anywhere there is development.

Coastal Erosion
The built environment on the North Carolina Atlantic Coast and its estuarine sounds face the some of the greatest risks of erosion on the east coast of North America. Many coastal communities are affected by erosion every year, especially after severe winter storms and during hurricane season. Owners of beach front and sound front properties may be impacted more than others; in extreme circumstances, some homes have been relocated to prevent toppling into the ocean; others have fallen in before mitigation measures could be implemented. As development pressure continues to increase in coastal areas, the impacts of erosion may become even greater. Although coastal communities try to solve erosion issues by dredging sandbagging, or creation of hardened structures, these are often only temporary solutions that may exacerbate erosion issues father down shore. State and Federal Coastal Area Management Act required Comprehensive Land Use Plans address erosion threats and identify areas most suited to development.

3.2.10.7 Future Probability
Landslides
Although North Carolina has experienced landslides, most occurrences were not extremely damaging. Most of these events have occurred in the western part of the state where there is more area with drastic slope changes. Landslides happen under specific geographic and geological conditions; therefore, the areas of concern are relatively small. Debris flows and debris slides originating on both modified and unmodified slopes become more frequent in Western North Carolina when precipitation is 5 inches or more in a 24-hour period. Development pressures coupled with an increase in rainfall intensity may exacerbate the hazard. Planning and mapping efforts of NC Geological Survey and sharing of information with local planners, developers, and emergency responders will help to mitigate future issues.

Sinkholes
Sinkholes have affected parts of North Carolina in recent history, mainly in the southeastern region of the state. Because most sinkholes have been relatively small, mostly not geologic in nature, and property damage has been limited, they maintain an unlikely rating (between 1 and 33.3 percent annual probability) for impact on North Carolina in the future.

Coastal Erosion

The state has shown to be more likely to experience erosion, especially in coastal areas. In areas with faster moving water, such as inlets or overwash areas, an increase in erosion is anticipated. Based on historical occurrences, it is and will continue to be a likely occurrence (between 10 and 100 percent annual probability)

3.2.10.8 NCEOP Reference

Landslides, Sinkholes, Coastal Erosion

Annex C, Appendix 6, Hazards and Threats

3.2.11 Infectious Disease

3.2.11.1 Description

Communicable, or infectious, diseases are conditions that result in clinically evident illness which are transmissible directly from one person to another or indirectly through vectors such as insects, air, water, blood, or other objects. The impact of communicable disease can range from the mild effects of the common cold to the extreme lethality of pneumonic plague or anthrax. The public health system in the United States was developed in large part as a response to the often urgent need to respond to or prevent outbreaks of communicable diseases. Through public health methods of disease reporting, vaccinations, vector control, and effective treatments, most communicable diseases are well controlled in the United States and across North Carolina. However, control systems can fail, and when people come together from locations outside of the state, outbreaks can occur, even in the most modern of communities. In this section, some of the more significant potentially communicable disease concerns are described.

The threats discussed in this section usually do not occur on a regular basis, though some are more frequent. The diseases described herein do not originate from intentional exposure (such as through terrorist actions) but do present significant issues and concerns for the public health community. There are numerous infectious diseases that rarely, if ever, occur in the State of North Carolina, such as botulism or bubonic plague. Some highly dangerous diseases which could potentially be used as biological weapons, such as anthrax, pneumonic plague, and smallpox, are safely housed and controlled in laboratory settings, such as at the Center for Disease Control and Prevention (CDC). Other diseases have not (yet) mutated into a form that can infect humans, or otherwise lie dormant in nature.

There have been several significant viral outbreaks from emerging diseases in recent years of both national and international importance. The Zika virus and West Nile virus are viruses that are typically passed to humans or animals by mosquitoes and made major news as emergent disease threats. Meanwhile, diseases that are spread directly between human beings such as Severe Acute Respiratory Syndrome (SARS) and Ebola have also been identified as serious threats. While each of these conditions caused a great deal of public health concern when they were first identified, SARS has virtually disappeared, West Nile virus occurs with low frequency and causes serious disease in only a very small percentage of cases, Ebola has been more or less contained and a vaccine is in development, and many people infected with Zika will not experience symptoms from the disease.

Other communicable diseases pose a much more frequent threat to the citizens of North Carolina. Some of the infectious diseases of greatest concern include influenza, particularly in a pandemic form, as well as norovirus, and multiple antibiotic-resistant tuberculosis. Even in one of its normal year-to-year variants, influenza (commonly referred to as "flu") can result in serious illness and even death in young children, the elderly and immune-compromised persons. There is always the potential risk of the emergence of influenza in one of the pandemic H1N1 forms, such as in the "Spanish Flu" outbreak of 1918-19, which killed over 50 million people worldwide or the Novel Corona Viruses such as COVID-19 that resulted in over one million deaths in the US and over 26,000 deaths in North Carolina alone. Every year, North Carolina sees hundreds of cases of influenza, leading to hundreds of hours of lost productivity in businesses due to sick employees. Of note, a vaccine for influenza is produced every year and, according to the CDC, is highly effective in preventing the disease. Tremendous gains over the past decade in US and world capacity to quickly develop and deploy effective vaccines will, if distributed and taken widely enough could effectively diminish the virulence of pandemic disease processes.

Norovirus is recognized as the leading cause of foodborne-disease outbreaks in the United States. The virus can cause diarrhea, vomiting, and stomach pain, and is easily spread from person to person through contaminated food or water and by surface-to-surface contact. Especially vulnerable populations to this virus include those living or staying in nursing homes and assisted living facilities and other healthcare facilities such as hospitals. Norovirus could also be a threat in the event of large public gatherings such as sporting events, concerts, festivals, and so forth. North Carolina often experiences norovirus outbreaks on an annual basis. No vaccine or treatment exists for the Norovirus, making it especially dangerous for the public in the event of an outbreak.

Coronavirus disease 2019 (COVID-19) is a contagious disease caused by a virus, the Severe Acute Reparatory Syndrome Coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. The disease spread worldwide, leading to the COVID-19 pandemic. COVID-19 transmits when people breathe in air contaminated by respiratory droplets and small airborne particles containing the virus. The risk of breathing these in is highest when people are in close proximity, but they can be inhaled over longer distances, particularly indoors. Of those people who develop symptoms noticeable enough to be classified as patients, 81% develop mild to moderate symptoms (up to mild pneumonia), while 14% develop severe symptoms, and 5% develop critical symptoms (respiratory failure, shock, etc.).

Foreign Animal Disease

A Foreign Animal Disease (FAD) is an animal disease or pest, whether terrestrial or aquatic, not known to exist in the United States or its territories. A FAD in the United States has the potential to threaten food security, cause production losses for livestock producers while significantly increasing livestock production costs through costly disease control measures, affect the income of livestock producers, disrupt movement of livestock products, cause animal welfare problems in affected animals, possibly cause public health issues, and cause environmental consequences with the wildlife population.

The NC Department of Agriculture and Consumer Services (NCDA&CS) is the lead state agency if North Carolina is impacted by any foreign animal diseases. There are several diseases which are considered FADs in North Carolina and their presence in the state could potentially decimate the agricultural and consumer sections: African Swine fever, Dourine, Contagious bovine pleuropneumonia (CBPP), foot and mouth disease (FMD), highly pathogenic avian influenza (HPAI), and Glanders. It should be noted that all of these diseases are strictly controlled and heavily monitored by agencies in the United States and in North Carolina, although there have been occurrences of FADs in the past.

Public health threats can occur at any time and can have varying impacts. Discussions between public health professionals, planning officials, and first response agencies are essential in order to facilitate safe, effective, and collaborative efforts toward outbreaks.

3.2.11.2 Extent

Extent is difficult to measure for an infectious disease and/or a foreign animal disease event as the extent is largely dependent on the type of disease and on the effect that it has on the population (discussed above). Extent can be somewhat defined by the number and spatial distribution of people and animals impacted, which depending on the type of disease could number in the tens of thousands within the state.

3.2.11.3 Location/Spatial Extent

Infectious diseases can occur in any location and are not easily predictable in terms of where they will occur; the disease itself could originate anywhere. Dense concentrations of population may be more susceptible to a widespread outbreak due to the proximity of people to one another. Due to the nature of the infectious disease threat, it is difficult to identify a precise location where this type of event would occur. Moreover, a large-scale event would have impacts that spread throughout the State. Therefore, all areas in North Carolina are considered equally susceptible to infectious diseases.

3.2.11.4 Hazard History

Before the widespread distribution of vaccinations, many serious, often deadly contagious diseases were commonplace in North Carolina. Cases of Ague, a fever (such as malaria) marked by paroxysms of chills, fever, and sweating that recur at regular intervals, was present in North Carolina from colonial times until the 1930s. Additionally, cases of diphtheria, malaria, influenza, and poliomyelitis (otherwise known as “polio”) were especially common among children from the beginning of the 19th century and continuing into the later part of the 20th century,[44]

[44] *Infectious Diseases – Part II: Significant Infectious Disease in North Carolina History. NC Department of Natural and Cultural Resources. Retrieved on September 18, 2022 from: https://www.ncpedia.org/infectious-diseases-part-ii.*

Vaccines to prevent many diseases were developed in the late nineteenth and early twentieth centuries. Despite a few failed or fledgling efforts in the past for communities and the State Board of Health to implement inoculation programs, the NC legislature eventually passed laws for compulsory vaccination for school children against diphtheria in 1939.[45] A particular concern was polio, which ravaged the state during the 1930s. In 1959 North Carolina was the first state to initiate compulsory inoculation with the Salk vaccine. Despite the availability of vaccines and the mandatory vaccine laws, preventable diseases continue to appear in North Carolina.

Prior to the COVID-19 pandemic, the 1918 "Spanish Flu" was the deadliest infectious disease event to impact the State, killing nearly 14,000 North Carolina citizens.[46]

In 2003, the SARS outbreak that began in Southeast Asia began showing up in the United States. There were three confirmed cases of SARS in Georgia in 2003. Since that time there have not been any reported cases of SARS.[47] No cases of Ebola were reported in the State of North Carolina, though several locations in the United States did experience cases.

The only disaster declaration (DR-4487-NC) for an infectious disease event in the 21st century for North Carolina is related to the ongoing COVID-19 pandemic. According to the North Carolina Department of Health and Human Services (NCDHHS), COVID-19 was first reported in North Carolina by the North Carolina State Laboratory of Public Health on March 3, 2020.[48] Several COVID-19 vaccines have been approved and distributed in North Carolina. As of October 6, 2021, 69% of the adult population in North Carolina has been at least partially vaccinated, while 65% of the adult population has been fully vaccinated. As of September 7, 2022 there have been 3,120,822 cases and 26,335 deaths from COVID-19 across North Carolina.[49]

Vector-Borne Diseases

Bacterial, viral and parasitic diseases that are transmitted by mosquitoes, ticks and fleas are collectively called "vector-borne diseases" (the insects and arthropods are the "vectors" that carry the diseases). Although the term "vector" can also apply to other carriers of disease — such as mammals that can transmit rabies or rodents that can transmit hantavirus — those diseases are generally called zoonotic (animal-borne) diseases.

The most common vector-borne diseases found in North Carolina are carried by ticks and mosquitoes. The tick-borne illnesses most often seen in the state are Rocky Mountain

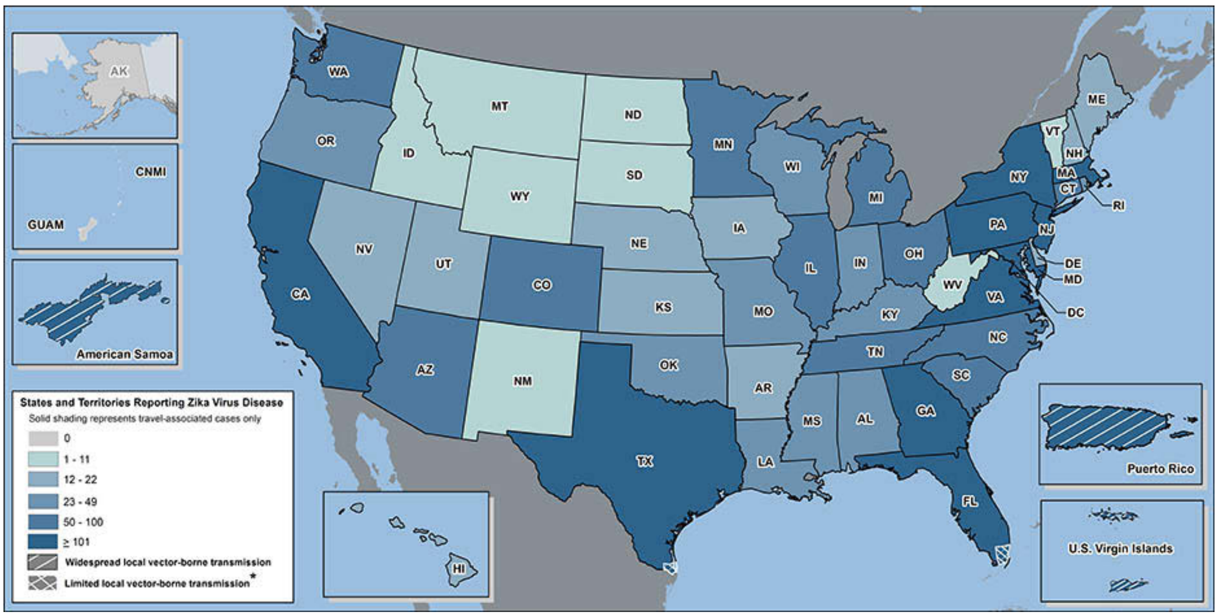
---

[45] *Infectious Disease – Part I: Overview. NC Department of Natural and Cultural Resources. Retrieved on September 18, 2022 from: https://www.ncpedia.org/infectious-diseases.*
[46] *https://www.ncdcr.gov/blog/2016/09/19/spanish-flu-epidemic-1918*
[47] *Severe Acute Respiratory Syndrome (SARS) Report of Cases in the United States. Centers for Disease Control and Prevention. Retrieved on December 14, 2017 from: https://www.cdc.gov/media/presskits/sars/cases.htm*
[48] *North Carolina Identifies First Case of COVID-19. North Carolina Department of Health and Human Services. Retrieved on September 6, 2022 from: https://www.ncdhhs.gov/news/press-releases/2020/03/03/north-carolina-identifies-first-case-covid-19*
[49] *North Carolina Coronavirus Resource Center – State Overview. John Hopkins University of Medicine. Retrieved on September 7, 2022 from: https://coronavirus.jhu.edu/region/us/north-carolina*

Spotted Fever, ehrlichiosis, Lyme disease and Southern Tick-Associated Rash Illness (STARI). The most frequent mosquito-borne illnesses, or “arboviruses,” in North Carolina include La Crosse encephalitis, West Nile virus and Eastern Equine Encephalitis. Yellow fever, carried by mosquitos posed problems in early North Carolina (1800s) and did so until a vaccine was developed in 1937, An outbreak of the West Nile Virus began showing up in the United States in 1999, with North Carolina reporting 63 cases from that time through the end of 2016.

A map showing the number of Zika cases reported in each state in 2016 can be found in Figure 3-45. According to the Centers for Disease Control, there were 97 cases of Zika in the State of North Carolina in 2016, and only five reported cases in 2017.

Figure 3-45 Number of Zika Cases Reported in 2016 by State

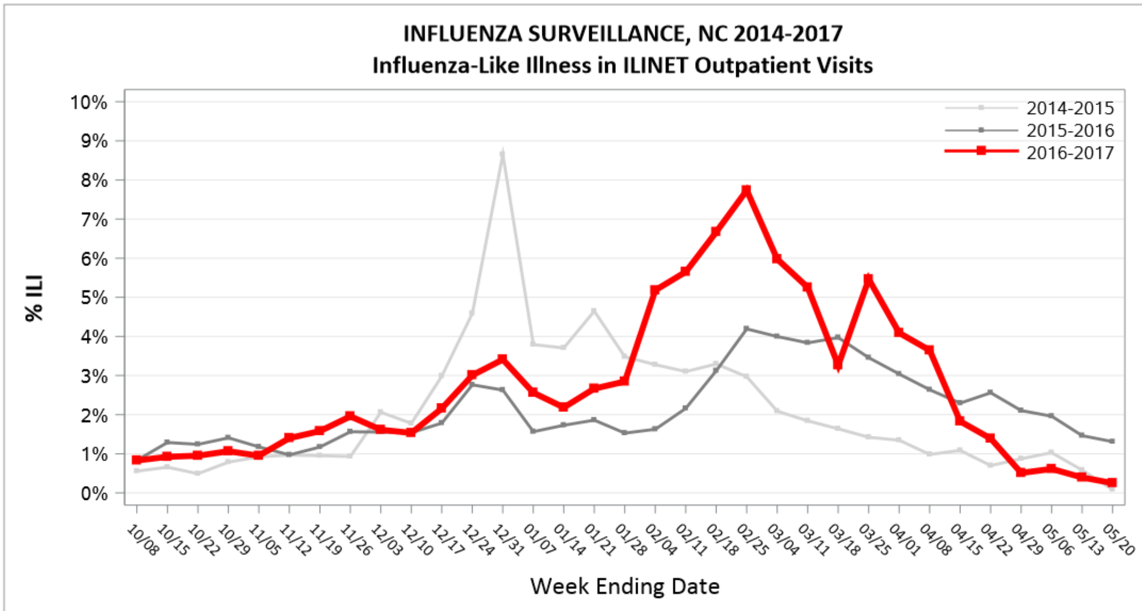


Source: Centers for Disease Control

As stated previously, diseases like influenza and norovirus are regularly occurring health issues in North Carolina. These conditions are not legally reportable to county or state public health agencies, so data on disease incidence is not readily available. These diseases are monitored through local epidemiological surveillance systems in hospitals and health departments and any potential outbreaks are investigated promptly.

Influenza: There were over 452,000 Influenza cases report in North Carolina in the 2016-2017 Flu season, contributing to 219 Influenza related deaths. Most of these deaths occurred between February and April 2017. These events are displayed in Figure 3-46 below.

Figure 3-46 Influenza Surveillance, NC 2014-2017



Source: http://www.flu.nc.gov/

COVID-19: There has been over 2.7 million cases of COVID-19 reported in North Carolina since April 7, 2020, of those cases they have contributed to 24,644 deaths. These events are displayed in Figure 3-46 below.

Figure 3-47: NC COVID Cases Per 10,000 Residents

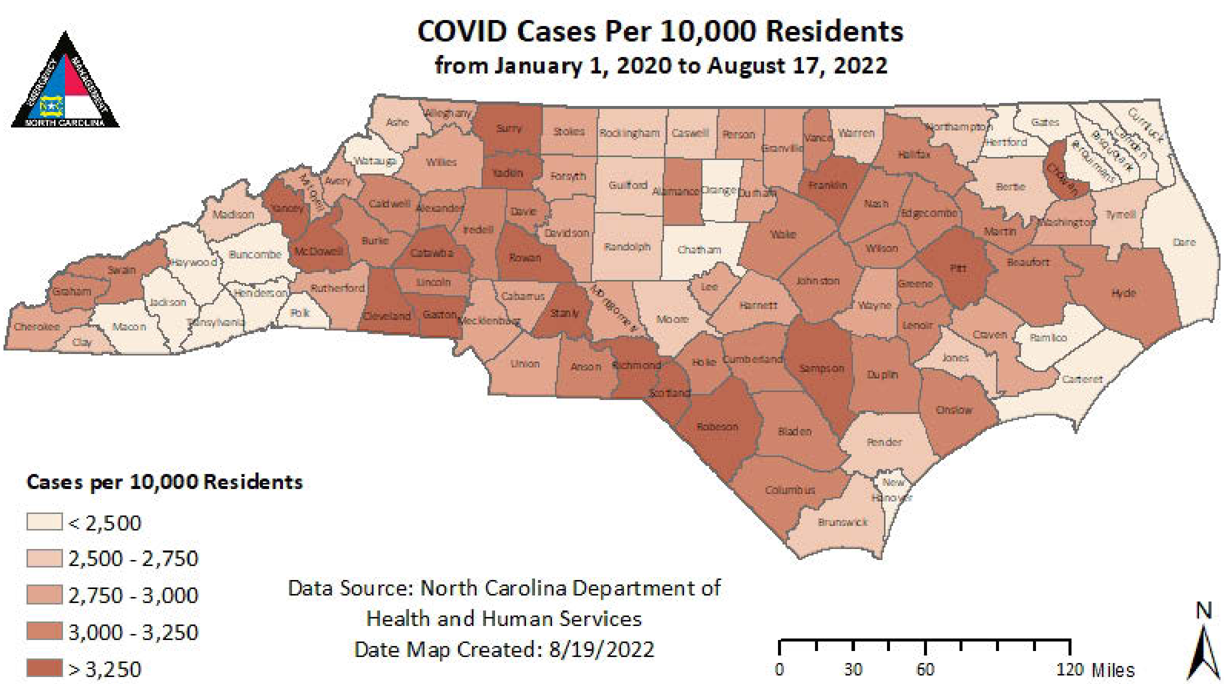


Figure 3-48: NC COVID Deaths by County

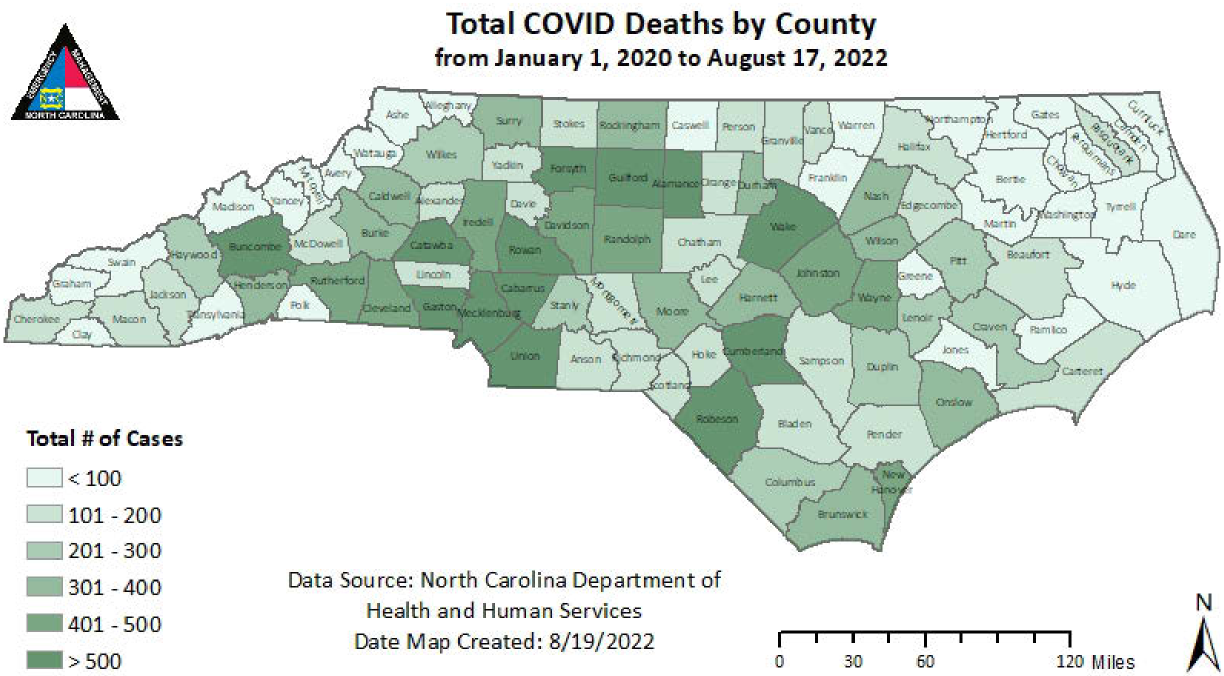
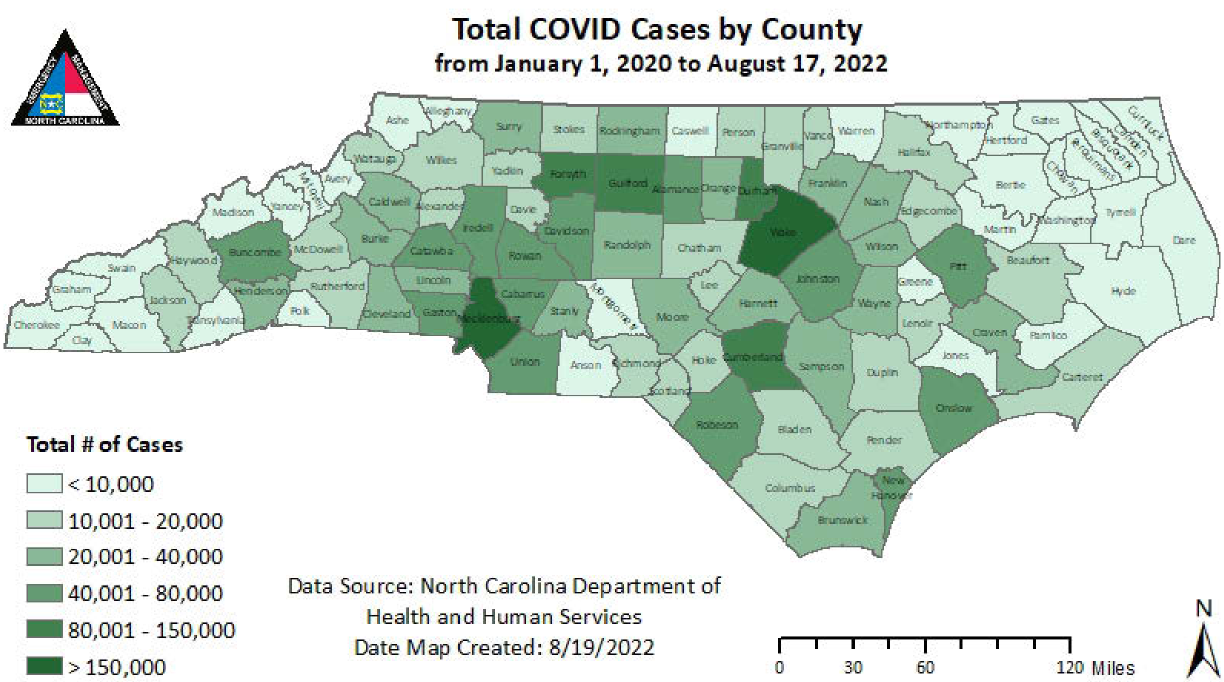


Figure 3-49: NC COVID Cases by County



Foreign Animal Diseases: As previously discussed above, foreign animal diseases are closely monitored by the United States Department of Agriculture (USDA), and the North

Carolina Department of Agriculture and Consumer Services to prevent widespread infections. However there have been cases of highly pathogenic avian influenza (HPAI) in North Carolina. On March 30, 2022 the USDA Animal and Plant Health Inspection Service (APHIS) confirmed the presence of HPAI in a commercial poultry flock in Johnston County, North Carolina in samples tested at the Rollins Diagnostic Laboratory. Although a case of HPAI was detected, the CDC reported that it did not present an immediate public health concern to other poultry operations. No human cases of avian influenza virus were detected either in the United States.

3.2.11.5 Changing Future Conditions

There have been many studies conducted concerning climatic conditions and infectious diseases, that demonstrate a link. Many diseases, such as malaria, dengue fever, and yellow fever are spread through mosquitoes that reproduce and thrive in warm, wet conditions. According to the World Health Organization, Malaria epidemic risk has shown to increase nearly five-fold after El Niño events; therefore, if warming surface temperatures and increased precipitation trends continue, North Carolina may be more susceptible to disease occurrence. Existing inequities in environmental health exposures are exacerbated by climate change; older adults, children, low-income earners, communities of color, and veterans are disproportionately harmed.

3.2.11.6 Impact

COVID-19 made a profound impact on influenza cases in North Carolina. In comparison to the previous two reporting years, cases of influenza significantly dropped. There was a total of 391 deaths for the 2017-2018 Flu season, and 203 deaths for the 2018 – 2019 Flu season. Additionally, a total of 186 deaths from influenza was reported for the 2019 – 2020 Flu season. For the period September 2020 to May 2021, the North Carolina Department of Health reported seven deaths related to seasonal flu. COVID-19 mitigation measures such as wearing face masks, staying home, hand washing, school closures, reduce travel, increased ventilation of indoor spaces, and physical distancing likely contributed to the decline in 2020 – 2021 incidence of illness hospitalizations, and deaths form COVID-19 and other contagious diseases including seasonal flu and other respiratory illnesses.

Economic Impact: The COVID-19 pandemic has negative effects on the North Carolina economy. According to the Carolina Small Business organization, preliminary reports from April 2020 suggested the expected impacts on small (employing 1 – 19) and medium-sized (employing 20 – 99) to be most significant. Estimates suggest 141,877 smaller businesses and 1.38 million jobs across the state were in high-risk industry sectors like leisure and hospitality, food and beverage services, trade and transportation, educational and health services, and manufacturing.

In a recent study published by the NC Policy Collaboratory Research Project on the impact of COVID-19 in the Piedmont Triad region. With an estimated population of over 1.75 million, the Piedmont Triad is the third largest combined statistical area in North Carolina. Five of the largest counties in the region (Guilford, Forsyth, Alamance, Davidson, and Randolph) account of 80% of the population. Pre-pandemic, this region had 30% of households that were living at or below the federal poverty level ($26,000 for a family of four), and labor force participation rate for the entire region was 58%, with median household incomes of just over $46,000.

In March of 2020, a statewide quarantine was declared in an effort to curb COVID-19 cases in North Carolina. Most business – except for those offering essential services – and K-12 schools, closed May 15th. The study showed that the unemployment rate in the Piedmont Triad region peaked in May 2020 at 13.3% with slight variations across the Piedmont /Triad 12-county population. Additionally, a survey of business and households in the Triad indicate 64% of businesses had moderate to large negative effects from COVID-19, and 60% will either temporarily or permanently shut down if there was another lockdown. 42% of households reported lost employment income since March 2020 directly due to COVID-19; and 42% of households reported having difficulty paying their mortgage/rent, 49% had problems paying for utilities, and 50% had trouble paying for groceries. Conservative models estimate the annual economic impacts of COVID-19 on the economy of the Piedmont /Triad region includes 55,960 lost jobs, $10.5 billion lost output, and $1,1 trillion lost state and local tax revenues.[50]

While this study does not cover the entire economic loss due to the COVID-19 pandemic and subsequent public health measures, it does provide a better understanding of the economic impact of an extended infectious disease event like the COVID-19 pandemic.

Influenza also has negative effects on the North Carolina economy. It accounts for 7-10 lost work days per case, and there were over 3 million combined lost work days during the 2016-2017 Flu season.

3.2.11.7 Future Probability

It is difficult to predict the future probability of infectious diseases due to the limited availability of information on this type of hazard. The most common and probable pandemic or endemic disease in the state has shown to be influenza; based on historical data, it is relatively unlikely (between 1 and 33.3 percent annual probability) that North Carolina will experience an outbreak of infectious diseases in the near future.

3.2.11.8 NCEOP Reference

Annex B, Appendix 6, Communicable Disease and Biohazard Response Plan
Annex C, Appendix 6, Hazards and Threats

[50] *Economic Impact of COVID-19 in the Piedmont Triad Region – NC Policy Collaboratory Research Project. North Carolina Agricultural and Technical State University's Willie A. Deese College of Business and Economics. Retrieved on September 16, 2022 from: https://collaboratory.unc.edu/wp-content/uploads/sites/476/2021/03/economic-impact-of-covid-19-in-the-piedmont-triad-region.pdf.*

3.3 TECHNOLOGICAL HAZARD IDENTIFICATION

3.3.1 Hazardous Substances

3.3.1.1 Description

Hazardous Materials

For the purposes of this plan, NCEM defines a hazardous substance as any element, chemical, substance, compound, mixture, agent, solution or substance that an accidental or deliberate release of may cause disease or harm to human health and the environment. Hazardous substances may have one or more of the following intrinsic properties: explosiveness, flammability, ability to oxidize (or accelerate a fire), human toxicity, or corrosiveness. Hazardous materials are found in many different forms and quantities that can potentially cause property damage, injuries, long-lasting health effects, and death. Many of these materials are used and stored daily in homes and businesses, and transported through major highways, waterways, pipelines, and railways. Each hazard has a different threshold level, and can be naturally occurring, which creates many risks in the event of an accidental or intentional event.

Hazardous material (HAZMAT) incidents consist of solid, liquid and/or gaseous contaminants that can occur at fixed facilities or mobile sources. Many HAZMAT emergencies result from accidents or negligent behavior, but some may be purposefully designed, such as a terror attack. These incidents can be acute or long-lasting, and can cause poisoning, fires or explosions, potentially affecting vast populations of people and wildlife.

HAZMAT incidents may also be a result of natural hazard events, such as hurricanes, earthquakes, or floods. In these circumstances, response efforts may be hindered, which can intensify the disaster. An example of this occurred after Hurricane Floyd hit North Carolina in 1999; many communities were left with flooded junkyards, deceased livestock, disturbed cemeteries, along with environmental pollutants such as uncontrolled fertilizer spills and floating propane tanks.

In 1984, a chemical plant leak in Bhopal, India resulted in the death of thousands of people. Approximately six months later, a similar incident occurred in West Virginia. These two events raised concerns about community preparedness in the event of a chemical emergency, which led to the establishment of the Emergency Planning and Community Right-To-Know Act (EPCRA) in 1986. This act created requirements for local, state, and federal governments in the event of toxic chemical emergencies, which include planning and response efforts, and that information be made available to the public to increase awareness and protect public and environmental health. Furthermore, emergency notification requirements call for the release of specific information, including the name of the released chemical, quantity released, method of release (air, water, and/or land), anticipated health risk involved, proper precautions, and emergency contact information. More information about EPCRA can be found here: https://www.epa.gov/epcra/what-epcra

3.3.1.2 Extent

The extent of hazardous materials incidents can be defined in terms of the amount of material released. The United States Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains a database of reported mobile hazardous materials incidents. According to that database, the largest release of a hazardous substance in North Carolina occurred in Hertford County in 1978 when 187,000 liquid gallons of gasoline were released during a highway HAZMAT incident.

Measuring extent of hazardous materials accidents is difficult because there are so many different types of hazardous substances. EPCRA reporting requirements have led to the publication of a consolidated list of chemicals subject to EPCRA, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Clean Air Act that can be accessed by anyone online at: https://www.epa.gov/sites/production/files/2015-03/documents/list_of_lists.pdf

The EPA's List of Lists also provides the threshold for the quantities of materials that must be reported by facilities if those materials are stored on-site. These thresholds, by hazardous material, can also be considered hazard extents for hazardous materials.

3.3.1.3 Location/Spatial Extent

Most fixed HAZMAT operations in North Carolina are in rural areas, away from large cities. However, many mobile HAZMAT emergencies occur from transportation accidents on major highways and railways in metropolitan areas. "Hot spots" have been identified and tend to happen in heavily populated areas. Some of these locations are recorded by the Department of Transportation and can be accessed at: https://www.phmsa.dot.gov/

As a result of the 1986 accidents and establishment of EPCRA, the Environmental Protection Agency publishes some hazardous material information for the public. The EPA collects information from industrial facilities when toxic agents are released and/or transferred, and this data is reported to the Toxic Release Inventory (TRI). According to the EPA, in October 2021 there are 753 TRI facilities in North Carolina. These facilities are mapped in Figure 3-49.

Figure 3-50 TRI Facilities in North Carolina

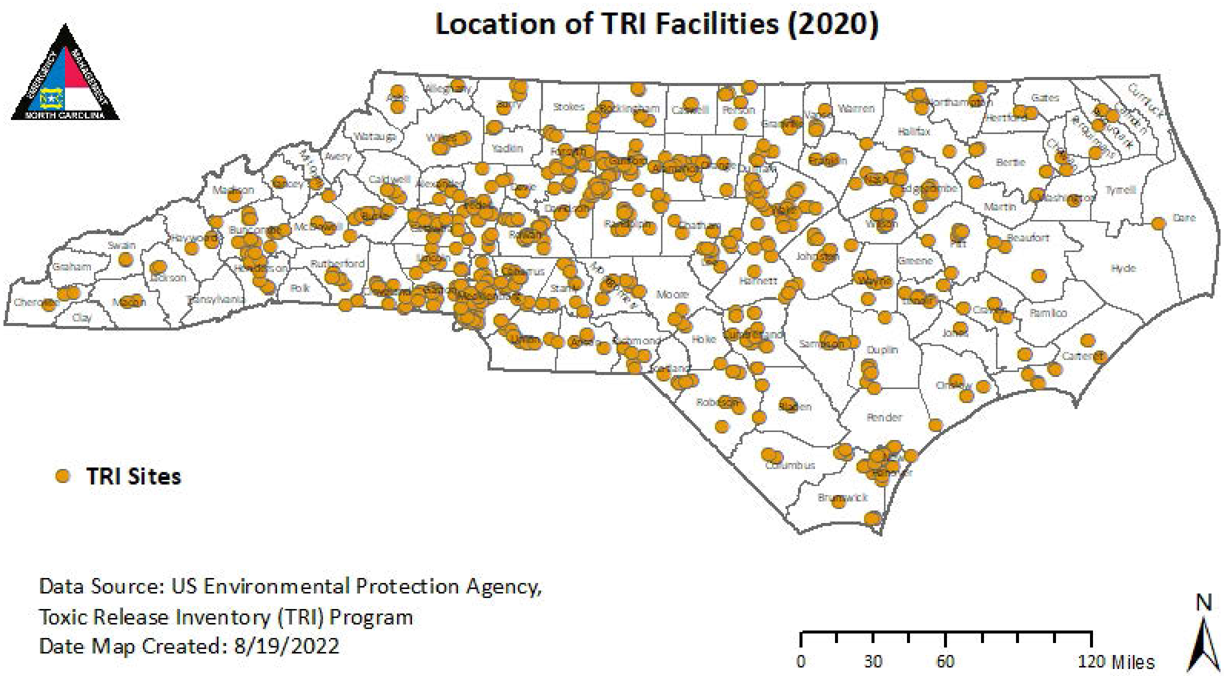
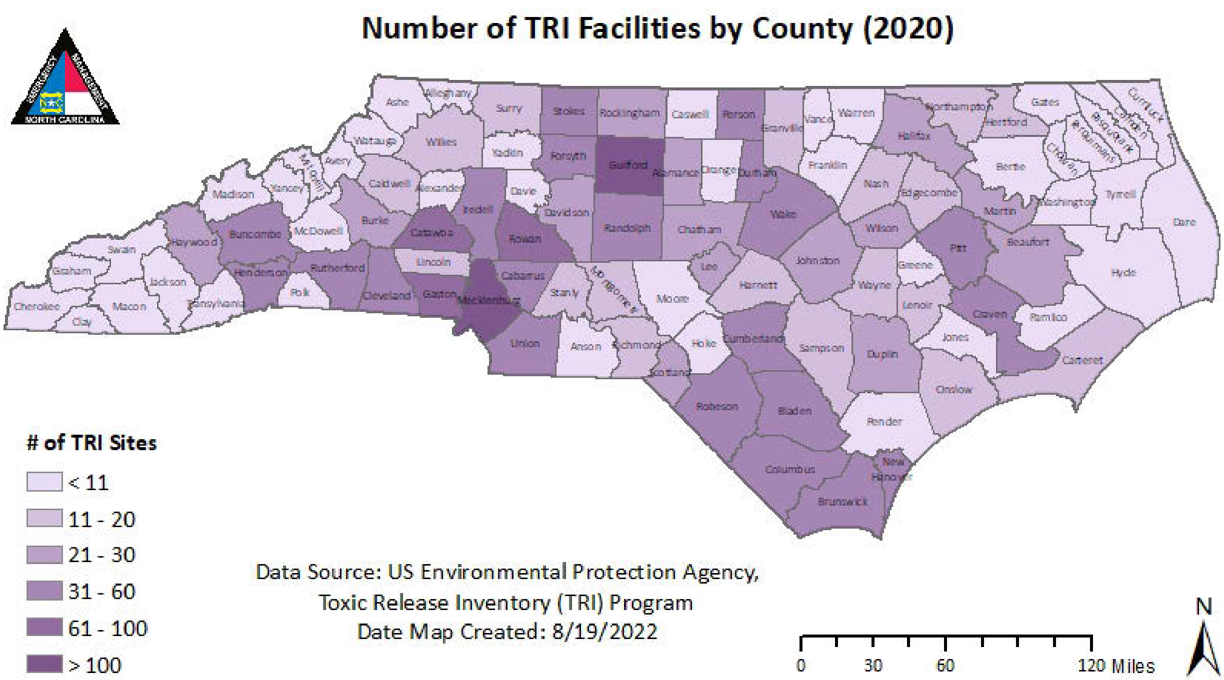


Figure 3-51: Number of TRI Facilities by County



Another source of location data for hazardous materials facilities includes SARA Tier II facilities reported to the EPA as part of the agency's Risk Management Plan rules (not available to the public).

The Environmental Protection Agency (EPA) also maintains a National Priority List (NPL) which identifies known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation. Inclusion of a site on the NPL does not in itself reflect a judgment of the activities of its owner or operator, it does not require those persons to undertake any action, nor does it assign liability to any person. In North Carolina, there are currently 38 NPL sites listed in Table 3-27 by county.

Table 3-27 North Carolina Active National Priority List Sites by County

County	Site Name
Ashe	Ore Knob Mine
Beaufort	FCX, Inc. (Washington Plant)
Brunswick	Kerr-McGee Chemical Corp – Navassa
	Potter's Septic Tank Service Pits
Buncombe	Blue Ridge Plating Company
	CTS of Asheville, Inc.
	Chemtronics, Inc.
Cabarrus	Bypass 601 Ground Water Contamination
Cleveland	Celanese Corp. (Shelby Fiber Operations)
Columbus	Wright Chemical Corporation
Craven	Cherry Point Marine Corps Air Station
Cumberland	Carolina Transformer Co.
	Cape Fear Wood Preserving
Gaston	Jadco-Hughes Facility
	Davis Park Road TCE
	North Belmont PCE
	Hemphill Road TCE
Granville	JFD Electronics/Channel Master
	Cristex Drum
Haywood	Benfield Industries, Inc.
	Barber Orchard
Henderson	General Electric Co/Shepherd Farm
Iredell	Sigmon's Septic Tank Service
	FCX, Inc. (Statesville Plant)
Mecklenburg	Ram Leather Care
Moore	Aberdeen Contaminated Ground Water
	Aberdeen Pesticide Dumps
	Geigy Chemical Corp. (Aberdeen Plant)
New Hanover	Horton Iron and Metal
Onslow	Camp Lejeune Military Reservation
	ABC One Hour Cleaners
Person	GMH Electronics

County	Site Name
Richmond	Charles Macon Lagoon & Drum Storage
Rowan	National Starch & Chemical Corp.
Wake	Koppers Co., Inc. (Morrisville Plant)
	North Carolina State University (Lot 86, Farm Unit #1)
	Ward Transformer
Yadkin	Holcomb Creosote Co

3.3.1.4 Hazard History

For mobile HAZMAT incidences, the PHMSA database of hazardous materials incidents indicates that for North Carolina, there have been 18,205 reported incidents dating back to 1971. This accounts for more events than for any other hazard event types combined.

There is no known database of fixed facility HAZMAT incidents.

3.3.1.5 Changing Future Conditions

Some HAZMAT emergencies may be triggered by natural disasters, and changing climatic conditions may cause more extreme weather events. A Government Accountability Office (GAO) Study on Chemical Accident Prevention from February 2022 found that about 31 percent of EPA-regulated Risk Management Plan facilities across the country are in areas that may be impacted by flooding, storm surge, wildfire, or sea level rise, which are hazards that may be exacerbated by climate change. Increasing frequency and/or intensity of these hazards due to climate change may result in increased risk of HAZMAT emergencies due to extreme weather conditions or natural hazard impacts at industrial and other sites.

Furthermore, as North Carolina’s population continues to grow, more people become increasingly vulnerable to incidents involving hazardous substances. Therefore, it is important to carefully monitor all hazardous fixed facilities and transportation routes and continue to attempt to prevent future incidents from occurring through controlled growth and continued preparedness, monitoring, and training.

3.3.1.6 Impact

HAZMAT accidents can potentially affect large populations of people and wildlife. Impacts may go unnoticed for several hours, days, or weeks depending on the substance released. Although impacts can be widespread, the most vulnerable populations tend to be localized near railroads, pipelines, highways, and/or fixed facilities.

3.3.1.7 Future Probability

Unfortunately, there isn’t a “typical” type of HAZMAT emergency. While most incidents are the result of negligent behavior, transportation accidents or criminal acts, it is difficult to predict the probability or type of a future occurrence. However, due to historical occurrences, people living along major highways or near HAZMAT operations may be most at risk. North Carolina is known to have one of the best HAZMAT response programs in the country, but it is still highly likely (between 66.7 and 100 percent annual probability) that a hazardous materials incident may occur in any given year.

3.3.1.8 NCEOP Reference

Annex B, Appendix 5, Oil-Petroleum Products Spill Response Plan
Annex C, Appendix 6, Hazards and Threats

3.3.2 Radiological Emergency – Fixed Nuclear Facilities

3.3.2.1 Description

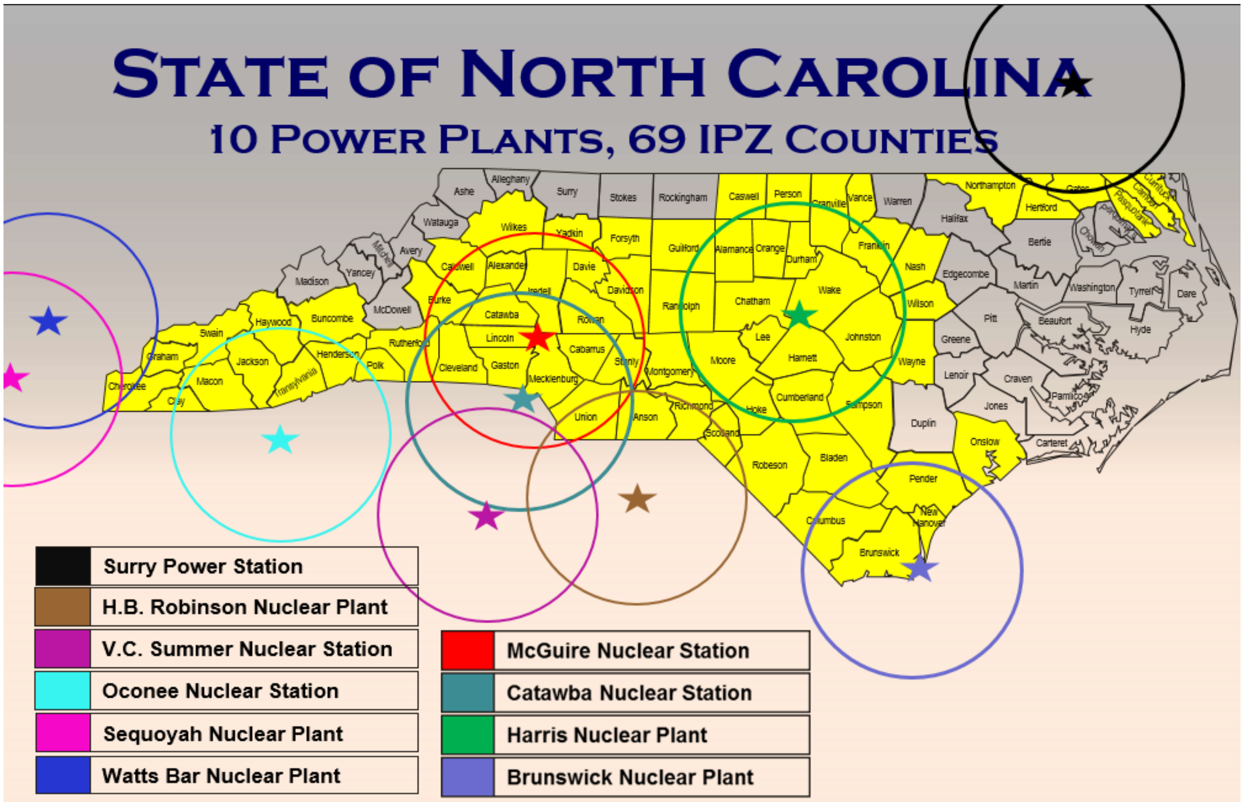
A nuclear and radiation accident is defined by the International Atomic Energy Agency as "an event that has led to significant consequences to people, the environment, or the facility." Often, this type of incident results from damage to the reactor core of a nuclear power plant from a range of proximate causes which can release radioactivity into the environment. The degree of exposure from nuclear accidents has varied from serious to catastrophic.

The Department of Homeland Security's Radiation Emergency Preparedness (REP) program, established in 1979 after a nuclear accident at Three Mile Island Nuclear Generating Center in Harrisburg, PA, coordinates the national efforts of state and local governments in implementation of mitigation strategies involving nuclear power plants. The program deals with fixed nuclear facilities (FNF) within or having a portion of the 10-mile Emergency Planning Zone (EPZ) within the country, including North Carolina. More information about the REP Program can be found here: https://www.fema.gov/radiological-emergency-preparedness-program

Globally, there are around 430 operational reactors, and 200 of them are expected to retire by the year 2040 (Source: IEA). In North Carolina nuclear energy contributes the second-largest share of the state's electricity generation with 28% in 2022, according to the U.S. Energy Information Administration. Natural gas is the leading source, accounting for 47% of electricity generation, while coal and renewables account for 12% and 14% respectively. The state also produced 5.3% of the nation's total electricity from nuclear power in 2020, ranking fourth in the nation. (Source: https://www.eia.gov/state/?sid=NC).

The following figure displays all nuclear power plants in North Carolina and those within 50 miles of the border. (See Figure 3-52)

Figure 3-52 North Carolina Radiological Emergency Preparedness



Source: NC Emergency Management

The following counties are located within a 50-mile radius of the a nuclear power plant's center:

- Alamance
- Alexander
- Anson
- Bladen
- Brunswick
- Buncombe
- Burke
- Cabarrus
- Caldwell
- Camden
- Caswell
- Catawba
- Chatham
- Cherokee
- Clay
- Cleveland
- Columbus
- Cumberland
- Currituck
- Davidson
- Davie
- Duplin
- Durham
- Forsyth
- Franklin
- Gaston
- Gates
- Graham
- Granville
- Guilford
- Harnett
- Haywood
- Henderson
- Hertford
- Hoke
- Iredell
- Jackson
- Johnston
- Lee
- Lincoln
- Macon
- Mecklenburg
- Moore
- Montgomery
- Nash
- New Hanover
- Northampton
- Onslow
- Orange
- Pasquotank
- Pender

- Person
- Polk
- Randolph
- Richmond
- Robeson
- Rowan
- Rutherford
- Sampson
- Scotland
- Stanly
- Swain
- Transylvania
- Union
- Vance
- Wake
- Wayne
- Wilson
- Wilkes
- Yadkin

Harris Nuclear Plant

The Harris Nuclear Plant is located in New Hill, North Carolina, about 20 miles southwest of Raleigh. It commenced operation on May 2, 1987 and its current license of operation expires in 2046. The plant staffs approximately 800 people and generates electricity for more than 550,000 homes in the surrounding areas[51].

The plant is surrounded by North Carolina's "triangle" region, which includes Raleigh, Durham, and Chapel Hill. Located within a half hour of the plant, Research Triangle Park (RTP) is the nation's leading and largest technology research and science park. Raleigh-Durham International Airport is around 25 miles away, and three of the state's largest universities (Duke, NC State, and UNC-Chapel Hill) are also in the same area.

Brunswick Nuclear Plant

The Brunswick Nuclear Plant is located just north of Southport, North Carolina on the Cape Fear River. The plant is a two-unit boiling water reactor, and the units commenced operation in 1975 and 1977. This was the first nuclear power plant built in North Carolina and it has a capacity of 1,870 megawatts.

Covering 1,200 acres, the plant is less than thirty miles outside of downtown Wilmington, and less than forty miles from Wrightsville Beach. It is also adjacent to many woodlands, wetlands, and the Atlantic Ocean. Its proximity to tourist destinations make the surrounding areas very economically and environmentally vulnerable, and the nearby populations are steadily increasing[52].

McGuire Nuclear Station

The McGuire Nuclear Station is located on Lake Norman in Mecklenburg County, about 17 miles north of Charlotte. Lake Norman was built by Duke Energy in 1963 and is the state's largest man-made lake. The first unit of the station commenced operation in 1981, and the second in 1984. It has a capacity to produce 2,316 megawatts of power and employs more than 1,200 employees[53].

[51] *https://www.duke-energy.com/our-company/about-us/power-plants*
[52] *https://www.census.gov/quickfacts/fact/table/wilmingtoncitynorthcarolina/PST045216*
[53] *https://nuclear.duke-energy.com/2013/06/25/mcguire-nuclear-station-focuses-on-operational-excellence-and-community-outreach*

The plant lies in between North Carolina's largest city, Charlotte, and the Hickory/Statesville area. These highly populated nearby cities are home to many universities, big industries, and airports. In Charlotte alone, the population rose by 1.9% from 2019-2020, and population and employment are continuing to increase[54]. As more people move to the surrounding area, the population is therefore more vulnerable to potential emergencies at the McGuire Nuclear Station.

The following fixed nuclear facilities are located outside of the state, but have 50-mile emergency management zones that affect North Carolina:

- Catawba Nuclear Station
- H. B. Robinson Nuclear Generating Station
- Oconee Nuclear Station
- Watts Bar Nuclear Plant
- Virgil C Summer Nuclear Generating Station
- Sequoyah Nuclear Plant
- Surry Power Station

Catawba Nuclear Station

The Catawba Nuclear Station is located on Lake Wylie in York County, South Carolina; however, it is jointly owned by North Carolina Municipal Power Agency Number One. Its first unit began operating in 1985, followed by the next unit in 1986. It has a capacity for 2,310 megawatts of power, and is only 11 miles southwest of Charlotte, NC[55].

H.B. Robinson Nuclear Generating Station

The H.B. Robinson Nuclear Generating Station is located in Hartsville, South Carolina. It began operation in 1970, and renewed its contract in 2004.

Oconee Nuclear Station

The Oconee Nuclear Station is located near Seneca, South Carolina. It began operation in 1973 and is currently operating under a renewed license until 2033. With three nuclear stations, it is one of the nation's largest nuclear plants.

Surry Power Station

The Surry Power Station is located in Surry, Virginia, about 17 miles away from Newport News. Its license of operation was issued in 1972 and is currently operating under a renewed license until 2032. The plant generates enough power for 420,000 homes.

Watts Bar Nuclear Plant

The Watts Bar Nuclear Plant is located in Spring City, Tennessee, about 60 miles from Knoxville. It first began operation in 1996, and recently commenced a second unit in 2016. It is currently licensed to operate until 2055.

[54] *https://datausa.io/profile/geo/charlotte-nc/*
[55] *https://www.duke-energy.com/our-company/about-us/power-plants*

Sequoyah Nuclear Plant

The Sequoyah Nuclear Plant is located in Soddy-Daisy, Tennessee near Chattanooga. The plant received its operating license in 1980 and is scheduled to remain operational until 2040.

Virgil C. Summer Nuclear Station

The Virgil C. (V.C.) Summer Nuclear Station is located in Jenkinsville, South Carolina. It has a combined license that was issued in 2012.

3.3.2.2 Extent

Only 31 of North Carolina's 100 counties are not located in ingestion pathway zones (IPZ) from a nuclear facility. The primary focus of the REP is on the four nuclear power plants that are located in the state and/or surrounding EPZ counties, which are:

- Brunswick NPP - Brunswick & New Hanover Counties
- Harris NPP - Wake, Chatham, Lee, and Harnett Counties
- McGuire NS - Mecklenburg, Gaston, Lincoln, Catawba, and Iredell Counties
- Catawba NS - Mecklenburg, and Gaston Counties

Figure 3-53: Harris Nuclear Plant

Source: https://www.nrc.gov/info-finder/reactors/har1.html

Figure 3-54: McGuire Nuclear Station

Source: https://www.nrc.gov/info-finder/reactors/mcg1.html

The program also supports the EPZ planning for Sequoyah, Watts Bar, Oconee, Summer, Robinson, and Surry facilities located in adjacent states and monitor the research reactor, NCSU PULSTAR in Wake County and Fuel Rod Fabrication Facility at Global Nuclear in New Hanover County.

The EPZ represents the time critical decision area where concern for safety of the general public and emergency workers drives emergency management decision making. The goal is to protect the health and safety of the public living in the vicinity of the nuclear power facility by providing reasonable assurance that appropriate protective measures can be taken offsite in the event of a radiological emergency. In North Carolina, each nuclear facility has two planning zones. A ten-mile radius around each plant would be expected to evacuate in the event of an emergency (**Error! Reference source not found.**). Secondly, the IPZ is a 50-mile radius zone. The IPZ has been designed to mitigate contamination of the human food chain by a radiological accident at a nuclear power plant. The ingestion pathway is characterized by radionuclides being deposited on surfaces, potentially contaminating foods such as milk, fresh vegetables, and water supplies.

Historically, there have been no major release events at North Carolina REP facilities, and one reported situation where the nuclear material was being monitored for criticality that occurred in 2008 within the at the fuel rod fabrication facility. The probability is considered very unlikely due to the extensive accident prevention and emergency preparedness programs that these facilities support. The consequence of the worst-case scenario is considered catastrophic.

Concerns that an event at a REP facility may impact the continuity of response operations has led to planning changes over the past few years where these facilities have moved response equipment storage areas and other facilities outside the 10-mile EPZ. While it would be likely that a major event could impact local Emergency Operations Centers (EOCs) in some jurisdictions, these could be relocated or transferred to the State EOC if needed, given the long timescales for these events. With these improvements, an event at a REP facility would be expected to have a minor impact on continuity of operations. Due to the nature of the hazard and the general over estimation of the radioactive hazards by the public a significant event at a nuclear facility would present a challenge to public confidence. To increase mitigation, State and local governments are also required to conduct off-site radiological emergency preparedness activities within the EPZs of all nuclear power facilities every two years.

Existing REP plans are believed to have adequate measures in place to address these concerns.

In summary:

- The REP program has primary responsibility for preparedness for four fixed nuclear facilities that are in or may significantly impact the state.
- An additional 6 facilities have portions of the 50-mile IPZ within the state.
- A test reactor and fuel rod assembly facility are monitored by the program.

The NRC

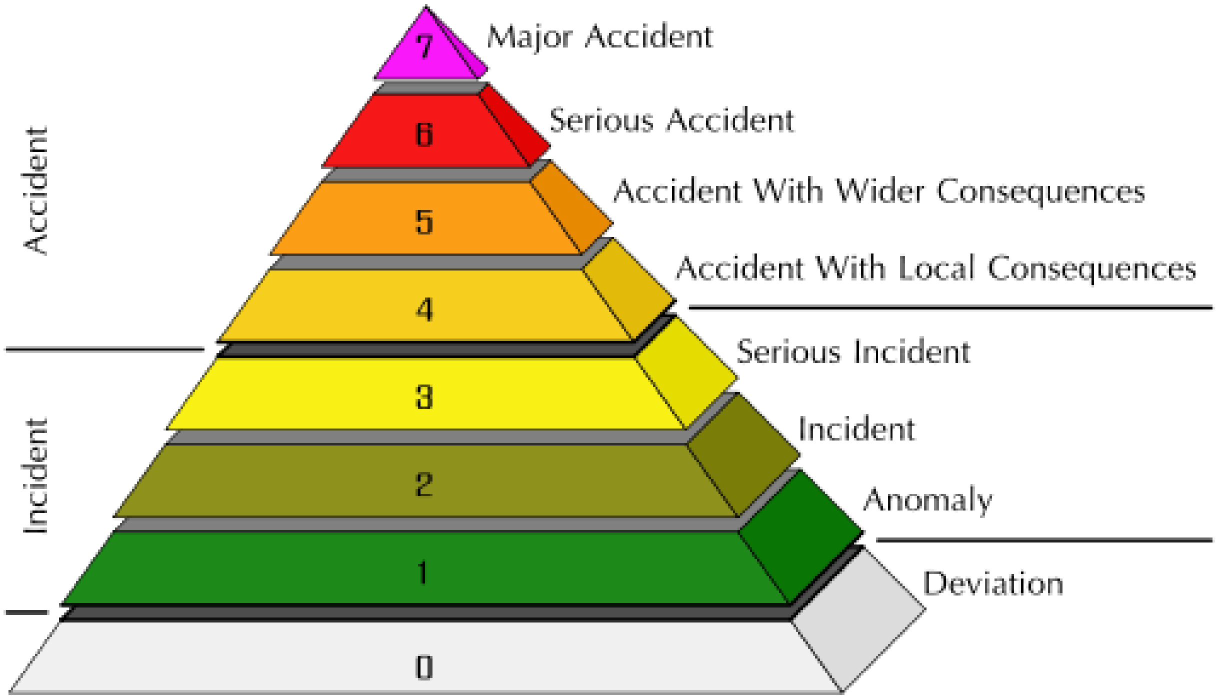
The US Nuclear Regulatory Commission (NRC) is an agency that was formed by Congress in 1974 to ensure the safe use of radioactive materials. The NRC regulates commercial nuclear power plants and other uses of nuclear materials. The agency is headed by commissioners that formulate policy, issue orders, and enforce regulations.

The IAEA

The International Atomic Energy Agency (IAEA) is an agency that was established in 1957 in response to fears and expectations associated with nuclear technology. Its statute was unanimously approved by 81 nations in 1956 as the world's "Atoms for Peace" organization to promote safe, secure, and peaceful nuclear technologies.

The IAEA has developed a scale called the International Nuclear and Radiological Event Scale (INES) which provides a quantifiable means of assessing the extent of a nuclear event. This scale is logarithmic, which means that each increasing level on the scale represents an event 10 times more severe than the previous level.

Figure 3-55 International Nuclear and Radiological Event Scale

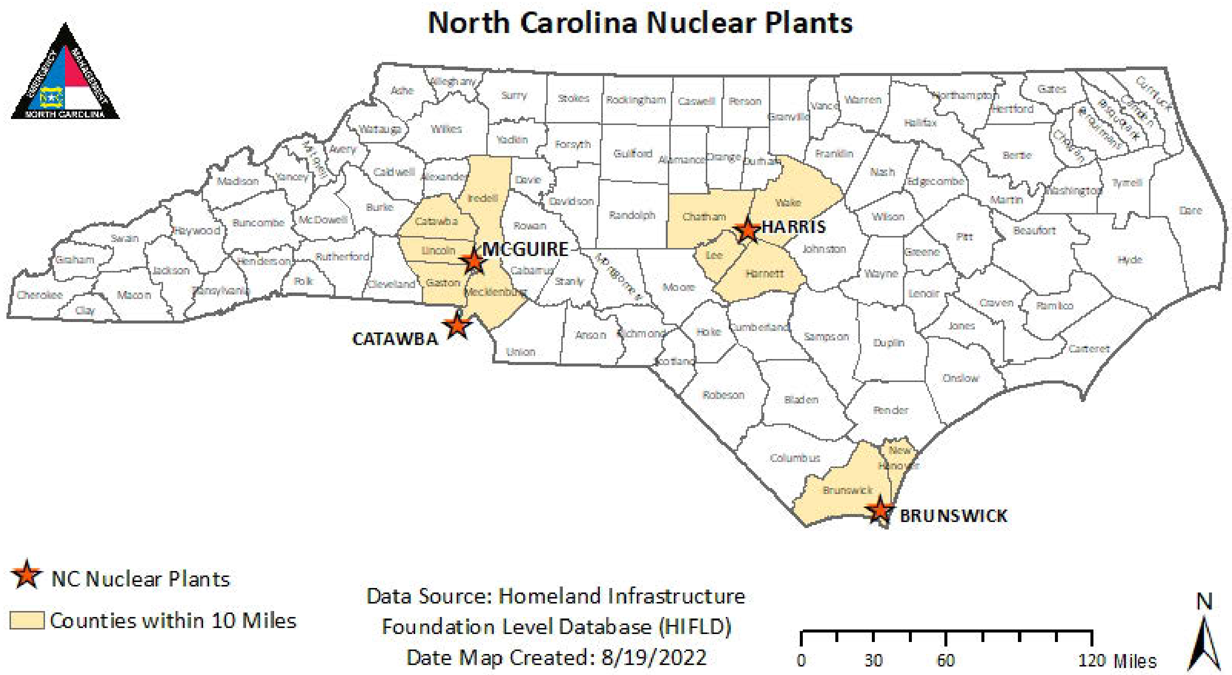


Source: International Atomic Energy Association

3.3.2.3 Location/Spatial Extent

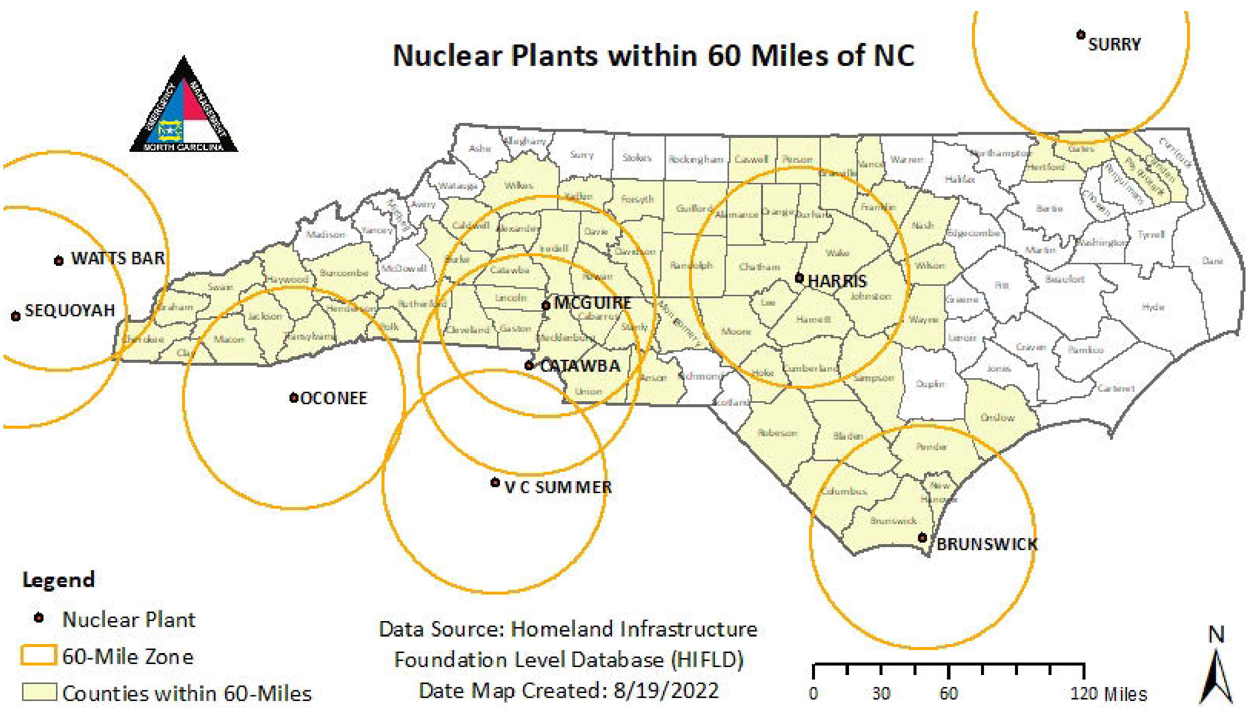
There are four nuclear power plants in North Carolina, which are displayed in Figure 3-63. In the event of an emergency, areas surrounding these plants would be the most affected areas; however, farther areas could potentially be harmed depending on natural factors such as wind direction.

Figure 3-56: Nuclear Power Plants within a 10-mile EPZ in North Carolina



Source: NC Emergency Management

Figure 3-57: Nuclear Plants within 60 Miles of NC



3.3.2.5 Hazard History

Although North Carolina has no history of major radiological emergencies, the State still prepares for the worst-case scenario. Public concern grew following the deadly emergency that struck Japan in March 2011. After a 9.0 earthquake and tsunami hit the Fukushima Dai-ichi Nuclear Power Plant, radioactive material was released and transported globally, even reaching parts of the US. Immediately after the earthquake, the US Center for Disease Control (CDC) activated its Emergency Operations Center (EOP) in anticipation of effects spreading across the country. While high levels of contaminants did not reach the US Pacific Coast, there was still fear of American interactions with Japan and the possibility of cross-contamination. The CDC worked, and still works, with federal, state, and local governments to provide public health protective action recommendations in the event of a similar emergency.

3.3.2.6 Changing Future Conditions

Although North Carolina has not recently experienced nuclear catastrophes, severe weather is one of the causes of potential harm to nuclear facilities. Radiological emergencies can be caused by physical damage to a nuclear facility, loss of power, or loss of cooling capacity. A 2004 Nuclear Information and Resource Service (NIRS) fact sheet on Natural Disasters and Safety Risks at Nuclear Power Stations reviewed past damages at nuclear facilities in the U.S. highlighted these risks of failure and noted flooding, severe weather, and high wind events as major hazards for nuclear facilities. Flooding can damage critical equipment or spread contamination within a nuclear site. Flooding, severe weather and wind, or wildfires can cause power outages that could compromise nuclear facility operations, including communications, ventilation, and cooling. Additionally, severe droughts could threaten water supply needed to maintain cooling capacity. The possibility of extreme weather, flooding, and drought and wildfire is increasing due to changing climatic conditions, so it is critically important to continue to monitor radiological facilities in the state.

North Carolina’s population growth is also a concern for nuclear emergencies; as the population increases, more people become subject to radiological effects. In the event of a disaster, millions of people could be harmed or killed. This growth is especially apparent in the areas surrounding the Harris Nuclear Plant, which is partially due to technological advances and increasing employment at Research Triangle Park. As more people move to or commute to the area, they are also more susceptible to a hazardous event occurrence.

The NRC and local governments study and develop evacuation time estimates (ETEs), which are part of the planning basis for each nuclear power plant. ETEs are required to be performed to estimate the time needed to evacuate the public in the event of a disaster, and they are updated based on population growth near nuclear facilities. In North Carolina, the most recent ETE update took place in 2017 because of population booms. The number of Wake County residents in a 10-mile zone of a nuclear facility rose from 84,654 in 2008 to 118,967 in 2017. As the state’s population continues to grow, it will be important to advance mitigation strategies as well.

3.3.2.7 Impact

The impacts of a nuclear emergency could potentially be catastrophic. Radioactive contamination can spread quickly, or immediately by explosion, putting millions of people at risk. However, it is also important to consider the agricultural and economic impacts of an emergency.

One of North Carolina's main economic resources is agriculture, and many people's jobs are dependent upon the land. North Carolina's agricultural economy would clearly be acutely impacted after a radiological emergency, but the effects would be long-lasting; land would continue to be unusable for years and possibly even decades. The Price-Anderson Nuclear Industries Indemnity Act (commonly known as the Price-Anderson Act) is a Federal law that was passed in 1957 to address this type of issue. The Act's purpose is to provide compensation for nuclear radiological emergencies and can offer $12.8 billion in public compensation to a state in need. This money is financed through reactor companies themselves, and any emergencies that require more monetary compensation would require Congressional approval.

While nearly $13 billion may seem like a huge compensation, it would not be enough to keep the state's economy afloat. Furthermore, initial funding is not available until 3-5 days after the event. Contaminated land could completely ruin the agricultural industry for North Carolina, the nation's leading producer of tobacco and sweet potatoes. Therefore, it is crucial to consider how a radiological emergency could impact the state's agriculture and economy and mitigation efforts should be aimed at prevention. Guidance should also be developed to cover funding gaps for the public.

3.3.2.8 Future Probability

The future incidence of radiological hazards is highly unpredictable. Conditions may be localized or widespread, and no historical data is available, however as society moves away from a petroleum- based energy regime in pursuit of reduced climate change impacts, it is likely that nuclear energy will make up a larger segment of the portfolio, thus possibly increasing risk of exposure. None the less, based on historical evidence, the likelihood that North Carolina will experience a radiological emergency in the near future is deemed unlikely (between 1 and 33.3 percent annual probability).

3.3.2.9 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.3.3 Terrorism

3.3.3.1 Description

Terrorism is defined in the United States by the Code of Federal Regulations as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives." Terrorist acts may include assassinations, kidnappings, hijackings, bombings, small arms attacks, vehicle ramming attacks, edged weapon attacks, incendiary attacks, cyber-attacks (computer based), and the use of chemical, biological, nuclear and radiological weapons of mass destruction (WMDs). For the purposes of this plan, cyber-attacks are included as a separate hazard.

Historically the main categories of WMDs used in terror attacks are Chemical, Biological, Radiological, Nuclear, and Explosive (collectively referred to as CBRNE). As we rank these categories, considering immediate danger posed, impact, probability, technical feasibility, frequency, and historical success, they are typically ranked in the following order: Explosive, Chemical, Radiological, Biological, and Nuclear.

Explosive – Explosive attacks lead all others due to their immediate danger to life and health, immediate and measurable impact, high probability, low cost/easy degree of technical feasibility, and a long history of successful attacks.

Chemical - Chemical attacks can pose immediate danger to life and health depending upon the materials used. Chemicals are easy to access, low cost, and easy to deploy. Chemical terrorism can have high and persistent impacts to people and places. These types of attacks are probable and have enjoyed historical success.

Radiological – Radiological attacks can pose significant threats to life and health depending upon the specific materials used. Radiological materials, while restricted and regulated, are accessible to people with some knowledge in this discipline. Though radiological incidents have occurred, they occur less frequently than explosive and chemical attacks.

Biological – Biological attacks can pose significant threats to life and health. They are typically deployed as diseases and biotoxins. They require some degree of technical expertise in order to be deployed successfully. While biological incidents have occurred, they occur less frequently than explosive and chemical attacks.

Nuclear - While yielding a very high impact, the nuclear attack is extremely rare as execution is cost prohibitive and very technically difficult to achieve, however, state sponsorship and current instability in international relations could increase the probability of such an incident.

OTHER - Terrorism Hazard Assessment must also account for modern trends and changes. An additional "OTHER" category should be considered that includes small arms attacks, vehicle ramming attacks, edged weapon attacks, and incendiary attacks.

3.3.3.2 Extent

A terror threat could arise at any location in the State. However, the very definition of a terrorist event indicates that it is most likely to target large groups of people along with critical or symbolic locations. Ensuring and protecting the continuity of critical infrastructure and key resources (CIKR) of the United States is essential to the Nation's security, public health and safety, economic vitality, and way of life. CIKR includes physical and/or virtual systems or assets that, if damaged, would have a detrimental impact on national security, including large-scale human casualties, property destruction, economic disruption, and significant damage to morale and public confidence. Table 3-28 shows the U.S. Department of Homeland Security's (DHS) identified main critical infrastructure sectors.

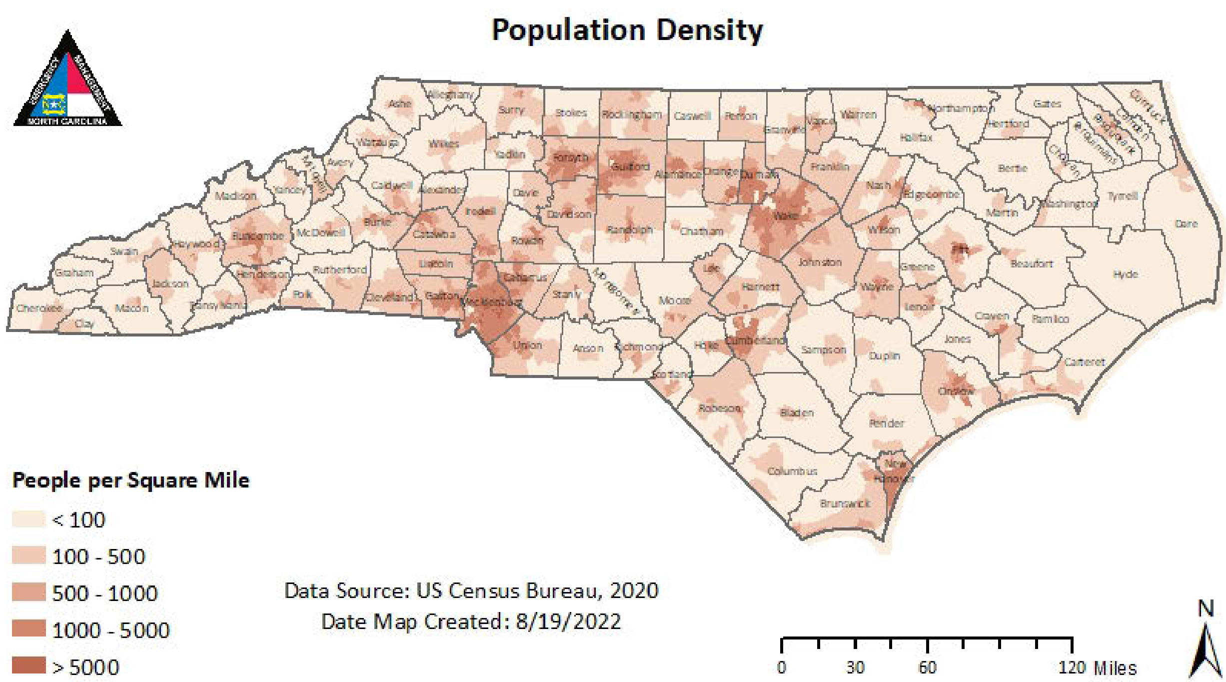
Table 3-28 U.S. Department of Homeland Security Critical Infrastructure Sectors

U.S. Department of Homeland Security Critical Infrastructure Sectors	
Agriculture and Food	Energy
Chemical	Financial
Commercial Facilities	Government Facilities
Communications	Healthcare and Public Health
Critical Manufacturing	Information Technology
Dams	Nuclear Reactors, Materials, and Waste
Defense Industrial Base	Transportation Systems
Emergency Services	Water and Wastewater Systems

3.3.3.3 Location/Spatial Extent

All parts of North Carolina are vulnerable to a terror event; however, terrorism tends to target more densely populated areas. The following map displays the population density in the state and therefore more vulnerable areas.

Figure 3-58 Population Density of North Carolina



3.3.3.4 Hazard History

Although there have been no major terror attacks in North Carolina, there have been several terror related incidents including: the arrest of terrorism suspects, the disruption of terrorism planning and training activities, and the response to lone suspect attacks. North Carolina has for decades dealt with homegrown extremists with a propensity for terror and violence. Examples of these extremists include militia groups, white supremacy groups, sovereign citizens, and left wing/right wing extremist groups. In 2018 the Southern Poverty Law Center identified and tracked 28 hate groups in North Carolina. More information about the specific groups and their location within the state can be found here: https://www.splcenter.org/states/north-carolina.

Historically, North Carolina has experienced incidents of domestic terrorism. The Wilmington Coup of 1898 was a planned political coup and violent attack led by white supremacists to overthrow the City's coalition Fusionist government and black leaders. As many as 2,000 people participated in the insurrection which caused an estimated 14 to 60 deaths. (https://www.ncpedia.org/history/cw-1900/wilmington-massacre-1898)

3.3.3.5 Changing Future Conditions

Population growth continues to change the face of North Carolina. North Carolina is now the ninth most populated state in the Nation. Population growth necessarily raises the odds of incidents involving terror within the state. Terrorism is also driven by trends, technology, and information exchange. Terrorist propaganda and literature continues to play a role in provoking attacks and educating terrorists in attack t, tactics, technology, targets and procedures.

3.3.3.6 Impact

Terrorism can impact people, property, government, the economy, and the environment. Impact can be minimal or severe depending on the type of attack and how successful it is. Attacks against people can result in a small number of injuries or may result in mass casualty or mass fatality events. Impacts to property can be negligible or debilitating, requiring large scale recovery and repair operations. Terrorism can impact government services by destroying or exhausting personnel and equipment. Terrorism also has the capability to disrupt the economy. Environmental impacts can be insignificant or may be measurable and persistent requiring remediation. It is incumbent that Federal, State, and Local government work together to minimize the impacts of terrorism through community building, planning, training, and effective law enforcement/emergency response.

3.3.3.7 Future Probability

North Carolina has experienced no major terrorist attacks in recent decades but has had a number of terror related incidents and threats as well as ongoing activity by hate groups. For example, in 2019 armed Ku Klux Klan members held a rally in Hillsborough. Given the continued presence of these groups, the probability of future occurrences of a terrorist attack, while unlikely (between 1 and 33.3 percent annual probability), is a real possibility for which the state must be prepared.

3.3.3.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.3.4 **Civil Disturbance**

3.3.4.1 Description

Civil disruption is a term that generally refers to groups of people purposely choosing not to observe a law, regulation, or rule, usually to bring attention to a cause, concern or agenda. In North Carolina, state statues differentiate public disturbances from riots by the presence of disorderly or violent conduct. A public disturbance is defined as "Any annoying, disturbing, or alarming act or condition exceeding the bounds of social toleration normal for the time and place in question which occurs in a public place or which occurs in, affects persons in, or is likely to affect persons in a place to which the public or a substantial group has access," whereas a riot is defined as "the public assemblage of three or more persons which by disorderly and violent conduct, or the imminent threat of disorderly and violent conduct, results in injury or damage to persons or property or creates a clear and present danger of injury or damage to persons or property" (G.S. §14- 288.2).

In modern society, laws have evolved to peacefully resolve conflict. In the United States, a crowd itself is constitutionally protected under "the right of the people to peacefully assemble." However, assemblies that are not peaceable are not protected, and this is generally the dividing line between demonstrations and riots. The laws that deal with disruptive conduct are generally grouped into offenses that disturb the public peace. They range from misdemeanors, such as blocking sidewalks or challenging another to fight, to felonies, such as assault, looting and rioting.

According to North Carolina G.S. 14-288.2 any person who willfully engages in a riot, or who willfully incites or urges another to engage in a riot is guilty of a Class 1 misdemeanor. Similarly, a person is guilty of a Class H felony if they "teach or demonstrate to any other person the use, application, or making of any firearm, explosive or incendiary device, or technique capable of causing injury or death to persons, knowing or having reason to know or intending that the same will be unlawfully employed for use in, or in furtherance of, a civil disorder."

When a riot or public disturbance occurs, local law enforcement agencies from the emergency area are initially responsible for addressing the event. If local law enforcement agencies lack sufficient capacity or become overwhelmed by the response effort, State law enforcement agencies may be deployed. According to the North Carolina Emergency Operation plan (EOP), The State Emergency Response Team (SERT) Emergency Services Branch will coordinate state law enforcement activities during public disturbances, riots and/or emergency situations. In extreme cases, the Governor has the authority to mobilize the National Guard in effort to protect persons and property and restore order.

3.3.4.2 Extent

The extent of any civil disorder incident will depend on the magnitude of that event and its location. The more widespread an incident is, the greater the likelihood of casualty, loss of life and property damage. Additional factors, such as the ability of law enforcement to contain the event, are also critical in minimizing damages.

A book published by the University of Minnesota, *Sociology: Understanding and Changing the Social World*, discusses the typology of crowds based on their purpose and different dynamics. A crowd may be defined as a casual, temporary collection of people without strong, cohesive relationships. Building off of the work of sociologist Herbert Blumer, the book distinguishes five types of crowds:

- **Casual Crowd** – A collection of people who happen to be in the same place at the same time. They crowd has no common identity or long-term purpose. Examples of this type include shoppers and sightseers. The likelihood of violent conduct is all but nonexistent.
- **Conventional Crowd** – A collection of people who gather for a specific or common purpose or activity, like dancing, a sporting event, or a concert. Behavior for these crowds is fairly structured and would require substantial provocation to arouse disruptive action.
- **Expressive Crowd** – A collection of people who gather primarily to be excited and to express one of more emotions. Examples include a political rally and protests.
- **Protest Crowd** – A collection of people who gather to protest a political, social, cultural, or economic issue. People in these crowds may participate in sit-ins, demonstrations, marches or rallies.
- **Acting Crowd** – The crowd is made up of individuals who have assembled for a specific purpose. Acting crowds tend to be unpredictable and highly emotional and may require only minimal stimulation to arouse them to violence. Acting crowds sometimes become so large and out of control that they develop into full-scale riots.

3.3.4.3 Location/Spatial Extent

Civil disruption can arise from a number of causes for a variety of reasons. Circumstances may be spontaneous or may result from escalating tensions. Civil disruption can erupt anywhere, but the most likely locations are those in areas with large population groupings or gatherings. Sites that are attractive for political or other rallies should be considered as probable locations for the epicenter of civil disorder events including public buildings, spaces and monuments, arenas and stadiums, arenas, or other venues where crowds can gather and civil disruptions can occur. Civil disorder can also occur in proximity to locations where a “trigger event” occurred.

3.3.4.4 Hazard History

Events in North Carolina’s early history, as well as those from the late 1960s through this decade, indicate the State has a rich history of activism and is not immune to marches, protests, and riots. Some brief examples of North Carolina’s notable events are provided below.

The Greensboro sit-in was a civil rights protests in 1960 when young African American students staged a sit-in at a segregated lunch counter in Greensboro, North Carolina. The students refused to leave after being denied service. The peaceful protest gained heavy media attention and sit-in movements spread around college towns throughout the South. Though many of the protesters were arrested for trespassing, disorderly conduct or disturbing the peace, their actions made an immediate and lasting impact, forcing the diner and other establishments to change their segregationist policies.

The attack commonly known as the Greensboro Massacre occurred on November 3rd 1979, when the Communist Workers Party organized a “Death to the Klan” march. Days before the rally Klansmen and neo- Nazis from across North Carolina heard about the planned demonstration and showed up to the gathering. Tension escalated and five participants died.

In 2013 tensions rose in Charlotte over the police shooting of Keith Lamont Scott. Protests against police violence against people of color erupted in Charlotte. The first two nights of protest were characterized by violence, looting, and riots. Several people were injured, and police deployed tear gas to try and disperse crowds

After decades of protest, in August 2018 more than 200 protesters toppled a Confederate statue on the University of North Carolina campus in Chapel Hill. Students have long regarded the statue, Silent Sam, as a symbol of white supremacy. The moment ended a decades-long battle to remove the confederate monument and marked a tense moment in a growing movement to remove confederate monuments from public spaces in the South.

Specific incidents in a single jurisdiction can cause civil unrest nationally. The Michael Brown shooting incident in Ferguson, Missouri is an example of this. On November 25, 2014, CNN reported that thousands of people in more than 170 U.S. cities rallied to protest the grand jury decision not to indict the officer involved. Protests also took place internationally, with demonstrations held in several major cities in Canada, and as far away as London. Just six years later, on May 25, 2020 George Floyd was killed by Minneapolis police after being handcuffed and pinned to the ground by Derek Chauvin, a white police officer. A video of the incident is captured and widely shared via social media sparking protests in Minneapolis and around the county. According to the New York Times, protests erupted in at least 140 cities across the United States, and the National Guard was activated in at least 21 states. In North Carolina, peaceful protests turned to violence in several different cities and towns. Local officials declared states of emergency in Raleigh, Charlotte, Fayetteville and Wilmington. In all of those towns, law enforcement officers used tear gas and other less-lethal weapons against people demonstrating. These events were exacerbated by the ongoing COVID 19 Pandemic and its public health and social distancing requirements. Many cities across the state imposed nightly curfews for weeks after the incident.

3.3.4.5 Changing Future Conditions

Any changes in climate would not have a direct impact on civil disorder. However, the implications of future climate change could present a cause for civil disorder. Climate change impact forecasts include increasingly extreme weather patterns that exacerbate issues of drought, flooding, severe weather, and other weather hazards globally that could affect whole ecosystems and access to critical resources (water, food, energy). As society adjusts and confronts these changes, incidents of civil disturbance could be a secondary result related to societal unrest associated with other climate-related hazard impacts.

3.3.4.6 Impact

If North Carolina experiences future incidents of disruptive civil disorder or rioting, the severity of a given event could range from low to high, depending on contributing factors. A spirited demonstration that gets out of hand may result in several arrests, minor damage to property (police vehicles with broken windows, etc.), some injuries, and manpower/overtime costs for police, fire, and other response services. To a greater extent, the threat of riots in larger cities or urban areas has the potential for millions of dollars in property damage, possible loss of life, and serious injuries, and extensive arrests. Sustaining police at the scene for extended periods, and possibly mobilizing state highway patrol and National Guard units, can add to the extensive manpower costs. Still, such riots tend to be confined to a single site or general area of a community rather than multiple locations or several areas of the State at the same time. Once a riot has occurred, police in other cities are generally on standby for possible riotous conditions and are better able to alleviate potential disturbances before they develop into full-scale riots.

3.3.4.7 Future Probability

Nationwide, civil disruptions are bound to be a recurrent, as they are an unpredictable feature of social life. North Carolina will continue to experience future marches, protests, demonstrations, and gatherings in various cities and communities that could lead to some type of disruptive civil disorder. However, based on the State's general history of civil disturbance and the various human factors noted above, the probability that such incidents will develop into full-scale, widespread riots is considered low.

3.3.4.8 NCEOP Reference

Annex A, Appendix 3, Law Enforcement

3.3.5 Cyber

3.3.5.1 Description

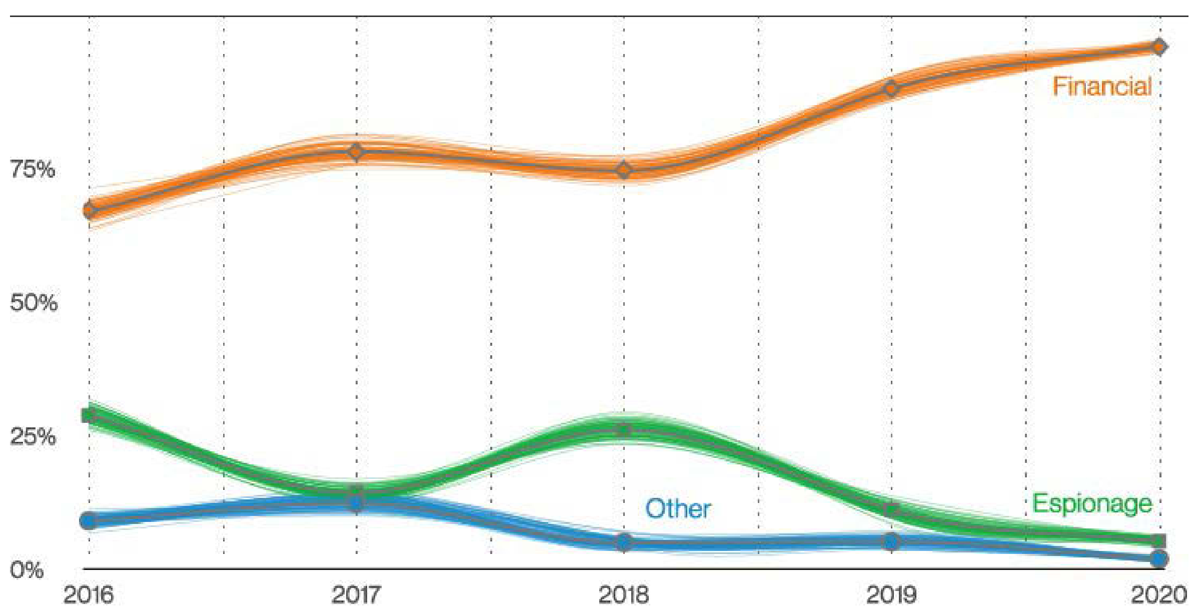
Cyberattacks are deliberate attacks on information technology systems in an attempt to gain illegal access to a computer or system, or purposely cause damage. As the world becomes more technologically advanced and dependent upon computer systems, the threat of cyberattacks is becoming increasingly prevalent. Also known as computer network attacks, cyberattacks are difficult to recognize and typically use malicious code to alter computer data or steal information.

Though it is an emerging hazard, cyber disruption has not gone unnoticed. Mitigating and preparing for cyberattacks is challenging because of how diverse and complex attacks can be. The risks associated with the Nation's dependence on these networked technologies led to the development of Presidential Policy Directive 41 (PPD-41): United States Cyber Incident Coordination, which outlines the roles of federal agencies during any significant cyber incident, whether involving government or private sector entities. PPD-41 recognizes that the frequency of cyber incidents is increasing, and this trend is unlikely to be reversed anytime soon. The National Cyber Incident Response Plan (NCIRP) was developed according to the direction of PPD-41. In 2010, the Department of Homeland Security (DHS) issued the NCIRP Interim Version. This plan was recently updated in December of 2016. (https://www.us-cert.gov/ncirp).

The Federal Bureau of Investigation (FBI) is the lead federal agency for investigating cyberattacks by criminals, overseas adversaries, and terrorists. In North Carolina, the Department of Information Technology is the lead agency that maintains Cybersecurity and Risk Management resources.

Cyberattacks can happen in both the public and private sector. They may be carried out by a specific individual, or by groups from afar. Many attacks attempt to steal money or to disturb normal operations. According to the 2021 Verizon Report of Data Breaching, 93% of all data breaches had a financial or espionage motive.

Figure 3-59 Threat Actor Motives Over Time



Source: 2021 Verizon Data Breach Investigations Report

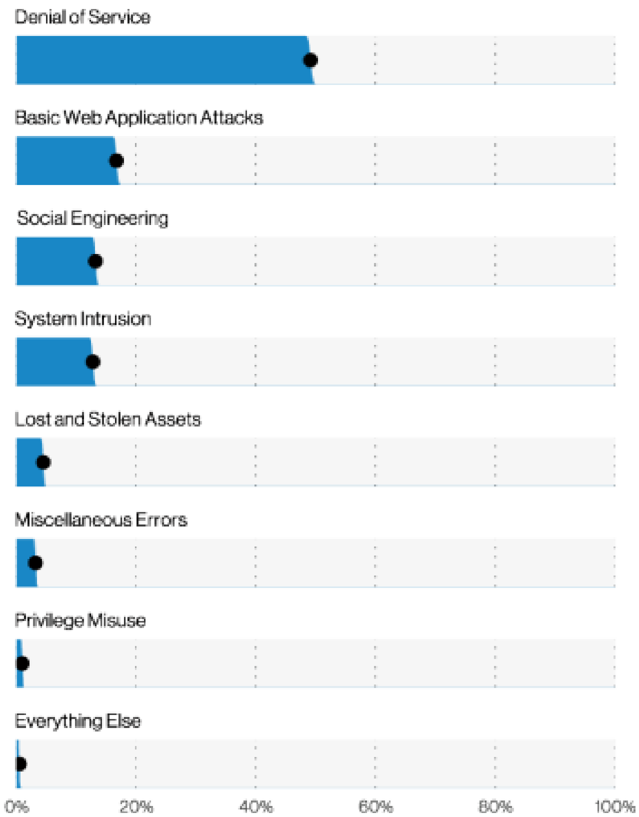
Cyberattack incident patterns include:

- Web App Attacks: Incidents in which web applications were attacked, which can include exploiting code-level vulnerabilities in the application.
- Social Engineering: Psychological compromise of a person, which alters their behavior into taking an action or breaching confidentiality.
- System Intrusion: System Intrusion captures the complex attacks that leverage malware and/or hacking to achieve their objectives including deploying ransomware.
- Insider and Privilege Misuse: Unapproved or malicious use of legitimate privileges.
- Miscellaneous Errors: Incidents in which unintentional actions directly compromise a security attribute of an information asset.
- Lost and Stolen Assets: Incidents where an information asset went missing through misplacement or malice.

- Denial-of-Service Attacks: Any attack intended to compromise the availability of networks and systems that are designed to overwhelm systems, resulting in performance degradation or interruption of service.

The figure below, Figure 3-60 displays cyberattack incident patterns from the 2021 Verizon Data Breach Investigations Report.

Figure 3-60 Percentage of incidents per pattern



Source: 2021 Verizon Data Breach Investigations Report

3.3.5.2 Extent

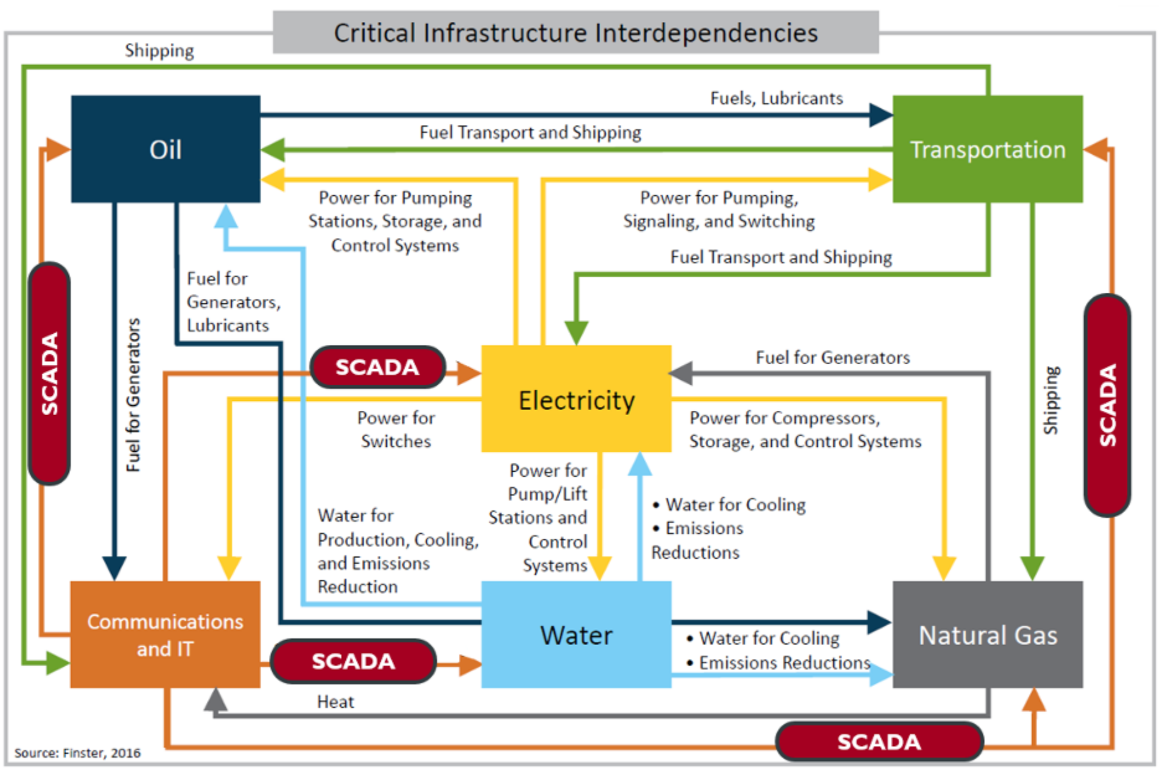
There is no generally recognized scale for measuring the magnitude or severity of cyber-attack events. The magnitude/severity of a cyberattack is variable depending on the nature of the disruption. The system that is disrupted and the source of the disruption are major factors in the impact. intentional disruption of critical systems could have devastating effects on both the public and private sectors.

3.3.5.3 Location/Spatial Extent

Cyberattacks occur all over the world and are difficult to predict. All areas of the state are considered prone to this hazard. As the populace and infrastructure within North Carolina increasingly rely on cyber systems in daily operations, the risk for cyberattacks will only increase.

Critical utility, transportation, and communications infrastructure, including water and sewer plants, power plants, gas works and distribution networks, transportation networks including air traffic control, rail roads, dams, GPS systems, medical systems, and banking, are particularly vulnerable to cyberattacks. This vulnerability is in part due to growing use of supervisory control and data acquisition (SCADA) systems and other operational technology (OT) to control physical processes, as noted in the August 2017 report "Security Cyber Assets Addressing Urgent Cyber Threats to Critical Infrastructure" from the President's National Infrastructure Advisory Council (NIAC). (https://www.cisa.gov/sites/default/files/publications/niac-securing-cyber-assets-final-report-508.pdf) Per this report, because SCADA and other OT systems operate vital services such as the generation, process, and delivery of power, water, fuels, and chemicals as well as the controls for communication and transportation, cyberattacks can disrupt these services, damage critical equipment, threaten health and safety, and trigger disruptions in other sectors (NIAC, 2017). Figure 3-61 from the NIAC report highlights the interdependencies of some critical utility and transportation sectors and their SCADA controls, illustrating the potential for cascading impacts should one sector experience a cyberattack.

Figure 3-61 Critical Infrastructure Interdependencies



Source: NIAC Security Cyber Assets Addressing Urgent Cyber Threats to Critical Infrastructure, August 2017

The 2021 Verizon Data Breach Investigations Report documents attacks in 88 countries. However, the Verizon Report also indicates that the "Public" industry is far more susceptible to breaches than other industries. The 2021 Verizon Report states there were 7,065 reported cyberattack incidents in the "Entertainment" industry, and the next closest industry after that was the "Public" industry with 3,236 incidents.

Figure 3-62 Number of security incidents and breaches by victim industry and organization size

Incidents	Total	Small (1-1,000)	Large (1,000+)	Unknown	Breaches	Total	Small (1-1,000)	Large (1,000+)	Unknown
Total	29,207	1,037	819	27,351		5,258	263	307	4,688
Accommodation (72)	69	4	7	58		40	4	7	29
Administrative (56)	353	8	10	335		19	6	7	6
Agriculture (11)	31	1	0	30		16	1	0	15
Construction (23)	57	3	3	51		30	3	2	25
Education (61)	1,332	22	19	1,291		344	17	13	314
Entertainment (71)	7,065	6	1	7,058		109	6	1	102
Finance (52)	721	32	34	655		467	26	14	427
Healthcare (62)	655	45	31	579		472	32	19	421
Information (51)	2,935	44	27	2,864		381	35	21	325
Management (55)	8	0	0	8		1	0	0	1
Manufacturing (31-33)	585	20	35	530		270	13	27	230
Mining (21)	498	3	5	490		335	2	3	330
Other Services (81)	194	3	2	189		67	3	0	64
Professional (54)	1,892	793	516	583		630	76	121	433
Public (92)	3,236	22	65	3,149		885	13	30	842
Real Estate (53)	100	5	3	92		44	5	3	36
Retail (44-45)	725	12	27	686		165	10	19	136
Wholesale Trade (42)	80	4	10	66		28	4	7	17
Transportation (48-49)	212	4	17	191		67	3	8	56
Utilities (22)	48	1	2	45		20	1	2	17
Unknown	8,411	5	5	8,401		868	3	3	862
Total	29,207	1,037	819	27,351		5,258	263	307	4,688

Source: 2021 Verizon Data Breach Investigations Report

3.3.5.4 Hazard History

In North Carolina, the Department of Information Technology specializes in cybersecurity and risk management. Within the department, the NC Information Sharing and Analysis Center gathers information on cyber threats within the State to raise cybersecurity.

In 2016, North Carolina reported the highest number of cybercrimes in the "non-payment/non-delivery" sector.

Figure 3-63 North Carolina Cybercrimes with Victim Counts in 2016

Crime Type by Victim Count

Crime Type	Victim Count	Crime Type	Victim Count
419/Overpayment	614	Health Care Related	10
Advanced Fee	384	IPR/Copyright and Counterfeit	58
Auction	442	Identity Theft	345
BEC/EAC	254	Investment	28
Charity	10	Lottery/Sweepstakes	119
Civil Matter	28	Malware/Scareware	62
Confidence Fraud/Romance	326	Misrepresentation	102
Corporate Data Breach	74	No Lead Value	121
Credit Card Fraud	274	Non-payment/Non-Delivery	1,844
Crimes Against Children	19	Other	218
Criminal Forums	0	Personal Data Breach	569
Denial of Service	28	Phishing/Vishing/Smishing/Pharming	399
Employment	467	Ransomware	67
Extortion	468	Re-shipping	25
Gambling	1	Real Estate/Rental	280
Government Impersonation	319	Tech Support	298
Hacktivist	2	Terrorism	6
Harassment/Threats of Violence	364	Virus	29
Descriptors*			
Social Media	455	Virtual Currency	38

Source: FBI Internet Crime Complaint Center

Although North Carolina has not reported any catastrophic cyberattacks, they are unpredictable and could happen at any time. There have been notable cyberattack events that have attained national attention over the past few years:

- During the 2012 election, requests for absentee ballots in Miami-Dade Florida were discovered to be the first officially documented instance that an election was attempted to be altered by a cyber-attack (https://www.politico.com/story/2013/03/report-voting-cyberattack-in-florida-089014).
- February 2016, a hacker with the Twitter handle @DotGovs released the names and contact information online of 29,000 Department of Homeland Security and FBI employees (https://motherboard.vice.com/read/hacker-publishes-personal-info-of-20000-fbi-agents).
- Between March and December 2020, Russian- based hackers targeted a Texas- based company, Solar Winds. The hackers used a routine software update to slip malicious code into the company's network and then used it as a vehicle for a massive cyberattack against America. The attack compromised about 100 companies and about a dozen government agencies. The companies included Microsoft, Intel, and Cisco; the list of federal agencies so far includes the Treasury, Justice, and Energy departments and the Pentagon. (https://www.npr.org/2021/04/16/985439655/a-worst-nightmare-cyberattack-the-untold-story-of-the-solarwinds-hack).
- In April 2021, ransomware gang Revil demanded $50 million from Apple in exchange for data and schematics they claimed to have stolen that were focused on unreleased products. (https://www.wired.com/story/apple-ransomware-attack-quanta-computer/)
- In March 2021, CNA Financial Corp., one of the largest insurance companies in the U.S., paid $40 million to regain access of its network after a ransomware attack. The hackers stole a

trove of company data and CAN officials were locked out of their network. (https://www.bloomberg.com/news/articles/2021-05-20/cna-financial-paid-40-million-in-ransom-after-march-cyberattack)

- In May 2021, the Colonial Pipeline Company reported that they were the victim of a ransomware attack. The attack was orchestrated by DarkSide, a criminal hacker group based in Eastern Europe. The pipeline, which supplies about half of the East Coast's gasoline, shut down for several days, causing gas panic-buying, shortages, and price spikes in some states. (https://www.vox.com/recode/22428774/ransomeware-pipeline-colonial-darkside-gas-prices)

3.3.5.5 Changing Future Conditions

As digital data continues to be the predominant format of data collection it will be important to closely monitor computer systems as our technological capabilities expand.

3.3.5.6 Impact

Most cyberattacks have negligible impacts; however, it is possible for a cyberattack to have catastrophic impacts if the data breach is significant enough or if critical, protected information gets into the hands of terrorist groups. One of the primary challenges of cyberattacks for North Carolina state government and local government partners is fully understanding their system's vulnerabilities. Pinpointing when or how a cyberattack initially happens can lead to prolonged and extensive data intrusions.

3.3.5.7 Future Probability

Cyberattacks occur daily, but most impacts are negligible or limited. However, it is possible that a cyberattack could occur that could be catastrophic. Based on historical occurrences and the increasing digital dependency, it is unlikely (between 1 and 33.3 percent annual probability) that North Carolina may experience a severe cyberattack in the future.

3.3.5.8 NCEOP Reference

Annex C, Appendix 6, Hazards and Threats

3.3.6 Electromagnetic Pulse

3.3.6.1 Description

The United States Department of Energy defines electromagnetic pulses (EMPs) as "intense pulses of electromagnetic energy resulting from solar-caused effects or man-made nuclear and pulse power devices." EMPs can be naturally occurring or human-caused hazards. Examples of natural EMP events include:

- Lightning electromagnetic pulse
- Electrostatic discharge
- Meteoric electromagnetic pulse, and
- Coronal mass ejection, also known as a solar electromagnetic pulse.

A human-caused EMP (such as a nuclear EMP) is a technological hazard that can cause severe damage to electrical components attached to power lines or communication systems.

The Cybersecurity and Infrastructure Security Agency's (CISA) National Coordinating Center for Communications (NCC) defines the following three types of potential human-caused EMPs:

- High-altitude EMP (HEMP), from a nuclear detonation typically occurring 15 or more miles above the Earth's surface;
- Source Region EMP (SREMP), created when a nuclear weapon detonates at lower altitudes, especially when the detonation is at or near the surface of the earth;
- Intentional Electromagnetic Interference (IEMI), from nearby sources such as an Electromagnetic weapon or Radio Frequency weapon.

One of the most complex aspects of EMPs is the fact they are invisible, unpredictable, and have a rapid onset. They can also overload electronic devices that people heavily rely on every day. EMPs are harmless to people biologically; however, an EMP attack could damage electronic systems such as planes or cars. This could cause destruction of property and life and potentially generate disease or societal collapse.

In 2015, Congress amended the Homeland Security Act of 2002 by passing the Critical Infrastructure Protection Act (CIPA), which reduces vulnerability and increases response and recovery capability related to EMPs. CIPA required the reporting of EMP threats, research and development to mitigate EMP impacts, and a campaign to educate planners and emergency responders about EMP events.

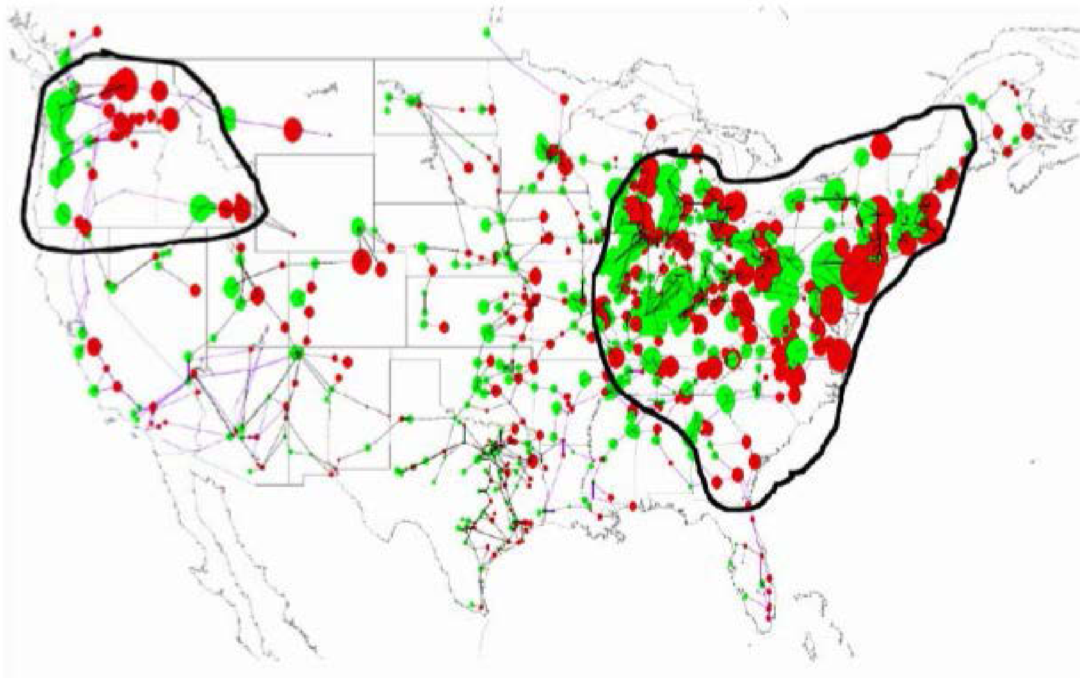
3.3.6.2 Extent

The strength and area impacted by an EMP depends on the type. For example, a nuclear device detonated at high altitudes can generate a pulse with tens of kilovolts per meter and impact a radius from hundreds to thousands of kilometers. This type of event can disable very large electrical and electronic systems such as power and long-haul communications. Per the Department of Homeland Security's "Strategy for Protecting and Preparing the Homeland against Threats of Electromagnetic Pulse and Geomagnetic Disturbances", an EMP could damage much of the nation's critical infrastructure including the electrical grid, communications equipment, water and wastewater systems, and transportation systems.

3.3.6.3 Location/Spatial Extent

An EMP can happen in any location and are relatively unpredictable. However, due to technological advances in the United States and the increased reliance of critical infrastructure on electronic systems and equipment, the country may be more susceptible to an EMP attack. Highly populated areas may be more prone to damages from an EMP; cities such as Charlotte or Raleigh in North Carolina may be more at risk. The impacts of EMPs are likely to cascade beyond the initial affected sectors and geographic regions.

Figure 3-64 Areas of Probable Power System Collapse as a Consequence from EMP



Source: Federal Energy Regulatory Commission Report on Electromagnetic Pulse: Effects on the US Power Grid

3.3.6.4 Hazard History

North Carolina has not experienced an EMP occurrence.

3.3.6.5 Changing Future Conditions

One of the most problematic threats of EMPs is the lack of understanding of the consequences among local, State, and Federal authorities. However, as technology increases globally, more can be learned about the effects of an EMP occurrence.

3.3.6.6 Impact

EMPs can impact telecommunications, electronics and control systems, relays, lighting arrestors, power lines, tower structures, transformers, and protective relays. Nuclear and high-altitude EMPs have the potential to damage or destroy areas for hundreds of miles. An EMP detonated at high altitude can maximize the impacts and damage a larger area.

3.3.6.7 Future Probability

The probability of an EMP is unlikely (between 1 and 33.3 percent annual probability) but any occurrence could have catastrophic impacts.

3.3.6.8 NCEOP Reference

The EMP plan contains sensitive information and is therefore not published.

Annex C, Appendix 6, Hazards and Threats

3.3.7 Food Emergency

3.3.7.1 Description

A food emergency refers to the adulteration and/or contamination, threatened or actual, of food that impacts or may impact human health or the safety or availability of the state's food supply (National Food and Agriculture Incident Annex to the Response and Recovery Federal Interagency Operations Plans, August 2019). A food emergency could result from a natural hazard, including hurricanes, floods, severe weather, or associated power outages that result in the loss of food from contamination or spoilage. A food emergency may also be human caused, including from unintentional or deliberate contamination or adulteration of food that results in a public health threat or foodborne disease outbreak. For example, improper processing or production of a food product or deliberate contamination or adulteration of food could cause harm to the public or to the economy of the United States.

North Carolina is the third largest state in the U.S. for food and beverage processing, with over 1,200 food and beverage manufacturing establishments and extensive national and international exports markets. North Carolina's food and agricultural production, processing and retail systems industry is valued at over $68 billion and employs approximately 20 percent of the state's workforce. An incident affecting the food chain could have significant economic impact on this multi-billion-dollar industry, and the consumption of contaminated foods could have serious public health impacts, including potential human illness and death. The NCEOP indicates the potential cost of food contamination illness is estimated at $10-83 billion per year in the U.S.

3.3.7.2 Extent

There is no established scale for rating the relative magnitude of a food emergency. The severity of a food emergency will depend on its type, cause, and the affected supply.

3.3.7.3 Location/Spatial Extent

Food emergencies can result from impacts to a variety of components of the food system. Initial contamination, spoilage, or damage to food supply may be localized, but the impacts of a food emergency could affect the entire state.

3.3.7.4 Hazard History

According to data from the CDC's National Outbreak Reporting System (NORS) Dashboard, from 2009 to 2020 North Carolina experienced 180 foodborne outbreaks, which resulted in 13,901 reported illnesses and 42 deaths.

The North Carolina Department of Agriculture & Consumer Services (NCDA&CS) supports farms and agribusinesses in disaster preparedness, response, and recovery. NCDA&CS issued press releases during Tropical Storm Fred in August 2021 and Hurricane Florence in September 2018 notifying farmers that flooded crops could not be used for human food. In these instances, the NCDA&CS and NC Cooperative Extension offered testing and support to find alternate uses for the affected crops to minimize losses.

3.3.7.5 Changing Future Conditions

Food emergencies can occur as a result of natural hazard events, which are subject to impacts of climate change, as discussed in each hazard profile. The North Carolina Climate Science Report states that it is likely that major droughts will become more frequent and severe due to higher temperatures and evaporation rates; this change may have negative impacts on agricultural production. Additionally, the report finds that heavy precipitation from hurricanes passing over North Carolina is very likely to increase, thereby increasing the potential for flooding. Given the records of past hurricane-related flooding causing crop damages, this change may also affect potential for future food emergencies.

3.3.7.6 Impact

As noted in the Vulnerability Assessment, crops and livestock are vulnerable to losses from heat, droughts, floods, severe storms, winter weather, and wildfires. Food supplies may also be impacted during processing or storage. Food manufacturing plants or food warehousing and storage facilities may incur direct damages from hazard events or indirect damages from power outages, both of which can disrupt operations and cause contamination or spoilage. A food or agriculture incident at either of these stages would have cascading impacts on related industries, including service, distribution, and retail. Any incident could pose a threat to public health, plant or animal health, and crop and livestock production, with impacts on the security, cost, and safety of the U.S. food supply.

In the case of a food emergency due to pathogens, vector and contamination control may require discarding large quantities of agricultural products and organic matter, invoking embargoes or trade restrictions, culling livestock or poultry, and identifying alternative sources of food. Disposal of contaminated foods may requirement treatment as hazardous waste.

3.3.7.7 Future Probability

Records of foodborne outbreaks in the state indicate an average frequency of over 16 outbreaks annually. Data is limited on past food emergencies resulting from other means, including deliberate acts and direct damages to food supply, but the potential for these factors to cause additional food emergencies increases the overall probability of such an event. Food emergencies are highly likely to continue to occur throughout the State of North Carolina. However, the magnitude of these events can vary widely and the probability of a severe event cannot be determined.

3.3.7.8 NCEOP Reference

Annex B, Appendix 7

3.4 STATEWIDE PRIORITY RISK INDEX

Conclusions on at-large hazard risk for the State of North Carolina utilized the results of the hazard profiling process from the Regional Hazard Mitigation Planning Process run on the NCEM Risk Assessment Tool platform. In the regional planning process, Statewide hazard classifications were identified according to a “Priority Risk Index” (PRI). The purpose of the

PRI is to categorize and prioritize all potential hazards for the State of North Carolina as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided in the next section, the summary hazard classifications generated using the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the prioritization of hazard mitigation opportunities for North Carolina to consider as part of their proposed mitigation strategy.

The statewide prioritization and categorization of identified hazards for North Carolina is based on a roll-up of the Priority Risk Indices established in 29 of the 30 recently updated Regional and Multi-Jurisdictional Hazard Mitigation Plans covering all 100 North Carolina Counties and over 550 municipalities. The PRI was used in all but one of the regional hazard mitigation plan updates completed 2018-2022 to assist the Regional Hazard Mitigation Planning Teams in gaining consensus on the nature of hazards that pose the most significant threat to the regions. The PRI is not scientifically based, but rather is meant to be used as an objective planning tool for classifying and prioritizing hazard risks in North Carolina based on standardized criteria.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor, as summarized in Table 3.28. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

According to the weighting scheme and point system applied, the highest possible value for any hazard is 4.0. Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the Regional Hazard Mitigation Planning Teams.

Table 3-29: Priority Risk Index: Explanation of Values

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self-explanatory	1	10%
	12 to 24 hours	Self-explanatory	2	
	6 to 12 hours	Self-explanatory	3	
	Less than 6 hours	Self-explanatory	4	
Duration	Less than 6 hours	Self-explanatory	1	10%
	Less than 24 hours	Self-explanatory	2	
	Less than one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

Priority Risk Index Results

Table 3.29 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Regional Hazard Mitigation Planning Team. The results were then used in calculating PRI values and making final determinations for the risk assessment.

The current version of the Risk Management Tool is designed to identify hazards and calculate exposure and risk at county and municipal levels. It is not currently equipped to roll up individual plan information to a statewide granularity, however, NCEM has manually calculated an average of inputs and established Drought, (3.0) Severe Winter Weather (2.9) Flooding (2.8) and Hurricane (2.8) as the hazards with the most likely/most serious impact statewide. All other identified hazards fell in the 2-2.5 range statewide.

Table 3-30: Statewide PRI Score from Regional Hazard Mitigation Plans

Plan Name	Branch	Drought	Hurricane and Coastal Hazards	Tornadoes Thunder-storms	Severe Winter Weather	Earthquakes	Geological	Dam Failures	Flooding	Excessive Heat	Wildfires	Infectious Disease	Hazardous Substances	Radiological Emergency	Terrorism	Cyber	EMP
Cape Fear Regional Plan	Central	2.5	2.9	3.3	2.5	1.7		2.1	3.0	2.4	2.3		2.5	2.2	2.2		
Davidson, Randolph Regional Plan	Central	2.5	2.9	3.1	2.8	2.0		2.4	2.8	2.1	2.5	2.6		2.0	2.1		2.5
Eno Haw Regional Plan	Central	2.5	2.9	3.1	3.3	1.9	1.2	2.4	2.5	3.3	2.5	2.8	2.0	2.7	2.8	2.4	
Guilford County MJ Plan	Central	2.5	2.9	2.8	3.1	2.0			2.8	2.4	2.3	2.7	2.8	2.1	2.2	2.5	
Halifax, Northampton Regional Plan	Central	2.8	2.9	3.1	2.5	2.3		1.8	2.7		2.9						
Nash, Edgecombe, Wilson Regional Plan	Central	2.5	3.0	3.1	3.0	1.9	1.6	2.1	3.0	3.3	2.8			2.4	2.4		
Northern Piedmont Regional Plan	Central	2.5	2.6	2.8	3.0	2.0	2.1		2.7	2.1	2.4	1.8	2.2	1.9	2.2	1.9	1.7
Pee Dee Lumber Regional Plan	Central	2.5	2.9	2.8	3.0	2.0	2.1	2.4	3.0	2.4	2.7	2.5	2.3	2.4	2.6	3.0	3.1
Tar River Regional Plan	Central	2.5	2.9	3.1	2.8	2.0		2.1	2.8	2.1	2.8						
Wake County MJ Plan	Central	2.5	2.9	3.0	3.0	1.9		2.4	2.8	3.3	2.5		2.3	2.7	2.2		
Central Branch Average		2.5	2.9	3.0	2.9	2.0	1.8	2.2	2.8	2.6	2.6	2.5	2.4	2.3	2.3	2.5	2.4
Albemarle Regional Plan	Eastern	2.5	3.3	3.1	3.0	1.9		1.8	2.4	2.7	2.3			2.6			
Bladen, Columbus, Robeson Regional Plan	Eastern	2.5	2.9	3.1	2.5	2.3		1.8	2.7		2.9						
Cumberland, Hoke Regional Plan	Eastern	2.5	2.9	3.1	2.5	2.3		2.4	2.7	2.1	2.9						
Neuse River Regional Plan	Eastern	2.5	3.3	3.1	3.0	1.9		2.1	2.7	3.3	2.8						
Northeastern NC Regional Plan	Eastern	2.5	3.6	3.1	2.7	1.9		2.1	3.0	1.9	2.8						
Outer Banks Regional Plan	Eastern	2.5	3.3	3.1	2.7	1.9			3.0	3.0	2.5		2.0	2.1	2.7	2.1	
Pamlico Sound Regional Plan	Eastern	2.5	3.3	3.1	3.0	1.9		2.1	2.7	3.2	2.8						
Sampson, Duplin Regional Plan	Eastern	2.5	2.9	3.1	2.5	2.3		1.8	2.7		2.9						
Southeastern NC Regional Plan	Eastern	2.5	3.0	2.8	2.4	2.0	2.1	1.7	3.3	2.5	2.1	2.3	2.2	2.6	2.2	3.0	
Eastern Branch Average		2.5	3.2	3.1	2.7	2.0	2.1	2.0	2.8	2.7	2.7	2.3	2.1	2.4	2.5	2.6	
Buncombe, Madison Regional Plan	Western	2.5	2.0	3.2	3.3	2.3	2.8	2.0	2.9		2.2	2.4	2.2	2.2	2.1	3.0	1.7
Cabarrus, Stanly, Union Regional Plan	Western	2.5	2.6	2.8	3.0	2.0	2.1	2.2	2.7	2.1	2.4	1.6					
Clay, Macon Regional Plan	Western	2.5	2.6	2.8	3.0	2.0	2.1	2.2	2.7	2.1	2.4	2.0	2.2	2.4	2.6	1.9	2.5
Cleveland, Gaston, Lincoln Regional Plan	Western	2.5	2.6	2.8	3.0	2.0	2.1	2.2	2.7	2.1	2.4	2.0	2.2	2.4	2.6	1.9	2.5

Plan Name	Branch	Drought	Hurricane and Coastal Hazards	Tornadoes Thunder-storms	Severe Winter Weather	Earthquakes	Geological	Dam Failures	Flooding	Excessive Heat	Wildfires	Infectious Disease	Hazardous Substances	Radiological Emergency	Terrorism	Cyber	EMP
High Country Regional Plan	Western	2.5	2.6	2.8	3.3	2.0	2.4	2.4	2.8		2.7	2.5	2.3		2.6	3.0	3.1
Iredell, Rowan Regional Plan	Western	2.5	2.6	3.1	3.0	2.0	2.1	2.3	2.5	2.1	2.4		2.5				
Mecklenburg County MJ Plan	Western	2.5	2.3	3.1	3.0	1.9	1.6	2.1	3.0	3.3	2.0		3.1	3.1		2.1	2.8
Smokey Mountain Regional Plan	Western	2.5	2.6	2.8	3.3	2.3	2.1	2.3	3.1		2.4	2.0	2.2	2.4	2.6	2.6	2.5
South Mountain Regional Plan	Western	2.5	2.3	3.1	3.3	2.0	2.2	2.3	3.0	2.1	2.6	1.6	2.2	1.9	2.2	1.5	1.3
Toe River Regional Plan	Western	2.5	2.0	3.2	3.3	2.1	2.8	2.0	2.9	2.1	2.2	1.5	2.2	1.9	2.1	3.0	1.7
Unifour Regional Plan (No data)	Western																
Western Branch Average		2.5	2.4	3.0	3.2	2.1	2.2	2.2	2.8	2.3	2.4	2.0	2.3	2.3	2.4	2.4	2.3
Statewide PRI Averages		2.5	2.8	3.0	2.9	2.0	2.1	2.1	2.8	2.5	2.5	2.2	2.3	2.3	2.4	2.4	2.3

3.5 VULNERABILITY ASSESSMENT

3.5.1 Demographics

3.5.1.1 Census 2020

The 2020 Census represents the last official federal comprehensive population count. The 2020 Census was overseen by the U.S. Census Bureau. In North Carolina, the State Demographics branch of the Office of State Budget and Management is responsible for producing population estimates and projections. Table 3-31 provides population counts for each county in the State per the 2020 Census and the North Carolina State Demographics Office. The table also lists the percent growth rate in each county from 2010-2022 according to NC State Demographics 2022 estimates. Overall, the population in the State is up by about 9.5% since 2010.

Table 3-31 North Carolina 2017 Populations and Growth Changes by County

Rank (2017 Population)	County	Population (2020 Census)	Population (2022 NC State Demographics Estimate)	Percent Growth 2010-2022
1	Wake County	1,129,410	1,173,220	29.37%
2	Mecklenburg County	1,115,482	1,160,170	25.66%
3	Guilford County	541,299	550,875	12.51%
4	Forsyth County	382,590	391,532	11.43%
5	Cumberland County	334,728	341,746	4.45%
6	Durham County	324,833	335,015	23.46%
7	Buncombe County	269,452	266,987	11.83%
8	Union County	238,267	251,946	24.66%
9	Gaston County	227,943	230,226	11.70%
10	Cabarrus County	225,804	231,021	29.38%
11	New Hanover County	225,702	241,124	18.61%
12	Johnston County	215,999	229,280	35.13%
13	Onslow County	204,576	201,007	7.55%
14	Iredell County	186,693	192,228	20.31%
15	Alamance County	171,415	178,494	17.87%
16	Pitt County	170,243	184,243	9.11%
17	Davidson County	168,930	171,362	5.23%
18	Catawba County	160,610	162,143	4.79%
19	Orange County	148,696	149,964	11.93%
20	Rowan County	146,875	144,968	4.80%
21	Randolph County	144,171	144,921	2.07%
22	Brunswick County	136,693	160,640	48.65%
23	Harnett County	133,568	140,896	21.72%
24	Wayne County	117,333	122,813	-0.06%
25	Robeson County	116,530	126,848	-5.68%
26	Henderson County	116,281	120,168	12.42%
27	Craven County	100,720	101,542	-2.52%
28	Moore County	99,727	107,105	20.89%
29	Cleveland County	99,519	99,231	1.34%

Rank (2017 Population)	County	Population (2020 Census)	Population (2022 NC State Demographics Estimate)	Percent Growth 2010-2022
30	Nash County	94,970	94,910	-0.91%
31	Rockingham County	91,096	92,189	-1.57%
32	Burke County	87,570	90,725	0.16%
33	Lincoln County	86,810	92,168	17.96%
34	Caldwell County	80,652	82,634	-0.47%
35	Wilson County	78,784	83,028	2.13%
36	Chatham County	76,285	78,499	22.95%
37	Surry County	71,359	71,255	-3.42%
38	Franklin County	68,573	75,865	24.71%
39	Carteret County	67,686	69,578	4.31%
40	Wilkes County	65,969	67,959	-1.88%
41	Rutherford County	64,444	67,791	0.08%
42	Lee County	63,285	63,492	9.70%
43	Stanly County	62,504	64,684	6.78%
44	Haywood County	62,089	63,598	7.92%
45	Granville County	60,992	61,835	7.22%
46	Pender County	60,203	66,189	26.28%
47	Sampson County	59,036	64,089	0.88%
48	Lenoir County	55,122	55,826	-6.16%
49	Watauga County	54,086	56,606	11.05%
50	Hoke County	52,082	56,851	19.70%
51	Columbus County	50,623	54,575	-5.89%
52	Edgecombe County	48,900	49,936	-11.80%
53	Duplin County	48,715	57,991	-1.15%
54	Halifax County	48,622	48,138	-11.62%
55	Beaufort County	44,652	46,808	-2.12%
56	McDowell County	44,578	46,629	3.39%
57	Stokes County	44,520	45,831	-3.20%
58	Jackson County	43,109	44,952	11.36%
59	Richmond County	42,946	44,652	-4.25%
60	Davie County	42,712	43,695	5.92%
61	Vance County	42,578	44,235	-2.33%
62	Pasquotank County	40,568	40,547	-0.19%
63	Person County	39,097	39,652	0.61%
64	Yadkin County	37,214	38,225	-0.54%
65	Macon County	37,014	37,610	10.75%
66	Dare County	36,915	38,215	12.46%
67	Alexander County	36,444	37,995	2.05%
68	Scotland County	34,174	35,039	-2.84%
69	Transylvania County	32,986	35,021	5.85%
70	Bladen County	29,606	31,435	-10.65%
71	Cherokee County	28,774	29,341	6.95%
72	Currituck County	28,100	30,004	26.74%
73	Ashe County	26,577	27,515	1.05%
74	Montgomery County	25,751	27,461	-0.97%
75	Caswell County	22,736	22,514	-5.20%
76	Anson County	22,055	24,374	-9.23%
77	Martin County	22,031	21,780	-11.12%

Rank (2017 Population)	County	Population (2020 Census)	Population (2022 NC State Demographics Estimate)	Percent Growth 2010-2022
78	Hertford County	21,552	23,074	-6.82%
79	Madison County	21,193	22,025	6.01%
80	Greene County	20,451	20,958	-1.41%
81	Polk County	19,328	20,892	2.04%
82	Warren County	18,642	19,467	-7.24%
83	Yancey County	18,470	18,657	4.79%
84	Bertie County	17,934	18,470	-13.06%
85	Avery County	17,806	17,644	-0.87%
86	Northampton County	17,471	18,838	-14.52%
87	Mitchell County	14,903	14,868	-4.15%
88	Swain County	14,117	14,337	2.36%
89	Chowan County	13,708	13,577	-7.88%
90	Perquimans County	13,005	13,709	1.70%
91	Pamlico County	12,276	13,005	-0.79%
92	Clay County	11,089	11,552	8.90%
93	Washington County	11,003	11,013	-16.05%
94	Alleghany County	10,888	11,134	-0.03%
95	Gates County	10,478	11,559	-4.98%
96	Camden County	10,355	11,440	14.30%
97	Jones County	9,172	8,837	-12.88%
98	Graham County	8,030	8,381	-5.48%
99	Hyde County	4,589	4,670	-19.64%
100	Tyrrell County	3,245	3,719	-15.76%

Source: North Carolina State Demographics Office

3.5.1.2 Projected Population Growth

The State Demographics Office also produces population growth estimates for each county. Table 3-32 provides a summary of projected population growth rates through 2036.

Table 3-32 North Carolina Population Growth Estimates Through 2036

Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Alamance	151,582	157,522	167,375	177,741	188,157	198,573	200,656
Alexander	37,255	37,952	38,405	38,745	38,999	39,189	39,219
Alleghany	11,146	11,190	11,517	11,844	12,173	12,499	12,566
Anson	26,868	26,155	26,156	26,157	26,157	26,157	26,156
Ashe	27,250	27,332	27,086	26,876	26,728	26,625	26,608
Avery	17,745	17,816	17,912	18,007	18,102	18,199	18,216
Beaufort	47,781	47,829	47,827	47,826	47,827	47,827	47,828
Bertie	21,217	20,533	20,010	19,502	18,996	18,490	18,388
Bladen	35,159	35,011	35,009	35,013	35,010	35,011	35,012
Brunswick	108,181	123,535	138,430	154,332	170,230	186,128	189,307
Buncombe	238,801	254,836	270,328	285,823	301,321	316,816	319,915
Burke	90,688	89,114	89,727	90,003	90,124	90,179	90,185
Cabarrus	178,652	195,714	217,101	238,084	258,895	279,779	283,952
Caldwell	82,955	82,577	83,109	83,411	83,577	83,666	83,680
Camden	9,983	10,224	10,223	10,223	10,224	10,223	10,222
Carteret	66,693	69,826	71,265	72,706	74,146	75,584	75,874
Caswell	23,683	23,606	23,612	23,613	23,614	23,612	23,612
Catawba	154,315	155,828	157,209	158,588	159,969	161,349	161,626
Chatham	63,783	71,815	78,625	85,438	92,249	99,058	100,421
Cherokee	27,428	27,770	28,094	28,316	28,502	28,654	28,681
Chowan	14,745	14,541	13,932	13,321	12,711	12,102	11,979
Clay	10,583	11,036	11,294	11,543	11,778	12,003	12,049
Cleveland	97,987	97,871	98,334	98,544	98,637	98,681	98,687
Columbus	57,918	57,206	57,089	57,090	57,088	57,090	57,089
Craven	104,184	103,691	101,893	101,074	100,714	100,556	100,539
Cumberland	327,331	328,860	325,775	325,216	325,117	325,101	325,102
Currituck	23,663	25,627	28,473	31,319	34,164	37,012	37,581
Dare	33,987	36,001	37,798	39,083	40,005	40,664	40,772
Davidson	162,886	165,193	169,118	173,068	177,018	180,969	181,759
Davie	41,281	41,743	42,975	44,208	45,441	46,674	46,920
Duplin	58,678	59,868	59,866	59,866	59,866	59,866	59,867
Durham	271,382	297,219	322,728	348,110	373,364	398,490	403,500

Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Edgecombe	56,637	54,367	53,777	53,188	52,596	52,006	51,887
Forsyth	351,458	366,543	384,537	404,725	425,225	445,765	449,873
Franklin	60,838	64,206	68,065	71,976	75,886	79,794	80,577
Gaston	206,068	212,636	222,780	232,927	243,072	253,216	255,247
Gates	12,161	11,739	11,637	11,617	11,615	11,614	11,615
Graham	8,868	8,761	8,595	8,508	8,463	8,438	8,433
Granville	57,600	58,547	60,508	62,493	64,478	66,466	66,863
Greene	21,237	21,158	21,073	21,072	21,073	21,073	21,074
Guilford	489,487	517,124	536,923	553,524	567,448	579,125	581,224
Halifax	54,548	52,423	50,621	48,814	47,012	45,209	44,848
Harnett	115,731	127,127	134,189	141,178	148,167	155,154	156,552
Haywood	58,956	60,631	63,105	65,575	68,048	70,521	71,014
Henderson	106,950	112,511	118,807	124,682	130,161	135,271	136,249
Hertford	24,735	24,426	24,309	24,196	24,080	23,966	23,941
Hoke	47,570	51,776	58,774	65,004	70,888	77,246	78,468
Hyde	5,797	5,631	5,625	5,557	5,490	5,423	5,408
Iredell	159,797	170,230	185,140	200,059	214,975	229,894	232,875
Jackson	40,345	41,597	43,151	44,703	46,259	47,810	48,119
Johnston	169,638	184,519	205,975	227,712	249,508	271,316	275,677
Jones	10,079	10,423	10,426	10,425	10,424	10,424	10,425
Lee	57,871	58,908	58,907	58,907	58,908	58,907	58,909
Lenoir	59,451	58,338	58,017	57,696	57,378	57,056	56,991
Lincoln	78,412	81,397	86,794	92,187	97,581	102,977	104,056
Macon	33,939	34,771	36,367	37,962	39,556	41,152	41,471
Madison	20,777	21,663	22,430	23,197	23,964	24,733	24,887
Martin	24,460	23,746	23,263	22,779	22,296	21,812	21,715
McDowell	45,077	45,370	45,927	46,215	46,355	46,423	46,430
Mecklenburg	923,316	1,035,605	1,144,013	1,254,246	1,364,481	1,474,714	1,496,762
Mitchell	15,536	15,335	15,296	15,292	15,291	15,290	15,291
Montgomery	27,944	27,826	28,162	28,496	28,832	29,168	29,235
Moore	88,589	94,492	100,788	106,435	111,479	115,983	116,826
Nash	95,867	94,370	93,920	93,471	93,025	92,576	92,485
New Hanover	203,289	220,231	234,826	249,424	264,016	278,612	281,530
Northampton	22,007	21,073	20,889	20,704	20,518	20,332	20,296
Onslow	186,977	194,636	205,607	216,578	227,549	238,521	240,716
Orange	134,044	140,144	147,929	155,679	163,385	171,058	172,586

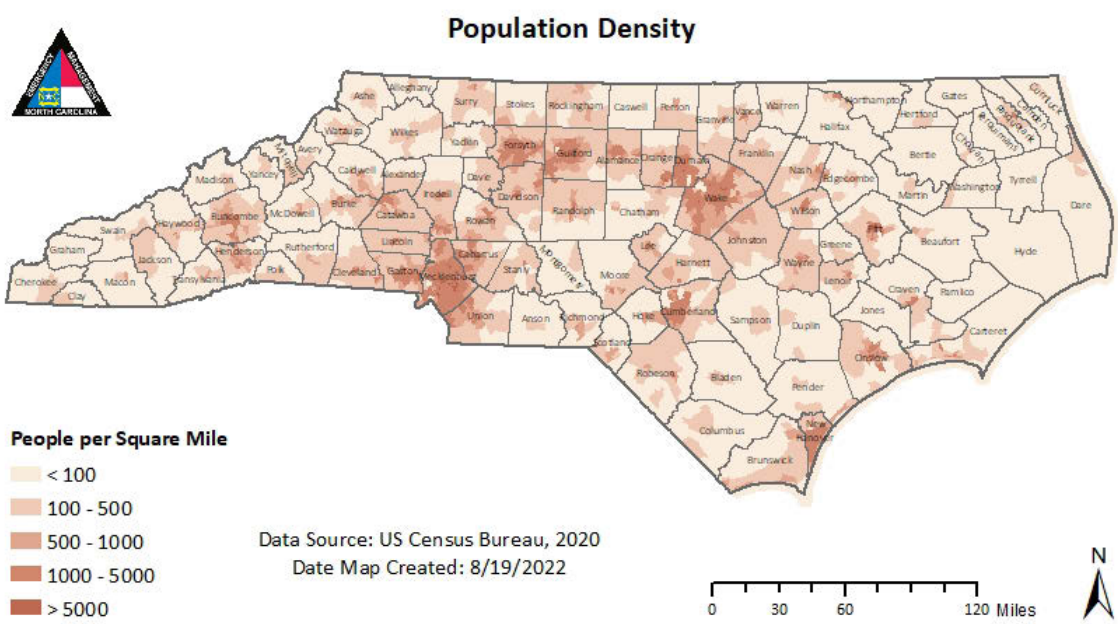
Population							
County	July 2010	July 2015	July 2020	July 2025	July 2030	July 2035	July 2036
Pamlico	13,093	13,174	13,201	13,231	13,260	13,289	13,296
Pasquotank	40,652	39,731	40,330	40,411	40,423	40,422	40,423
Pender	52,361	57,941	64,102	70,254	76,410	82,566	83,797
Perquimans	13,484	13,648	14,112	14,778	15,475	16,173	16,315
Person	39,421	39,574	40,214	40,745	41,184	41,543	41,606
Pitt	168,822	175,532	179,437	183,346	187,251	191,158	191,942
Polk	20,450	20,828	21,278	21,636	21,922	22,148	22,187
Randolph	141,944	142,943	143,683	144,423	145,163	145,902	146,052
Richmond	46,605	45,353	45,058	44,754	44,450	44,149	44,088
Robeson	134,392	133,375	132,087	130,797	129,510	128,218	127,962
Rockingham	93,651	92,084	91,713	91,636	91,621	91,619	91,620
Rowan	138,327	140,122	144,335	148,551	152,766	156,981	157,825
Rutherford	67,735	67,617	67,883	68,024	68,082	68,113	68,117
Sampson	63,460	63,993	63,992	63,992	63,994	63,993	63,993
Scotland	36,077	35,821	34,933	34,063	33,189	32,315	32,140
Stanly	60,557	61,234	62,340	63,460	64,577	65,696	65,921
Stokes	47,336	46,763	46,642	46,571	46,530	46,505	46,501
Surry	73,693	73,195	73,197	73,198	73,194	73,195	73,194
Swain	13,996	14,953	15,714	16,474	17,234	17,996	18,149
Transylvania	33,065	33,745	35,308	36,868	38,430	39,994	40,308
Tyrrell	4,400	4,217	4,216	4,215	4,217	4,215	4,215
Union	202,117	219,992	240,175	260,360	280,541	300,722	304,757
Vance	45,303	45,097	45,162	45,197	45,218	45,231	45,234
Wake	906,964	1,007,631	1,119,118	1,230,780	1,342,440	1,454,103	1,476,434
Warren	20,935	20,473	20,491	20,516	20,541	20,566	20,569
Washington	13,162	12,589	12,192	11,796	11,401	11,004	10,925
Watauga	50,981	53,737	56,744	59,752	62,757	65,764	66,363
Wayne	122,855	124,984	128,020	132,844	135,616	139,698	140,458
Wilkes	69,244	69,663	69,664	69,664	69,663	69,664	69,661
Wilson	81,247	81,689	84,504	87,770	91,092	94,420	95,088
Yadkin	38,436	37,705	37,022	36,620	36,378	36,231	36,208
Yancey	17,797	17,959	18,062	18,165	18,267	18,372	18,393
North Carolina	**9,574,408**	**10,056,683**	**10,584,376**	**11,116,784**	**11,643,181**	**12,167,836**	**12,272,264**

Source: North Carolina OSBM, Standard Population Estimates, Vintage 2016 and Population Projections, Vintage 2017

3.5.1.3 Population Diversity Map

Figure 3-65 illustrates the population density per square mile across the State as it was reported by the U.S. Census Bureau in 2020 at the census block level. The 2020 total population in the State according to Census data was 10,439,388 persons. As can be seen in the figure, a majority of the State has less than 100 people per square mile, and Mecklenburg and Wake Counties have the highest population concentrations in the state. More specific information on the estimated number of people living within identified hazard areas is provided throughout this section.

Figure 3-65 Population Density in North Carolina



3.5.1.4 State Collected Synthetic Census Data

NCEM's Risk Management department purchased RTI International's U.S. Synthetic Household Population™ dataset. This data provides an accurate representation of the complete household and person population throughout the United States. The database includes locations and descriptive sociodemographic attributes derived completely from public data sources. It statistically matches the real household population and contains no personally identifiable information. One of the primary goals of the data is to create a dot displayed on maps for every person and every home. NCEM has worked to associate those dots with specific buildings in the statewide building inventory.

For this version of the State Plan update, the synthetic populations data was used to evaluate how vulnerability changes for the fixed nuclear radiological hazard. For future updates of this plan Hazard Mitigation staff will work to conduct analyses that will provide summaries of risk associated with changes in day and night-time populations and differences in seasonal populations.

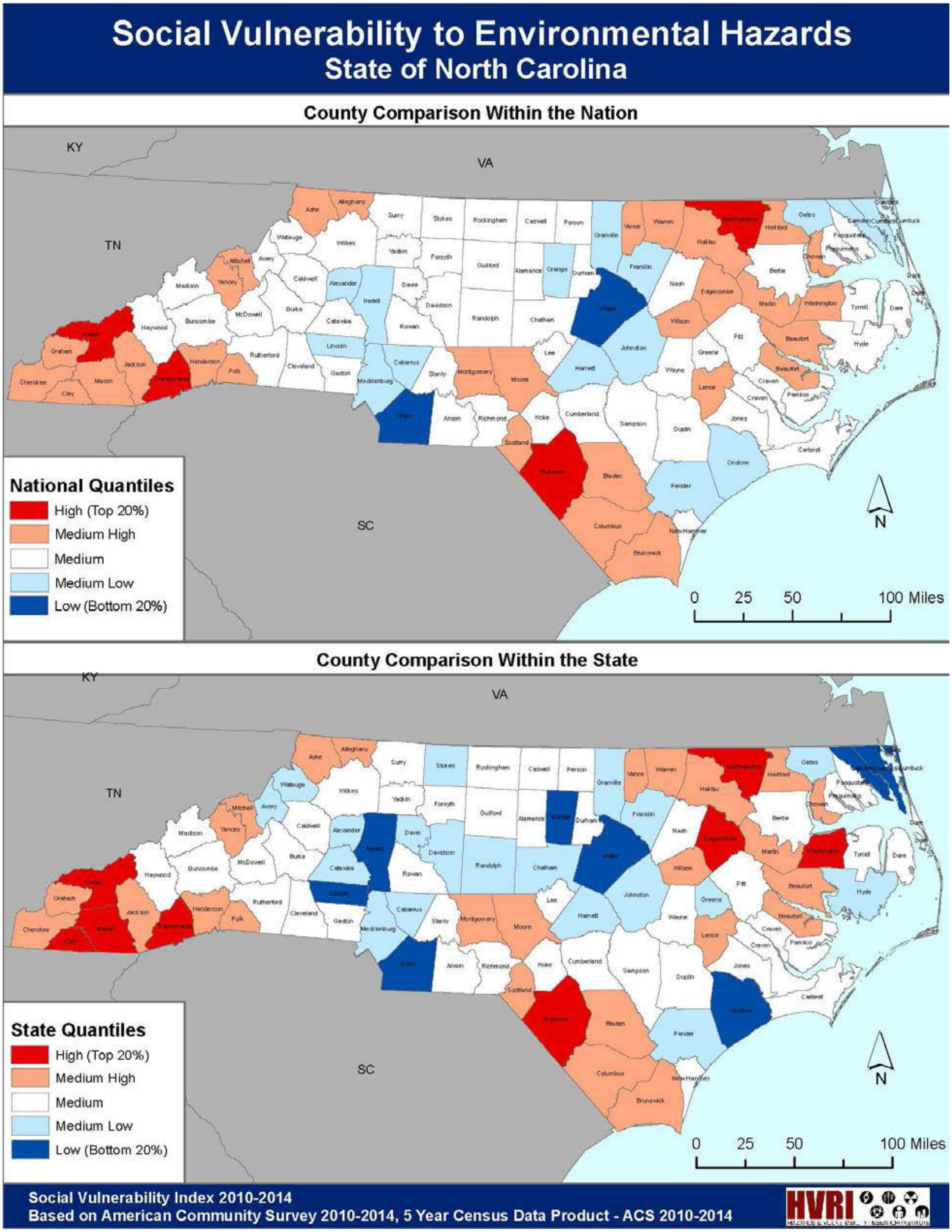
3.5.1.5 Social Vulnerability

In addition to identifying those assets potentially at risk to identified hazards, it is important to identify and assess those segments of the resident population in the State that are potentially at risk to these hazards.

Natural disasters and infectious disease outbreaks can pose a threat to a community's health and safety. Socially vulnerable populations are especially at risk during public health emergencies because of factors such as socioeconomic status, household composition, minority status, or housing type and transportation. The Geospatial Research, Analysis, and Services Program (GRASP) created and maintains the CDC/ATSDR Social Vulnerability Index (CDC/ATSDR SVI) to help public health officials and emergency planners meet the needs of socially vulnerable populations in emergency response and recovery efforts.

Figure 3-66 provides social vulnerability results for the State as developed by the University of South Carolina's Hazards and Vulnerability Research Institute. Their method of evaluating 29 socioeconomic variables was used to indicate where there is potential social vulnerability when comparing counties to other counties nationally and against other counties in North Carolina. On the national level, most of the counties in the State fall within the "low" and "medium-low" social vulnerability category when compared with other counties in the country. In comparing North Carolina counties against themselves, counties in the mountains and in the coastal plain are more socially vulnerable than those in the Piedmont.

Figure 3-66 Social Vulnerability of the State of North Carolina



3.5.2 Land Use and Development

3.5.2.1 Changes in the Past Ten Years

The population of North Carolina grew by approximately 9.5% over the 10-year period from 2010 to 2020 (OSBM, 2022).[56] Population growth was strong in both coastal and non-coastal counties. However, the population of non-coastal counties grew faster than coastal counties with a growth rate of 9.5% in non-coastal counties compared to 6.5% in coastal counties. The largest population gains were observed in urban counties, which grew by nearly 13% as a whole, while the population in rural counties declined by nearly 2.6% over the same 10-year period.[57]

Population growth was highest in the central and outlying metropolitan areas, while the population of rural counties declined overall. Central and outlying metropolitan areas within urban areas are delineated by the Office of Management and Budget. Central metropolitan counties contain a substantial portion of the core urbanized area of at least 50,000 population and outlying metropolitan areas include adjacent counties having a high degree of social and economic integration with central metropolitan counties as measured through commuting ties.[58] Between 2010 and 2020, population growth within non-coastal counties was highest in central metropolitan counties at 13.7% followed by population growth in outlying metropolitan counties, which grew at 9%, while the population of rural, non-coastal counties declined by 2.4%. Similar trends were observed within coastal counties, where population growth was highest in central metropolitan counties at 11.1% followed by population growth of 9.9% in outlying metropolitan counties and a decline in the population of rural, coastal counties by nearly 4%.

In urban, non-coastal areas, the population growth rates were highest in Johnston (28.3%), Cabarrus (27.2%), Wake (25%), Mecklenburg (21.1%), and Chatham (20%) Counties. Urban, coastal counties also had high population growth led by Brunswick (27.5%), Currituck (19.8%), Pender (15.3%), New Hanover (11.1%), and Onslow (9.6%) Counties. Population declines were highest in rural, coastal counties led by Tyrrell (-28.8%), Hyde (-21.2%), Washington (-16.5%), Bertie (-15.7%), and Hertford (-14.3%) Counties. Rural, non-coastal counties also had population declines, led by Northampton (-21.5%), Anson (-17.7%), Duplin (-17.3%), Bladen (-16.1%), and Robeson (-13.8%) Counties.

Despite broad population growth in urban areas and population declines in rural areas between 2010 and 2020, the population of several rural counties grew, while multiple urban counties saw population declines. In rural counties, the coastal counties of Dare (9%), Camden (3.8%), and Carteret (1.4%) saw positive population growth. Additionally, the population grew in

[56] Office of State Budget and Management (OSBM). North Carolina Population Projections by Sex and Age 2000-2050. https://www.osbm.nc.gov/facts-figures/population-demographics/state-demographer/countystate-population-projections
[57] Urban areas are defined by the United States Office of Management and Budget (OMB), which designates counties as Metropolitan, Micropolitan, or Neither. A Metropolitan area contains a core urban area of 50,000 or more population. OMB considers all counties that are part of a Metropolitan Statistical Area (MSA) to be urban and all counties that are not part of an MSA to be rural. In NC there are 46 metropolitan (urban) counties and 54 non-metropolitan (rural) counties (based on 2015 designations). https://www.census.gov/programs-surveys/metro-micro/about/glossary.html
[58] https://www.census.gov/programs-surveys/metro-micro/about/glossary.html

numerous rural, non-coastal counties, led by Harnett (15.7%), Moore (13.1%), Lee (9.8%), Macon (9.2%), and Jackson (6.8%) Counties. Population declined in the urban, coastal counties of Gates (-14.3%), Pamlico (-6.4%), and Craven (-3.4%). In urban, non-coastal counties, population declined the fastest in Edgecombe (-13.8%), Jones (-9.9%), Stokes (-5.9%), Wayne (-4.6%), and Burke (-3.4%) Counties.

Considerations for Vulnerability and Risk

In North Carolina, the frequency and intensity of flood events are likely increasing at the same time that more people may be entering flood-prone areas. Population increases coupled with land use changes and increasing precipitation extremes can not only increase the number of people and amount of infrastructure at risk to flooding but can also increase the likelihood of a severe flood event.

Urban population growth is associated with a reduction of vegetation and bare lands coverage, an expansion of impervious surfaces, and a reduction in pervious surfaces. This can raise flood risk by hindering groundwater recharge, perturbing evapotranspiration losses, and accumulating surface runoff.[59]

Coastal communities in particular are likely to become more exposed to frequent and intense flooding due to tropical storms, hurricanes, sea level rise (SLR), and nuisance flooding. SLR is expected to affect the extent of storm surge and tidal inundation, eventually leading to permanent flooding of low-lying coastal areas.[60]

Rural communities, coastal and non-coastal alike, are also at risk of continued decline in the face of increased hazard risk. For example, if homeowners do not have adequate access to disaster assistance, flood insurance, or other resources to prepare for and recover from a disaster, they won't be able to repair and rebuild their homes and may leave the community. This could put further downward pressure on the community's local housing stock, potentially limit a community's ability to attract workers, restrict property tax receipts, and negatively impact a community's development plans.[61]

Potential Solutions

There is no one-size-fits-all solution to sustainable and resilient development, as evidenced by the large variation between population growth rates between and within urban and rural areas and coastal and non-coastal counties, as well as varying risk characteristics by location. Resiliency in the face of increasing risk of flooding due to climate change and urban development will require a collaborative effort across many stakeholders, including government agencies, as well as the local communities that understand their specific needs. Comprehensive development and land use plans must be created or updated through a

---

[59] *https://www.nature.com/articles/s41598-022-16475-x#:~:text=Climate%20change%2C%20particularly%20precipitation%20extremes,and%20critical%20infrastructure6%2C7.*
[60] *https://www.sciencedirect.com/science/article/pii/S2212096318301037*
[61] *https://www.stlouisfed.org/-/media/project/frbstl/stlouisfed/files/pdfs/community-development/investing-rural/investinginruralprosperity-book.pdf*

collaborative approach so that community members have an equitable stake in the solutions and opportunities to carry them forward.

Sustainable development of urban areas will require urban planning that incorporates a combination of mitigation and protective measures. Urban planning policies and socioeconomic incentives such as acquisition, zoning, insurance, and taxation are forms of nonstructural measures that can not only shape development, but also mitigate future flood risk and lead to more resilient communities.[62] Because communities face a number of options and alternatives, when designing development plans, it is important to explore flood risk under various urban development scenarios. This can be done to explore both the effectiveness of urban planning policies on reducing flood and other hazard risk, as well as the costs and benefits of such policies. It is important that a maintenance plan is in place to re-evaluate urban plans in the future, as development and risks may change, and need to be adjusted accordingly.

Rural communities must not be left behind. Preparedness plans that assist resource-limited, rural communities to mitigate and prevent disaster risk, as well as respond to and recover from a disaster once it strikes could be developed through partnerships outside of the community. Mitigation could be coupled with insurance affordability programs to help disaster victims remain in the community and rebuild and recover from a disaster, while reducing future disaster risk.

It should be noted that the possibility of climate-induced housing impacts, including retreat, migration, quality and availability of adequate HVAC and other potential challenges could also be anticipated in North Carolina's future.

New Residents, New Jobs

Three kinds of development contributed most to population growth in North Carolina counties during the second half of the twentieth century. New and rapidly expanding businesses created jobs and led to increased population in some counties. Much of this kind of growth occurred in the Piedmont, with Mecklenburg and Wake counties having the greatest population increase. Military base development contributed much to the population growth in some coastal plain counties, especially Cumberland (Fort Bragg) and Onslow (Camp LeJeune). Resort and retirement community developments also contributed to major population growth in several counties, particularly in the mountains (Henderson, Watauga) and at the beach (Brunswick, Currituck, Dare).

In each case, additional jobs were also created as people moved into these developing counties. Whether they came to take jobs created by expanding businesses, to serve on military bases, or to retire, new residents needed housing, food, clothing, banking and other goods and services. This need led to the expansion of other businesses and to the creation of additional jobs. As a result of the development of new jobs, people in counties with

[62] *https://iopscience.iop.org/article/10.1088/1748-9326/ac1e3c*

population growth generally have higher incomes than those who live in counties with little or no population growth.

Population growth creates the need for additional government services. Not only are there more people to be served, but the kinds of services needed may also change as the population increases. For example, housing developments are springing up along the North Carolina countryside, creating some of the same problems that cities experience. Many counties have begun providing water, sewers, and other services to housing developments in unincorporated areas. New school buildings and other public facilities are also needed as the population increases. County governments must pay for these new facilities and hire new employees to serve their larger population.

Needs of Counties That Have Not Grown

In North Carolina, many counties that are primarily agricultural had little population growth or even experienced a decrease in population in the second half of the 20th century. Machines replaced people for many farming operations, including tobacco and cotton during this period. In 1947, 42 percent of North Carolinians worked in agriculture. A 2016 report produced by North Carolina State University indicates that the number is now at 17 percent[63]. In some rural counties, manufacturing or tourist jobs replaced agricultural jobs. In other counties, however, there were few new jobs to replace those lost on the farms. These are the counties that lost population or had little population growth. These are also the counties where per capita income is lowest.

Counties with constant or declining population often have special problems. High unemployment and low wages mean that a larger proportion of the population needs financial assistance and health care from the county government. At the same time, poorer people pay less in taxes. A county with a low per capita income may have trouble raising funds to assist its needy residents.

(Excerpted in part from Local Government in North Carolina by Gordon P. Whitaker. 2003. North Carolina City and County Management Association.)

Growth pressures and rapid expansion can affect how willing or able a local government is to respond to changes in vulnerability as populations increase. Pressure to build in remaining open space may lead some counties to allow development to encroach on floodplains and other hazardous areas. Counties and municipalities must be careful to provide services, such as water and sewer, to support new development only in areas that are not hazardous. Counties with declining populations must not be so eager to grow that they, too, encourage new development in inappropriate areas.

[63] *2016 State Agribusiness Values – Michael L. Walden. PhD.*

3.5.2.2 Current Conditions

Statewide there are areas that have been experiencing steady growth and development and some areas that have experienced population loss between 2010 and 2017. Brunswick, Wake, Mecklenburg, Durham, Harnett, Chatham, Hoke, Johnston, Cabarrus, Pender, Union and New Hanover Counties have all experienced greater than 10% population increases and can be expected to have higher rates of development when compared to the rest of the State, resulting in an increased number of structures that are vulnerable to the potential impacts of the identified hazards. Therefore, development and population growth have impacted the State's vulnerability since the previous State hazard mitigation plan was approved and there has been an increase in the overall vulnerability.

3.5.2.3 Projected Future Changes

It is also important to note that as development increases in the future, greater populations and more structures and infrastructure will be exposed to potential hazards if development occurs in hazard areas. According to the Office of State Budget and Management, North Carolina counties where growth rates are anticipated to be greater than 10% between 2010 and 2020 include the following: Alamance (10.9%), Brunswick (31.7%), Buncombe (13.7%), Cabarrus (22.1%), Chatham (25.2%), Cherokee (12.8%), Clay (13.1%), Currituck (19.4%), Dare (11.6%), Durham (18.6%), Franklin (15.2%), Harnett (19.9%), Henderson (13.6%), Hoke (23.7%), Iredell (16.7%), Jackson (11.1%), Johnston (24.9%), Lincoln (11.9%), Madison (10.9%), Mecklenburg (24.3%), Moore (15.6%), New Hanover (17.5%), Onslow (13.5%), Pender (24.4%), Swain (10.4%), Union (19.7%), Wake (24.0%), Watauga (16.9%). Statewide, the growth rate is expected to be 11.4% with the majority of counties expected to experience some form of growth. Twenty-seven (27) counties are expected to lose population during this same time period.

3.5.3 Economic Vulnerability

As has been experienced in recent events such as Hurricane Florence and the COVID-19 pandemic, economic impacts as a result of natural hazards can be significant. Economic losses following a disaster can be very detrimental to the vitality of a community and to the State as a whole. One methodology for determining economic vulnerability is to identify the major employers in the State, evaluate the types of businesses and the locations of those major employers, and take into consideration factors that may already be contributing to distressing a local economy and consider how a hazard event might exacerbate those conditions.

3.5.3.1 Major Employers

The top 25 employers in North Carolina, as of first quarter 2021 employment size are included in the table below.

Table 3-33 Top 25 NC Employers as of Q1 2021 by Employment Size

Name	Industry
1. Walmart Associates Inc	Retail Trade
2. Food Lion	Retail Trade
3. Duke University	Health Care and Social Assistance

Name	Industry
4. Atrium Health	Health Care and Social Assistance
5. Wells Fargo Bank	Finance and Insurance
6. Amazon Fulfillment Services	Transportation and Warehousing
7. Lowes Home Centers	Retail Trade
8. Defense Ex-Army Navy and Air Force	Public Administration
9. Department of Public Safety	Public Administration
10. Harris Teeter	Retail Trade
11. Wake County Public School System	Educational Services
12. Bank of America	Finance and Insurance
13. U.S. Postal Service	Transportation and Warehousing
14. Charlotte-Mecklenburg Board of Education	Educational Services
15. Wake Forest University Baptist Medical Center	Health Care and Social Assistance
16. UNC Chapel Hill	Educational Services
17. State of North Carolina Department of Health and Human Services	Health Care and Social Assistance
18. United Parcel Service (UPS)	Transportation and Warehousing
19. Veterans Administration	Health Care and Social Assistance
20. BB&T	Finance and Insurance
21. Vidant Medical	Health Care and Social Assistance
22. UNC Health Care System	Health Care and Social Assistance
23. Guilford County Board of Education	Educational Services
24. Charter Communications	Information
25. Smithfield Foods	Manufacturing

3.5.3.2 Locations

Most of the top employers in the State are located in multiple places of business across the State. For example, Wal Marts, Food Lions and many of the banks listed above can be found in most urban areas and even in some more rural locations. Therefore, it is difficult to get a clear picture on the number of these specific locations that are vulnerable to hazards.

3.5.3.3 Type of Employers

The major types of employers in North Carolina fall into one of the following categories:

- Retail Trade (4)
- Health Care and Social Assistance (7)
- Finance and Insurance (3)
- Transportation and Warehousing (3)
- Manufacturing (1)
- Information (1)
- Educational Services (4)
- Public Administration (2)

The number listed in parenthesis by the employment sector represents the number of Top 25 businesses in North Carolina that are in that sector.

3.5.3.4 Development

Since 2007, the North Carolina Department of Commerce has used a three-level system for designating development tiers and determining county economic distress rankings. These state-mandated designations help determine state funding opportunities to aid economic development and assigns each county a designation of Tier One (most distressed), Tier Two, or Tier Three (least distressed). To determine a county's ranking, four factors are assessed:

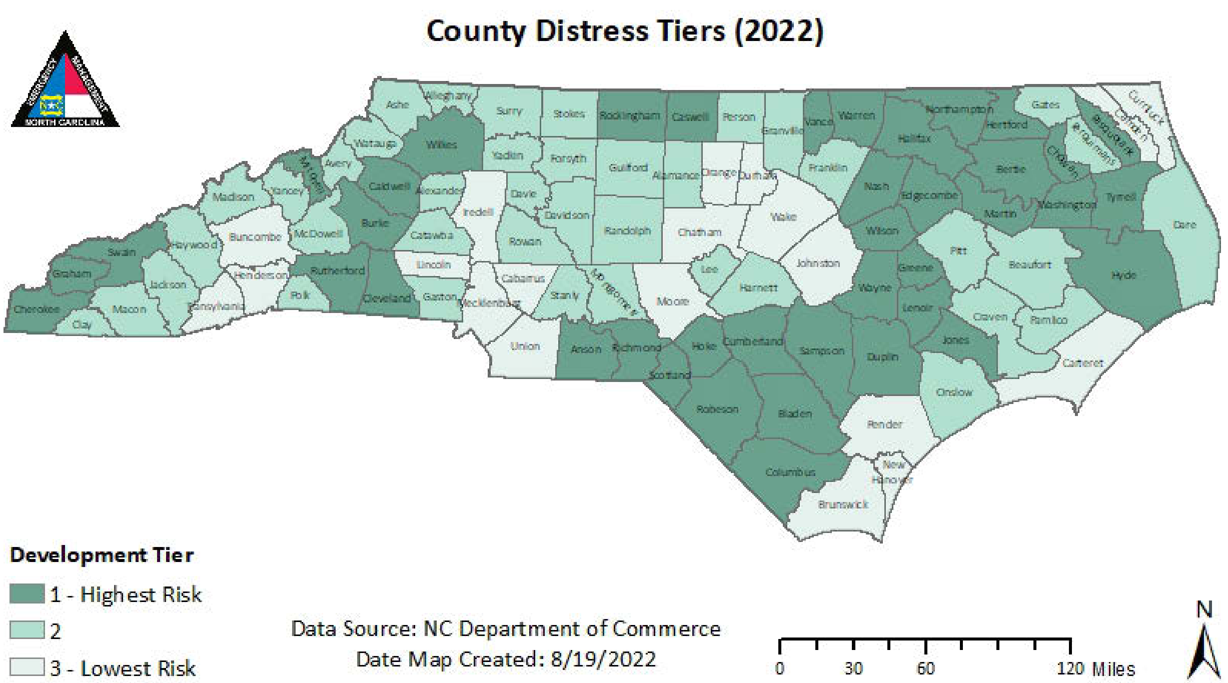
- Average unemployment rate for the most recent twelve months
- Median household income for the most recent twelve months
- Percentage growth in population for the most recent 36 months
- Adjusted property tax base per capita for the most recent taxable year

Each county is ranked from 1 (most distressed) to 100 (least distressed) based on the above variable assessments. Tier 1 consists of the lowest ranking 40 counties, Tier 2 contains the middle 40 counties, and Tier 3 is designated to the remaining 20 counties. A county may be automatically qualified as Tier 1 if the county:

- Is a Tier 1 county for at least 2 consecutive years
- Has a population of less than 12,000 people
- Has a population of less than 50,000 and a poverty rate of 19% or higher.

Figure 3-67 below displays county tier designations for 2022.

Figure 3-67 2022 County Tier Designations



Source: NC Department of Commerce

Table 3-34 displays a list of each county's economic distress ranking and tier designations.

Table 3-34 2022 County Development Tier Rankings

County	Economic Distress Rank (#1 = most distressed)	2022 Tiers
Alamance	71	2
Alexander	53	2

County	Economic Distress Rank (#1 = most distressed)	2022 Tiers
Alleghany	50	2
Anson	12	1
Ashe	67	2
Avery	76	2
Beaufort	47	2
Bertie	6	1
Bladen	17	1
Brunswick	81	3
Buncombe	83	3
Burke	32	1
Cabarrus	89	3
Caldwell	37	1
Camden	93	3
Carteret	88	3
Caswell	21	1
Catawba	68	2
Chatham	99	3
Cherokee	40	1
Chowan	33	1
Clay	53	2
Cleveland	58	1
Columbus	5	1
Craven	47	2
Cumberland	20	1
Currituck	100	3
Dare	77	2
Davidson	63	2
Davie	77	2
Duplin	30	1
Durham	94	3
Edgecombe	3	1
Forsyth	63	2
Franklin	74	2
Gaston	57	2
Gates	44	2
Graham	25	1
Granville	69	2
Greene	28	1
Guilford	58	2
Halifax	4	1
Harnett	46	2
Haywood	73	2
Henderson	91	3
Hertford	9	1
Hoke	24	1
Hyde	26	1
Iredell	89	3
Jackson	72	2
Johnston	86	3
Jones	34	1
Lee	62	2

County	Economic Distress Rank (#1 = most distressed)	2022 Tiers
Lenoir	16	1
Lincoln	95	3
Macon	80	2
Madison	58	2
Martin	11	1
McDowell	45	2
Mecklenburg	84	3
Mitchell	36	1
Montgomery	61	2
Moore	91	3
Nash	31	1
New Hanover	82	3
Northampton	14	1
Onslow	41	2
Orange	97	3
Pamlico	69	2
Pasquotank	38	1
Pender	87	3
Perquimans	51	2
Person	58	2
Pitt	43	2
Polk	65	2
Randolph	42	2
Richmond	8	1
Robeson	1	1
Rockingham	22	1
Rowan	55	2
Rutherford	22	1
Sampson	27	1
Scotland	2	1
Stanly	66	2
Stokes	55	2
Surry	51	2
Swain	34	1
Transylvania	84	3
Tyrrell	14	1
Union	96	3
Vance	7	1
Wake	98	3
Warren	13	1
Washington	10	1
Watauga	79	2
Wayne	18	1
Wilkes	29	1
Wilson	19	1
Yadkin	49	2
Yancey	75	2

Eleven counties will change tiers in 2022. Counties moving to a less distressed tier include Alexander, Brunswick, Buncombe, New Hanover, Randolph and Rowan. Counties moving to a more distressed tier include Chowan, Jones, Macon, Polk, and Watauga.

3.5.3.5 Agricultural Industry

An integral part of the North Carolina economy is ag-based industry. There were 2,067 farms in operation according to 2015 data obtained from the North Carolina Department of Agriculture and 912,000 acres in farming. Natural hazards can have a tremendous impact on the agricultural industry. Droughts, floods, severe storms, winter weather and wildfires can be devastating to farmers and crops.

3.5.4 Environmental Vulnerability

Although North Carolina's environment is adaptable to natural hazards, the state's natural resources, environmental diversity, and protected lands are still vulnerable to unpredictable disasters. Mitigation strategies are put in place to offset unavoidable environmental damage; however, it is important to assess varying vulnerability across the state. Environmental vulnerability takes various factors into consideration, including land uses, protected areas, population densities, land resiliency, and impacts on tourism and the economy.

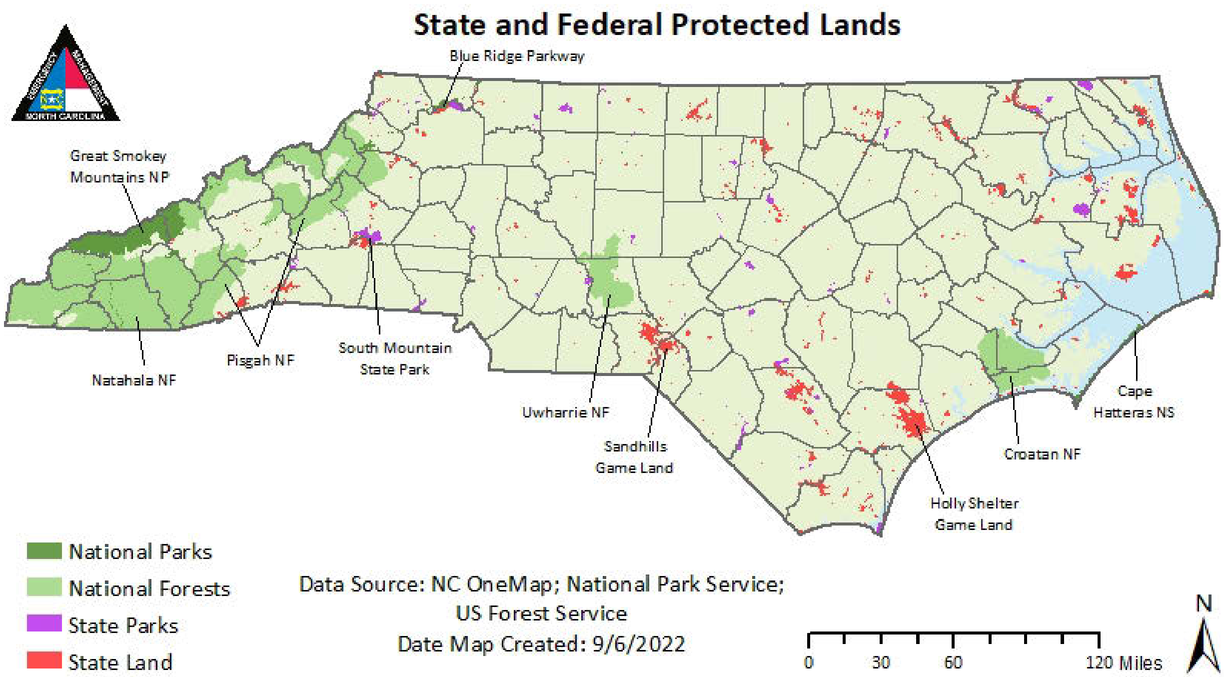
According to the North Carolina Forest Service, forestland covers 18.6 million acres, or 60% of the state's land area. There are four national forests within state borders: Croatan, Nantahala, Pisgah, and Uwharrie. North Carolina is also home to multiple state parks, which cover over 225,000 acres. Protected forests and parks are an asset to the state, and they are also areas of high vulnerability. Table 3-35 below lists all of North Carolina's state parks, and a graphic representation follows in Figure 3-68.

Table 3-35 North Carolina State Parks

NC State Park	Region
Boone's Cave State Park	Piedmont
Carolina Beach State Park	Coastal Plain
Cliffs of the Neuse State Park	Coastal Plain
Crowders Mountain State Park	Piedmont
Duke Power State Park	Piedmont
Eno River State Park	Piedmont
Fort Macon State Park	Coastal Plain
Goose Creek State Park	Coastal Plain
Hammocks Beach State Park	Coastal Plain
Hanging Rock State Park	Piedmont
Jockey's Ridge State Park	Coastal Plain
Jones Lake State Park	Coastal Plain
Lack Waccamaw State Park	Coastal Plain
Lake James State Park	Western Mountains
Medoc Mountain State Park	Coastal Plain
Morrow Mountain State Park	Piedmont
Merchants Millpond State Park	Coastal Plain
Mt. Jefferson State Park	Western Mountains
Mt. Mitchell State Park	Western Mountains
New River State Park	Western Mountains
Pilot Mountain State Park	Piedmont
Pettigrew State Park	Coastal Plain
Raven Rock State Park	Piedmont

NC State Park	Region
Singletary Lake State Park	Coastal Plain
South Mountains State Park	Western Mountains
Stone Mountain State Park	Piedmont
Wayneborough State Park	Coastal Plain
William B Umstead State Park	Piedmont

Figure 3-68 State and Federal Protected Lands in North Carolina



In addition to state and national parks and lands, there are many other environmentally sensitive lands in North Carolina that also serve a role in mitigating hazard impacts. These include agricultural lands, coastal habitats, floodplains and wetlands, pocosins and urban lands. Future updates of this plan will build upon identifying those lands and will discuss their benefits for mitigation purposes. Additionally, those lands will be considered in mitigation actions in future plans updates.

3.5.5 Vulnerability to Natural Hazards

The vulnerability assessments for both the County-level summaries were conducted using the following methodologies:

General Vulnerability

- Methodology 1 – Vulnerability Estimates from Local Mitigation Plans: All of the existing local hazard mitigation plans were reviewed to determine which plans had calculated annualized losses for the hazards identified in this plan. One of the challenges with this methodology is that annualized losses are not calculated in the same manner across all plans so results will not be developed using the same techniques.

Flood Vulnerability

- Methodology 1 – GIS Analysis of NC Flood Risk Data: This methodology represents a geospatial approach using multiple GIS datasets and intersecting building data with flood hazard data. Building footprints are intersected with the flood hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve is applied to each structure to calculate damages. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages.
- Methodology 2 – Analysis of NFIP Claims Data and Repetitive Loss Claims Data: This methodology does not account for flood losses that occur to uninsured properties which are most often those properties located outside of the special flood hazard area.

Other Hazards Vulnerability

- Methodology 1 – GIS Analysis of NC Risk Data: This methodology was used for the hurricane, earthquake, and tornado hazards and represents a geospatial approach using multiple GIS datasets and intersecting building data with hazard data. Building footprints are intersected with the hazard areas most likely to be impacted in North Carolina. Based on the hazard, a damage curve is applied to each structure to calculate damages. A cost based on the estimated structure value multiplied by the damage percentage illustrates the expected cost of damages. This approach for calculating vulnerability differs from previous versions of the plan.
- Methodology 2 – GIS Hazard Area Overlay Analysis of NCEM Building Data to Determine Exposure: This methodology was used for the coastal surge (as part of hurricanes), wildfire and geological hazards (landslide, sinkhole and coastal erosion).
- Methodology 3 – Analysis of NCEI Data: This methodology was used for the severe winter weather, drought, tornado/severe thunderstorm hazards. Previous occurrence records from the NCEI database were evaluated and any reported dollar losses were inflated to 2017 dollars and calculations were made to determine how much damage (dollar losses) could be expected to occur during any given year.

3.5.5.1 General Vulnerability

The table on the following page provides annualized loss data as calculated and presented in the local hazard mitigation plans. It is important to note that, as of the 2023 update, many of the regional hazard mitigation plans no longer provide annualized loss estimates.

Summary of Annualized Losses from Local Plans

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Alamance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alexander	Negligible	N/A	N/A	N/A	N/A	N/A	Negligible	$295,918.00	N/A$67,150.00	N/A	N/A	N/A
Alleghany	$34,386.00	$11,720.00	$58,439.00	$23,000.00	Negligible	Negligible	Negligible	$40,101.00	$1,734.00	Negligible	N/A	N/A
Anson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ashe	$71,496.00	$19,840.00	$40,153.00	$11,200.00	Negligible	Negligible	Negligible	N/A	$1,577.00	Negligible	N/A	N/A
Avery	$30,226.00	$1,103,784.00	$3,803,738	$146,001.00	Negligible	Negligible	Negligible	$345,135.00	$345,135.00	Negligible	N/A	Negligible
Beaufort	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bertie	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bladen	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Brunswick	$791,848	$53,436,605	Negligible	Negligible	Negligible	Negligible	Negligible	$$1,284,177	$1,284,177	Negligible	N/A	Negligible
Buncombe	$14,314,247.0 0	$8,087,911.00	$571,384.00	$1,264,156.00	Negligible	Negligible	Negligible	$822,765.00	$822,765.00	Negligible	N/A	Negligible
Burke	$82,329.00	N/A	N/A	N/A	N/A	N/A	Negligible	$10,089,444.0 0	N/A	N/A	N/A	Negligible
Cabarrus	$549,600.00	N/A	$722,244.00	Negligible	Negligible	Negligible	Negligible	$6,179.00	$6,179.00	Negligible	N/A	Negligible
Caldwell	$556,965.00	N/A	N/A	N/A	N/A	N/A	Negligible	$449,851.00	N/A	Negligible	N/A	N/A
Camden	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Carteret	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Caswell	$40,681.00	$4,339,280.00	$16,271.00	$66,240.00	Negligible	Negligible	$761,667.00	$492,555.00	$492,555.00	Negligible	N/A	Negligible
Catawba	$2,426,935.00	N/A	N/A	N/A	N/A	N/A	Negligible	$5,532,087.00	N/A	N/A	N/A	N/A
Chatham	$452	$511,000	$40,343	$12,000	N/A	Negligible	Negligible	$18,229	$25,249	N/A	N/A	Negligible
Cherokee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chowan	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Clay	$77,134.00	$9,000.00	Neg	$40,000.00	Negligible	Negligible	Negligible	$10,785.00	$22,670.00	Negligible	N/A	Negligible
Cleveland	$86,396.00	N/A	$1,061,230.00	N/A	Negligible	Negligible	Negligible	$1,982,072.00	$1,982,072.00	Negligible	N/A	Negligible
Columbus	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Craven	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cumberland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Currituck	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dare	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Davidson	$46,533.00	$790,000.00	$344,444.00	$165,000.00	$116,000.00	Negligible	Negligible	$501,190.00	$162,030.00	Negligible	N/A	Negligible
Davie	$147,303.00	$8,572,098.00	$589,495.00	$225,696.00	Negligible	Negligible	Negligible	$849,784.00	$849,784.00	Negligible	N/A	Negligible
Duplin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Durham	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Edgecombe	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Forsyth	$121,113	$27,798,992.0 0	$23,688.00	$832,816.00	Negligible	Negligible	Negligible	$625,700.00	$625,700.00	Negligible	N/A	Negligible

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Franklin	$3,252.00	$890,000.00	$27,221.00	$3,000.00	Negligible	Negligible	Negligible	$862,405.00	$145,089.00	Not Calculated	Not Calculated	Negligible
Gaston	$2,859,579.00	N/A	$1,061,230.00	N/A	Negligible	Negligible	Negligible	$1,440,865.00	$1,440,865.00	N/A	N/A	Negligible
Gates	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Graham	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Granville	$4,207.00	$517,000.00	$41,868.00	$3,000.00	Negligible	Negligible	Negligible	$130,271.00	$12,129.00	Not Calculated	Not Calculated	Negligible
Greene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Guilford	$67,895,131.0 0	$3,836,000.00	$409,030.00	$541,000.00	Negligible	Negligible	Negligible	$67,895,161.0 0	$65,036.00	N/A	Negligible	Negligible
Halifax	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Harnett	$452	$1,669,000	$40,624	$21,000	Negligible	Negligible	Negligible	$411,492	$29,061	N/A	N/A	Negligible
Haywood	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Henderson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hertford	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hoke	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hyde	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iredell	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jackson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Johnston	$2,293	$2,339,000	$40,624	$20,000	Negligible	Negligible	Negligible	$4,4492,630.0 0	$26,524	N/A	N/A	Negligible
Jones	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lee	Negligible	$674,000	$61,319	$15,000	Negligible	Negligible	Negligible	$1,040,079	$18,425	N/A	N/A	Negligible
Lenoir	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lincoln	$2,232,000.00	N/A	$553,614.00	N/A	Negligible	Negligible	Negligible	$2,314,700.00	2,314,700.00	N/A	N/A	Negligible
Macon	$290,279.00	$40,000.00	Neg	$177,000.00	Negligible	Negligible	Negligible	$27,797.00	$49,911.00	$202,636.00	N/A	Negligible
Madison	$1,160,697.00	$1,432,115.00	$319,567.00	$10,000.00	Negligible	Negligible	Negligible	$60,793.00	$51,740.00	Negligible	N/A	Negligible
Martin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
McDowell	$32,418.00	1,692,227	$3,810,122.00	$241,940	Negligible	Negligible	Negligible	$365,849	$365,849	Negligible	N/A	Negligible
Mecklenburg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mitchell	$$34,616.00	$1,125,176.00	$58,255	$179,695	Negligible	Negligible	Negligible	$367,383.00	$367,383.00	Negligible	N/A	Negligible
Montgomery	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moore	$25,939.00	$6,445,000.00	$160,578.00	$104,000.00	Negligible	Negligible	Negligible	$224,085	$61,319	N/A	N/A	Negligible
Nash	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
New Hanover	$$2,319,798.0 0	$167,594,285. 00	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	N/A	Negligible
Northampton	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Onslow	$216,407.00	$90,454,925,0 00.00	Negligible	Negligible	Negligible	Negligible	Negligible	$18,892.00	$18,892.00	Negligible	N/A	Negligible
Orange	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pamlico	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

County	Flooding	Hurricanes	Severe Winter Weather	Earthquakes	Wildfires	Dam Failures	Drought	Tornado	Thunderstorms	Landslides	Infectious Disease	Extreme Heat
Pasquotank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pender	$233,189.00	$19,447,689.00	Negligible	Negligible	Negligible	Negligible	Negligible	$416,457	$416,457	Negligible	N/A	Negligible
Perquimans	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Person	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pitt	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Polk	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Randolph	Negligible	$880,000.00	$191,139.00	$15,000.00	Negligible	Negligible	Negligible	$189,670.00	$36,169.00	Negligible	N/A	Negligible
Richmond	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Robeson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rockingham	$306,191.00	$17,624,340.00	$27,255.00	$357,653.00	Negligible	Negligible	$626,528.00	$1,572,022.00	$1,572,022.00	Negligible	N/A	Negligible
Rowan	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rutherford	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sampson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scotland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stanly	$11,914.00	N/A	Negligible	Negligible	Negligible	Negligible	Negligible	$21,143.00	$21,143.00	Negligible	N/A	Negligible
Stokes	$999.00	$324,440.00	$16,880.00	$114,986.00	Negligible	Negligible	$590,277.00	$324,440	$324,440	Negligible	N/A	Negligible
Surry	$385,351.00	$10,036,913.00	$69,083	$318,876.00	Negligible	Negligible	$589,916.00	$373,760.00	$373,760.00	Negligible	N/A	Negligible
Swain	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Transylvania	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tyrrell	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Union	$15,488.00	N/A	$51,077	Negligible	Negligible	Negligible	Negligible	$37,598	$37,598	Negligible	N/A	Negligible
Vance	$9,230.00	$341,000.00	$41,346.00	$2,000.00	Negligible	Negligible	Negligible	$792,592.00	$10,013.00	N/A	N/A	Negligible
Wake	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Warren	$1,127.00	$189,000.00	$40,139.00	$1,000.00	Negligible	Negligible	Negligible	$70,835.00	$12,423.00	N/A	N/A	Negligible
Washington	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Watauga	$597,880.00	$39,500.00	$58,411.00	$30,600.00	Negligible	Negligible	Negligible	$10,819.00	$17,839.00	Negligible	N/A	N/A
Wayne	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wilkes	$225,784.00	$81,290.00	$72,156.00	$7,800.00	Negligible	Negligible	Negligible	$87,089.00	$20,766.00	Negligible	N/A	N/A
Wilson	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yadkin	$3,245.00	$4,409,788.00	$42,113.00	$111,730.00	Negligible	Negligible	$476,257.00	$296,718.00	$296,718.00	Negligible	N/A	Negligible
Yancey	$$67,058.00	$1,217,909.00	$58,268.00	$179,695.00	Negligible	Negligible	Negligible	$441,323.00	$441,323.00	Negligible	N/A	Negligible
North Carolina	$95,890,696.00	$90,802,261,902.00	$14,523,348.00	$5,241,084.00	$116,000.00	$0.00	$3,044,645.00	$146,348,663.00	$15,169,221.00	$202,636.00	$0.00	$0.00

N/A indicates that the County did not consider the hazard, there wasn't enough data to compute an annualized loss, or an annualized loss wasn't calculated.
Data as of 09/16/2022

3.5.5.2 Vulnerability for State-Owned Facilities

According to the North Carolina Department of Insurance, Office of State Fire Marshall's Office, the North Carolina State-Owned Properties insures the State's universities and colleges, government business services – transportation, parks, legislative, offices, etc., correctional facilities, ports authority, medical facilities, stadiums and arenas and college housing. The account has 14,310 locations with Total Insurable Values (TIV) of $38,038,303,059 as of 2017. The coastal, Tier 1 county value exposure is $2,464,303,095 or 6.48% of the TIV."

The North Carolina Department of Insurance reports that, according to two modeling programs (2016 AIR Worldwide Touchstone v3.1 and RMS's RiskBrowser v15.0 models) State-Owned Property Losses based on worst case scenarios modeling, for 1,000-year hurricane event the cost would be $783,623,225; for a 20-year hurricane event the property loss would be $88,752,422; and annual average loss (AAL) is $16,910,600. These figures are based on total insured value of about $40 billion. UNC Campuses, Universities, UNC Hospitals represent about 73 % of the overall values or about $28 billion.

The modeling programs used to determine those losses are proprietary and therefore, the details of the methodology used to develop those estimates cannot be provided in this document. Other vulnerability analyses were conducted by NCEM and their contractors to determine vulnerability for state-owned facilities. Those methodologies are described in the hazard-specific vulnerability discussions found below.

3.5.5.3 Flood Hazard Vulnerability

The State of North Carolina has developed advanced technology and continues to acquire tremendous amounts of data for the purposes of determining flood hazard vulnerability. This includes creating building footprints for every building in the State (for buildings greater than 500 square feet) and collecting first floor elevations for every building in the State. Having this data, and combining it with the digital flood data that has been developed, allows NCEM to conduct detailed flood risk assessments that take into account the first-floor elevation of structures and associated depth of flooding (and associated damages).

At this time, this plan includes county level vulnerability estimates as calculated by annualized loss. Future updates of the plan will attempt to expand on this analysis by incorporating results from other return period flood events and factor in impacts of climate change and sea level rise.

Table 3-36 Annualized Flood Hazard Losses by County

County	Annualized Losses
Alamance	$ 190,069.75
Alexander	$ 1,452.16
Alleghany	$ 15,898.44
Anson	$ 53,805.49
Ashe	$ 118,948.98
Avery	$ 30,225.90
Beaufort	$ 510,486.01
Bertie	$ 9,602.90
Bladen	$ 36,564.31
Brunswick	$ 791,848.17
Buncombe	$ 14,314,247.24
Burke	$ 41,225.67
Cabarrus	$ 240,305.29
Caldwell	$ 260,033.69
Camden	$ 21,493.67
Carteret	$ 779,712.65
Caswell	$ 40,681.10
Catawba	$ 97,335.77
Chatham	$ 182,933.96
Cherokee	$ 73,128.33
Chowan	$ 9,437.50
Clay	$ 8,650.81
Cleveland	$ 51,089.09
Columbus	$ 8,080.53
Craven	$ 160,761.35
Cumberland	$ 43,975.62
Currituck	$ 174,498.83
Dare	$ 775,745.20
Davidson	$ 15,297.30
Davie	$ 147,302.50
Duplin	$ 308,315.50
Durham	$ 1,973,614.48
Edgecombe	$ 704,827.40
Forsyth	$ 121,112.73
Franklin	$ 35,580.87
Gaston	$ 58,104.97
Gates	$ 2,974,202.51
Graham	$ 23,605.85
Granville	$ 1,661.63
Greene	$ 13,285.60
Guilford	$ 318,727.68

County	Annualized Losses
Halifax	$ 394,506.10
Harnett	$ 12,967.05
Haywood	$ 338,641.30
Henderson	$ 364,351.16
Hertford	$ 5,205,709.45
Hoke	$ 1,062.99
Hyde	$ 313,676.88
Iredell	$ 315,169.10
Jackson	$ 9,025,286.05
Johnston	$ 572,641.62
Jones	$ 5,649.21
Lee	$ 6,877.03
Lenoir	$ 5,110,209.97
Lincoln	$ 201,014.35
Macon	$ 94,363.73
Madison	$ 160,959.58
Martin	$ 79,310.15
McDowell	$ 32,418.29
Mecklenburg	$ 785,367.29
Mitchell	$ 34,616.02
Montgomery	$ 58,263.75
Moore	$ 6,443.29
Nash	$ 7,217,910.34
New Hanover	$ 2,319,798.50
Northampton	$ 2,814,138.18
Onslow	$ 216,407.43
Orange	$ 180,524.71
Pamlico	$ 127,493.08
Pasquotank	$ 41,971.87
Pender	$ 233,188.63
Perquimans	$ 9,696.20
Person	$ 442,478.00
Pitt	$ 2,344,846.28
Polk	$ 42,361.15
Randolph	$ 41,905.24
Richmond	$ 544,766.03
Robeson	$ 31,452,319.00
Rockingham	$ 306,191.37
Rowan	$ 259,074.76
Rutherford	$ 176,093.67
Sampson	$ 226,564.56
Scotland	$ 131,796.69
Stanly	$ 88,864.85

County	Annualized Losses
Stokes	$ 999.47
Surry	$ 385,351.30
Swain	$ 18,272,384.76
Transylvania	$94,180.74
Tyrrell	$ 37,649.69
Union	$ 16,835.26
Vance	$ 5,576.70
Wake	$ 921,373.19
Warren	$ 770.91
Washington	$ 5,580.94
Watauga	$ 158,827.40
Wayne	$ 676,092.57
Wilkes	$ 511,849.81
Wilson	$ 1,478,961.63
Yadkin	$ 3,244.77
Yancey	$ 67,057.72
North Carolina	$ 120,618,328.43

Source: NCEM

National Flood Insurance Program (NFIP) and Repetitive Loss Data

According to FEMA records compiled as of July 31, 2019, there were 144,314 flood insurance policies in force in the state of North Carolina, with almost $37 billion in coverage and almost $ 108 million of annual premiums in force. There have been 101,116 claims under the NFIP totaling over $1.8 billion. Table 3-37 provides a summary of the NFIP policies and claims that have been made in North Carolina.

Table 3-37 North Carolina NFIP Policy and Claims Data

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Alamance	Alamance County	43	$12,206,000	40	$855,860
	Burlington	172	$37,805,000	48	$420,756
	Elon	30	$7,854,000	4	$38,064
	Gibsonville	15	$3,797,000	1	$0
	Graham	52	$13,462	10	$63,753
	Haw River	11	$315,000	1	$60,000
	Mebane	49	$12,464,000	3	$4,622
	Swepsonville	9	$2,478,000	$0	$0
Alexander	Alexander County	26	$7,059,000	4	$4,911
	Taylorsville	4	$1,400,000	0	$0
Alleghany	Alleghany County	17	$4,224,000	6	$106,505
	Sparta	3	$248,000	2	$34,861
Anson	Anson County	3	$980,000	1	$11,013
	Wadesboro	4	$1,105,000	1	$6,580

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Ashe	Ashe County	144	$34,721,000	77	$489,249
	Jefferson	6	$2,507,000	4	$8,618
	Lansing	3	$465,000	1	$24,194
	West Jefferson	7	$1,518,000	14	$198,579
Avery	Avery County	134	$32,216,000	118	$2,034,079
	Banner Elk	33	$10,108,000	9	$85,397
	Beech Mountain	3	$1,050,000	0	
	Crossnore	4	$689,000	4	$34,481
	Elk Park	5	$575,000	2	$2,487
	Grandfather Village	14	$4,750,000	1	$0
	Newland	8	$2,504,000	10	$586,225
	Sugar Mountain	8	$2,300,000	0	
Beaufort	Aurora	42	$7,554,000	43	$840,426
	Bath	102	$24,542,000	40	$397,714
	Beaufort County	2,274	$493,876,000	5,190	$79,437,885
	Belhaven	386	$44,358,000	2,053	$22,984,388
	Chocowinity	2	$370,000	8	$101,059
	Pantego	18	$2,920,000	14	$141,202
	Washington Park	127	$25,416,000	375	$5,945,621
	Washington (City)	1,233	$222,879,000	1,461	$18,263,311
Bertie	Aulander	11	$1,071,000	7	$51,959
	Bertie County	89	$16,155,000	100	$2,380,394
	Colerain	2	$700,000	0	$0
	Kelford	1	$70,000	0	$0
	Roxobel	1	$140,000	0	$0
	Windsor	111	$19,251,000	301	$10,572,998
Bladen	Bladen County	114	$34,890,000	112	$6,179,407
	Bladenboro	27	$4,793,000	31	$1,536,052
	Clarkton	10	$2,345,000	3	$209,496
	Elizabethtown	20	$5,150,000	6	$82,292
	White Lake	24	$8,129,000	9	$199,227
Brunswick	Bald Head Island	1,048	$328,759,000	644	$5,653,281
	Belville	66	$19,814,000	8	$7,667
	Boiling Spring Lakes	171	$45,755,000	82	$2,105,008
	Bolivia	7	$2,060,000	0	$0
	Brunswick County	3,891	$1,125,772,000	709	$13,615,957
	Calabash	97	$28,996,000	5	$75,749
	Carolina Shores	779	$215,186,000	28	$1,118,098
	Caswell Beach	638	$140,212,000	183	$1,181,432
	Holden Beach	1,851	$514,351,000	2,140	$11,995,039
	Leland	1,031	$514,351,000	43	$3,043,686

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Long Beach	0	$0	1,854	$17,086,476
	Navassa	17	$3,610,000	3	$66,632
	Northwest	7	$1,939,000	1	$4,179
	Oak Island	3,476	$916,141,000	428	$3,906,629
	Ocean Isle Beach	2,608	$678,466,000	1,679	$7,308,888
	Shallotte	202	$63,355,000	26	$1,194,222
	Southport	564	$166,968,000	123	$1,930,443
	St James	1,189	$384,085,0000	60	$388,614
	Sunset Beach	1,808	$490,961,000	250	$476,810
	Yaupon Beach	0	$0	90	$749,362
	Varnamtown	21	$6,193,000	1	$16,458
Buncombe	Asheville	535	$170,286,000	344	$15,058,870
	Biltmore Forest	12	$4,816,000	1	$539
	Black Mountain	60	$16,025,000	29	$135,058
	Buncombe County	410	$112,089,000	227	$3,999,949
	Montreat	14	$4,625,000	2	$4,947
	Weaverville	35	$11,205,000	1	%5,799
	Woodfin	26	$11,463,000	5	$41,308
Burke	Burke County	76	$17,663,000	25	$744,546
	Drexel	4	$593,000	1	$0
	Glen Alpine	2	$210,000	0	$0
	Hildebran	1	$70,000	0	$0
	Long View	3	$1,853,900	1	$0
	Morganton	53	$14,585,500	22	$1,202,461
	Rhodhiss	4	$1,312,400	2	$12,587
	Valdese	3	$552,500	0	$0
Cabarrus	Cabarrus County	186	$54,777,000	99	$1,873,948
	Concord	278	$83,291,000	22	$160,318
	Harrisburg	115	$32,036,000	44	$658,622
	Kannapolis	108	$31,083,000	19	$1,197,904
	Locust	3	$980,000		
	Midland	5	$1,296,000		
	Mount Pleasant	3	$1,050,000	0	$0
Caldwell	Caldwell County	77	$16,631,000	20	$294,774
	Gamewell	1	$149,000		$0
	Granite Falls	8	$1,854,000	2	$6,652
	Hudson	6	$3,286,000		$0
	Lenoir	81	$18,279,000	32	$168,252
Camden	Camden County	796	$198,053,000	261	$1,987.133
Carteret	Atlantic Beach	2,982	$521,431,000	1,128	$12,656,667
	Beaufort	788	$220,588,000	222	$3,170,335

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Bogue	41	$12,391,000	10	$538,015
	Cape Carteret	188	$53,957,000	176	$2,601,774
	Carteret County	3,905	$926,052,000	4,392	$73,092,242
	Cedar Point	320	$67,804,000	119	$2,359,857
	Emerald Isle	2,708	$680,588,000	1,721	$12,060,877
	Indian Beach	643	$146,750,000	41	$218,169
	Morehead City	1,653	$465,889,000	489	$8,157,861
	Newport	199	$44,331,000	92	$5,167,599
	Peletier	12	$3,044,000	3	$18,204
	Pine Knoll Shores	1,325	$320,396,000	296	$2,023,739
Caswell	Caswell County	6	$1,330,000	0	$0
Catawba	Brookford	1	$108,000		$0
	Catawba County	111	$29,727,000	96	$1,735,226
	Catawba (Town of)	1	$350,000	1	$0
	Claremont	6	$1,697,000		$0
	Conover	24	$5,813,000	9	$72,528
	Hickory	93	$25,660,000	35	$439,438
	Maiden	8	$3,866,000	1	$2,379
	Newton	15	$3,640,000	4	$50,078
Chatham	Chatham County	158	$48,729,000	6	$381,512
	Pittsboro	32	$8,585,000	6	$147,125
	Siler City	28	$5,106,000	5	$149,040
Cherokee	Andrews	8	$2,863,000	5	$192,489
	Cherokee County	140	$31,289,500	37	$320,636
	Murphy	5	$1,826,000	3	$21,380
Chowan	Chowan County	238	$66,299,000	107	$1,455,527
	Edenton	210	$57,383,000	161	$4,434,161
Clay	Clay County	118	$31,870,000	22	$102,154
	Hayesville	14	$3,007,000	0	
Cleveland	Cleveland County	10	$2,124,000	7	$29,294
	Kings Mountain	12	$2,893,000	3	$11,804
	Shelby	36	$8,639,000	28	$403,318
Columbus	Boardman	4	$890,000	0	$0
	Bolton	3	$553,000	0	$0
	Brunswick	2	$420,000	1	$0
	Chadbourn	9	$2,317,000	6	$68,871
	Columbus County	346	$65,254,000	313	$10,701,979
	Fair Bluff	72	$8,732,000	58	$3,219,005
	Lake Waccamaw	61	$15,439,000	75	$2,164,675
	Tabor City	14	$1,832,000	14	$244,751
	Whiteville	94	$19,113,000	115	$4,157,393

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Craven	Bridgeton	82	$16,729,000	109	$2,985,682
	Cove City	1	$210,000		$0
	Craven County	2,647	$658,639,000	2,905	$103,369,782
	Dover	1	$140,000		$0
	Havelock	290	$68,482,000	168	$5,775,705
	New Bern	1,673	$370,051,000	1,784	$64,925,149
	River Bend	503	$113,409,000	808	$41,852,466
	Trent Woods	344	$101,772,000	260	$14,156,470
	Vanceboro	7	$1,835,000	3	$15,959
Cumberland	Cumberland County	952	$267,011,000	239	$9,784,425
	Eastover	6	$1,900,000		$0
	Falcon	1	$350,000		$0
	Fayetteville	1,527	$397,052,000	472	$13,637,745
	Hope Mills	61	$21,729,000	8	$361,137
	Spring Lake	9	$2,590,000	1	$6,355
	Stedman	2	$525,000	1	$11,839
	Wade	952	$267,011,000	239	$9,784,425
Currituck	Currituck County	4,704	$1,413,996,000	1,858	$19,979,322
Dare	Dare County	8,568	$2,155,808,000	10,320	$129,218,344
	Duck	1,164	$369,813,000	87	$802,818
	Kill Devil Hills	4,277	$1,027,320,000	1,992	$18,354,162
	Kitty Hawk	1,536	$410,362,000	1,813	$18,822,013
	Manteo	993	$236,039,000	281	$5,047,962
	Nags Head	3,470	$973,401,000	3,204	$32,987,958
	Southern Shores	1,015	$305,444,000	340	$1,773,575
Davidson	Davidson County	187	$45,380,000	40	$403,394
	Denton	2	$455,000		$0
	Lexington	1	$350,000		$0
	Thomasville	60	$16,288,000	17	$251,101
	Wallburg	2	$630,000	1	$102,880
Davie	Bermuda Run	37	$11,576,000	2	$97,025
	Cooleemee	0	$0	0	$0
	Davie County	36	$10,027,000	7	$27,597
	Mocksville	4	$1,040,000	0	$0
Duplin	Beulaville	6	$1,575,000	3	$51,801
	Calypso	2	$490,000	2	$35,412
	Duplin County	580	$155,319,000	444	$48,181,775
	Faison	2	$490,000	1	$0
	Greenevers	1	$350,000		$0
	Kenansville	3	$1,410,000		$0
	Magnolia	4	$825,000		$0

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Mount Olive	0	$-0	1	$774
	Rose Hill	5	$980,000		$0
	Wallace	65	$17,246,000	42	$1,928,650
	Warsaw	12	$2,800,000	3	$110,734
Durham	Durham	1,345	$357,297,000	251	$3,714,248
	Durham County	264	$75,535,000	77	$733,141
Edgecombe	Conetoe	10	$1,121,000	2	$99,804
	Edgecombe County	150	$32,051,000	104	$3,152,177
	Leggett	6	$813,000	1	$518
	Pinetops	43	$3,226,000	26	$889,288
	Princeville	165	$33,966,000	124	$7,706,284
	Rocky Mount	879	$208,717,000	899	$38,990,020
	Sharpsburg	17	$3,825,000	12	$169,452
	Speed	13	$2,226,000	9	$83,696
	Tarboro	255	$55,384,000	109	$2,677,182
	Whitakers	2	$160,000	0	$0
Forsyth	Bethania	2	$1,180,000	0	$0
	Clemmons	47	$12,749,000	2	$56,318
	Forsyth County	154	$44,755,000	79	$713,223
	Kernersville	39	$11,361,000	4	$157,501
	Lewisville	20	$6,263,000	1	$14,438-
	Rural Hall	3	$805,000	0	$0
	Tobaccoville	2	$700,000	0	$0
	Walkertown	3	$770,000	0	$0
	Winston-Salem	477	$129,520,000	263	$2,665,061
Franklin	Franklin County	68	$18,054,000	4	$13,729
	Franklinton	2	$490,000	0	$0
	Louisburg	9	$2,097,000	13	$115,879
	Youngsville	2	$700,000	0	$0
Gaston	Belmont	30	$8,061 .000	4	$8,067
	Bessemer	2	$190,000	0	$0
	Cherryville	3	$840,000	0	$0
	Cramerton	23	$5,481,000	6	$38,048
	Dallas	9	$1,344,000	2	$12,878
	Gaston County	61	$14,473,000	12	$63,614
	Gastonia	176	$42,565,000	32	$66,479
	Lowell	5	$1,472,000	0	$0
	McAdenville	6	$3,260,000	0	$0
	Mount Holly	63	$16,076,000	6	$47,347
	Ranlo	3	$751,000	0	$0
	Stanley	4	$1.175,000	0	$0

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Gates	Gates County	82	$19,736,000	21	$170,794
	Gatesville	4	$1,580,000	3	$159,447
Graham	Graham County	44	$8157,000	4	$10,847
	Robbinsville	2	$197,000	0	$0
Granville	Butner	7	$1,512,000	1	$0
	Creedmoor	3	$462,000	0	$0
	Granville County	36	$10,620,000	6	$161,880
	Oxford	3	$433,000	4	$2,433
Greene	Greene County	101	$21,191,000	51	$1,613,923
	Hookerton	1	700,000	1	$52,611
	Snow Hill	17	$7,111,000	22	$785,018
Guilford	Gibsonville	8	$2,037,000	1	$0
	Greensboro	684	$172,236,000	373	$4,944,474
	Guilford County	119	$32,483,000	62	$773,036
	High Point	262	$61,839,000	91	$306,671
	Jamestown	9	$3,180,000		$0
	Oak Ridge	5	$1,687,000	3	$27,750
	Pleasant Garden	4	$1,330,000		$0
	Sedalia	1	$280,000		$0
	Stokesdale	1	$350,000		$0
	Summerfield	19	$5,782,000	0	$0
Halifax	Enfield	3	$1,550,000	4	$139,888
	Halifax County	39	$10,003,000	4	$3,753
	Hobgood	2	$700,000	1	$2,349
	Littleton	1	$140,000		$0
	Roanoke Rapids	77	$19,871,000	37	$456,562
	Scotland Neck	2	$700,000	1	$85,319
	Weldon	8	$2,725,000	2	$70,364
Harnett	Angier	11	$3,618,000	2	
	Dunn	61	$11,249,000	19	$291,745
	Erwin	10	$2,610,000	2	$202,472
	Harnett County	421	$111,349,000	73	$1,648,033
	Lillington	10	$2,945,000	1	$7,617
Haywood	Canton	34	$9,976,000	59	$3,045,873
	Clyde	50	$10,134,000	149	$3,873,916
	Haywood County	185	$48,350,000	69	$1,013,911
	Maggie Valley	38	$14,242,000	4	$22,982
	Waynesville	242	$51,286,000	35	$121,336
Henderson	Flat Rock	36	$10,295,000	1	$0
	Fletcher	56	$15,247,000	3	$39,290
	Henderson County	217	$59,730,000	34	$590,982

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Hendersonville	143	$37,695,000	156	$1,803,867
	Laurel Park	9	$2,383,000	3	$9,272
Hertford	Ahoskie	20	$6,573,000	67	$1,444,593
	Cofield	1	$210,000		
	Hertford County	75	$16,738,000	68	$1,475,120
	Murfreesboro	4	$1,348,000	3	
	Winton	3	$875,000	3	$31,123
Hoke	Hoke County	207	$54,269,000	28	$583,593
	Raeford	11	$2,902,000	2	$0
Hyde	Hyde County	1,258	$249,496,000	1,167	$16,277,178
Iredell	Iredell County	129	$39,813,000	15	$103,518
	Mooresville	48	$14,290,000	0	$0
	Statesville	39	$11,573,000	28	$939,287
	Troutman	2	$1,350,000	0	$0
Jackson	Dillsboro	6	$2,232,000	7	$307,079
	Forest Hills	3	$699,000	1	$21,378
	Jackson County	244	$61,594,000	27	$249,475
	Sylva	40	$10,783,000	8	$121,213
	Webster	5	$966,000	1	$0
Johnston	Archer Lodge	2	$700,000		$0
	Benson	19	$4,379,000	1	$68,722
	Clayton	90	$26,566,000	7	$10,977
	Four Oaks	18	$5,357,000	2	$56,264
	Johnston County	361	$96,650,000	105	$3,451,933
	Kenly	10	$2,700,000	3	$86,598
	Micro	2	$290,000	0	$0
	Pine Level	7	$1,960,000	0	$0
	Princeton	11	$1,937,000	0	$0
	Selma	29	$6,447,000	1	$2,990
	Smithfield	133	$32,062,000	135	$6,025,147
Jones	Jones County	198	$49,991,000	144	$12,915,537
	Maysville	9	$1,854,000	4	$61,587
	Pollocksville	29	$6,962,000	27	$2,767,333
	Trenton	19	$3,995,000	24	$801,134
Lee	Lee County	72	$21,185,000	28	$650,510
	Broadway	7	$1,890,000	1	$20,240
	Sanford	68	$18,858,000	20	$214,367
Lenoir	Kinston	371	$88,900,000	580	$36,682,694
	La Grange	12	$2,926,000	2	$40,079
	Lenoir County	225	$40,803,000	192	$6,331,109
Lincoln	Lincoln County	110	$32,698,000	7	$130,380

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Lincolnton	16	$3,934,000	1	$3,934
Macon	Macon County	152	$38,712,000	50	$1,019,308
	Highlands	30	$9,058,000	0	$0
	Franklin	14	$3,990,000	0	$0
Madison	Hot Springs	5	$1,109,000	1	$2,361
	Madison County	54	$14,370,000	20	$400,863
	Marshall	30	$6,971,000	40	$476,649
	Mars Hill	5	$1,096,000	1	$0
Martin	Hamilton	0	$0	1	$26,019
	Martin County	40	$8,672,000	20	$278,533
	Robersonville	8	$1,755,000	5	$39,838
	Williamston	56	$10,323,000	12	$216,950
McDowell	Marion	14	$3,961,000	3	$56,415
	McDowell County	78	$18,211,000	53	$508,649
	Old Fort	14	$3,850,000	3	$140,685
Mecklenburg	Charlotte	3,045	$811,299,000	2,275	$39,497,088
	Cornelius	151	$46,110,000	8	$81,234
	Davidson	62	$19,913,000	2	$4,942
	Huntersville	159	$48,337,000	0	$0
	Matthews	78	$23,981,000	12	$128,206
	Mecklenburg County	257	$65,533,000	213	$3,920,659
	Mint Hill	56	$16,300,000	3	$27,461
	Pineville	68	$20,622,000	5	$19,718
Mitchell	Bakersville	11	$3,130,000	13	$307,038
	Mitchell County	24	$5,730,000	13	$316,564
	Spruce Pine	1	$192,000	6	$256,600
Montgomery	Montgomery County	21	$5,497,000	5	$60,219
	Troy	2	$700,000	0	$0
Moore	Aberdeen	41	$11,174,000	3	$913
	Carthage	3	$630,000	0	$0
	Foxfire	1	$350,000	0	$0
	Moore County	300	$74,430,000	71	$936,424
	Pinebluff	5	$1,210,000	0	$0
	Pinehurst	134	$37,138,000	25	$381,380
	Robbins	1	$280,000	0	$0
	Southern Pines	95	$27,555,000	11	$68,415
	Vass	5	$1,750,000	1	$75,162
	Whispering Pines	53	$14,721,000	10	$152,994
Nash	Dortches	2	$700,000	0	$0
	Middlesex	1	$350,000	0	$0
	Momeyer	1	$350,000	0	$0

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Nash County	115	$31,464,000	62	$2,558,928
	Nashville	45	$9,633,000	39	$1,595,831
	Red Oak	15	$4,883,000	3	$3,693
New Hanover	Carolina Beach	3,510	$719,356,000	2,773	$34,489,479
	Kure Beach	971	$275,722,000	548	$17,193,391
	New Hanover County	6,302	$1,876,083,000	3,075	$52,838,370
	Wilmington	3,817	$1,101,829,000	576	$9,424,103
	Wrightsville	2,621	$668,477,000	3,535	$51,886,583
Northampton	Conway	1	$350,000		$0
	Garysburg	5	$1,330,000	1	$13,364
	Jackson	4	$299,000		$0
	Northampton County	43	$7,640,000	17	$93,953
	Seven	5	$840,000	6	$44,261
	Woodland	2	$400,000	2	$11,589
Onslow	Holly Ridge	42	$10,513,000	3	$48,767
	Jacksonville	887	$232,473,000	283	$5,953,315
	North Topsail Beach	1,217	$241,624,000	1,503	$20,581,302
	Onslow County	2,406	$643,308,000	2,050	$37,037,869
	Richlands	41	$10,872,000	11	$534,351
	Surf City	329	$79,968,000	508	$4,744,354
	Swansboro	217	$56,322,000	123	$2,690,897
Orange	Carrboro	110	$33,538,000	17	$171,494
	Chapel Hill	698	$140,618,000	328	$13,628,667
	Hillsborough	28	$9,527,000	7	$9,032
	Orange County	125	$38,362,000	19	$256,345
Pamlico	Alliance	13	$2,785,000	4	$29,633
	Bayboro	50	$10,064,000	66	$1,302,532
	Mesic	49	$7,162,000	35	$1,055,083
	Minnessott Beach	23	$6,841,000	15	$90,871
	Oriental	751	$195,725,000	1,459	$34,047,702
	Pamlico County	1,173	$271,833,000	2,486	$55,226,865
	Stonewall	25	$4,314,000	35	$871,107
	Vandemere	70	$13,169,000	186	$6,132,955
Pasquotank	Pasquotank County	1,127	$278,480,000	212	$1,353,892
	Elizabeth City	1,333	$277,525,000	282	$4,686,818
Pender	Atkinson	2	$399,000	0	$0
	Burgaw	89	$21,276,000	41	$1,980,521
	Pender County	2,284	$621,937,000	1,261	$70,456,824
	Saint Helena	4	$1,225,000	0	$0
	Topsail Beach	948	$256,131,000	2183	$23,213,045
	Watha	2	$385,000		$0

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Perquimans	Hertford	42	$10,952,000	23	$300,392
	Perquimans County	602	$157,737,000	129	$583,949
	Winfall	16	$4,121,000	2	$57,408
Person	Person County	16	$4,300,000	2	$5,837
	Roxboro	9	$3,750,000	2	$24,522
Pitt	Ayden	22	$7,410,000	17	$248,464
	Bethel	2	$700,000	4	$12,469
	Falkland	2	$583,000	1	$21,317
	Farmville	84	$24,339,000	31	$843,689
	Greenville	1,249	$297,444,000	572	$21,424,242
	Grifton	96	$17,814,000	72	$2,660,522
	Grimesland	4	$1,362,000	2	$59,781
	Pitt County	445	$102,918,000	400	$10,348,141
	Simpson	7	$2,135,000	2	$7,981
	Winterville	126	$35,886,000	41	$264,714
Polk	Columbus	1	$350,000	0	$0
	Polk County	72	$19,610,000	31	$394,446
	Saluda	1	$280,000	0	$0
	Tryon	20	$4,974,000	3	$68,792
Randolph	Asheboro	51	$10,839,000	14	$64,127
	Archdale	30	$5,452,000	16	$130,196
	Liberty	2	$630,000	0	$0
	Ramseur	0	$0	1	$5,528
	Randleman	6	$890,000	0	$0
	Randolph County	38	$9,283,000	12	$109,271
	Trinity	10	$2,729,000	4	$14,092
Richmond	Hamlet	5	$1,092,000	3	$77,012
	Richmond County	44	$5,496,000	6	$149,174
	Rockingham	29	$5,337,000	11	$164,293
Robeson	Rennert	3	$270,000	0	$0
	Fairmont	19	$2,624,000	6	$123,428
	Lumberton	1,074	$211,161,000	826	$38,571,737
	Orrum	0	$0	1	$252
	Parkton	3	$525,000	1	$3,878
	Pembroke	12	$2,202,000	2	$205,554
	Red Springs	26	$6,398,000	8	$117,064
	Robeson County	651	$87,704,000	486	$13,246,872
	Saint Pauls	8	$1,995,000	2	$10,954
Rockingham	Eden	26	$3,371,000	55	$363,336
	Madison	10	$3,182,000	21	$149,410
	Mayodan	7	$1,512,000	12	$295,063

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
	Reidsville	25	$5,882,000	6	$10,804
	Rockingham County	21	$4,014,000	13	$73,434.00
Rowan	Faith	1	$108,000	0	$0
	Granite Quarry	18	$4,165,000	5	$63,936
	Landis	1	$68,000	0	$0
	Rockwell	9	$1,881,000	1	$700
	Rowan County	73	$19,515,000	15	$255,061
	Salisbury	103	$26,183,000	30	$205,992
	Spencer	5	$708,000	1	$0
Rutherford	Bostic	1	$350,000	0	$0
	Chimney Rock	24	$7,160,000	1	$15,741
	Forest City	5	$1,126,000	1	$40,378
	Lake Lure	47	$11,973,000	2	$28,746
	Rutherford County	44	$11,896,000	53	$1,022,915
	Rutherfordton	10	$2,206,000	2	$780
	Spindale	2	$378,000	0	$0
Sampson	Autryville	1	$210,000	1	$7,237
	Clinton	44	$11,897,000	29	$313,934
	Newton Grove	4	$985,000	4	$292,185
	Sampson County	133	$33,531,000	115	$5,668,987
	Turkey	1	$280,000	0	$0
Scotland	East Laurinburg	3	$278,000	2	$55,949
	Laurinburg	61	$15,467,000	13	$323,627
	Scotland County	18	$4,425,000	3	$66,659
Stanly	Albemarle	36	$8,031,00	36	$1,608,619
	Badin	3	$770,000	1	$0
	Misenheimer	2	$288,000	0	$0
	Norwood	2	$603,000	3	$25,933
	Stanly County	19	$5,348,000	7	$61,809
Stokes	Danbury	0	$0	1	$3,828
	Stokes County	22	$4,970,000	11	$198,126
	Walnut Cove	1	$350,000	1	$6,669
Surry	Elkin	3	$739,000	1	$3,582
	King	10	$2,535,000	2	$6,832
	Mount Airy	41	$11,942,000	44	$1,047,033
	Surry County	8	$4,095,000	22	$355,747
Swain	Bryson City	30	$6,954,000	17	$415,291
	Swain County	64	$13,390,000	19	$47,890
Transylvania	Brevard	113	$31,463,000	15	$151,991
	Rosman	9	$1,261,000	29	$93,223
	Transylvania County	157	$41,927,000	41	$345,020

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Tyrell	Columbia	143	$25,578,000	158	$3,458,371
	Tyrell County	412	$65,354,000	369	$4,602,591
Union	Fairview	8	$1,655,000	1	$741
	Hemby Bridge	6	$1,935,000	0	$0
	Indian Trail	115	$33,497,000	12	$52,003
	Lake Park	8	$2,170,000	0	$0
	Marshville	4	$1290,000	0	$0
	Marvin	20	$6,900,000	0	$0
	Mineral Springs	2	$700,000	0	$0
	Monroe	34	$9,426,000	6	$32,304
	Stallings	51	$15,483,000	3	$91,652
	Union County	209	$62,448,000	38	$512,418
	Unionville	8	$2,197,000	4	$176,534
	Waxhaw	43	$13,000,000	0	$0
	Weddington	30	$9,555,000	1	$3,554
	Wesley Chapel	19	$5,817,000	2	$40,660
	Wingate	3	$731,000	0	$0
Vance	Henderson	12	$2,895,000	6	$72,940
	Vance County	17	$4,924,000	4	$105,760
Wake	Apex	128	$35,962,000	1	$1,300
	Cary	856	$260,753,000	164	$2,558,004
	Fuquay-Varina	147	$42,502,000	7	$120,381
	Garner	139	$37,537,000	33	$1,677,744
	Holly Springs	105	$32,522,000	12	$187,594
	Knightdale	50	$14,206,000	3	$31,364
	Morrisville	93	$26,979,000	6	$92,752
	Raleigh	2,084	$599,437,000	1,112	$23,764,755
	Rolesville	17	$5,362,000	0	$0
	Wake County	506	$143,584,000	98	$1,030,365
	Wake Forest	165	$47,984,000	7	$13,131
	Wendell	24	$6,767,000	9	$144,907
	Zebulon	36	$7,663,000	11	$187,065
Warren	Warren County	35	$10,458,000	4	$0
Washington	Creswell	13	$2,189,000	6	$25,575
	Plymouth	75	$19,983,000	43	$1,267,063
	Roper	11	$2,457,000	5	$100,478
	Washington County	151	$32,820,000	98	$1,310,209
Watauga	Blowing Rock	32	$8,659,000	12	$202,274
	Boone	259	$58,761,000	81	$1,370,556
	Seven Devils	4	$1,150,000	0	$0
	Watauga County	291	$77,454,000	171	$1,388,903

County Name	Community Name	Policies in Force	Insurance in Force	Total Losses	Total Payments
Wayne	Fremont	3	$273,000	1	$18,025
	Goldsboro	816	$166,851,600	739	$27,155,061
	Pikeville	7	$1,820,000	6	$71,531
	Seven Springs	12	$983,000	37	$2,358,490
	Walnut Creek	50	$14,850,000	20	$1,049,212
	Wayne County	448	$97,238,000	333	$15,052,996
Wilkes	North Wilkesboro	19	$5,964,000	0	$0
	Ronda	1	$119,000	0	$0
	Wilkes County	26	$4,864,000	4	$4,189
	Wilkesboro	21	$9,146,000	14	$452,467
Wilson	Black Creek	3	$161,000	0	$0
	Elm City	9	$1,580,000	0	$0
	Lucama	8	$2,212,000	1	$20,039
	Stantonsburg	4	$1,805,000	1	$35,445
	Wilson County	79	$1,569,000	84	$2,726,181
	Wilson	493	$116,430,000	365	$7,760,925
Yadkin	Jonesville	3	$841,000	0	$0
	Yadkin County	6	$1,428,000	2	$2,110
	Yadkinville	2	$600,000	0	$0
Yancey	Burnsville	6	$978,000	4	$70,736
	Yancey County	114	$27,494,000	53	$674,940
Total	**North Carolina**	**144,314**	**$36,984,811,000**	**101,116**	**$1,874,323,970**

Source: FEMA, 2019

Many of North Carolina's insured losses have involved repetitive loss properties. The Federal definition of a repetitive loss property is "any insured structure with at least two paid flood insurance losses of more than $1,000 each in any rolling 10-year period since 1978" (FEMA). Table 3-38 lists North Carolina repetitive loss data by community, according to FEMA records compiled in the Fall of 2022.

A few summary statistics regarding repetitive loss and severe repetitive loss properties in North Carolina:

- 9 counties have no repetitive loss properties.
- 66 of the State's 100 counties experienced an increase in the number of repetitive loss properties from 2017 to 2022.
- 10 counties had a decrease in the number of repetitive loss properties from 2017 to 2022.
- There are 18 counties with over 100 repetitive loss properties. Of those 18, 14 of them are coastal counties.
- Beaufort, Dare, New Hanover and Pamlico Counties have over 1,000 repetitive loss properties each and represent 45% of all repetitive loss properties in the State.

Table 3-38 Repetitive Loss Property Counts by County, 2022

County	Residential Repetitive Loss Count	Commercial/Other Non-Residential Repetitive Loss County	Total Losses	Total 2022 Repetitive Loss County	Total 2017 Repetitive Loss County	RL Property Increase from 2017
Alamance	11	1	37	12	12	0
Alexander	0	1	2	1	0	1
Alleghany	1	0	2	1	1	0
Anson	0	0	0	0	0	0
Ashe	2	4	12	6	7	-1
Avery	14	2	37	16	13	3
Beaufort	1,504	127	5,751	1,631	1,355	276
Bertie	66	36	269	102	98	4
Bladen	25	5	69	30	4	26
Brunswick	678	31	1,980	709	679	30
Buncombe	21	34	156	55	34	21
Burke	0	1	2	1	2	-1
Cabarrus	26	0	87	26	21	5
Caldwell	6	3	19	9	7	2
Camden	22	3	67	25	54	-29
Carteret	934	59	2,975	993	796	197
Caswell	0	0	0	0	0	0
Catawba	27	1	72	28	11	17
Chatham	1	1	5	2	19	-17
Cherokee	7	1	25	8	9	-1
Chowan	33	3	88	36	36	24
Clay	2	0	5	2	1	1
Cleveland	5	0	17	5	3	2
Columbus	62	14	177	76	25	51
Craven	931	41	2,756	973	388	585
Cumberland	60	5	148	65	31	34
Currituck	190	4	624	194	161	33
Dare	1,491	235	5,844	1,726	1,306	420
Davidson	13	3	38	16	11	5
Davie	0	0	0	0	1	-1
Duplin	58	7	162	65	19	46
Durham	26	9	91	35	47	-12
Edgecombe	10	1	25	11	51	-40
Forsyth	38	9	188	47	35	12
Franklin	5	1	11	6	5	1
Gaston	5	0	10	5	2	3
Gates	2	1	9	3	3	0
Graham	0	0	0	0	0	0

County	Residential Repetitive Loss Count	Commercial/Other Non-Residential Repetitive Loss County	Total Losses	Total 2022 Repetitive Loss County	Total 2017 Repetitive Loss County	RL Property Increase from 2017
Granville	1	0	4	1	1	0
Greene	7	1	18	8	5	3
Guilford	56	6	261	62	50	12
Halifax	4	1	11	5	2	3
Harnett	8	0	16	8	2	6
Haywood	32	3	78	35	17	18
Henderson	10	12	92	22	16	6
Hertford	17	4	53	21	22	-1
Hoke	1	0	2	1	0	1
Hyde	187	37	628	224	131	93
Iredell	6	0	16	6	1	5
Jackson	1	2	6	3	3	0
Johnston	29	5	86	34	21	13
Jones	30	2	77	32	7	25
Lee	6	0	13	6	3	3
Lenoir	88	37	293	125	42	83
Lincoln	1	0	2	1	0	1
Macon	6	0	15	6	4	2
Madison	0	5	16	5	4	1
Martin	4	1	10	5	6	-1
McDowell	2	2	12	4	4	0
Mecklenburg	325	21	1,122	346	334	12
Mitchell	3	4	18	7	7	0
Montgomery	1	0	2	1	0	1
Moore	6	1	17	7	2	5
Nash	73	16	228	90	7	83
New Hanover	1,396	91	4,124	1,487	1,399	88
Northampton	1	0	3	1	1	0
Onslow	489	25	1,498	514	718	-204
Orange	37	30	140	40	2	38
Pamlico	1,009	39	2,781	1,048	664	384
Pasquotank	46	9	152	55	21	34
Pender	761	25	2,186	786	435	351
Perquimans	6	0	15	6	6	0
Person	0	0	0	0	0	0
Pitt	70	5	214	75	52	23
Polk	1	3	8	4	2	2
Randolph	5	0	20	5	1	4
Richmond	1	2	8	3	3	0

County	Residential Repetitive Loss Count	Commercial/Other Non-Residential Repetitive Loss County	Total Losses	Total 2022 Repetitive Loss County	Total 2017 Repetitive Loss County	RL Property Increase from 2017
Robeson	257	15	576	272	14	258
Rockingham	12	2	40	14	12	2
Rowan	6	0	15	6	4	2
Rutherford	8	2	29	10	6	4
Sampson	24	2	65	26	5	21
Scotland	0	0	0	0	0	0
Stanly	2	6	23	8	3	5
Stokes	0	0	0	0	0	0
Surry	0	7	20	7	7	0
Swain	0	2	12	2	2	0
Transylvania	5	0	15	5	5	0
Tyrrell	97	7	255	104	79	25
Union	7	0	20	7	4	3
Vance	1	0	2	1	1	0
Wake	140	37	544	177	135	42
Warren	0	0	0	0	0	0
Washington	21	1	52	22	8	14
Watauga	13	9	66	22	17	5
Wayne	117	21	313	138	51	87
Wilkes	0	1	5	1	1	0
Wilson	29	10	118	39	34	5
Yadkin	0	0	0	0	0	0
Yancey	5	0	15	5	2	3
Totals	**11,984 (3,041 increase)**	**1,026 (303 increase)**	**38,629**	**13,010**	**9,666**	**3,344**

Source: FEMA

Figure 3-69 Summary of North Carolina Repetitive Loss Properties by County

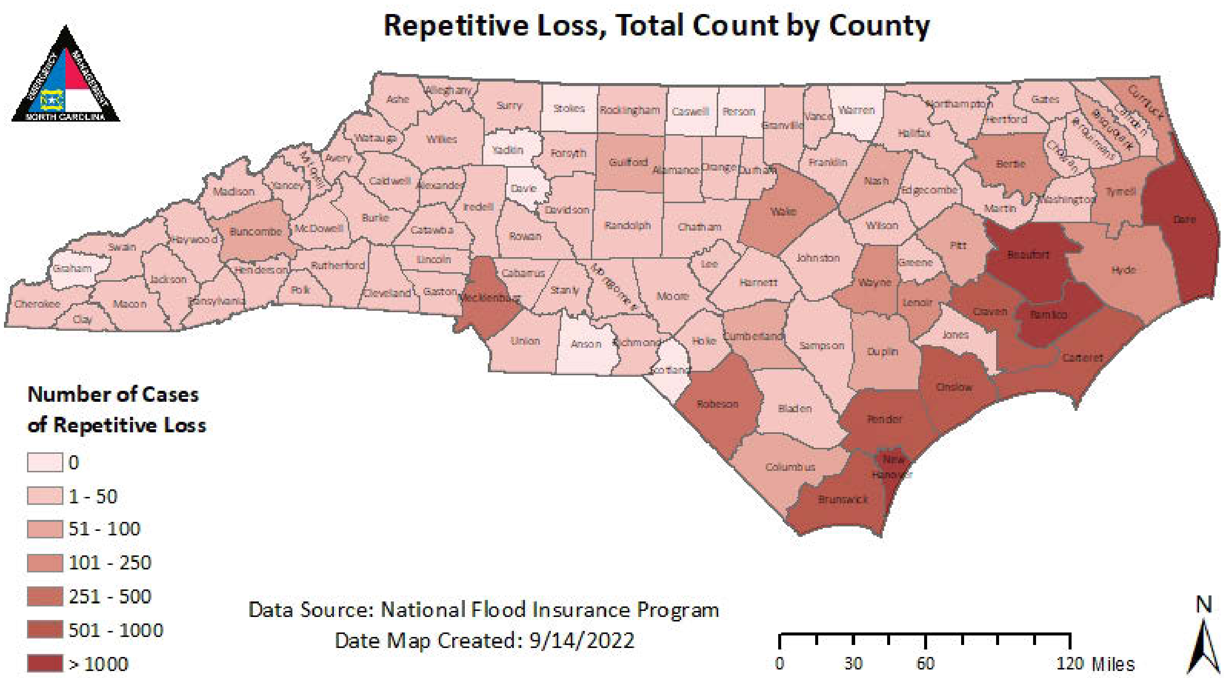
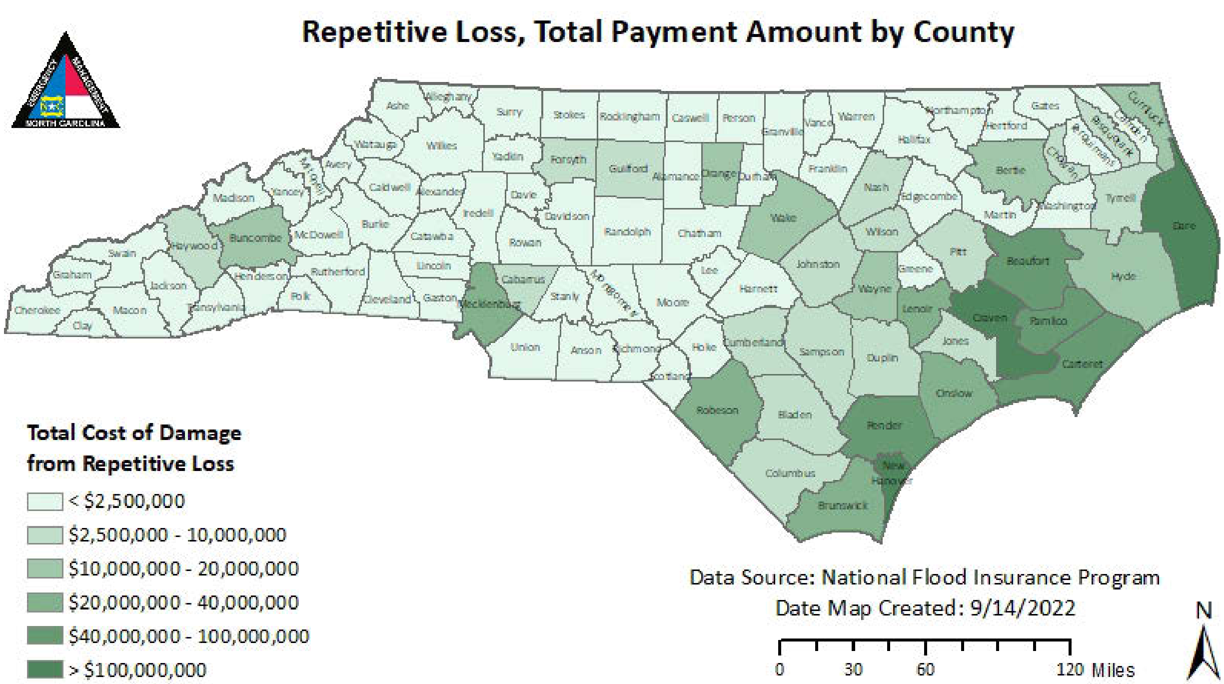


Figure 3-70 NC Repetitive Loss by County and Total Payment Amounts



Severe Repetitive Loss Properties in North Carolina

There are 803 validated severe repetitive loss properties in the North Carolina. There are an additional 179 severe repetitive loss properties that are pending validation. Beaufort and Dare counties make up 47% of the validated severe repetitive loss properties in the State.

Flood Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	During flood events, people are often stranded and have to be rescued by first responders. Often lives are lost or people are injured. Even when injuries and fatalities are avoided, the impact on the public can be great as many people will be forced into shelters or will need to find temporary lodging as they wait for flooding to recede. They may be unable to return to their homes if the damage is great and may find their homes uninhabitable if personal property has become waterlogged and is unusable. Another major impact on the public can be the deteriorating health conditions that result from flooding. After floodwaters recede, homes and personal property that were covered in water may begin to become infested with mold which can create serious health risks. Additionally, waterborne diseases can be pervasive in areas impacted by flooded sewer and water systems. Mosquitoes and other carriers of illnesses often thrive in post-flood conditions, increasing the chances of transmitting vector-borne diseases. Public confidence is often impacted by flood events, especially when impacted people do not have flood insurance and are not covered by their home insurance policy. This can create public relations issues for the government and a loss of public confidence.
Responders	High	Responders are often affected by flooding because floods can trap people in their homes or in other locations, forcing responders to put their lives at risk to return members of the public to safety. Often responders in flood situations face blocked roads and have difficulty safely protecting citizens. Water rescues can be some of the most dangerous as rapidly moving flood waters are difficult to navigate. Rescuers are typically at high risk to loss of life or personal injury during flood events, especially compared to other types of natural hazards.
Operations/Continuity of Operations	High	Flooding can impact continuity of operations by knocking out power sources and preventing emergency management personnel from being able to do their jobs properly. Floods typically have some impact on continuity of operations as they can cause severe disruption to normal operations and have done so in the past in North Carolina in nearly every county. Operations would be most impacted at a localized level as areas that are flooded would experience the most disruption to normal operations.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a flood event, but critical infrastructure and key resources (CIKR) within the state are especially important to identify. When these facilities are located in flood-prone areas, there is a substantial risk to important functions of government such as law enforcement and medical care. This also includes any assets, systems, and networks that are vital to the continued operation of government services such as power generation facilities, transmission infrastructure, and road networks, among others. The incapacitation or destruction of these resources would have a debilitating and costly effect on many aspects of the state's normal functionality. Often, in the case of

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td></td><td></td><td>flooding, water and wastewater infrastructure are some of the most prominently impacted. Since these types of infrastructure deal directly with water, often they are located in the most flood prone areas and are severely impacted during flood events. When these facilities or infrastructure are flooded, it complicates recovery and impacts people who are unable to utilize normal water sources for drinking, sanitation, and other everyday uses.

In addition, personal property such as homes and businesses have been impacted to a large degree by past flooding events and are a major concern in future flooding events. Although a great deal of effort has been undertaken to reduce the number of properties at risk through the use of progressively improved risk assessment and mitigation techniques, there are still a significant number of structures throughout the state that are located in flood zones or which have not been properly mitigated to reduce risk. These properties may sustain billions of dollars of damage during future flood events and are often a major focus of post-disaster recovery efforts.</td></tr>
<tr><td>Economy</td><td>High</td><td>There are a variety of economic impacts that could result from a large-scale flood event. One major impact is on soil that is covered by flood waters, causing the rapid depletion of oxygen, which is essential for plant growth and development. This can hurt agricultural production in areas of the state were that is a key economic driver. Secondly, flooding often causes the shutdown of businesses, many of which never re-open after a flood event. Indeed, FEMA reports that almost 40 percent of small businesses never reopen their doors after a disaster because only small amounts of flood waters can cause thousands of dollars of damage.[64] The shutdown of these small businesses in many communities can be devastating as many small, rural communities in the state rely heavily on these small businesses as economic drivers and the base of the local economy.

After Hurricane Floyd, which was primarily considered to be a flood event, the North Carolina Floodplain Mapping Program reported the following statistics which serve as a sort of benchmark for potential future flooding events:

<table>
<tr><th colspan="2">Hurricane Floyd Impacts (1999)[65]</th></tr>
<tr><td>Businesses Affected</td><td>60,000</td></tr>
<tr><td>Estimated Jobs Lost</td><td>31,000</td></tr>
<tr><td>Physical Damage to Businesses</td><td>$1,000,000,000</td></tr>
<tr><td>Business Revenue Lost</td><td>$4,000,000,000</td></tr>
</table>
</td></tr>
<tr><td>Environment</td><td>Moderate to High</td><td>The fluctuation of water levels in a wetland, especially flood waters, supports the biological diversity of low-lying areas by releasing nutrients into the soil and germinating wetland flora. Flooding also offers some control of invasive water weeds. Most features of the environment have come to adapt to the effects of a flood event and respond quickly, although</td></tr>
</table>

[64] *FEMA. (2017). Protecting Your Businesses. Retrieved August 21, 2017, from https://www.fema.gov/protecting-your-businesses*

[65] *North Carolina Floodplain Mapping Program. Retrieved August 21, 2017, from: http://www.ncfloodmaps.com/flood_data.htm*

Category	Impact Rating	Description of Impacts
		it is possible that some species may not be resilient enough to survive and will experience population loss. However, areas that have been modified by human activity tend to suffer more negative consequences from flooding which can result from modifying stream banks or removing vegetation from riverside. When these modifications are present, flooding can cause unnatural erosion of sediment into the waterway and create an imbalance of nutrients in the water which may harm ecosystems and have a negative impact on downstream water quality.[66] Risk to fish stocks in mountain and coastal regions – natural populations as well as stocked fishes and hatcheries are vulnerable to high losses, natural populations may be deeply diminished by year after year events taking out age classes. Stream systems in urban environments and those with flow regimes altered by dams are already degraded. Flooding may increase these existing stressors such that natural aquatic species populations are extirpated and only species highly tolerant of sediment and pollution and non-native species remain. Flooding is likely to increase distribution of aquatic invasive plant species – this can be mitigated by treating those invasions well before flooding events. Wetland impacts – high water tables reduce likelihood that wetlands used by amphibians for breeding habitat will dry out completely, drying is necessary to prevent predaceous fish from colonizing the wetlands. Flooding of livestock waste dumps and lagoons contaminates waters, increases nutrient loads, and can lead to anoxic conditions that do not support aquatic species. Hazardous material spills resulting from flooding can impact aquatic animal and plant species, as well as rare floodplain plants. Reducing human infrastructure impacts by extending the flood duration at lower water levels, along Roanoke for example, impacts the natural communities in natural floodplains beyond the tolerances of native woody and herbaceous plants. Extensive clearing and snagging operations to remove large woody debris from streams and rivers can cause impacts to the instream habitat structure used by aquatic species for breeding, shelter, and foraging. Heavy equipment can also damage the riparian forest habitat adjacent to the streams and rivers

[66] *Office of the Queensland Australia Chief Scientist (2017). What are the consequences of floods? Retrieved August 21, 2017, from: http://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences*

Flood Hazard Vulnerability for State-Owned Facilities

NCEM has calculated the number of state-owned facilities in the special flood hazard areas. Table 3-39 below provides a summary of those findings.

Table 3-39 State-Owned Facilities and Flood Risk

Zone	Value	Number
A	$3,151,621	4
AE	$151,516,415	315
VE	$2,345,774	14
X500	$61,266,875	176

Source: NCEM

3.5.5.4 Hurricane/Coastal Hazards Vulnerability

Table 3-40 provides a summary of the expected annualized losses to hurricanes by county based on NCEM risk data analysis.

Table 3-40 Annualized Hurricane Hazard Losses by County

County	Annualized Losses
Alamance	$ 13,051,977.32
Alexander	$ 3,464,491.45
Alleghany	$ 2,765,951.13
Anson	$ 2,578,273.93
Ashe	$ 4,317,541.97
Avery	$ 1,103,784.03
Beaufort	$ 28,496,957.31
Bertie	$ 2,791,021.67
Bladen	$ 13,311,343.42
Brunswick	$ 53,436,605.42
Buncombe	$ 8,087,910.58
Burke	$ 4,244,313.41
Cabarrus	$ 22,080,792.80
Caldwell	$ 6,589,596.12
Camden	$ 3,316,297.60
Carteret	$ 53,890,219.27
Caswell	$ 4,339,280.00
Catawba	$ 10,806,009.36
Chatham	$ 15,408,174.29
Cherokee	$ 1,997,263.05
Chowan	$ 5,204,494.69
Clay	$ 571,224.76
Cleveland	$ 10,334,511.01
Columbus	$ 34,665,840.73
Craven	$ 44,811,960.36
Cumberland	$ 34,969,108.22
Currituck	$ 33,232,796.73
Dare	$ 70,807,891.07
Davidson	$ 24,291,358.87
Davie	$ 8,572,098.18
Duplin	$ 48,986,272.39
Durham	$ 18,889,639.06

County	Annualized Losses
Edgecombe	$ 7,867,137.59
Forsyth	$ 27,798,992.20
Franklin	$ 5,645,638.85
Gaston	$ 7,455,572.40
Gates	$ 5,487,742.44
Graham	$ 612,033.90
Granville	$ 3,767,592.52
Greene	$ 5,775,677.30
Guilford	$ 36,997,531.96
Halifax	$ 16,331,005.37
Harnett	$ 12,731,765.74
Haywood	$ 3,351,227.57
Henderson	$ 5,579,274.81
Hertford	$ 5,039,509.65
Hoke	$ 7,189,893.60
Hyde	$ 3,939,637.57
Iredell	$ 10,056,703.45
Jackson	$ 1,461,167.64
Johnston	$ 25,285,893.51
Jones	$ 4,565,754.76
Lee	$ 6,442,896.04
Lenoir	$ 17,155,818.53
Lincoln	$ 6,426,516.38
Macon	$ 1,435,935.43
Madison	$ 1,432,114.55
Martin	$ 15,709,847.42
McDowell	$ 1,692,227.20
Mecklenburg	$ 60,486,369.27
Mitchell	$ 1,125,175.60
Montgomery	$ 3,187,295.34
Moore	$ 12,955,854.18
Nash	$ 12,935,995.57
New Hanover	$ 167,594,284.67
Northampton	$ 5,697,304.28
Onslow	$ 90,454,924.79
Orange	$ 14,461,907.79
Pamlico	$ 5,619,501.20
Pasquotank	$ 19,096,536.58
Pender	$ 19,447,689.32
Perquimans	$ 9,069,429.58
Person	$ 5,275,846.59
Pitt	$ 31,099,665.75
Polk	$ 1,438,203.83
Randolph	$ 19,508,757.63
Richmond	$ 7,884,699.69
Robeson	$ 55,448,728.09
Rockingham	$ 17,624,340.56
Rowan	$ 22,167,408.18
Rutherford	$ 5,446,860.73
Sampson	$ 46,194,954.62
Scotland	$ 8,670,720.49
Stanly	$ 9,303,827.27
Stokes	$ 4,502,289.72

County	Annualized Losses
Surry	$ 10,036,912.68
Swain	$ 485,437.94
Transylvania	
Tyrrell	$ 2,245,937.25
Union	$ 16,476,134.79
Vance	$ 4,391,168.88
Wake	$ 92,211,100.39
Warren	$ 1,958,030.95
Washington	$ 2,288,212.67
Watauga	$ 2,463,287.89
Wayne	$ 55,908,582.46
Wilkes	$ 7,130,676.41
Wilson	$ 10,066,122.12
Yadkin	$ 4,409,787.60
Yancey	$ 1,217,908.77
North Carolina	$ 1,706,637,980.70

Source: NCEM

Hurricane/Coastal Hazards Risk and Consequence Analysis

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td>People (The Public and Public Confidence)</td><td>High</td><td>During previous hurricane events in North Carolina, there have been significant losses of life and injuries to citizens. A number of people are expected to be displaced from their homes and will require accommodations in temporary public shelters due to a hurricane. Many people may also be permanently displaced and require longer term housing after a major event. In addition, many of the same health and property damage effects listed under the flood hazard would also likely occur as a result of a hurricane. A major difference is that hurricanes can also bring negative effects from high winds and storm surge (especially in coastal areas). High winds can shatter glass and cause personal injury and storm surge and rip tides prior to and during the event can cause loss of life if members of the public are not cautious and continue normal activities in the ocean prior to a hurricane event.

Hurricane Matthew, which was perhaps the most impactful hurricane the state has experienced since the 1990s, had major implications for the people of North Carolina. The table below outlines some of the impacts and gives at least some idea of the potential consequences of future hurricane events. This information was updated on September 29, 2017 through the state's "Rebuild NC" website (rebuild.nc.gov).
<table>
<tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr>
<tr><td>Families registered for assistance</td><td>81,498</td></tr>
<tr><td>Total Dollars Distributed through Individual and Households Program</td><td>$98,193,197</td></tr>
<tr><td>Flood Claims</td><td>5,868</td></tr>
<tr><td>Total Dollars Distributed Through National Flood Insurance Program</td><td>$195,493,901</td></tr>
</table>

This hazard could potentially have a large negative effect on public confidence due to the possibility of a high magnitude event and the</td></tr>
</table>

Category	Impact Rating	Description of Impacts
		difficulties that might arise for local governments in terms of response and recovery. As has been the case with several previous events, members of the public who are displaced or whose homes/property are damaged may be frustrated causing a failure of confidence in the government's ability to respond to disasters.
Responders	High	The impacts on responders from this type of storm could potentially be very high as responders may be physically injured or killed during a storm event by flooding or high winds. In addition, their homes and personal effects could also be impacted, which would limit their response capability. In terms of their actual response capacity, downed trees in the wake of a hurricane often block roads and make ingress and egress difficult, thereby causing issues with response time. This is also often true of the resulting floodwaters. Moreover, due to the large-scale spatial impact of hurricanes and the number of citizens affected by the storm, response time will be reduced because of the number of incidents that require emergency responders.
Operations/Continuity of Operations	High	Continuity of operations in a hurricane event can be severely affected if power is lost or if critical facilities or infrastructure are damaged during an event. Although North Carolina has a plan in place to maintain continuity of operations in the event of a storm, a hurricane with a high magnitude would likely disrupt operations to some degree due to the impacts it would have on personnel. Some may experience damage from the storm themselves and be unable to work putting a strain on staff who are working as they will be forced to take on additional responsibilities during and after an event. In major events, all staff will likely be called on to work additional hours to maintain continuity of operations, which may result in fatigue and a reduced capability of employees in the long run.
Built Environment (Property, Facilities, Infrastructure)	High	Many buildings and structures could be impacted by a hurricane or tropical storm event including many local and state critical facilities such as police stations, fire stations, medical facilities, and other key buildings. There are also a number of important historic locations located along the coast such as Large-scale damage to infrastructure such as bridges and roads could occur from flood waters and storm surge especially in coastal areas such as the Outer Banks where roadways such as Highway 12 have been damaged severely during past events. Stormwater infrastructure such as culverts could also be damaged if they are clogged with debris from the storm or their design capacity is overrun. Many utilities including water/wastewater may be affected as a result of their location near rivers and other water sources. Power lines may be downed by falling trees or limbs and, due to high demand across the state, utility companies may face challenges in restoring power in a timely manner. Hurricane Matthew also offers some insight on impacts to public infrastructure based on funding distributed through FEMA's Public Assistance (PA) program, though these numbers fall far below total damage to the built environment. According to Rebuild NC, as of September 29, 2017:

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td></td><td></td><td><table><tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr><tr><td>Public Assistance (PA) Projects Submitted</td><td>81,498</td></tr><tr><td>Total Federal Dollars Distributed through PA Program</td><td>$62,663,672</td></tr></table></td></tr>
<tr><td>Economy</td><td>High</td><td>In general, the economy would be severely impacted by a hurricane or tropical storm event. Due to the massive scale of these events and multiple types of impacts from flooding and high winds, commerce would definitively slow down as efforts to rebuild are undertaken. Businesses may be shut down for long periods as owners try to rebuild after damage from flood waters, downed trees, or wind. Even business owners without direct physical damage to their workplaces may be shut down temporarily by loss of power or because employees are unable to come in to work as a result of roads that are shut down or personal property damage. As mentioned in the flooding analysis, many businesses that shut down after a major disaster never re-open their doors, which can have a major negative impact on local economies, especially in smaller communities.

Some data on impacted businesses during Hurricane Matthew is available via loans distributed through the Small Business Administration (SBA). This certainly does not encompass all the businesses impacted by the storm, but provides an estimate that can be used as a floor. This information was also retrieved from rebuild.nc.gov and is updated through September 29, 2017.<table><tr><th colspan="2">Hurricane Matthew Impacts (2016)</th></tr><tr><td>SBA Loans Approved</td><td>81,498</td></tr><tr><td>Total Dollars Distributed through SBA Program</td><td>$102,424,200</td></tr></table></td></tr>
<tr><td>Environment</td><td>High</td><td>Flooding and wind damage are the main impacts that would be felt by a hurricane in North Carolina. Hurricane winds can down trees and cause disruptions to local ecosystems, particularly if damage is heavy in areas where endangered or protected species are present. As mentioned in the flood analysis, flood waters may cause some losses in species population. In coastal areas, sensitive habitats could be drastically impacted by hurricane events if the storm damages dune systems via storm surge. This may also cause local communities to become more vulnerable to future events as dunes provide a natural barrier against storm surge. Additionally, estuarine habitats may be impacted if floodwaters inundate these complex ecosystems with additional freshwater or saltwater, thereby causing an abnormality in a system that relies on a particular balance of salinity. Hurricane events can also sometimes cause spills of hazardous materials which would have damaging effects on the environment (as detailed further in the hazardous substances analysis below).

Some types of human infrastructure protection can result in degradation of natural systems and can exacerbate impacts to natural systems. For example sea walls and groins alter the natural erosion and accretion patterns of the barrier island systems.

Canals established to drain freshwater from coastal plain agricultural</td></tr>
</table>

Category	Impact Rating	Description of Impacts
		fields and industrial/residential areas increase saltwater intrusion deeper into the coastal plain, and at higher volumes – this is a mitigable risk.

Hurricane/Coastal Hazards Vulnerability for State-Owned Facilities

Table 3-41 provides a summary of the number and value of state-owned facilities in storm surge zones.

Table 3-41 State-Owned Facilities and Storm Surge Zones

Storm Surge Zone	Number of State-Owned Facilities in Zone	Value of State-Owned Facilities in Zone
Category 1	37	$15,924,163
Category 2	181	$125,205,270
Category 3	274	$306,009,149
Category 4	321	$356,303,291
Category 5	391	$380,878,794

Source: NOAA, NCEM

3.5.5.5 Severe Winter Weather Hazard Vulnerability

Because winter weather is an atmospheric hazard and can occur anywhere throughout the state, all populations, buildings and infrastructure are vulnerable. NCEI data indicates that occurrences of severe winter weather are more frequent in the mountains of North Carolina, thereby increasing the risk to the hazard in those counties. However, vulnerability to winter weather is difficult to qualify and quantify because of the unique impacts the hazard has on people, structures and infrastructure. Snow alone does not pose a significant threat to structures unless it falls in extremely heavy amounts. Ice events occur less frequently, but can have significant impacts on people and particularly on infrastructure.

Table 3-42 provides a summary of the expected annualized losses by county based on NCEI data.

Table 3-42 Annualized Losses for Severe Winter Weather

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Alamance	$544,484.00	$25,927.81
Alexander	$12,197,820.00	$580,848.57
Alleghany	$187,278.00	$8,918.00
Anson	$0.00	$0.00
Ashe	$358,685.00	$17,080.24
Avery	$79,878,496.00	$3,803,737.90
Beaufort	$70,789.00	$3,370.90
Bertie	$35,833.00	$1,706.33
Bladen	$4,604,380.00	$219,256.19
Brunswick	$201,211.00	$9,581.48
Buncombe	$11,999,065.00	$571,384.05

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Burke	$169,609,440.00	$8,076,640.00
Cabarrus	$17,719,471.00	$843,784.33
Caldwell	$141,852,230.00	$6,754,868.10
Camden	$0.00	$0.00
Carteret	$334,011.00	$15,905.29
Caswell	$341,681.00	$16,270.52
Catawba	$13,605,347.00	$647,873.67
Chatham	$544,484.00	$25,927.81
Cherokee	$1,573.00	$74.90
Chowan	$0.00	$0.00
Clay	$0.00	$0.00
Cleveland	$14,858,933.00	$707,568.24
Columbus	$7,845,330.00	$373,587.14
Craven	$0.00	$0.00
Cumberland	$10,283.00	$489.67
Currituck	$0.00	$0.00
Dare	$34,070,106.00	$1,622,386.00
Davidson	$6,464,068.00	$307,812.76
Davie	$12,379,403.00	$589,495.38
Duplin	$0.00	$0.00
Durham	$1,494,102.00	$71,147.71
Edgecombe	$23,807.00	$1,133.67
Forsyth	$497,438.00	$23,687.52
Franklin	$538,532.00	$25,644.38
Gaston	$246,815,866.00	$11,753,136.48
Gates	$0.00	$0.00
Graham	$1,190,395.00	$56,685.48
Granville	$827,329.00	$39,396.62
Greene	$31,461.00	$1,498.14
Guilford	$9,046,072.00	$430,765.33
Halifax	$657,674.00	$31,317.81
Harnett	$28,138.00	$1,339.90
Haywood	$2,380,791.00	$113,371.00
Henderson	$13,639,279.00	$649,489.48
Hertford	$0.00	$0.00
Hoke	$0.00	$0.00
Hyde	$538,234.00	$25,630.19
Iredell	$14,949,651.00	$711,888.14
Jackson	$77,058,460.00	$3,669,450.48
Johnston	$600,763.00	$28,607.76
Jones	$0.00	$0.00
Lee	$0.00	$0.00
Lenoir	$62,923.00	$2,996.33
Lincoln	$13,604,006.00	$647,809.81
Macon	$2,380,791.00	$113,371.00
Madison	$3,751,186.00	$178,627.90
Martin	$62,923.00	$2,996.33
McDowell	$80,012,554.00	$3,810,121.62
Mecklenburg	$59,462,458.00	$2,831,545.62
Mitchell	$1,223,351.00	$58,254.81
Montgomery	$0.00	$0.00
Moore	$0.00	$0.00

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Nash	$554,767.00	$26,417.48
New Hanover	$0.00	$0.00
Northampton	$2,222,259.00	$105,821.86
Onslow	$222,211.00	$10,581.48
Orange	$3,892,063.00	$185,336.33
Pamlico	$23,596.00	$1,123.62
Pasquotank	$0.00	$0.00
Pender	$2,001,571.00	$95,312.90
Perquimans	$0.00	$0.00
Person	$1,095,275.00	$52,155.95
Pitt	$117,982.00	$5,618.19
Polk	$29,333,674.00	$1,396,841.62
Randolph	$3,770,566.00	$179,550.76
Richmond	$0.00	$0.00
Robeson	$5,947,616.00	$283,219.81
Rockingham	$572,356.00	$27,255.05
Rowan	$14,948,331.00	$711,825.29
Rutherford	$14,856,015.00	$707,429.29
Sampson	$0.00	$0.00
Scotland	$0.00	$0.00
Stanly	$0.00	$0.00
Stokes	$354,471.00	$16,879.57
Surry	$1,450,735.00	$69,082.62
Swain	$1,190,395.00	$56,685.48
Transylvania	$13,404,061.00	$638,288.62
Tyrrell	$0.00	$0.00
Union	$16,340,269.00	$778,108.05
Vance	$817,035.00	$38,906.43
Wake	$1,087,349.00	$51,778.52
Warren	$793,227.00	$37,772.71
Washington	$23,596.00	$1,123.62
Watauga	$616,110.00	$29,338.57
Wayne	$10,283.00	$489.67
Wilkes	$3,046,982.00	$145,094.38
Wilson	$554,767.00	$26,417.48
Yadkin	$884,380.00	$42,113.33
Yancey	$1,223,621.00	$58,267.67
North Carolina	**$1,181,948,148.00**	**$56,283,245.14**

Source: NCEI

Severe Winter Weather Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Winter weather most often impacts people indirectly and has differing impacts in different areas of the state. Mountainous areas in the western part of the state are much more accustomed to winter weather and therefore, are often more prepared to deal with it. However, these areas are also much more likely to experience larger accumulations of precipitation and colder temperatures than areas further east. Across the state, winter weather can create dangerous driving conditions by limiting visibility for drivers or creating slick conditions that make

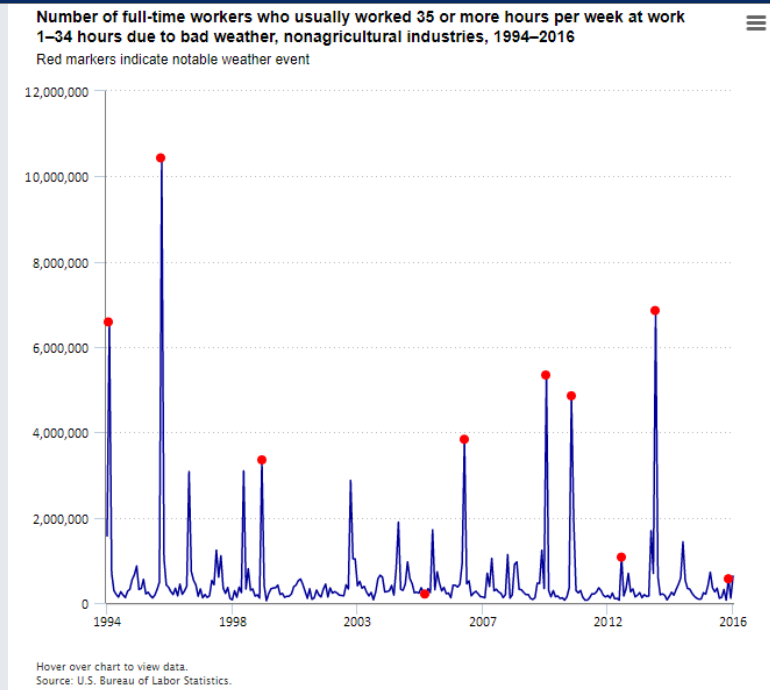
Category	Impact Rating	Description of Impacts
		maneuverability difficult. Loss of power can create very cold conditions for residents, making it difficult to stay warm. Residents may try to heat their home using alternative means, which runs the risk of carbon monoxide poisoning caused by improperly ventilated heating sources. In addition, dangerously cold temperatures increase the risk of wind chill, frostbite, and hypothermia. Another indirect impact of winter weather on the public is its potential to impact public and private school schedules through closings and delays. Poor driving conditions, lack of power and heat, and mechanical problems with school buses and equipment due to cold weather conditions are potential concerns. School closures and delays can lead to logistical problems for teachers and school administrators, especially in the event of end-of-term exams and standardized testing schedules. It can also result in logistical problems for making up school days. Winter storms generally do not have a large impact on public confidence, but it could be somewhat impacted if road clearing or response operations are slow.
Responders	Moderate	Responders in severe winter weather events face a variety of hazards, including slick or icy roads that could cause accidents if they are attempting to quickly respond to an emergency as is often the case. The chances of crashed emergency vehicles and injuries to responders are always a possibility, but increase during a winter storm event due to difficult driving conditions. Winter weather can also make it difficult to access more rural areas if roads are snowed/iced over and emergency vehicles cannot pass through.
Operations/Continuity of Operations	Moderate	Generally, continuity of operations can be maintained during a winter weather event in North Carolina. However, winter weather does have the potential to affect power transmission as the weight of ice and snow can cause trees and limbs to fall and damage transmission lines. Winter precipitation can also freeze to roadways or create slick conditions that make it difficult for emergency management employees to get to work. As a result, there will likely be some disruption of operations during a winter weather event.
Built Environment (Property, Facilities, Infrastructure)	Moderate	One of the primary identified impacts of winter weather in North Carolina is the disruption of utilities. Utilities that are at risk of being affected include telephone, internet, cable, and water. Newspaper reports typically cite trees falling on electrical wires—as well as trees that have already been damaged from previous incidents that fall during a winter storm—or the stress caused by ice accumulation as main causes for power outages. Damage to this infrastructure is one of the major consequences of a winter weather event in the state and can lead to life-threatening situations if the public is unable to utilize central heating systems to keep warm during the concurrent cold weather that often accompanies winter weather. Winter weather also has the potential to create hazardous driving conditions leading to accidents on roadways. The North Carolina Climate Office reports that 70 percent of winter-weather–related injuries are a result of accidents on the road.67 The North Carolina Highway Patrol call volume can double

[67] *State Climate Office of North Carolina. Winter weather—impacts. Retrieved August 21, 2017, from http://www.nc-climate.ncsu.edu/climate/winter_wx/Impacts.php*

Category	Impact Rating	Description of Impacts
		during a winter storm compared to a typical 24-hour period. This creates significant problems for emergency workers. Accidents can cause highways to become "large parking lots" as well as cause motorists to strand their vehicles, making it difficult for emergency workers to reach those who need assistance. In general, major and local roadways become severely impacted when temperatures drop, making pre-treatment solutions ineffective. Transportation impacts can be minimized during early- and late-season events when paved surfaces are able to warm sufficiently to prevent winter precipitation accumulation. Winter weather can also cause delays and cancellations of flights at airports in the state due to slick conditions on runways. There is also the potential of a loss of power that can close the airport. The North Carolina Department of Transportation (NCDOT), which maintains the second largest state network in the country, is primarily responsible for maintaining the state's transportation infrastructure during severe winter weather events. As of the end of 2016, NCDOT has the following capabilities in terms of storm preparation:
Economy	Moderate	In the event of winter weather, there is a high potential of business and office closures, modified business and office hours, and cancellation or postponement of sporting and other planned events in the state. This can be attributed to poor road conditions (including icy and slick conditions) that result in fewer people using the roads to get to their destination or a loss of power and heat that result in a loss of operations at specific facilities. In general, absenteeism is higher during winter weather events as many employers rightly encourage employees to stay home and avoid potential injury in unsafe driving conditions. As can be seen in the chart below, the Bureau of Labor Statistics[69] notes that although any major weather event can cause absences at work, workers are more likely to be absent because of bad weather during winter months because winter weather tends to impact much larger areas and makes travel difficult throughout much more of the transportation network.

NCDOT Winter Weather Capabilities[68]	
Plows/Salt and Sand Spreaders	1,739
Front-End Loaders and Backhoes	495
Motor Graders	332
Storage Space for Salt/Sand	170,000 tons
Storage Space for Brine	1,520,000 gallons
Annual Budget for Storm Preparation	$70,000,000

[68] North Carolina Department of Transportation. Severe Weather- Winter Storms. Retrieved August 21, 2017, from https://www.ncdot.gov/travel/severeweather/winter.html
[69] United States Bureau of Labor Statistics. Work Absences Due to Bad Weather from 1994 to 2016. Retrieved August 21, 2017, from https://www.bls.gov/opub/ted/2017/work-absences-due-to-bad-weather-from-1994-to-2016.htm

Category	Impact Rating	Description of Impacts
		
Environment	Moderate	Winter weather has an impact on the environment through the clearing of roadways. Snow on the roads can pick up contaminants from chemicals and oil products in traffic as well as the salt mixture that is used to de-ice the roads. These contaminants can be carried to nearby waterways, which contaminates water sources and is absorbed by groundwater. In addition, vegetation can be damaged by these storm types, which harms habitats and may threaten wildlife. Additional environmental impacts of severe winter weather include, but are not limited to the following: • Cold stunning of sea turtles • Cold damage to red spruce – needles killed, early budding with climate warming then cold snaps cause significant damage • Temperature fluxes warm to freezing to warm again affecting amphibians – primarily frogs • High risk for pollinators that emerge in warming temperatures but caught in freezing snaps

Severe Winter Weather Hazard Vulnerability for State-Owned Facilities

All state-owned facilities are vulnerable to severe winter weather. NCEI data indicates that occurrences of severe winter weather are more frequent in the mountains of North Carolina, thereby increasing the risk to the state-owned facilities in that region of the State. However, structural damages to severe winter weather are not common and losses are more confined to loss of productivity of workers and loss of wages which are not calculated in this assessment.

3.5.5.6 Excessive Heat Vulnerability

All buildings in the state should be considered vulnerable to excessive heat, but excessive heat does not cause significant structural or monetary damage. The most significant impacts from excessive heat are loss of life.

Excessive Heat Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Extreme heat can affect many people and to varying degrees. Often the elderly and very young are susceptible to the most detrimental impacts, but heat stroke and exhaustion can plague anyone. People who are overweight, who overexert during work or exercise, and who are ill or are on certain medications are also at greater risk of suffering from heat-related illness. Risks from exposure to extreme heat include heat cramps, heat exhaustion, heat stroke, and death. Many of the impacts of extreme heat on people are the result of heat exhaustion or improperly functioning air conditioning units. A heat wave or extreme heat event would have minimal effects on public confidence as these events are frequent and the public likely understands the potential impacts. However, if an extreme heat event results in a large number of illnesses and fatalities, government organizations may be accused of failing to properly prepare for or respond to the threat, and public confidence could suffer.
Responders	Moderate	Extreme heat can also affect responders who are often more susceptible to heat stroke and exhaustion due to the nature of their work. This work forces police and emergency medical providers to be exposed to the elements, physically exert themselves, or wear heavy personal protective equipment. In these cases, responders could be negatively impacted by extreme heat and will need to protect themselves and prepare accordingly.
Operations/Continuity of Operations	Low	Extreme heat would likely have few impacts on continuity of operations as the warning time for these events is usually long and direct impacts to large numbers of personnel or other resources necessary to maintain operations are unlikely. If air conditioning systems in operations centers break down due to overuse, operations could be interrupted or forced to move to secondary facilities.
Built Environment (Property, Facilities, Infrastructure)	Low	Extreme heat would likely have a minor effect on the built environment, although high temperatures could potentially put a strain on infrastructure such as power generation and water systems due to higher demand. During times of extreme heat, air conditioning units work harder and require more electricity, making brownouts and blackouts possible if electricity demands exceed generation. Extreme heat can also cause transportation infrastructure such as roads, bridges, railways, and runways to buckle, crack, or shatter.
Economy	Low	An extreme heat event could potentially have a negative impact on the economy in the short term as the public may be advised to stay indoors, causing them to reduce overall spending and negatively impact businesses in the community. Additionally, extreme heat events can also result in decreased worker productivity as high temperatures can result in decreased energy, loss of concentration, and heat-related illness in workers. This can cause disruptions to the regular working of the local economy. Extended periods of extreme heat may also disrupt the local economy if agricultural, dairy, and livestock production declines,

Category	Impact Rating	Description of Impacts
		resulting in income loss for farmers and other related industries as well as increased prices for consumers.
Environment	Moderate	The environment would be impacted by extreme heat as many plants and animals that are not able to withstand the heat may die off and crops and livestock may be impacted by unusually high temperatures, resulting in death or illness. Heat waves can also contribute to higher levels of air pollution since air becomes stagnant and traps emitted pollutants, often causing increased levels of surface ozone. Additional environmental impacts of excessive heat include, but are not limited to, the following: • Anoxic conditions in aquatic systems, temperature based and algal/ecological based impacts, fish losses. • Increased ground level ozone can damage plants. • Plant metabolism impacted by higher nighttime temperatures. • If accompanied by drought or dry spell there would be synergistic negative impacts.

Excessive Heat Hazard Vulnerability for State-Owned Facilities

All state-owned facilities buildings in the state should be considered vulnerable to excessive heat, but excessive heat does not cause significant structural or monetary damage. The most significant impacts from excessive heat are loss of life.

3.5.5.7 Earthquake Hazard Vulnerability

Table 3-43 provides a summary of the expected annualized losses to earthquakes by county based on NCEM risk data analysis.

Table 3-43 Annualized Earthquake Hazard Losses by County

County	Annual Losses
Alamance	$ 319,787.66
Alexander	$ 167,955.41
Alleghany	$ 97,486.32
Anson	$ 168,253.58
Ashe	$ 279,673.60
Avery	$ 146,001.01
Beaufort	$ 42,392.29
Bertie	$ 9,697.89
Bladen	$ 178,791.51
Brunswick	$ 409,577.54
Buncombe	$ 1,264,155.87
Burke	$ 461,660.02
Cabarrus	$ 1,097,106.10
Caldwell	$ 543,123.67
Camden	$ 1,825.24

County	Annual Losses
Carteret	$ 70,583.50
Caswell	$ 66,240.07
Catawba	$ 806,784.96
Chatham	$ 288,272.15
Cherokee	$ 503,852.64
Chowan	$ 7,997.75
Clay	$ 108,904.37
Cleveland	$ 763,509.54
Columbus	$ 411,352.64
Craven	$ 93,614.62
Cumberland	$ 1,409,514.67
Currituck	$ 7,820.52
Dare	$ 9,689.50
Davidson	$ 552,246.82
Davie	$ 225,696.42
Duplin	$ 257,214.17
Durham	$ 480,734.82
Edgecombe	$ 61,166.18
Forsyth	$ 832,815.82
Franklin	$ 82,439.88
Gaston	$ 800,913.37
Gates	$ 9,094.92
Graham	$ 178,421.07
Granville	$ 83,008.14
Greene	$ 25,811.29
Guilford	$ 1,234,939.99
Halifax	$ 145,739.17
Harnett	$ 187,749.30
Haywood	$ 620,125.86
Henderson	$ 764,597.22
Hertford	$ 22,727.45
Hoke	$ 134,708.26
Hyde	$ 2,394.19
Iredell	$ 632,179.02
Jackson	$ 324,709.03
Johnston	$ 310,796.50
Jones	$ 12,803.18
Lee	$ 189,627.29
Lenoir	$ 108,764.40
Lincoln	$ 442,674.21
Macon	$ 379,476.30

County	Annual Losses
Madison	$ 249,098.27
Martin	$ 44,071.90
McDowell	$ 241,940.43
Mecklenburg	$ 4,748,906.80
Mitchell	$ 164,451.75
Montgomery	$ 179,616.22
Moore	$ 445,012.07
Nash	$ 143,063.61
New Hanover	$ 831,870.81
Northampton	$ 25,023.10
Onslow	$ 231,483.91
Orange	$ 300,455.11
Pamlico	$ 8,172.45
Pasquotank	$ 13,936.49
Pender	$ 98,801.65
Perquimans	$ 6,234.17
Person	$ 99,583.00
Pitt	$ 145,331.97
Polk	$ 213,557.91
Randolph	$ 550,488.75
Richmond	$ 458,407.83
Robeson	$ 1,153,622.09
Rockingham	$ 357,653.24
Rowan	$ 773,176.03
Rutherford	$ 665,773.15
Sampson	$ 358,501.91
Scotland	$ 295,102.94
Stanly	$ 389,664.75
Stokes	$ 114,985.98
Surry	$ 318,876.46
Swain	$ 148,718.86
Transylvania	
Tyrrell	$ 1,521.62
Union	$ 855,554.82
Vance	$ 74,313.71
Wake	$ 1,612,877.44
Warren	$ 20,544.78
Washington	$ 4,098.27
Watauga	$ 255,762.35
Wayne	$ 374,681.96
Wilkes	$ 387,461.95

County	Annual Losses
Wilson	$ 100,334.65
Yadkin	$ 111,729.84
Yancey	$ 179,694.68
North Carolina	**$ 36,593,358.59**

Source: NCEM

Earthquake Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Low	Earthquakes in North Carolina generally are not high impact events that cause injury or death as most are moderate in terms of impacts. The public typically experiences some shaking in these events and the greatest threat to health and well-being is often from objects falling, from shelves or off walls. The western and southeastern parts of the state are where people are most likely to be impacted by an earthquake, but even in these cases, a major disaster would be unlikely. Therefore, public confidence would likely not be affected in the event of an earthquake.
Responders	Low	There would be little impact on responders in the event of an earthquake, because North Carolina is only likely to experience a moderate earthquake magnitude. Since there would be minimal damage to structures and infrastructure, responders would likely not be impacted in their ability to respond to an earthquake. If there were any major collapses of buildings or infrastructure however, responders will need to take care when accessing these structures in case they have become structurally unstable and unsafe. It should also be noted that because earthquakes can knock items such as candles off shelves or damage gas lines, fires are possible directly after an event. This may cause additional emergency calls for responders and create a burden on response operations.
Operations/Continuity of Operations	Low	During and after an earthquake, continuity of operations could relatively easily be maintained and there would likely be little disruption to services or operations during an event, especially at the state level. The most likely impact may be downed communication networks which could cause interruptions to normal operations.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Ground shaking is the primary cause of damage to the built environment during an earthquake. There are three important variables that determine the amount of damage: the intensity of the earthquake, local soil characteristics, and the quality of the impacted structures. The amount of damage caused by an earthquake is strongly influenced by soil characteristics. The velocity at which the rock or soil transmits shear waves is the main contributor to ground shaking. Shaking is increased by soft, thick, or wet soil types. Certain building types are particularly vulnerable to earthquake damage: wood-frame multi-unit buildings, single-family homes, mobile homes, and unreinforced masonry buildings.70 The most susceptible structures are wood-frame, multi-story, mixed-use buildings that have large

[70] *Association of Bay Area Governments. (2017). Guide to housing vulnerable resources. Retrieved August 21, 2017, from http://quake.abag.ca.gov/housing/*

Category	Impact Rating	Description of Impacts
		openings on the first floor for garages or commercial space and housing on the upper floors. During an earthquake, these types of structures could sway or even collapse. Single-family homes built prior to the 1970s are often not bolted to their foundations, and walls surrounding crawl spaces are not braced (i.e., cripple walls). Typical earthquake damage to these structures includes cracked foundations, chimneys breaking at the roof line, wood frames coming off their foundations, and racking of cripple walls. Mobile homes that are built of light-weight metal or a combination of steel frame and wood are easily damaged by a quake. Mobile homes installed prior to 1995 were often not attached to their foundations and could shift off their supports. The last type of susceptible building material is unreinforced masonry—masonry walls that have not been reinforced with steel. These buildings were often built before 1960 in an era when reinforcing was not generally used, anchorage to floors and roofs was missing, and use of low-strength lime mortar was common. Earthquake damage to these buildings can be severe. A lack of reinforcement and tie-downs can result in substantial damage in the form of cracked or leaning walls. Damage may also occur between the walls, and separation between the framing and walls could lead to full collapse due to a lack of vertical support. Critical Infrastructure There are a handful of key resource categories that could be impacted by an earthquake including transportation systems, communication systems, and utility systems. Historically, the state has not been impacted by an earthquake with more than a moderate intensity so damage to these resources would be very minor; however, an inspection of certain features after a strongly felt earthquake may be necessary.
Economy	Low	There are several sources of economic loss typically associated with an earthquake including property damage and business interruption costs; cost to repair public transportation, communication, or utility systems; and debris removal costs. Historically, there have been relatively minor economic losses from earthquakes in the state that have not already been described under the impacts to the built environment above.
Environment	Moderate	There would be moderate impacts to the environment following a significant earthquake that is felt in North Carolina with a moderate intensity. Secondary effects from the damage of key resources mentioned above (e.g., utility systems) could impact the environment, but the probability of this type of situation is very small. For instance, a ruptured pipeline could release dangerous materials that could damage the surrounding environment, but the likelihood of an earthquake causing this in North Carolina is relatively low. Additional environmental impacts of earthquakes include, but are not limited to, the following: • Earthquakes can result in disruption of groundwater systems: springs can dry, in-stream discharge points may change.

Category	Impact Rating	Description of Impacts
		• Landslides containing sulfidic materials are a threat to some aquatic systems in western North Carolina This hazard can be exacerbated by cut-fill slopes along roads, and un-vegetated slopes.

Earthquake Hazard Vulnerability for State-Owned Facilities

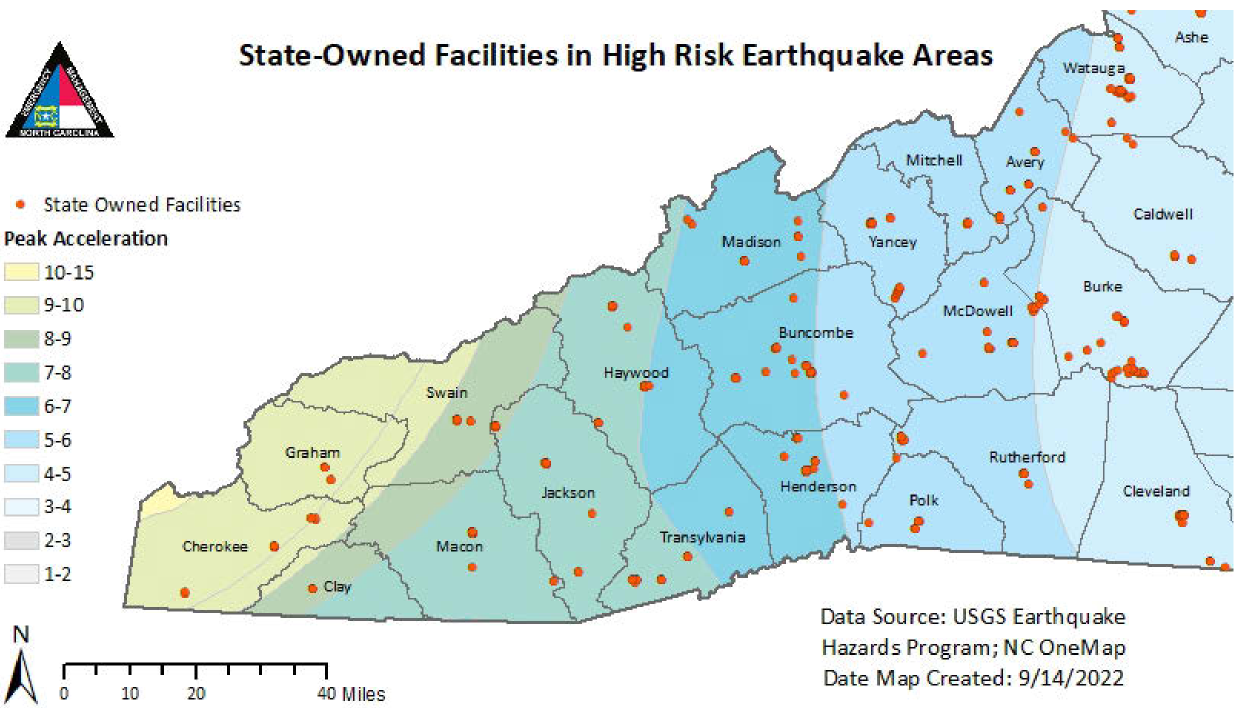
Table 3-44 provides a summary of vulnerability to earthquakes for state-owned facilities. Figure 3-71 State-Owned Facilities and Earthquake Risk provides a graphical representation of those facilities in the higher hazard risk areas.

Table 3-44 State-Owned Facilities and Earthquake Risk

Earthquake Hazard Zone	USGS Hazard Zone Indicator	Number of State-Owned Facilities in Hazard Zone	Value of State-Owned Facilities in Hazard Zone
8-15%g	Higher Hazard	48	$6,960,247
5-8%g		174	$41,067,139
3-5%g		791	$922,319,869
1-3%g	Lower Hazard	3678	$10,880,615,474

Source: USGS and NCEM

Figure 3-71 State-Owned Facilities and Earthquake Risk



3.5.5.8 Wildfire Hazard Vulnerability

To determine vulnerability to the wildfire hazard, a GIS analysis was run to determine, by County, the number and value of structures in high-risk wildland urban interface areas (areas

7 through 9 as depicted on Figure 3-72 below). Results of the analysis can be found in Table 3-45.

Figure 3-72 Value of Buildings in High WUI Risk Areas

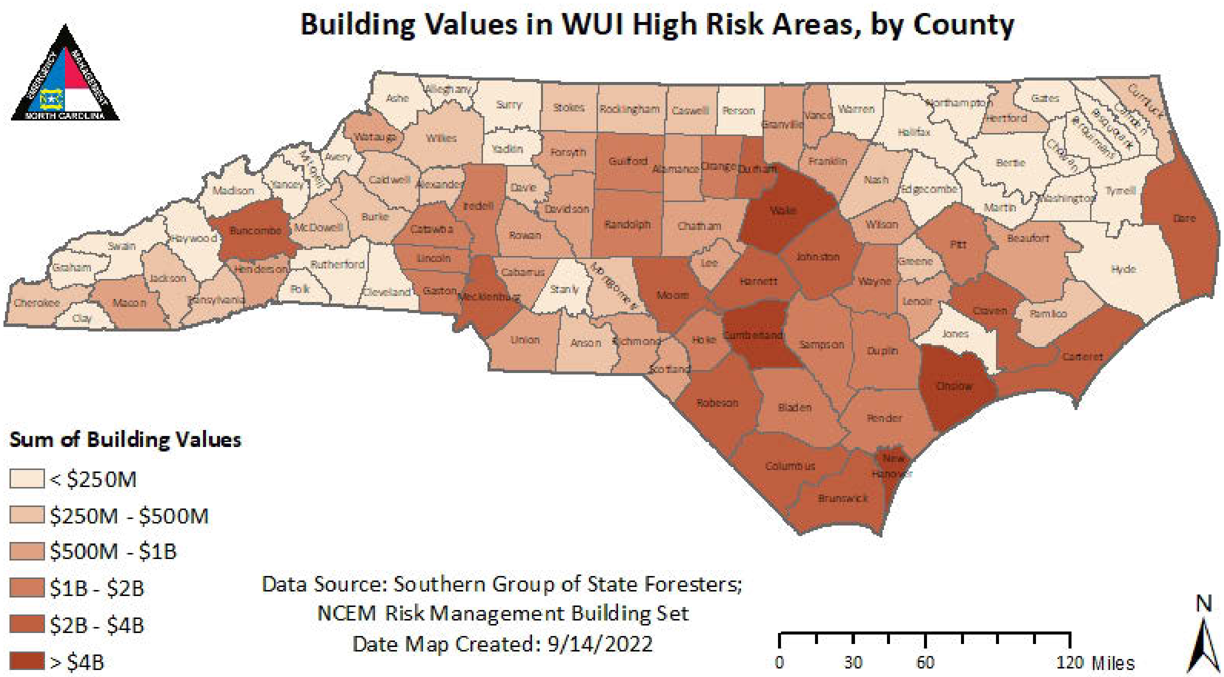


Table 3-45 Wildfire Vulnerability

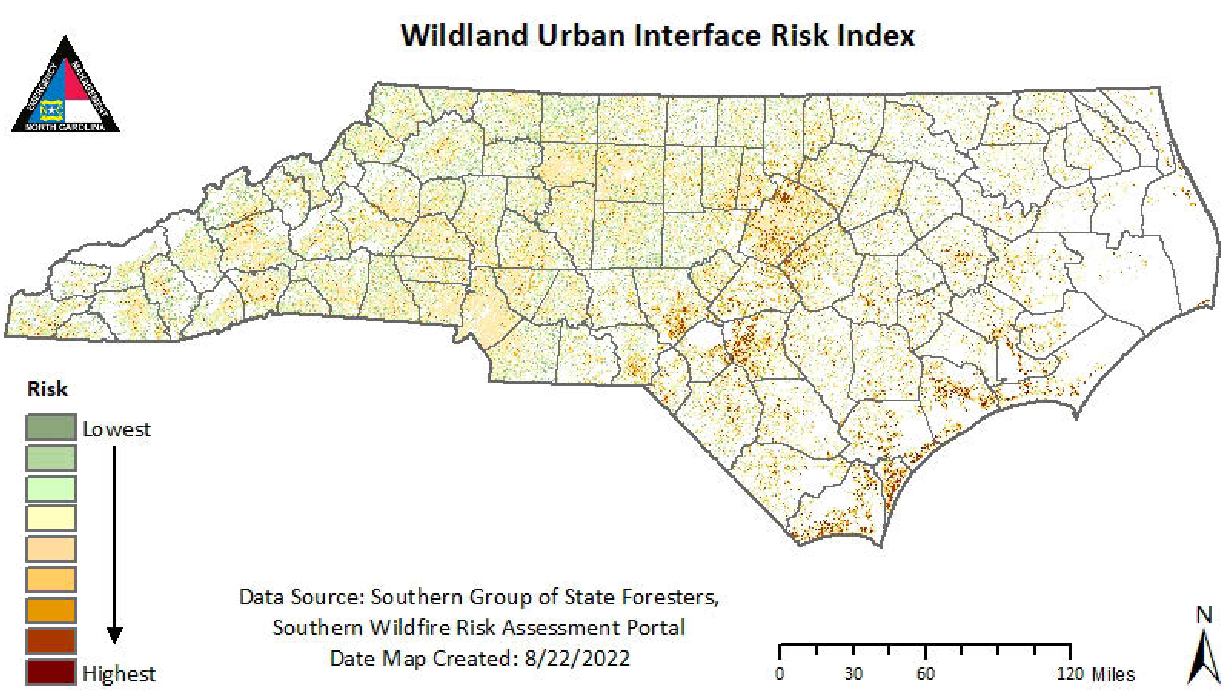
County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
Alamance	5,117	$825,246,230
Alexander	2,634	$370,630,421
Alleghany	906	$67,913,216
Anson	2,044	$400,362,936
Ashe	1,122	$133,156,373
Avery	815	$141,538,464
Beaufort	6,520	$547,958,106
Bertie	1,597	$92,035,172
Bladen	7,217	$1,299,935,823
Brunswick	31,970	$3,400,106,891
Buncombe	9,437	$2,507,297,598
Burke	4,372	$453,264,911
Cabarrus	5,849	$823,597,300
Caldwell	4,479	$434,791,183
Camden	670	$76,459,248
Carteret	16,919	$2,866,583,615
Caswell	1,561	$278,518,124
Catawba	7,803	$1,173,900,413
Chatham	5,447	$819,676,747
Cherokee	2,825	$254,272,638
Chowan	977	$135,943,385
Clay	914	$118,877,361

County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
Cleveland	1,816	$165,996,301
Columbus	10,172	$2,058,775,466
Craven	16,832	$2,540,419,805
Cumberland	57,207	$19,457,563,045
Currituck	4,201	$428,208,986
Dare	13,700	$2,097,457,863
Davidson	9,352	$641,532,936
Davie	3,747	$287,424,220
Duplin	7,474	$1,575,614,975
Durham	13,678	$2,743,854,083
Edgecombe	2,669	$197,745,090
Forsyth	8,134	$796,844,656
Franklin	7,602	$653,381,418
Gaston	7,108	$1,370,866,343
Gates	759	$78,754,425
Graham	731	$69,336,152
Granville	5,004	$705,624,430
Greene	992	$269,484,085
Guilford	13,957	$1,087,909,540
Halifax	1,364	$87,022,554
Harnett	24,109	$3,410,349,420
Haywood	594	$73,827,854
Henderson	6,116	$885,207,540
Hertford	1,990	$364,306,533
Hoke	11,257	$1,399,831,402
Hyde	1,354	$107,471,606
Iredell	9,638	$1,690,274,720
Jackson	2,156	$474,486,647
Johnston	25,681	$2,477,164,788
Jones	1,726	$235,988,297
Lee	6,761	$575,122,451
Lenoir	7,391	$878,102,800
Lincoln	5,549	$1,282,622,057
Macon	3,579	$652,883,289
Madison	1,045	$94,023,260
Martin	2,316	$234,765,295
McDowell	3,659	$409,449,787
Mecklenburg	12,787	$3,869,399,812
Mitchell	729	$80,477,714
Montgomery	3,253	$408,016,986
Moore	25,347	$3,150,938,091
Nash	4,335	$430,454,291
New Hanover	39,752	$10,931,733,206
Northampton	1,140	$76,212,559
Onslow	49,257	$4,308,735,426
Orange	7,715	$1,631,940,477
Pamlico	4,875	$296,238,128
Pasquotank	1,911	$232,529,353
Pender	18,205	$1,518,554,376
Perquimans	763	$100,467,043
Person	1,446	$131,419,516
Pitt	9,822	$1,474,684,279

County Name	Number of Buildings in High WUI Zones (7-9)	Value of Buildings in High WUI Zones (7-9)
Polk	797	$91,978,016
Randolph	7,698	$1,170,648,316
Richmond	9,404	$747,923,034
Robeson	15,284	$2,986,221,816
Rockingham	6,539	$419,445,863
Rowan	6,469	$570,503,879
Rutherford	2,354	$157,765,893
Sampson	7,138	$1,515,759,516
Scotland	5,750	$583,260,682
Stanly	2,795	$232,029,786
Stokes	2,088	$342,538,888
Surry	2,252	$197,401,094
Swain	883	$198,879,412
Transylvania	1,981	$275,774,077
Tyrrell	504	$40,521,492
Union	4,324	$705,891,245
Vance	4,183	$729,801,166
Wake	73,462	$16,885,949,202
Warren	2,152	$127,340,743
Washington	1,897	$106,034,879
Watauga	1,566	$500,712,545
Wayne	17,887	$1,442,317,609
Wilkes	4,250	$319,589,481
Wilson	2,404	$524,449,701
Yadkin	789	$59,713,189
Yancey	727	$63,600,478
North Carolina	**789,529**	**$129,419,613,531**

Source: NC Forest Service and NCEM

Figure 3-73 Wildland Urban Interface Risk Index



Wildfire Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	There are a number of potential losses from a wildland fire in North Carolina including loss of life and injury due to severe burns. Health hazards from smoke caused by wildland fires can include breathing difficulties and worsening of chronic breathing and/or cardiovascular disease. Smoke and air pollution pose a risk for children, the elderly, and those with respiratory and cardiovascular problems. Wildfire tends to create some issues with public confidence because of the very visible impacts that the fire has on the community.
Responders	High	Responders are often at great risk when responding to wildfire, especially firefighters who are responsible for putting out the blaze. All response personnel are potentially at risk when dealing with a wildfire, as changing winds and a number of other factors can often cause a fire to spread rapidly. Although many areas of the state are urbanized and are not at a high risk to wildfire, moderately-developed rural areas that are located in the wildland urban interface may require response personnel to be ready to act. Like the general public, first responders are also at risk for exposure to dangers from the initial incident and after-effects such as smoke inhalation and/or heat stroke. However, their risk is often more prominent as they are often in the middle of an incident through their responsibilities as a responder.
Operations/Continuity of Operations	Moderate	Since wildfire often moves quickly and can affect infrastructure that is important to maintaining continuity of operations, there is some level of concern for maintaining continuity. However, operations at the state level, which are generally run from urbanized areas, will probably not be impacted in a major way. Local continuity of operations in rural areas is much more susceptible to the impacts of a wildfire.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Wildland fires have the potential to substantially burn forested areas as well as private residences. Damage and destruction to state, county, private, and municipal structures and facilities are major losses that are attributed to wildland fires. Private residences and communities that are located within the Wildland Urban Interface (WUI) are particularly susceptible to the threat. Population increases in North Carolina's WUI areas, for example, can create significant challenges for firefighters and residents. This is especially notable considering a study in 2000 showed that North Carolina ranked number one in terms of the amount of land area located within the WUI zones and fifth in number of homes located within the WUI.71 Many new homes are constructed without considering community wildland fire planning. This creates neighborhoods with limited accessibility, flammable building construction, and landscaping. A lack of firewise planning can also greatly increase the probability of a wildland fire occurrence with more homes and emergency personnel being threatened.

[71] *North Carolina Firewise (2000). North Carolina Firewise. Retrieved August 21, 2017, from http://www.ncfirewise.org/index.htm*

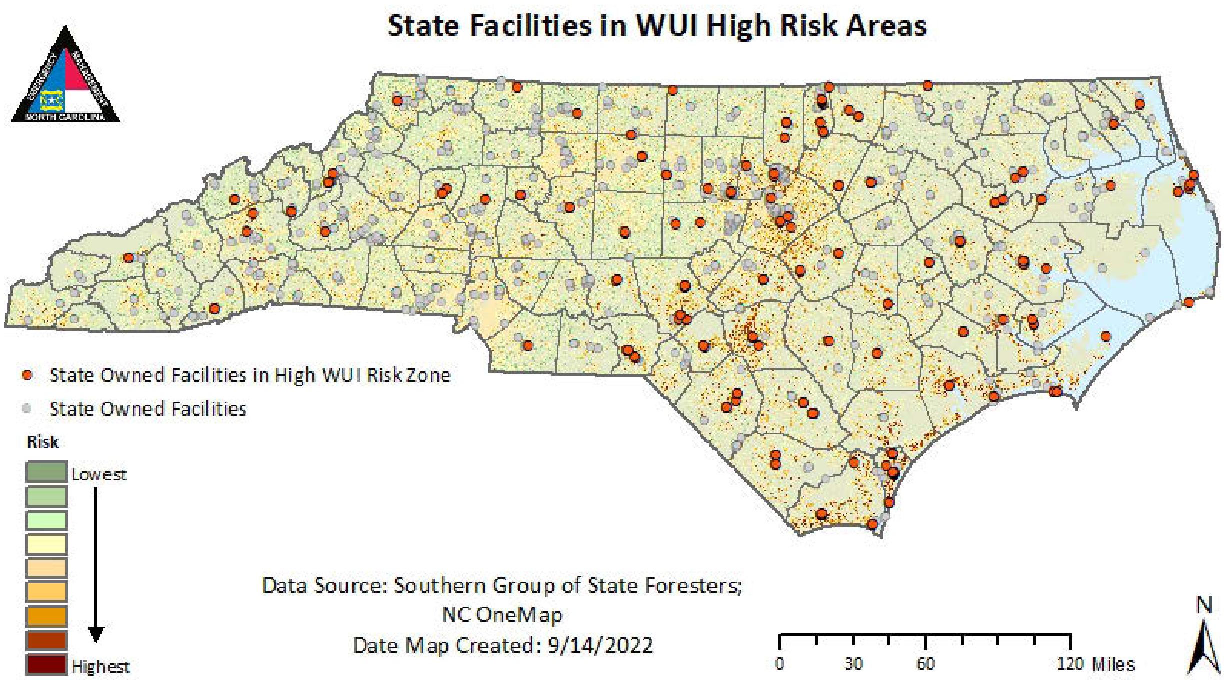
Category	Impact Rating	Description of Impacts
		All types of private property may suffer losses from wildfires. This includes business properties, homes, vehicles, and livestock. Damage to capital goods and equipment as well as evacuation expenses and other losses are directly related to fire and smoke damage. Additional potential losses include building and landscape maintenance expenses, firefighting equipment purchases, and fire-related business closures. Additional post-fire losses include cleanup, rehabilitation and repair expenses, equipment and capital goods replacement, drinking water pollution, smoke damage, deflated real estate values, and an increase in fire insurance premiums.
Economy	Moderate	Given the fact that a number of homes, businesses, and infrastructure are located in areas that could be impacted by wildfire, there could be some significant economic impacts of a wildfire in the state. If homes or businesses are burned, the cost of rebuilding could be substantial. Impacts to agricultural crops are another economic loss that the state could face in the event of a wildland fire. Wildfires can be particularly damaging to the lumber and Christmas tree farming industries which are important to the state.
Environment	Moderate	Wildland fires have the potential to damage or destroy forage on grazing lands, secondary forest products destruction, and/or degradation and loss of wildlife habitat on public lands. On private lands, vegetation losses could include agricultural crops that are either burned or impacted by wildland fire smoke. Indirect losses could include loss of growing stock as well as irrigation systems. Another potential loss includes damage and destruction to a wide variety of common or protected habitats in the state. Finally, the release of smoke from wildfires can pollute the air and reduce air quality. It should also be noted, however, that wildfires are a naturally occurring element of the environment and have played an important part in the development of many ecosystems in that they are regenerative and provide vital nutrients for the soil which can help sustain a forest habitat and all of the organisms living within it. Therefore, although there are some negative impacts of wildfire, there are also some positive impacts on the environment. Additional environmental impacts of wildfires include, but are not limited to, the following: • Although fire can be very beneficial (or required) for some ecosystems, wildfire during drought can be more far more destructive than prescribed fire (for example peat fires in the Coastal Plain). • Drought prevents land managers from implementing prescribed burning, thus increasing risk of destructive wildfire, and reducing the quality of firemaintained natural communities. • Some systems such as Spruce-Fir are not tolerant of fire and will not regenerate to high quality natural communities when burned in wildfire.

Category	Impact Rating	Description of Impacts
		• Human intervention used to fight wildfire can be destructive to vulnerable natural communities and rare species populations (for example, plow lines through rare species populations).

Wildfire Hazard Vulnerability for State-Owned Facilities

There are 566 State-owned facilities with a value of $1,133,718,049 located in high risk WUI areas (WUI categories 7, 8, 9). Figure 3-74 provides a graphical representation of where those facilities are located.

Figure 3-74 State Facilities in Wildland Urban Interface Risk Areas

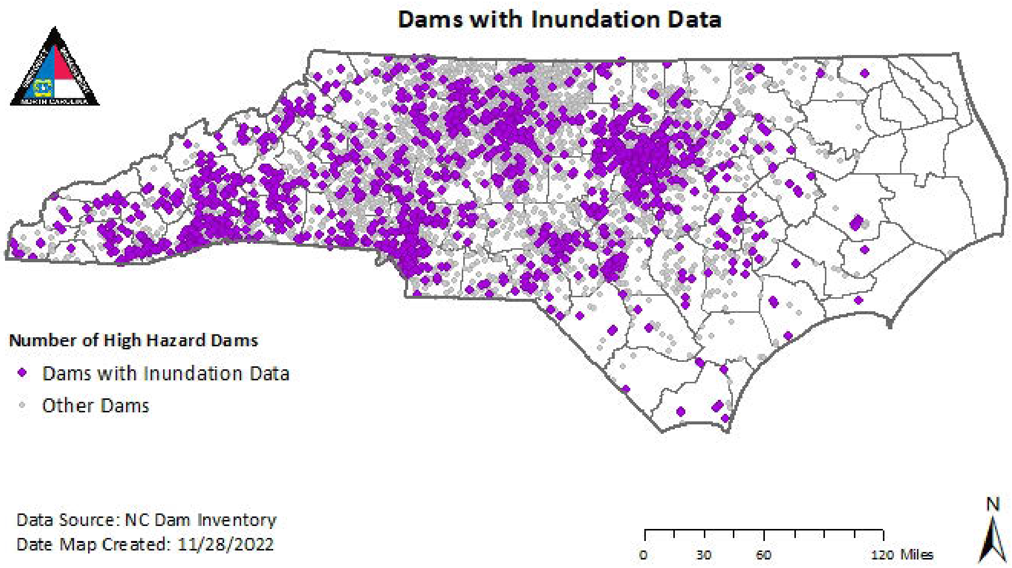


3.5.5.9 Dam Failure Hazard Vulnerability

Inventories of statewide dam inundation data is an area that NCEM is currently working hard to improve. Since the previous plan update, the State of North Carolina has taken great steps in updating inundation data for dams. At this time, there is geospatial data in final quality control review for 1,568 dams in North Carolina. That information has been added to the State Emergency Response Application (SERA). Additionally, NCEM is currently working with the USACE to acquire inundation data for 9 dams under the Corps' control. The inundation that is available is going to be used to conduct detailed assessments that can better determine statewide vulnerability to dam failures. NCDEQ's Dam Safety Office has completed risk assessments for 75 dams in North Carolina to determine populations at risk (PAR). This information is included in Appendix D. The NC Dam Safety Office is working to conduct additional risk assessments using HHPD funding. It is expected to take another 2 or 3 years to complete the assessments for the remaining high hazard dams. The 2028 update of the

NCEHMP will include a much more robust analysis of statewide dam failure vulnerability at the County level and for State-owned facilities.

Figure 3-75: Availability of Dam Inundation Data in in North Carolina



Dam Failure Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Many of the impacts associated with a dam/levee failure are the same as those that would be associated with a flood event. However, the primary difference for members of the public in the case of a dam/levee failure is that often citizens who might be impacted by a dam/levee failure may believe themselves to be protected from flood events as a result of the dam/levee and therefore, may not be anticipating the event. This may have a severe impact on public confidence in the long run as citizens may view this as a failure of government institutions to properly regulate and control the dam/levee. That is to say, they may ultimately view the incident as preventable, unlike a flood that occurs purely from natural causes.
Responders	Moderate	Similar to the issues associated with the flood hazard, responders would be impacted by a dam/levee failure as they may be forced to attempt to assist citizens who have become trapped in their homes or in flood waters. Responders may have difficulty accessing homes or other structures where they need to provide support and their lives and well-being will likely be put at risk if they are forced to assist in a flooded area.
Operations/Continuity of Operations	Low	A dam/levee failure would be unlikely to impact continuity of operations as the event would likely be confined to a specific area directly surrounding the dam/levee and most operations-related facilities in the state are not at risk of being impacted by a dam/levee failure.

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Moderate	A dam/levee failure may impact any properties located downstream of a dam/levee, especially any that are within identified inundation zones. The effects of a dam/levee failure on property, facilities, and infrastructure would be similar to those that have been outlined in the flood analysis although it is possible that the damage may be more severe, as high volumes of water are released all at once rather than over time. For example, during Hurricane Matthew a number of homes were damaged by dam breaks that were caused by massive rainfall in the state. Many of these dam breaks were at private dams and were the result of uncoordinated releases among operators along the river systems. In this scenario, when one dam failed, it caused a rush of water that impacted the downstream dams and resulted in similar failures and flooding of buildings.
Economy	Moderate	The economic costs of a dam/levee failure could be significant as there will likely be a high economic cost for the owner of the structure (whether it be a privately or publicly-owned) to rebuild or reconstruct the dam/levee. If a dam/levee fails, the owner may also need to rebuild the new structure to a higher standard to prevent future failures. If the dam was involved in electricity production as is the case for many dams in the state (Lake Jocassee Dam, Fontana Dam, High Rock Lake Dam), the failure will result in a loss of revenue for the owner, which could impact local utilities and may also result in temporary power outages (although most communities do not rely solely on hydroelectric power, so this is less likely). Many of these dams/levees are also used to create recreational lakes (Kerr Lake, Lake Gaston, Lake Norman) and when this type of dam fails, that recreational resource will be lost, which in turn may reduce tourism and visitors to the area and reduce property values in and around the lake.
Environment	Moderate to High	The impacts on the environment from a dam/levee failure might be that ecosystems and habitats that existed while a dam was in place on a stream/river could be destroyed as floodwaters destabilize areas by inundating places that had not previously been under water or causing higher flow rates downstream. Similar to flood events, if a facility that houses hazardous materials is impacted by flooding from a dam/levee failure, there may be contamination of the stream/river and ultimately the water supply. Although the dam failure itself would likely disrupt habitats in the short term, in some sense, a dam failure may restore the environment to a more natural state by allowing the river to return to its natural course and flow. That is to say, the absence of a dam/levee may be a long-term boon to the local environment. Dam failures can result in movement of large quantities of sediment, once held behind the dam, downstream through the natural stream channel causing significant degradation of instream habitat and impacts to aquatic species populations though impaired spawning substrates and foraging. Head cuts can form at the upstream reaches of former impoundments causing instream habitat degradation along an upstream gradient.

Dam Failure Hazard Vulnerability for State-Owned Facilities

As of the 2023 update, analysis of State-owned facilities at risk to dam failure has not been conducted. However, this analysis will be updated for the 2028 plan update by using GIS to overlay the large amount of new inundation data that has been developed (and continues to be developed) with state-owned facilities, other local critical infrastructure, facilities and community lifelines data, as available, to determine which facilities may be vulnerable.

3.5.5.10 Drought Hazard Vulnerability

Table 3-46 provides a summary of the expected annualized losses for the drought hazard by county based on NCEI data.

Table 3-46 Annualized Losses for Drought

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Alamance	$0.00	$0.00
Alexander	$0.00	$0.00
Alleghany	$12,271,076.00	$584,336.95
Anson	$0.00	$0.00
Ashe	$12,293,923.00	$585,424.90
Avery	$0.00	$0.00
Beaufort	$0.00	$0.00
Bertie	$0.00	$0.00
Bladen	$0.00	$0.00
Brunswick	$0.00	$0.00
Buncombe	$0.00	$0.00
Burke	$0.00	$0.00
Cabarrus	$0.00	$0.00
Caldwell	$0.00	$0.00
Camden	$0.00	$0.00
Carteret	$0.00	$0.00
Caswell	$15,995,005.00	$761,666.90
Catawba	$0.00	$0.00
Chatham	$0.00	$0.00
Cherokee	$0.00	$0.00
Chowan	$0.00	$0.00
Clay	$0.00	$0.00
Cleveland	$0.00	$0.00
Columbus	$0.00	$0.00
Craven	$0.00	$0.00
Cumberland	$0.00	$0.00
Currituck	$0.00	$0.00
Dare	$0.00	$0.00
Davidson	$0.00	$0.00
Davie	$0.00	$0.00
Duplin	$0.00	$0.00
Durham	$0.00	$0.00
Edgecombe	$0.00	$0.00
Forsyth	$0.00	$0.00
Franklin	$0.00	$0.00
Gaston	$0.00	$0.00
Gates	$0.00	$0.00
Graham	$0.00	$0.00
Granville	$0.00	$0.00
Greene	$0.00	$0.00
Guilford	$0.00	$0.00
Halifax	$0.00	$0.00
Harnett	$0.00	$0.00

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Haywood	$0.00	$0.00
Henderson	$0.00	$0.00
Hertford	$0.00	$0.00
Hoke	$0.00	$0.00
Hyde	$0.00	$0.00
Iredell	$0.00	$0.00
Jackson	$0.00	$0.00
Johnston	$0.00	$0.00
Jones	$0.00	$0.00
Lee	$0.00	$0.00
Lenoir	$0.00	$0.00
Lincoln	$0.00	$0.00
Macon	$0.00	$0.00
Madison	$0.00	$0.00
Martin	$0.00	$0.00
McDowell	$0.00	$0.00
Mecklenburg	$0.00	$0.00
Mitchell	$0.00	$0.00
Montgomery	$0.00	$0.00
Moore	$0.00	$0.00
Nash	$0.00	$0.00
New Hanover	$0.00	$0.00
Northampton	$0.00	$0.00
Onslow	$0.00	$0.00
Orange	$0.00	$0.00
Pamlico	$0.00	$0.00
Pasquotank	$0.00	$0.00
Pender	$0.00	$0.00
Perquimans	$0.00	$0.00
Person	$0.00	$0.00
Pitt	$0.00	$0.00
Polk	$0.00	$0.00
Randolph	$0.00	$0.00
Richmond	$0.00	$0.00
Robeson	$0.00	$0.00
Rockingham	$13,157,091.00	$626,528.14
Rowan	$0.00	$0.00
Rutherford	$0.00	$0.00
Sampson	$0.00	$0.00
Scotland	$0.00	$0.00
Stanly	$0.00	$0.00
Stokes	$12,395,810.00	$590,276.67
Surry	$12,388,243.00	$589,916.33
Swain	$0.00	$0.00
Transylvania	$0.00	$0.00
Tyrrell	$0.00	$0.00
Union	$0.00	$0.00
Vance	$0.00	$0.00
Wake	$0.00	$0.00
Warren	$0.00	$0.00
Washington	$0.00	$0.00
Watauga	$12,713,868.00	$605,422.29
Wayne	$0.00	$0.00
Wilkes	$10,021,767.00	$477,227.00
Wilson	$0.00	$0.00
Yadkin	$10,001,391.00	$476,256.71
Yancey	$0.00	$0.00
North Carolina	**$111,238,174.00**	**$5,297,055.90**

Source: NCEI

Drought Hazard Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Drought can have a detrimental effect on the livelihood of farmers and agricultural producers in North Carolina. Efforts to mitigate against drought, such as using irrigation equipment, have a high initial cost, including the need for an increase in management requirements, cost of operation and maintenance, and the lack of good quality water resources—which during times of drought would be severely affected. Although the general public may be subject to water restrictions during extreme drought events, it is unlikely that public confidence in the state's governance would be impacted severely as a result of a drought.
Responders	Low	Although drought would have many of the same impacts on responders as it would on the public, the overall effects would be relatively limited when compared to the impacts other hazards could potentially have on responders. Since a drought is typically a slowly developing event, the risk and exposure that responders would face is minimal.
Operations/Continuity of Operations	Low	Drought would have minimal impacts on continuity of operations due to the relatively long warning time that would allow for plans to be made to maintain continuity of operations. Normal operations would very likely be able to continue throughout the event and there would likely be little change to the program's management overall.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Water Use Drought has the potential to affect North Carolina's water supply for residential, commercial, institutional, industrial, and government-owned areas. Drought can reduce water supply in wells and reservoirs. When drought conditions persist with no relief, local or state governments often institute water restrictions which may have an impact on personal property to some degree, though generally these restrictions are meant to protect life safety by ensuring adequate supplies of drinking water for consumption and other critical purposes. Irrigation Drought would affect irrigation and outdoor landscaping efforts around residential, commercial, institutional, industrial, and government-owned land. Water conservation strategies can limit the amount of water used to maintain the aesthetic environment around buildings, businesses, and areas such as golf courses. This would include automatic and non-automatic spray irrigation systems, hose-end sprinklers, handheld hoses, bucket watering, drip irrigation, athletic field irrigation, swimming pools, car washing, pressure washing, and reuse water.
Economy	High	Drought can have a detrimental effect on agricultural and agribusiness industry sectors which account for one-sixth of North Carolina's income and employees.72 Extreme drought also has the potential to depress local businesses and industries such as landscaping, recreation and tourism, and public utilities. Nursery and landscape businesses can also face significant losses from a drought.

[72] *Walden, Mike. North Carolina State University College of Agriculture and Life Sciences. (2017). Agriculture and agribusiness: North Carolina's Number One Industry. Retrieved August 21, 2017, from https://cals.ncsu.edu/intranet/news/agriculture-and-agribusiness*

Category	Impact Rating	Description of Impacts
		Losses include reduction of output and sales of crops, reduction in plant sales, and an increase in watering costs. This can lead to the closing of many business locations, laying-off employees, and increases in bankruptcy filing. Agriculture The agriculture sector of North Carolina is particularly susceptible to drought damage. The table below shows there are more than 50,000 farms in North Carolina, with over ¼ of the land area of the state being farmland.73 Agricultural drought has the potential to directly affect much of the land in North Carolina. Agricultural areas at particular risk are cropland and pastures. **Census of Agriculture (2012)** Total Acres in State: 31,115,462 Number of Farms: 50,218 Total Land in Farms, Acres: 8,414,756 Average Farm Size, Acres: 168 Crops Prolonged periods of dry weather are the most difficult and damaging problem faced by crop growers and agricultural suppliers. North Carolina has 4,378,097 acres of harvested cropland, which is 14.1 percent of total land area of state. Short- or long-term moisture deficits—even with the use of irrigation methods—during critical stages of crop development can severely reduce yields, with the amount of yield lost depending on when the drought occurs (see table below for a list of North Carolina crop specific information), the growth stage of the crop, the severity of dry conditions, and the amount of available water that the soil can hold. **Crops / Value of Sales / U.S. Rank[74]** Tobacco / $732,772,000 / 1 Cut Christmas trees and short rotation woody crops / $67,097,000 / 2 Cotton and cottonseed / $403,366,00 / 5 Nursery, greenhouse, floriculture, and sod / $580,230,000 / 7 Vegetables, melons, potatoes, and sweet potatoes / $434,974,000 / 10 Livestock Table 5.1 shows the type of livestock in North Carolina, including the quantity of livestock and the state's rank compared to other states in

Census of Agriculture (2012)	
Total Acres in State	31,115,462
Number of Farms	50,218
Total Land in Farms, Acres	8,414,756
Average Farm Size, Acres	168

Crops	Value of Sales	U.S. Rank[74]
Tobacco	$732,772,000	1
Cut Christmas trees and short rotation woody crops	$67,097,000	2
Cotton and cottonseed	$403,366,00	5
Nursery, greenhouse, floriculture, and sod	$580,230,000	7
Vegetables, melons, potatoes, and sweet potatoes	$434,974,000	10

[73] *North Carolina: Census of agriculture—2012. Retrieved August 21, 2017, from https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/North_Carolina/index.asp*
[74] *Rank in production among all states*

<table>
<tr><th>Category</th><th>Impact Rating</th><th>Description of Impacts</th></tr>
<tr><td></td><td></td><td>the United States. These are at risk for being affected by drought conditions in the state.

Livestock losses from drought will most likely be confined to forage-based production systems. Losses in beef and dairy systems will potentially be of a single-season or multiyear variety. Single-season losses will include lost forage production (on both hay and grazing land), reduced weaning weights, reduced milk production, and increased mortality.

Multiyear losses could include the cost of reestablishing pastures and reduced meat or milk production in subsequent years due to forced sales in the drought year. In addition, drought conditions could result in poor pasture conditions, reduced drinking water supplies, and a critical hay shortage that directly affects livestock and poultry health.

<table>
<tr><th>Livestock</th><th>Number</th><th>U.S. Rank[75]</th></tr>
<tr><td>Turkeys</td><td>17,1919,277</td><td>2</td></tr>
<tr><td>Hogs and pigs</td><td>8,901,434</td><td>2</td></tr>
<tr><td>Broilers and other meat-type chickens</td><td>148,251,469</td><td>4</td></tr>
<tr><td>Layers</td><td>13,091,384</td><td>8</td></tr>
<tr><td>Pullets for laying flock replacement</td><td>6,239,251</td><td>8</td></tr>
</table>
</td></tr>
<tr><td>Environment</td><td>High</td><td>Drought may also lead to pollution of water sources as a result of lack of rainwater to dilute industrial and agricultural chemical runoff. This poses a risk to plants and animals and makes it difficult to maintain a clean drinking water supply. Lack of water reaching the soil may also cause the ground to become dry and unstable. Erosion can increase and loss of topsoil can be severe if a high-intensity rain falls on ground lacking a ground cover of plants. As a result of these environmental impacts, habitats may be degraded through a loss of wetlands, lake capacity, and vegetation.

Additional environmental impacts of droughts include, but are not limited to, the following:

• Increased risk of severe wildfire during drought which can be devastating even in fire adapted landscapes.
• Drought reduces opportunity for implementing prescribed fire which would otherwise reduce fuel loads and increase natural community viability
• Drought results in reduced in-stream flows and impacts to aquatic species, complete drying of some stream and even river reaches can result in localized extirpation – especially of short-lived species. Increases in water withdrawal from streams and rivers for human use, including irrigation during droughts increases the vulnerability of aquatic species.</td></tr>
</table>

[75] *Rank in production among all states*

Category	Impact Rating	Description of Impacts
		• Isolated wetlands take longer to recover from year after year droughts, which can cause significant impacts to amphibian populations when the wetlands are not filled with water necessary for breeding. The severity of impacts is greater because so many wetlands have already been altered for human use and the amphibians' populations are already reduced. • Lack of water significantly stresses plants and animals through dessication. • Drought impacts are more severe when accompanied by heat waves

Drought Hazard Vulnerability for State-Owned Facilities

All state-owned facilities should be considered vulnerable to drought, but drought does not cause significant structural or monetary damage. The most significant damages would be to water supplies so any state-owned facilities that has more dependency on water would be considered more vulnerable; however, at this time, there is no method for determining what those state-owned facilities might be.

3.5.5.11 Tornado/Thunderstorm Hazard Vulnerability

Tornado Vulnerability

Table 3-47 provides a summary of the expected annualized losses to tornadoes by county based on NCEM risk data analysis.

Table 3-47 Annualized Tornado Hazard Losses by County

County	Annualized Losses
Alamance	$ 1,526,398.39
Alexander	$ 234,081.44
Alleghany	$ 245,273.52
Anson	$ 300,275.33
Ashe	$ 649,499.14
Avery	$ 345,134.64
Beaufort	$ 488,760.10
Bertie	$ 188,365.66
Bladen	$ 559,007.20
Brunswick	$ 1,284,176.77
Buncombe	$ 796,429.41
Burke	$ 509,154.85
Cabarrus	$ 3,606,215.43
Caldwell	$ 1,465,994.70
Camden	$ 70,836.13
Carteret	$ 312,434.53
Caswell	$ 413,301.33
Catawba	$ 508,537.15
Chatham	$ 1,763,435.77
Cherokee	$ 1,755,646.83
Chowan	$ 217,690.11
Clay	$ 252,264.26
Cleveland	$ 2,293,834.24
Columbus	$ 703,981.66
Craven	$ 443,300.82
Cumberland	$ 740,509.70
Currituck	$ 177,329.23
Dare	$ 144,271.17
Davidson	$ 691,547.87
Davie	$ 839,925.73
Duplin	$ 1,419,944.84
Durham	No results
Edgecombe	$ 259,607.55
Forsyth	$ 578,327.30
Franklin	$ 382,957.27

County	Annualized Losses
Gaston	$ 344,320.30
Gates	$ 179,796.42
Graham	$ 595,608.32
Granville	$ 351,346.14
Greene	$ 156,256.78
Guilford	$ 960,238.92
Halifax	$ 1,353,010.07
Harnett	$ 659,461.81
Haywood	$ 1,693,481.79
Henderson	$ 2,286,765.74
Hertford	$ 322,033.62
Hoke	$ 220,290.25
Hyde	$ 31,969.82
Iredell	$ 713,927.01
Jackson	$ 1,022,316.14
Johnston	$ 2,132,896.82
Jones	$ 124,223.22
Lee	$ 400,360.58
Lenoir	$ 329,120.11
Lincoln	$ 430,001.28
Macon	$ 1,713,629.36
Madison	$ 582,168.19
Martin	$ 556,018.27
McDowell	$ 365,848.63
Mecklenburg	$ 13,611,075.94
Mitchell	$ 367,382.64
Montgomery	$ 371,863.38
Moore	$ 980,996.59
Nash	$ 460,175.46
New Hanover	No results
Northampton	$ 366,777.74
Onslow	$ 488,536.63
Orange	$ 2,012,151.22
Pamlico	$ 162,049.43
Pasquotank	$ 148,158.75
Pender	$ 416,457.44
Perquimans	$ 195,775.72
Person	$ 659,560.18
Pitt	$ 514,399.60
Polk	$ 675,018.90
Randolph	$ 584,500.80

County	Annualized Losses
Richmond	$ 279,723.21
Robeson	$ 2,586,565.19
Rockingham	$ 1,401,713.34
Rowan	$ 2,833,174.08
Rutherford	$ 2,006,982.85
Sampson	$ 1,808,690.71
Scotland	$ 247,605.43
Stanly	$ 1,233,213.18
Stokes	$ 268,306.63
Surry	$ 236,649.67
Swain	$ 262,544.16
Transylvania	No results
Tyrrell	$ 47,186.50
Union	$ 988,998.82
Vance	$ 178,736.29
Wake	$ 1,647,745.36
Warren	$ 274,551.90
Washington	$ 72,987.99
Watauga	$ 474,907.42
Wayne	$ 2,459,157.14
Wilkes	$ 438,655.21
Wilson	$ 69,538.97
Yadkin	$ 215,333.21
Yancey	$ 441,323.04
North Carolina	$ 86,182,710.38

Source: USGS and NCEM

Thunderstorm Vulnerability

Table 3-48 provides a summary of the expected annualized losses to thunderstorms by county based on NCEI data.

Table 3-48 Annualized Losses for Thunderstorms

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Alamance	$1,270,796.00	$60,514.10
Alexander	$1,338,000.00	$63,714.29
Alleghany	$145,274.00	$6,917.81
Anson	$228,566.00	$10,884.10
Ashe	$267,872.00	$12,755.81
Avery	$22,759.00	$1,083.76
Beaufort	$357,617.00	$17,029.38
Bertie	$428,462.00	$20,402.95
Bladen	$2,684,680.00	$127,841.90
Brunswick	$809,879.00	$38,565.67
Buncombe	$553,040.00	$26,335.24
Burke	$675,404.00	$32,162.10
Cabarrus	$792,885.00	$37,756.43
Caldwell	$505,293.00	$24,061.57
Camden	$75,958.00	$3,617.05
Carteret	$2,141,410.00	$101,971.90
Caswell	$1,664,330.00	$79,253.81
Catawba	$2,967,167.00	$141,293.67
Chatham	$680,888.00	$32,423.24
Cherokee	$1,131,580.00	$53,884.76
Chowan	$755,931.00	$35,996.71
Clay	$605,292.00	$28,823.43
Cleveland	$924,063.00	$44,003.00
Columbus	$9,609,388.00	$457,589.90
Craven	$367,027.00	$17,477.48
Cumberland	$1,749,515.00	$83,310.24
Currituck	$117,530.00	$5,596.67
Dare	$1,008,964.00	$48,045.90
Davidson	$1,960,533.00	$93,358.71
Davie	$207,019.00	$9,858.05
Duplin	$1,449,497.00	$69,023.67
Durham	$1,103,896.00	$52,566.48
Edgecombe	$1,494,863.00	$71,183.95
Forsyth	$994,835.00	$47,373.10
Franklin	$6,408,388.00	$305,161.33
Gaston	$773,856.00	$36,850.29
Gates	$108,792.00	$5,180.57
Graham	$55,752.00	$2,654.86
Granville	$306,017.00	$14,572.24
Greene	$382,703.00	$18,223.95
Guilford	$1,205,135.00	$57,387.38
Halifax	$712,246.00	$33,916.48
Harnett	$1,327,558.00	$63,217.05
Haywood	$205,551.00	$9,788.14
Henderson	$234,456.00	$11,164.57

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Hertford	$214,938.00	$10,235.14
Hoke	$504,494.00	$24,023.52
Hyde	$95,459.00	$4,545.67
Iredell	$1,073,976.00	$51,141.71
Jackson	$662,214.00	$31,534.00
Johnston	$1,180,931.00	$56,234.81
Jones	$145,531.00	$6,930.05
Lee	$425,038.00	$20,239.90
Lenoir	$905,826.00	$43,134.57
Lincoln	$551,959.00	$26,283.76
Macon	$539,158.00	$25,674.19
Madison	$52,800.00	$2,514.29
Martin	$521,848.00	$24,849.90
McDowell	$795,800.00	$37,895.24
Mecklenburg	$1,950,903.00	$92,900.14
Mitchell	$2,682.00	$127.71
Montgomery	$2,475,520.00	$117,881.90
Moore	$1,494,262.00	$71,155.33
Nash	$832,087.00	$39,623.19
New Hanover	$2,430,684.00	$115,746.86
Northampton	$614,478.00	$29,260.86
Onslow	$398,613.00	$18,981.57
Orange	$339,536.00	$16,168.38
Pamlico	$95,863.00	$4,564.90
Pasquotank	$790,776.00	$37,656.00
Pender	$3,584,115.00	$170,672.14
Perquimans	$171,881.00	$8,184.81
Person	$316,636.00	$15,077.90
Pitt	$1,106,637.00	$52,697.00
Polk	$40,168.00	$1,912.76
Randolph	$785,578.00	$37,408.48
Richmond	$688,071.00	$32,765.29
Robeson	$5,483,568.00	$261,122.29
Rockingham	$3,576,485.00	$170,308.81
Rowan	$2,075,756.00	$98,845.52
Rutherford	$1,577,437.00	$75,116.05
Sampson	$4,274,034.00	$203,525.43
Scotland	$851,930.00	$40,568.10
Stanly	$2,848,029.00	$135,620.43
Stokes	$1,178,810.00	$56,133.81
Surry	$2,879,310.00	$137,110.00
Swain	$69,630.00	$3,315.71
Transylvania	$121,119.00	$5,767.57
Tyrrell	$108,953.00	$5,188.24
Union	$1,813,030.00	$86,334.76
Vance	$255,699.00	$12,176.14
Wake	$3,813,352.00	$181,588.19
Warren	$399,560.00	$19,026.67
Washington	$125,764.00	$5,988.76
Watauga	$246,555.00	$11,740.71
Wayne	$5,187,599.00	$247,028.52
Wilkes	$1,418,572.00	$67,551.05

County	Total Damages for All Recorded Events (2017 Dollars)	Annualized Losses
Wilson	$265,439.00	$12,639.95
Yadkin	$1,709,075.00	$81,384.52
Yancey	$96,993.00	$4,618.71
North Carolina	$118,975,828.00	$5,665,515.62

Source: NCEI

Tornado/Thunderstorm Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The entire State of North Carolina's population is vulnerable to the impacts of a tornado regardless of the measured magnitude. Because it cannot be predicted where a tornado will touch down, it cannot be said which areas of the population within the state are most vulnerable. However, injuries and deaths resulting from tornadoes are the most significant impacts and are most likely to occur to those living in mobile homes or older homes that have not been built to current design standards. Tornadoes often have a high likelihood of affecting public confidence due to their destructive and highly visible impacts. Thunderstorms are generally associated with several other hazards such as high wind and flooding, the latter of which is caused by torrential rain. As such, the public could be impacted in a number of ways by a thunderstorm event. High wind can cause trees to fall and potentially result in injuries or death and rising floodwaters can lead to drowning or other serious injury. Although often not as severe as tornadoes, the impacts on the public from thunderstorms can be significant, especially in the long run. However, the public confidence is usually not affected to a large degree as a result of thunderstorms.
Responders	High	Responders could be critically affected by tornado events as the onset is often very rapid and unpredictable, thereby putting response personnel potentially in harm's way. Many responders may be out in the open while on duty when a tornado forms and they may be caught in a dangerous position as a result. Due to the unpredictability of such events, response may also be hindered post-event as responders may be unable to access those that have been affected if storm conditions persist and they are unable to safely enter affected areas. Responders are not generally affected to any great degree by thunderstorm events, although it should be noted that they could be impacted in many of the same ways as the public. Otherwise, responders could be affected by road blockages caused by downed trees or floodwaters, which would ultimately reduce their response time.
Operations/Continuity of Operations	Moderate	Continuity of operations could be greatly impacted by a tornado as personnel may be harmed and critical resources damaged or destroyed during a tornado. In many ways, since the impacts of a tornado are unpredictable, it is also difficult to predict and plan for the appropriate ways to ensure continuity of operations. Although North Carolina is prepared for such an event, disruption of operations will likely take place to some degree if the event is large

Category	Impact Rating	Description of Impacts
		enough and spurs multiple tornadoes across the state, as has happened frequently in the past. In general, continuity of operations during a thunderstorm event can be maintained as these events are common in all parts of the state. Thunderstorm events often affect power in much the same way as tornadoes and hurricanes, which ultimately may impact operations. However, thunderstorm events are typically not large enough to severely affect normal operations and their impacts are not wide enough to disrupt continuity of operations at the state level.
Built Environment (Property, Facilities, Infrastructure)	High	*Building Inventory* According to the National Climatic Data Center, North Carolina has been impacted by tornadoes ranging in intensity from F0/EF0 to F4/EF4 based on the Fujita scale. An F5/EF5 has never been experienced, but it is certainly possible. Because it cannot be predicted where a tornado may touch down, all buildings, facilities, and infrastructure within the state are considered exposed to the hazard and at risk for being impacted. Older buildings that are constructed with less-advanced building techniques are at higher risk as are mobile homes. Building materials play a role in how well a structure can withstand tornado force winds. Buildings that use structural steel, reinforced concrete, or load-bearing masonry have the best change of withstanding a tornado event in the state. Homes constructed of wood or manufactured material are most at risk. Non-engineered structures in the state are far more vulnerable than engineered buildings to damage from tornado winds. It is also notable that materials that are well-tied to all other building components are also more likely to survive extreme wind events.[76]The magnitude of the tornado will determine the extent of damage and impacts that are felt throughout the county. These impacts can include structural failure, debris damage, and loss of facility functionality. *Critical Infrastructure* The state's infrastructure system is also vulnerable to the impacts of a tornado. This includes critical infrastructure such as roads, railroads, bridges, utilities (power and gas), and pipelines. Any number of these infrastructure systems could be damaged in the event of a tornado, although often power lines are the most common assets that are affected during a tornado. Impacts could include structural damage, impassable or blocked roadways, failed utility lines, railway failure, and impassable bridges. Thunderstorms often have their greatest impact on the built environment as they can cause damage to homes via strong winds or flooding and will often impact facilities and infrastructure in the same way. Power losses often occur due to damage to power lines

[76] *Federal Emergency Management Agency. Tornado Protection: Selecting Refuge Areas in Buildings. FEMA P-431, Second Edition, October 2009. Retrieved August 21, 2017 from: https://www.fema.gov/media-library-data/20130726-1456-20490-4099/fema_p_431.pdf*

Category	Impact Rating	Description of Impacts
		and roads can flood and cause damage as well. In fact, thunderstorms are often considered one of the greater hazards of concern for local communities, even though any given event will cause relatively little damage, because damaging events occur so frequently.
Economy	High	A tornado can impact any area of North Carolina at any time and bring with it significant property damage costs to individual citizens and the disrupt the regular functioning of the local economy. After past events, there has been a substantial halt to many economic activities and losses to businesses have often been high. The loss of power can also interrupt local economies and have a strong negative impact on daily functioning of business activities. Similarly, economic impacts from thunderstorm events can often be far reaching as the damage from these events are often widespread, affecting both homes and businesses. This damage can result in business and economic disruption through the recovery process.
Environment	Low	Downed trees and other forms of vegetation are often one of the most visible impacts to the environment from a tornado. Additionally, building material or other debris can be carried or thrown great distances by the force of wind and end up spread out in unexpected places such as natural areas. Coordinated statewide cleanup efforts after a tornado can include removal of debris, but much debris ends up remaining in local habitats. Finally, if hazardous materials facilities are impacted by the tornado, these may release dangerous chemicals into the environment that can cause long-term harm. Thunderstorms can impact crops via high wind and flooding and can also impact the natural environment through these elements. Flooding can kill plants and animals as well as contaminate drinking water supplies for human populations. High wind can harm forests by bringing down trees and cause fires from downed power lines that impact the environment.

Tornado/Thunderstorm Hazard Vulnerability for State-Owned Facilities

Tornado Vulnerability for State-Owned Facilities

Based on the atmospheric nature of tornadoes and previous occurrences having been reported in all regions of the state, all state-owned facilities should be considered vulnerable to tornadoes.

Thunderstorm Vulnerability for State-Owned Facilities

Based on the atmospheric nature of thunderstorms and previous occurrences having been reported in all regions of the state, all state-owned facilities should be considered vulnerable to thunderstorms.

3.5.5.12 Geological Hazard Vulnerability

Landslide Vulnerability

To evaluate County-level vulnerability to the landslide hazard, a GIS analysis was run to identify buildings that intersect with USGS “Very High” and “High” landslide risk zones. Table 3-49 provides a summary of the findings from that analysis.

Table 3-49 Building Exposure to Landslide Hazard Areas

County Name	Number of Buildings in Very High Risk Zone	Value of Buildings in Very High Risk Zone	Number of Buildings in High Risk Zone	Value of Buildings in High Risk Zone
Alexander	3	$4,484,894	0	0
Alleghany	25	$4,191,545	23	$2,728,838
Anson	0	0	77	$39,815,520
Ashe	0	0	64	$20,215,409
Avery	8	$92,483,269	0	0
Buncombe	39	$13,497,117	5	$110,266
Cabarrus	19	$6,523,031	0	0
Caldwell	15	$1,976,681	0	0
Caswell	0	0	14	$1,639,192
Catawba	17	$9,422,773	0	0
Chatham	103	$22,135,858	23	$8,361,935
Cherokee	0	0	17	$3,236,964
Clay	0	0	6	385593
Durham	35	$7,254,084	1	$47,335
Gaston	14	$4,858,989	0	
Graham	0	0	8	$811,461
Guilford	0	0	11	$2,848,329
Haywood	0	0	23	$4,058,503
Henderson	5	$1,525,168	0	0
Jackson	2	$169,709	30	$4,927,778
Lee	0	0	1	$840,118
Macon	3	$593,067	18	$1,965,963
Madison	0	0	18	$3,345,449
McDowell	3	$1,493,765	0	0
Mecklenburg	84	$613,584,440	0	0
Montgomery	1	$2,879,262	0	0
Orange	209	$3,297,947,247	1	$0

County Name	Number of Buildings in Very High Risk Zone	Value of Buildings in Very High Risk Zone	Number of Buildings in High Risk Zone	Value of Buildings in High Risk Zone
Person	0	0	17	$5,512,389
Polk	13	$2,370,197	0	0
Rockingham	1	$50,760	43	$19,895,260
Stanly	31	$7,454,625	0	0
Surry	41	$11,686,693	0	0
Swain	0	0	8	$1,538,883
Transylvania	15	$6,449,980	0	0
Watauga	71	$597,721,683	14	$873,827
Wilkes	34	$21,142,510	0	0
Yancey	46	$12,358,714	2	$366,575
North Carolina	**837**	**$4,744,256,061.00**	**424**	**$46,984,535.00**

Source: USGS and NCEM

Sinkhole Vulnerability

To evaluate County-level vulnerability to the sinkhole hazard, a GIS analysis was run to identify buildings that are within 50-yards of an existing sinkhole based on data received from North Carolina Geological Survey. Table 3-50 provides a summary of the findings from that analysis.

Table 3-50 Building Exposure to Existing Sinkholes

County Name	Number of Buildings within 50 Yards of Existing Sinkholes	Value of Buildings within 50 Yards of Existing Sinkholes
Brunswick	1693	$274,060,857
Jones	4	$466,228
New Hanover	1223	$617,106,193
Onslow	1311	$50,397,642
Pender	97	$4,325,222
North Carolina	**4328**	**$946,356,142.00**

Source: North Carolina Geological Survey and NCEM

Coastal Erosion Vulnerability

To evaluate County-level vulnerability to the coastal erosion hazard, a GIS analysis was run to identify buildings that are within 50-yards of an eroding shoreline as identified by North Carolina Division of Coastal Management. Table 3-51 provides a summary of the findings from that analysis.

Table 3-51 Building Exposure to Coastal Erosion

County Name	Number of Buildings within 50 yards of eroding shoreline	Value of Buildings within 50 yards of eroding shoreline
Brunswick	101	$16,954,506
Carteret	23	$5,855,243
Currituck	3	$422,148
Dare	279	$44,564,918
New Hanover	39	$30,862,658
Onslow	130	$21,965,739
Pender	52	$4,569,816
North Carolina	**627**	**$125,195,028.00**

Source: North Carolina Division of Coastal Management and NCEM

Geological Hazards Risk and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	Geological hazards such as landslides/rock falls and sinkholes can pose a threat to human life and safety, as these events often occur with very little warning time due to a lack of available data on risk. Landslides/rock falls are especially a risk in the more mountainous western part of the state where several fatalities have been caused by in this region historically. The quick and unexpected slide of rocks, dirt, and other debris is extremely dangerous and can cover and destroy homes, thereby causing injuries and death. Sinkholes are a much larger risk in the eastern part of the state where soils are more conducive to this type of activity. Similar to landslides/rock falls, these events are often unexpected as they can develop from underneath the ground and suddenly cause a collapse of soil at the surface level, causing loss of life or injury. Any event that can cause loss of life could potentially have an impact on public confidence, however, since these events are often geographically confined to a small area and do not have wide-ranging impacts on large segments of the population, public confidence is typically not affected to a great degree.
Responders	Low	In most cases, responders are not directly impacted by geological events to any greater degree than the public. However, it should be noted that responders should generally be wary when responding to a geological event because of the risk of secondary events (additional landslides/rock falls or sinkholes). When the ground has been disrupted by one of these events, it could set the stage for additional events and any disruption to the soil by responders during their response may further exacerbate those conditions. Additionally, responders working on site of a geological event may find that the uneven terrain provides an extra challenge in terms of operating normally and carrying out life-saving tactics.
Operations/Continuity of Operations	Low	Continuity of operations during a geological event is unlikely to be interrupted in any major way. As mentioned previously, geological events tend to be confined to small areas and so it is unlikely that operations centers would be impacted. If they are, it should not prove too much of a challenge to move operations to a backup facility and continue normal operations from there.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Impacts on the built environment are probably the greatest effect of geological events. During both landslide/rock fall and sinkhole events, people's homes and/or businesses may be impacted and most typical insurance policies in the state do not cover these kinds of events so homeowners may suffer total losses to their homes. Even when these events do not cause complete destruction of homes, they can frequently damage foundations of structures and make them unsafe for dwelling. Similarly, landslides/rock falls and sinkholes that occur around major infrastructure such as roadways and other utilities can cause severe damage to key facilities. In western North Carolina, landslides/rock falls have occurred a number of times along major highways such as I-40 and caused local and state officials to have to shut down these roadways until equipment can be brought in to remove the large boulders and return the road to normal conditions.

Category	Impact Rating	Description of Impacts
		Similarly, sinkholes in the eastern part of the state have caused breaks in roadways, making them unsafe for driving. In many locations across the state, sinkholes have shut down primary roadways for weeks while the issues were addressed and roads were rebuilt. At times the cause of these sinkholes is man-made as leaking or faulty water/wastewater infrastructure can create the same conditions that cause sinkholes to form naturally.
Economy	Low	Although geological events could impact local businesses and therefore affect the economy, this would likely have very minor effects overall. The greatest impact to the economy from an economic standpoint would be related to the impacts on infrastructure such as roadways. When these are shut down for long periods of time, local economies can be dramatically affected, especially in more rural areas. If traffic has to be re-routed around these areas due to road closures for weeks or even just days, losses in revenue could be significant and have a negative impact on business owners. Both landslides/rock falls and sinkholes have the capacity to cause this level of shutdown as has been the case during a number of past events in the state.
Environment	Low	In general, the environment would be unaffected by a geological event. Some of the minor impacts that might be expected are damage to trees and habitats from falling rocks/debris or from other types of damage to the soil/ground. In past events, large swaths of mountainside have been torn away creating large dead areas where plant life is ripped away. These impacts would be generally confined to a small area and therefore would not have sweeping implications for the ecosystems overall. It is also possible that debris or structural materials could end up in streams or rivers as a result of the event and cause damage to localized populations in these habitats. Landslides containing sulfidic materials are a threat to some aquatic systems in western North Carolina. This threat can be exacerbated by cut-fill slopes along roads, and un-vegetated slopes.

Geological Hazards Vulnerability for State-Owned Facilities

Landslide Vulnerability for State-Owned Facilities

Table 3-52 provides information about the number and value of state-owned facilities located in the very high and high-risk landslide hazard zones as indicated by USGS. More detailed site assessments would have to be conducted to determine more exact estimates of vulnerability for these facilities.

Table 3-52 State-Owned Facilities in Landslide Hazard Zones

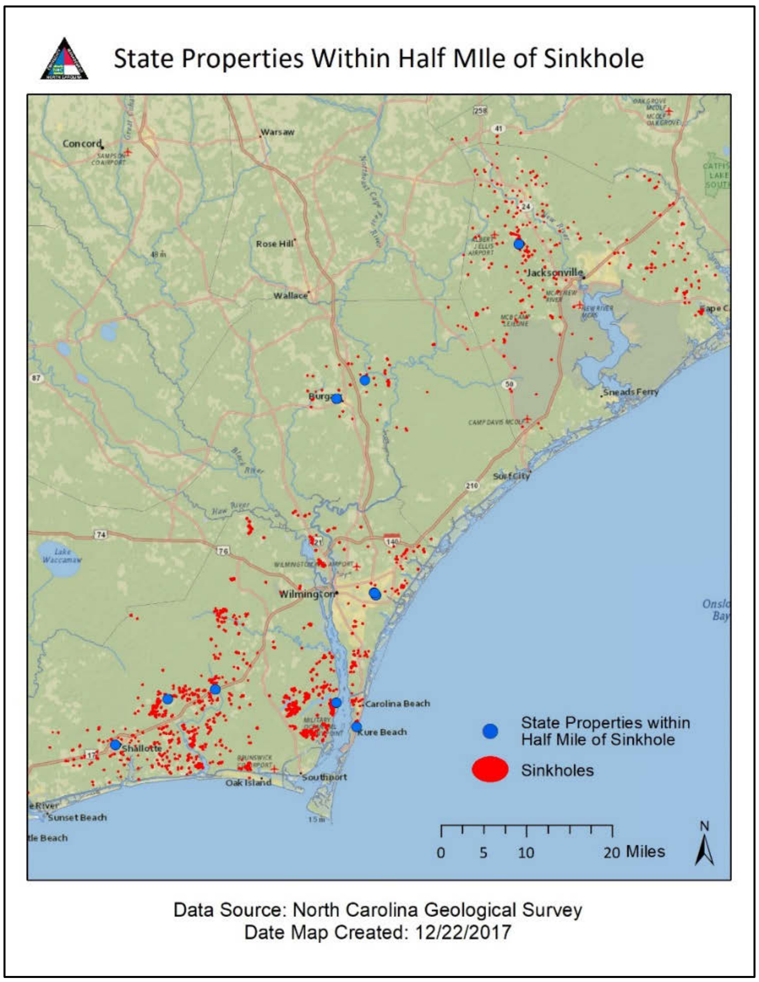
Landslide Hazard Zone	Number of State-Owned Facilities in Zone	Value of State-Owned Facilities in Zone
Very High Risk	843	$4,744,658,492
High Risk	418	$123,139,994

Source: USGS and NCEM

Sinkhole Vulnerability for State-Owned Facilities

There are 67 State-owned facilities with a value of $1,933,889 located within a half mile of an existing sinkhole.

Figure 3-76 Sinkholes and State-Owned Facilities



Coastal Erosion Vulnerability for State-Owned Facilities

GIS analysis indicated just one state-owned facility within 50 yards of an eroding shoreline.

3.5.5.13 Infectious Disease Hazard Vulnerability

Future updates of this plan may attempt to better capture losses experienced as a result of infectious disease as better data becomes available.

Infectious Disease Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The general public can be exposed to infectious diseases through different means based on the particular threat and its potential transmission routes. Vaccinations, when available, are the best means of preventing transmission and infection. Public health information messages will be disseminated via the media in order to provide preventative measures to limit or avoid exposure. According to the North Carolina Public Health Department, in terms of vaccine-preventable diseases, in 2016 there was a slightly higher occurrence rate of Hepatitis A and Mumps in 2016 compared to the five-year average from 2011-2015.[77] There were also increased rates of non-vaccine-preventable diseases like Zika which have become more prominent across the United States in recent years. Public confidence in government organizations may be impacted by public health outbreaks. The level of confidence the public possesses is based upon societal expectations, media influence, and past experience following other outbreaks. An effective response to the outbreak can help to guide public confidence toward a favorable level. Collaboration with media outlets can also assist in keeping the public informed and helping to protect them from exposure.
Responders	Low	During a disease outbreak, responders can expect an increase in workload and should practice a higher level of precaution toward exposure than they would normally. Plans exist for first response and health care to address the needs of such situations. Communication between these agencies regarding plans and procedures maximizes the efficiency and effectiveness of these combined efforts. Responders are much more likely on the whole to be impacted by an infectious disease since they will be working directly with those affected to help treat the disease (especially EMS personnel). This will make them more susceptible to becoming infected and, as such, it is critical that they wear the appropriate personal protective equipment to minimize their risk and ensure they can continue providing the care and assistance that is needed to help the public.
Operations/Continuity of Operations	Low	Continuity of operations may be impacted if those in governmental or other key roles are impacted by the disease or public health threat and cannot perform their normal duties. Although plans are in place to ensure continuity of operations, a large-scale event or one that has significant impacts on operational-level staff could negatively affect continuity of operations. Since many diseases are spread through some form of contact with others who have already been infected, a disease event could rapidly disable many of those who are working together to carry out normal operations. Due to

[77] *North Carolina Department of Public Health (2016). Vaccine-Preventable Diseases Reported in North Carolina, 2016. Retrieved August 21, 2017 from: http://epi.publichealth.nc.gov/cd/figures.html*

Category	Impact Rating	Description of Impacts
		their close proximity to one another and need to communicate and coordinate on a daily basis, it is incredibly important to try to reduce the spread of the disease among key personnel once an outbreak has been identified.
Built Environment (Property, Facilities, Infrastructure)	Low	An infectious disease would likely have little direct impact on the built environment itself as the disease would not affect the structural stability of any buildings or infrastructure. However, an infectious disease would have a major impact on the functioning of many structures that would be operating at a high capacity during an infectious disease event, especially medical care facilities. Hospitals and Medical Care Facilities The primary impacts for hospitals/medical facilities during disease outbreaks are an increase in patients and the spread of disease within hospitals. It is highly likely that those affected by the disease will make their way to a medical care facility and it may be necessary to implement quarantines or other measures to reduce the risk of disease spreading. Hospitals and other medical care facilities should have plans in place to deal with such a scenario and also reduce risk of spreading the disease to medical care providers whose workload may be increased as individuals infected with disease may require treatment.
Economy	Low	One of the more significant economic impacts that could be seen in North Carolina involves absenteeism at local businesses which could have a significant impact as the absence of several employees at a small business could force temporary shutdowns or reduced hours of availability. There would also likely be an impact on the local government budget as officials try to respond to the disease and assist those impacted. City centers and downtown areas tend to be where large masses of people congregate and thus may be where the likelihood of disease spread is more prominent. Many people may realize this and avoid these key economic hubs which would result in reduced revenue and a negative impact on the economy overall. Additionally, large events in communities across the state may have to be cancelled if the outbreak is large enough or has the potential to be spread easily and quickly. This would also reduce revenue for many local economies.
Environment	High	The environmental impact is dependent on the particular biological substance or disease being transmittable to animal or plant life or if it can be distributed through the water supply. If the infectious disease in question can be transmitted to other species, there could be an extremely negative impact on species populations. Since animal life does not have the same capacity has humanity to understand the spread of disease and reduce transmission rates, the disease may spread more quickly through animal populations and cause larger-scale loss of life. Infectious disease in animal and plant populations can reduce populations to very low levels or even result in extirpation. Examples include diseases affecting amphibians, reptiles, mammals, crustaceans, and fishes – Bsal, Chytrid, Ranavirus, Snake Fungal Disease, Chronic Wasting Disease, White-nose

Category	Impact Rating	Description of Impacts
		Syndrome, Rabbit Hemorrhagic Disease, Crayfish Plague, Whirling Disease. Plant populations have been affected by diseases such as American Chestnut Blight, Dutch Elm Disease and exotic insect pests. Potential Mitigation ideas include increase oversite on trade.

Infectious Disease Hazard Vulnerability for State-Owned Facilities

At this time, there is no available method for determining physical dollar losses relevant to state-owned facilities for infectious disease vulnerability. Future updates of this plan may attempt to better capture these losses as better data becomes available.

3.5.6 Vulnerability to Technological Hazards

3.5.6.1 Hazardous Substances Hazard Vulnerability

Hazardous Substances Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	The accidental or intentional release of a hazardous substance could have both immediate and long-lasting effects on the health of the public. Any release needs to be quickly identified and the proper response guidelines followed to reduce the possible impact on the public. Evacuation is always a consideration when dealing with harmful substances. The public should be aware that hazards exist from the presence of hazardous substances and should take preparedness actions at home and in the workplace to act should a release of substances occur. Hazardous substances can have a significant effect on public confidence in government as incidents often cause serious harm to people via long-term health impacts, contamination of soil or drinking water, and even death. Because of the dangers associated with many hazardous substances and the level of control that humans have over hazardous substance incidents compared to natural hazards, public confidence could be damaged severely in the event of an incident.
Responders	Moderate	First responders must be vigilant when hazardous substances are suspected to be involved. The proper protective apparel must be worn and protocols must be followed to ensure that contaminated individuals and objects go through appropriate decontamination procedures prior to being moved away from the incident, regardless of the situation. Contamination of other responders or citizens must be avoided. The appropriate personnel, such as Hazardous Materials teams, must be notified to ensure that the proper measures are taken to prevent further harm.
Operations/Continuity of Operations	Moderate	During a hazardous substance incident, normal operations are likely to be maintained with only moderate stress on daily operations. In the event of a larger scale hazardous substance spill, there could be some loss of continuity of operations as a result of strain on personnel and equipment, but typically this will not be the case.

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Moderate	Hazardous Materials Facilities A hazardous substance event is most likely to take place where the substance is created or stored. Hazardous materials facilities have their own highly-trained personnel for handling and cleaning up the particular substances stored onsite. The facility's plans are highly specific to the substances stored there, thus providing for effective responses to incidents that involve these substances. Some facilities contain hazardous substances that can spread or leak quickly, or are held in extremely dangerous concentrations. There can still be significant effects on workers and others in close proximity despite having good planning in place. These facilities are inventoried in the state through Tier II reporting and there have been some major incidents in the state historically. Utilities Natural gas distribution lines can be problematic with some hazardous substances if contact is made with the natural gas supply. Most of the natural gas infrastructure is located underground, making exposure highly unlikely. However, natural gas itself can be the hazardous substance involved in the incident. One example of how this may occur is if a utility, work crew, or citizen strikes a gas line causing a leak. Degradation of the line may also be the cause of a release. A gas leak would cause an immediate threat and explosions and fires would be significant concerns for the immediate vicinity. Transportation Systems Hazardous substances can have an impact on interstate transportation if a release occurs on or in the vicinity of the roadway which may be the case if a truck or other vehicle carrying hazardous materials is involved in a traffic accident. Significant traffic disruptions may occur, slowing commerce or forcing alternative routing and further congestion of other areas. Similarly, rail lines are one of the more prominent places that hazardous substances are transported. A hazardous substance event on the rail system can impact rail traffic and the overall system. Cleanup efforts wherever the event occurred could be costly and go on for extended periods, shutting down that part of the rail system for that time. Critical Facilities Hospitals utilize and store some hazardous substances on site. Biological materials and radioactive wastes are the primary concerns in a hospital setting. Plans are in place to manage these concerns in both routine and emergency situations. An external hazardous substance event that occurs near the hospital or directly impacts a hospital could create service disruptions such as patient care. A large event may also create a high demand on hospital services and cause an overload on resources. Similarly, some emergency services facilities such as emergency shelters may be opened if homes have been exposed to hazardous substances and evacuations occur. Other Structures

Category	Impact Rating	Description of Impacts
		Commercial, industrial, and residential buildings all may have hazardous substances contained within them that are not reported through the Tier II reporting system but which could still present a smaller scale hazard. Proper containers and labeling can prevent inappropriate use, but accidents can still cause workers to be exposed. Cleaning products, fertilizers, and pesticides are common examples of supplies that are considered hazardous substances and which could cause a smaller incident.
Economy	Moderate	The economic impact of a hazardous substance related incident can be significant locally. Affected commerce is the greatest concern, as spills and releases can force businesses such as shopping centers, markets, and financial centers to be shut down for indeterminate periods of time. Contaminated water can be especially problematic as it can cause extensive shutdowns and put many people in danger. The overall costs depend on the substance(s) involved, how much is released, the processes and time used to manage the spill or release, who or what is contaminated, whether a fire takes place, etc. Cleanup can be a less significant cost and is typically handled by the party responsible for the spill or release. A hazardous substance incident could occur at any large gathering if it was the target of a terrorism event (see Terrorism below). Also, a large event arena could be forced to deal with a hazardous substance incident if it is located in close proximity to them. Arenas and other major event venues may be at significant threat as they are often situated along transportation routes where vehicles transporting such substances could become involved in an accident.
Environment	High	The environmental impact is highly dependent on the location and the severity of the event. Some of the substances involved in these incidents can be cleaned up or do not have lasting impacts on the areas affected. Others may cause crops and other vegetation to be destroyed, sometimes beyond the ability to grow back and animal populations may become displaced or killed. Some areas may be deemed uninhabitable or not fit for development. Water sources may also be impacted by hazardous substance releases or spills, which can affect fish, animal, and plant populations as well as humans that come in contact with contaminated water. The threat to water sources is perhaps the greatest potential threat of a hazardous substance spill on the environment. Water can rapidly transport the substance great distances and expand the scope of the incident. This can make it difficult to respond to the incident and cause serious health impacts.

3.5.6.2 Radiological Emergency – Fixed Nuclear Facility Hazard Vulnerability

Radiological Emergency – Fixed Nuclear Facility Risk, Vulnerability and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	Although many areas of the state are well outside of the defined risk zones for a radiological emergency, there are also a number of areas that are located within the emergency planning risk zones, including several of the major metropolitan areas of the state. Areas located within 10 miles of a nuclear station are considered to be within the zone of highest risk to a nuclear incident and this radius is the designated evacuation radius recommended by the Nuclear Regulatory Commission. Within the 10-mile zone, the primary concern is exposure to and inhalation of radioactive contamination. In the 50-mile zone, the public would be most impacted from ingesting radiological materials through home grown crops, milk produced from livestock which have fed on contaminated grasses, and consuming contaminated surface water. Ingestion of radiological materials may result in internal contamination if ionizing radiation is released in the body. This can cause serious health risks, especially if critical organs are affected. Some organs such as the thyroid take in certain isotopes. It is extremely difficult to purge the material from the body. The public will be extremely concerned about their health and safety during and after a nuclear incident. Confidence will be dependent upon the availability of information and perceived quality of response by government and non-government service providers, but it is likely that confidence in the state's governance will be a significant concern.
Responders	High	First responders are vulnerable to the same impacts as the general public but will also be at greater risk due to their need to function outdoors and operate in contaminated environments. These responders will likely need to operate in personal protective equipment to limit their outdoor exposure. Proper decontamination is likely to be necessary to reduce the spread of contamination. Since responders will be first on the scene and directly dealing with the issues of a radiological incident, their risk will potentially be very high.
Operations/Continuity of Operations	Moderate	In the wake of a nuclear accident, continuity of operations could be impacted. It is very likely that many key employees could be a part of the evacuation if their homes are located within the 10-mile evacuation zone. This could cause many issues with maintaining continuity of operations and, depending on the severity of the event, there may be significant disruption to normal operations. Generally, it is likely that operations would proceed from outside their normal location, as there are plans at all stations for setting up command posts outside of high-risk areas when incidents occur. This will likely impact continuity of operations to some degree, though exercises on radiological incidents are carried out frequently.

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Moderate	It is unlikely that a radiological incident would cause the kind of damage that is typical of many other hazards identified in this plan as there would be minimal destruction of buildings and other infrastructure as a result of this type of incident. However, many structures and facilities could potentially be contaminated with radioactivity rendering it extremely dangerous for humans to be near them or live/work there. In this sense, a major radiological event may cause significant damage to the built environment and result in large areas that must be quarantined or considered off-limits to the public after an incident. Further, checkpoints and decontamination stations may need to be set up along routes that leave the evacuation zones, resulting in increased travel times along major roadways and necessitating traffic re-routes.
Economy	Moderate	Economies within the risk zones are likely to see decreased spending as evacuation takes place. Travel and tourism across the state may be limited for an extended period of time due to travelers associating the entire state with the incident. Interstate commerce may be impacted as decontamination stations may need to be established and some drivers may elect to attempt to circumnavigate the state altogether extending travel times and increasing the time to market for products on a regional and statewide level. Employers in the surrounding areas may see increased absenteeism and requests for leaves of absence to deal with the aftermath of the event and some employees may self-evacuate, resulting in a loss of productivity.
Environment	High	Environmental impacts as a result of a radiological incident may be very serious. Contaminants may impact the land and water for many years and wildlife may experience increased likelihood of cancer and other health problems. In general, habitats and ecosystems will suffer long-term from a radiological incident as the organisms within these areas will face similar impacts to those that humans experience, but since they are unable to evacuate or permanently migrate to new locations, they will be exposed for longer periods and be impacted to a greater degree.

Radiological Emergency – Fixed Nuclear Facility Hazard Vulnerability

The following map displays the population changes during the day and night (as modeled in RTI International's U.S. Synthetic Household Population™ dataset) for the entire state of North Carolina, which demonstrates how vulnerability changes at different time periods. These changes were analyzed using pre-existing data of the population's residences, schools, workplaces, and commuting patterns. It also includes 50-mile buffer zones around each nuclear facility that touches part of the state.

Figure 3-77: Day Time Population Density within 50 Miles of Nuclear Power Plants in NC

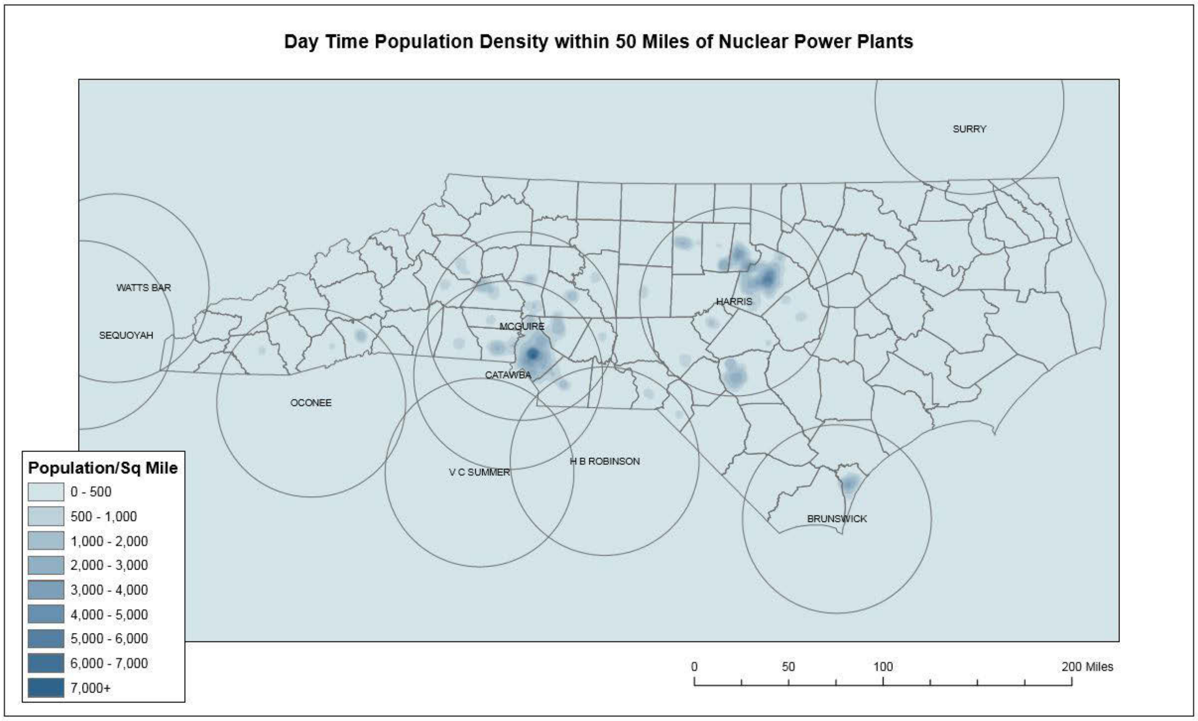
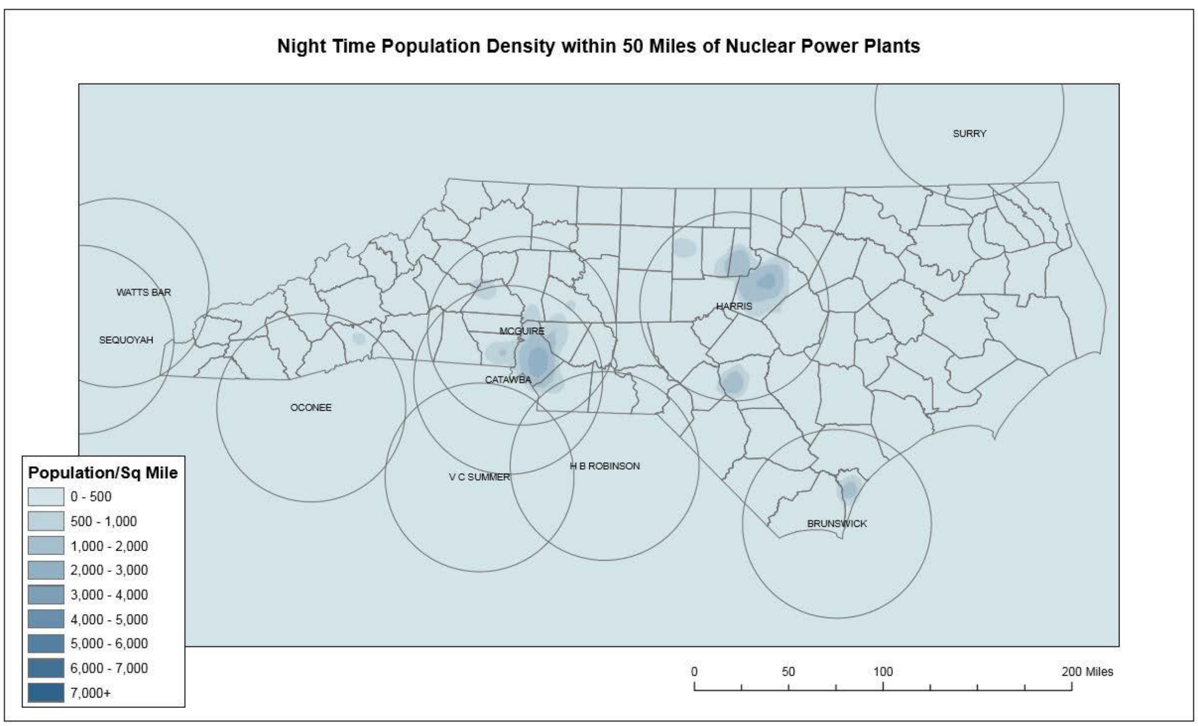


Figure 3-78: Night Time Population Density within 50 Miles of Nuclear Power Plants in NC



Harris Nuclear Plant

Figure 3-79 depicts the location of the Harris Nuclear Plant and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-53. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night.

Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Harris Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the nighttime hours. The population change is most apparent near Research Triangle Park in Wedge 1.

Figure 3-79: Population Density Changes in Areas Surrounding Harris Nuclear Plant

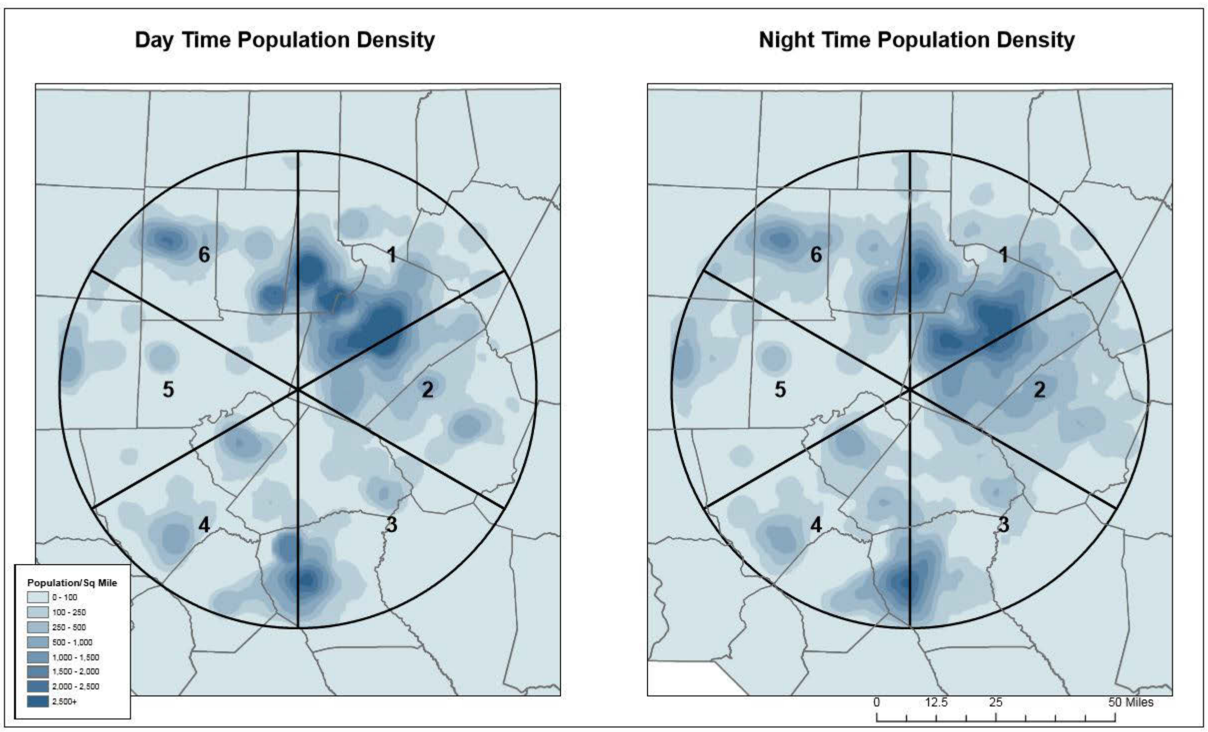


Figure 3-80 and Figure 3-81 below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-80: Population Density Changes 20 Miles Surrounding Harris Nuclear Plant

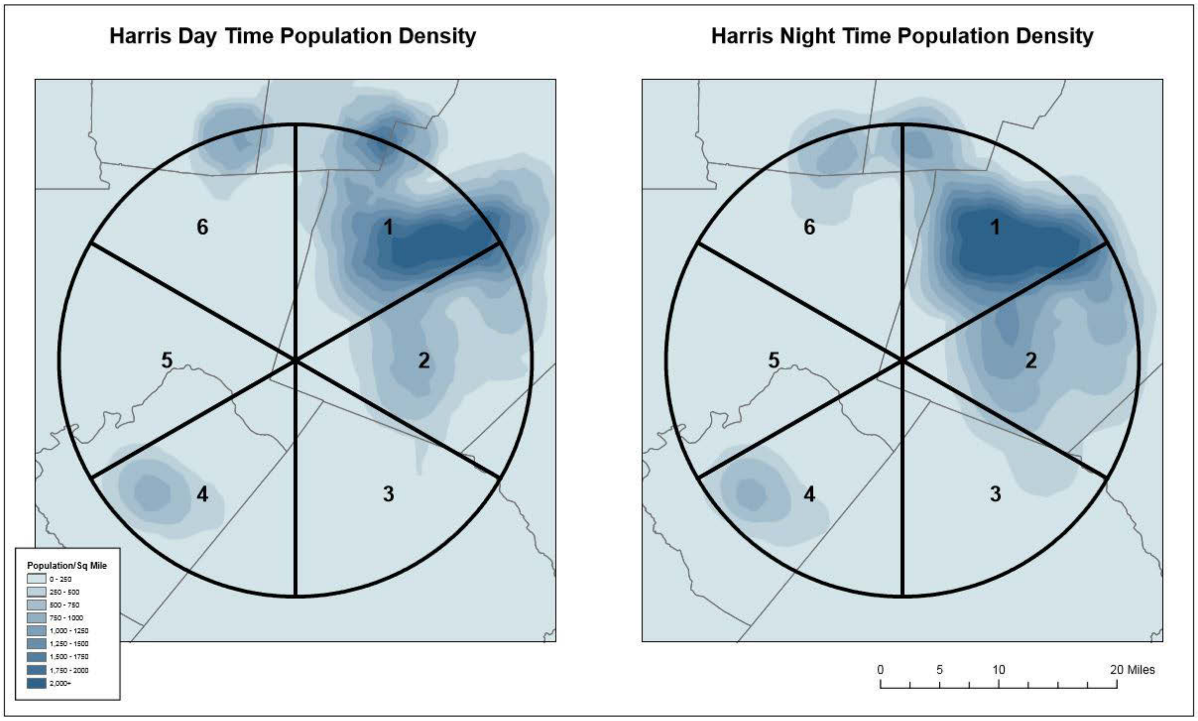
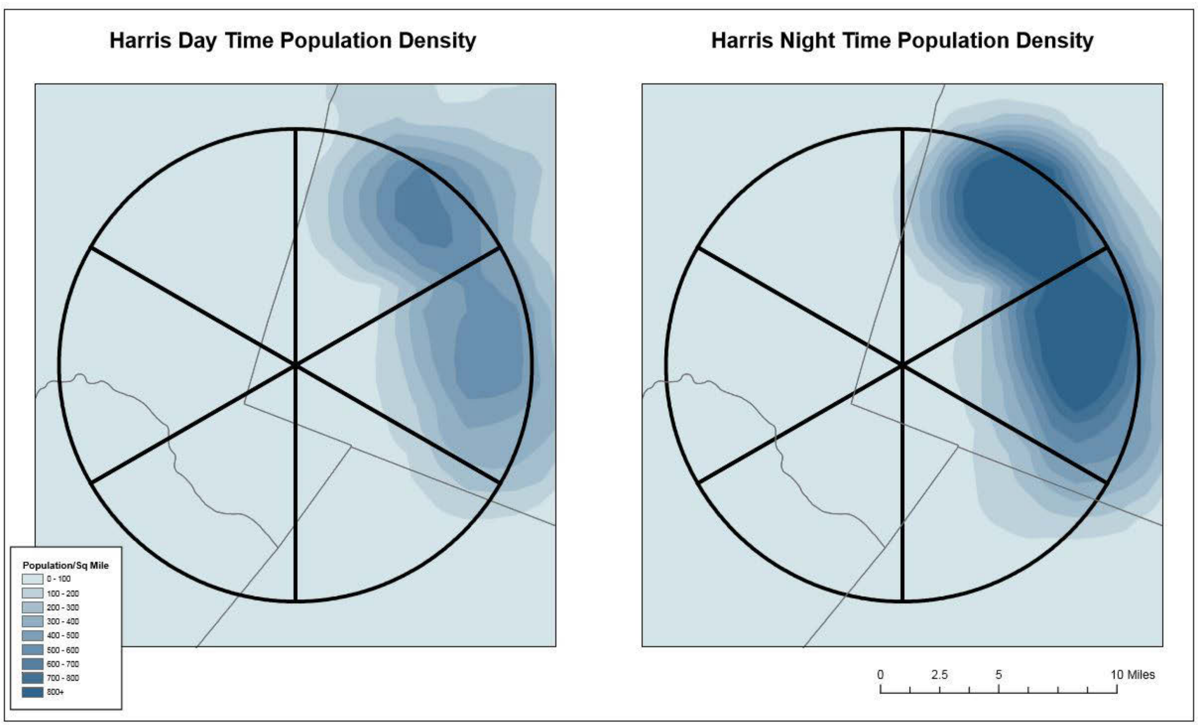


Figure 3-81: Population Density Changes 10 Miles Surrounding Harris Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Wake Franklin Durham Orange Granville Vance Person	Durham Raleigh Creedmoor Oxford	Cary Morrisville Wake Forest Youngsville Butner Stem Apex Holly Springs Rolesville Bunn Franklinton Louisburg Kittrell	n/a

Wedge 2

Counties	Cities	Towns	Villages
Wake Franklin Harnett Johnston Wayne Wilson Nash	Raleigh	Archer Lodge Clayton Four Oaks Pine Level Selma Smithfield Wilson's Mills Angier Apex Cary Fuquay-Varina Garner Holly Springs Knightdale Wendell Bunn Kenly Micro Princeton Wilson's Mills Bailey Middlesex	n/a

Wedge 3

Counties	Cities	Towns	Villages
Wake Chatham Harnett Johnston Sampson Cumberland Wayne Robeson	Fayetteville Dunn	Eastover Falcon Godwin Linden Wade Angier Benson Coats Hope Mills Stedman Dunn Erwin Lillington Autryville Newton Grove Salemburg Spring Lake	n/a

Wedge 4

Counties	Cities	Towns	Villages
Wake Chatham Harnett Moore Cumberland Lee Robeson Hoke Richmond Montgomery	Fayetteville Sanford	Broadway Cameron Carthage Southern Pines Vass Spring Lake Hope Mills Raeford Aberdeen Foxfire Taylortown Parkton	Pinehurst Whispering Pines

Wedge 5

Counties	Cities	Towns	Villages
Wake Chatham Alamance Moore Lee Randolph Guilford	Sanford Asheboro Randleman	Goldston Pittsboro Siler City Robbins Liberty Ramseur Staley Pleasant Garden Biscoe Candor Star Franklinville Seagrove	n/a

Wedge 6

Counties	Cities	Towns	Villages
Wake Durham Orange Chatham Alamance Guilford Person Caswell	Burlington Graham Mebane Durham Greensboro Roxboro	Green Level Haw River Swepsonville Pittsboro Chapel Hill Carrboro Hillsborough Elon Gibsonville Ossipee Gibsonville Sedalia Whitsett	Alamance

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-53: Number and Value of Building Vulnerable to Nuclear Accident at Harris Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	338,332	$82,848,227,625	94,419	$30,826,291,852	12,897	$3,212,949,868
2	216,809	$33,379,154,883	68,133	$12,897,383,269	17,899	$4,024,396,295
3	146,610	$33,803,877,585	19,681	$3,103,774,864	4,308	$733,461,820
4	176,124	$29,878,067,919	26,177	$2,873,365,076	678	$282,050,522
5	109,898	$10,925,541,857	10,212	$1,491,725,021	1,829	$504,511,088
6	189,285	$33,088,624,270	21,385	$6,157,949,855	1,596	$413,361,617
Totals	**1,176,451**	**$222,766,353,802**	**239,829**	**$56,484,919,279**	**39,170**	**$8,355,219,836**

Source: NCEM

North Carolina's agricultural industry is extremely important to the state's economy, and it is important to consider how a nuclear emergency would impact agricultural areas surrounding nuclear plants. Since 2012, North Carolina has been the top ranked state from the value of sales from poultry, and number 2 from hogs and pigs[78]. It is also a top ranking state in milk and dairy production. In the event of an emergency, processing plants would need to shut down and be evacuated, which could cause many negative effects on the economy. The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Harris Nuclear Plant, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 3.

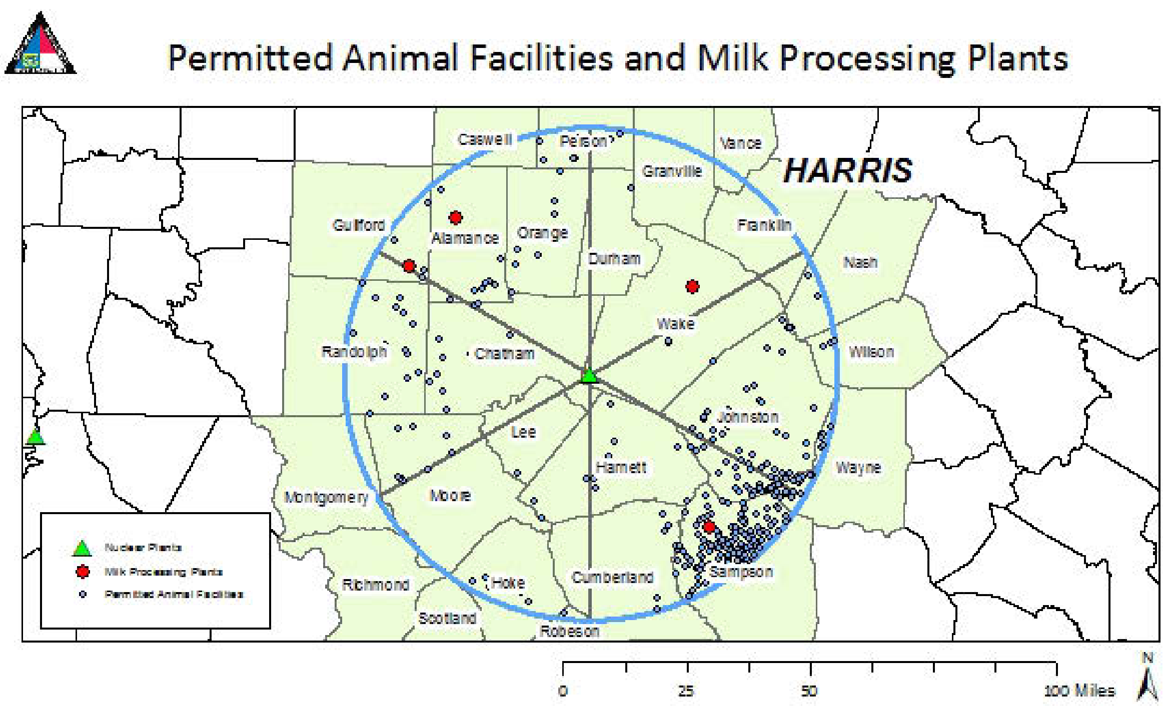
[78] *https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA*

Table 3-54: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Harris Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Beef Cattle	1
	Swine	2
	Milk Processing Plant	3
2	Dairy	1
	Swine	65
	Poultry	1
3	Dairy	1
	Swine	193
	Milk Processing Plant	1
4	Swine	12
5	Beef Cattle	4
	Dairy	14
	Swine	19
6	Beef Cattle	1
	Dairy	17
	Swine	17
	Poultry	1
	Milk Processing Plant	3

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

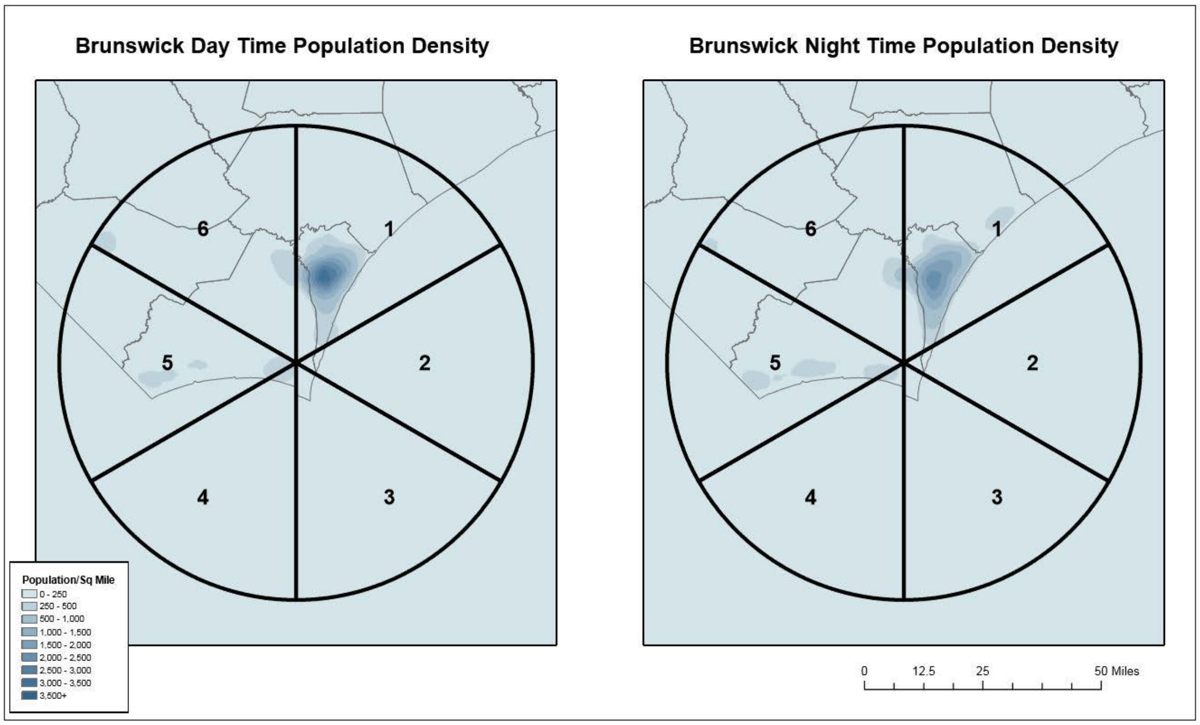
Figure 3-82: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Harris Nuclear Plant



Brunswick Nuclear Plant

Figure 3-83 below portrays the location of the Brunswick Nuclear Plant and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-55. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. The data suggests that the biggest population change takes place in New Hanover County, just outside of the plant's center in Wedge 1.

Figure 3-83: Population Density Changes in Areas Surrounding Brunswick Nuclear Plant



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-84: Population Density Changes 20 Miles Surrounding Brunswick Nuclear Plant

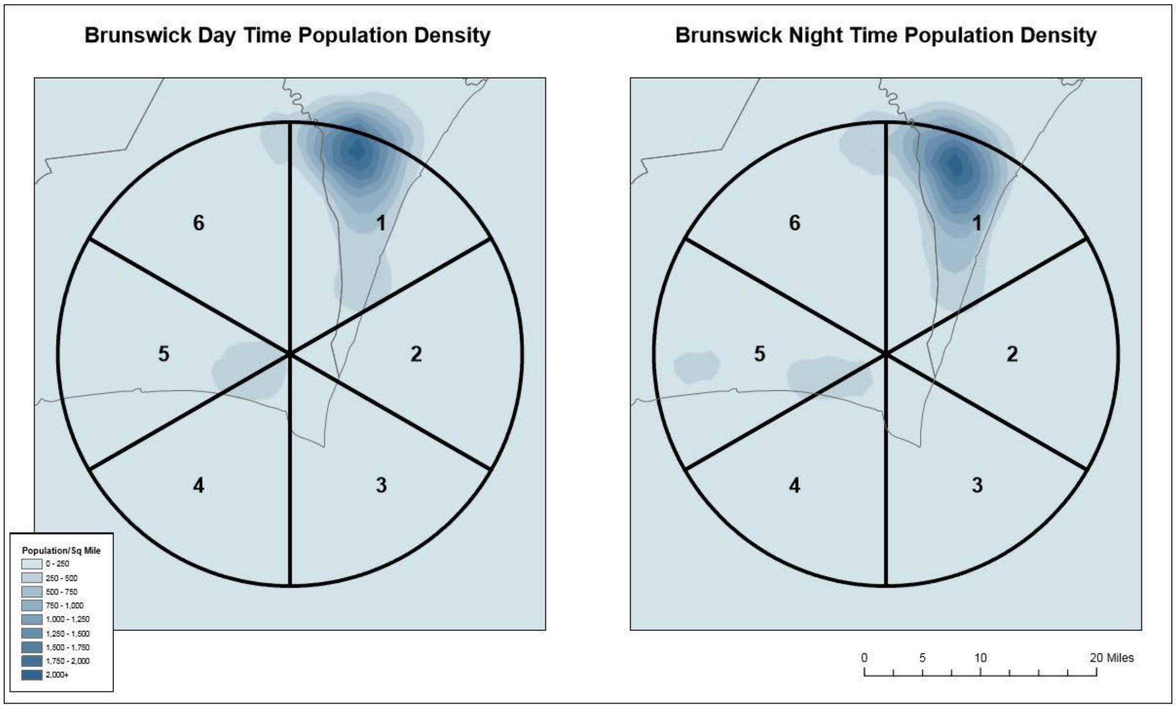
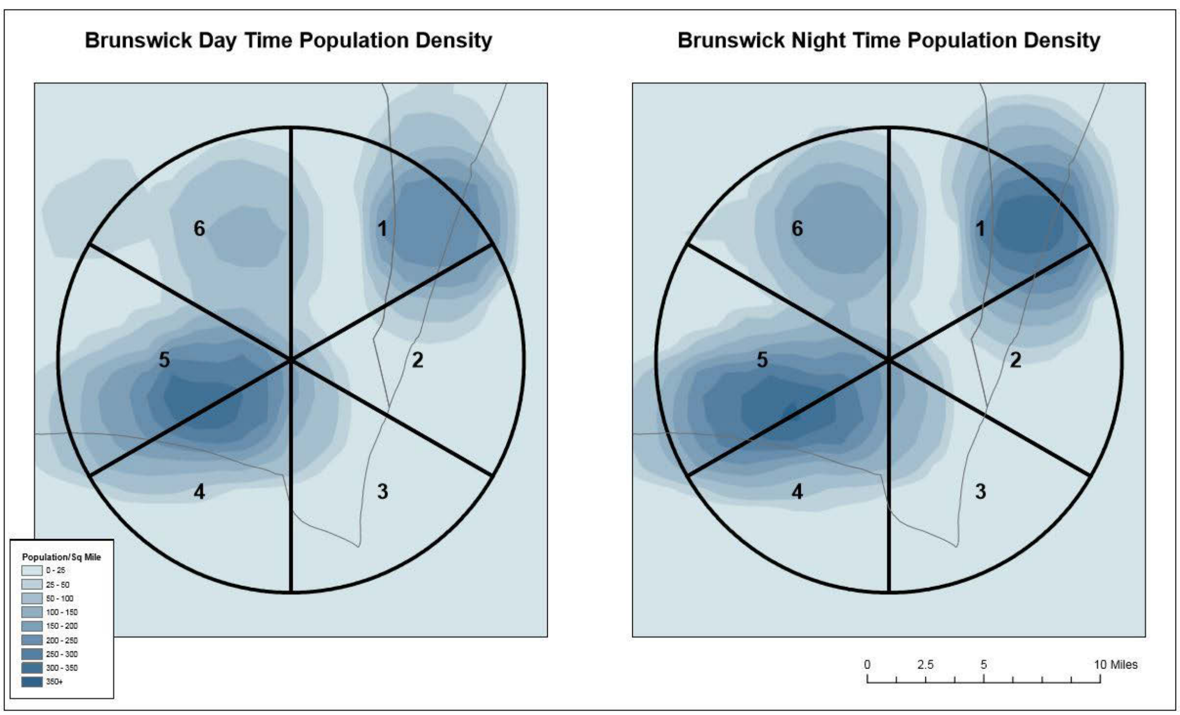


Figure 3-85: Population Density Changes 10 Miles Surrounding Brunswick Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Pender New Hanover Brunswick Onslow	Southport Wilmington	Belville Leland Navassa Carolina Beach Kure Beach Wrightsville Beach Holly Ridge Surf City Burgaw Topsail Beach Watha North Topsail Beach	Saint Helena

Wedge 2

Counties	Cities	Towns	Villages
New Hanover Brunswick	n/a	Kure Beach	n/a

Wedge 3

Counties	Cities	Towns	Villages
n/a	Southport	n/a	Bald Head Island

Wedge 4

Counties	Cities	Towns	Villages
Brunswick	Southport	Caswell Beach Oak Island	Bald Head Island

Wedge 5

Counties	Cities	Towns	Villages
Brunswick Columbus	Boiling Springs Lake Southport Whiteville	Calabash Carolina Shores Holden Beach Oak Island Ocean Isle Beach Saint James Shallotte Sunset Beach Varnamtown Brunswick Tabor City	n/a

Wedge 6

Counties	Cities	Towns	Villages
Pender New Hanover Brunswick Columbus Bladen Sampson	Boiling Springs Lake Northwest Southport Whiteville	East Arcadia Belville Bolivia Leland Navassa Sandy Creek Bolton Brunswick Lake Waccamaw Sandy Field Atkinson	

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-55: Number and Value of Building Vulnerable to Nuclear Accident at Brunswick Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	127,995	$31,022,961,898	51,049	$13,672,332,444	6,223	$2,105,186,314
2	1,406	$747,960,939	1,406	$747,960,939	1,406	$747,960,939
3	1,483	$638,703,925	1,483	$638,703,925	1,483	$638,703,925
4	4,414	$767,464,188	4,414	$767,464,188	4,414	$767,464,188
5	59,174	$7,474,035,322	24,901	$2,547,170,032	7,807	$1,104,578,034
6	37,235	$5,585,945,847	9,405	$901,696,007	2,635	$258,253,601
Totals	**231,608**	**$46,178,214,033**	**92,577**	**$19,225,604,363**	**23,899**	**$5,573,043,696**

Source: NCEM

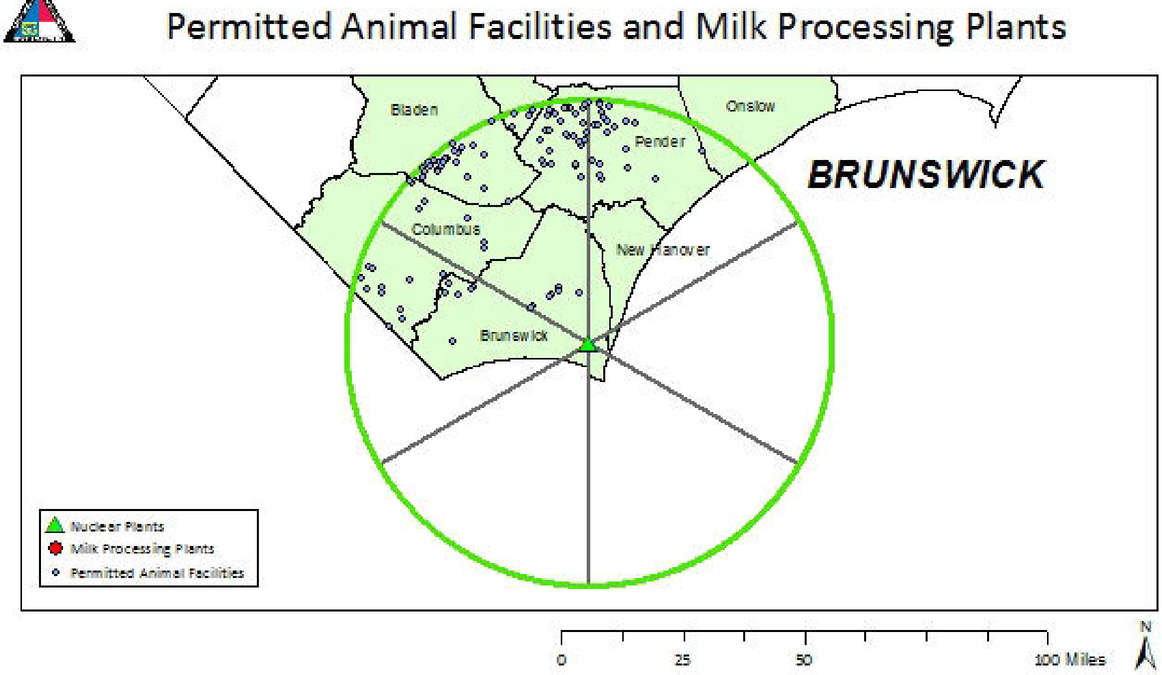
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Brunswick Nuclear Plant, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 6.

Table 3-56: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Brunswick Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Swine	24
5	Swine	21
6	Swine	91

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

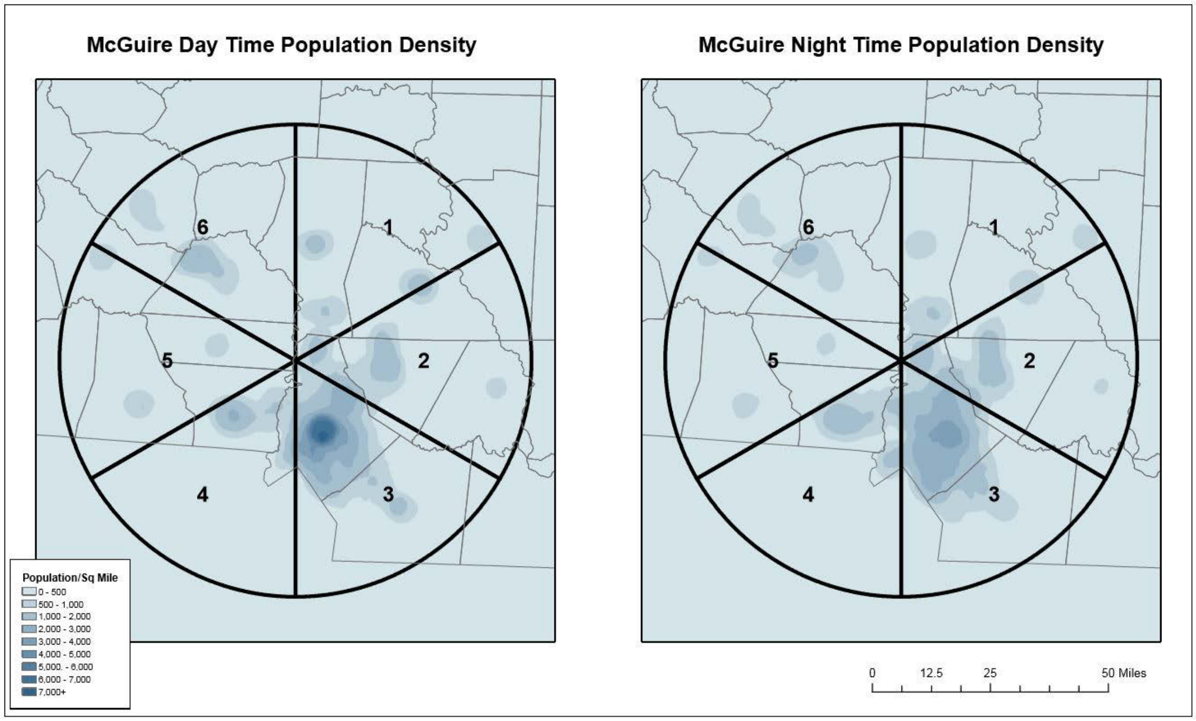
Figure 3-86: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Brunswick Nuclear Plant



McGuire Nuclear Station

Figure 3-87 depicts the location of the McGuire Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-57. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the McGuire Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Charlotte in Wedge 3.

Figure 3-87: Population Density Changes in Areas Surrounding McGuire Nuclear Plant



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-88: Population Density Changes 20 Miles Surrounding McGuire Nuclear Plant

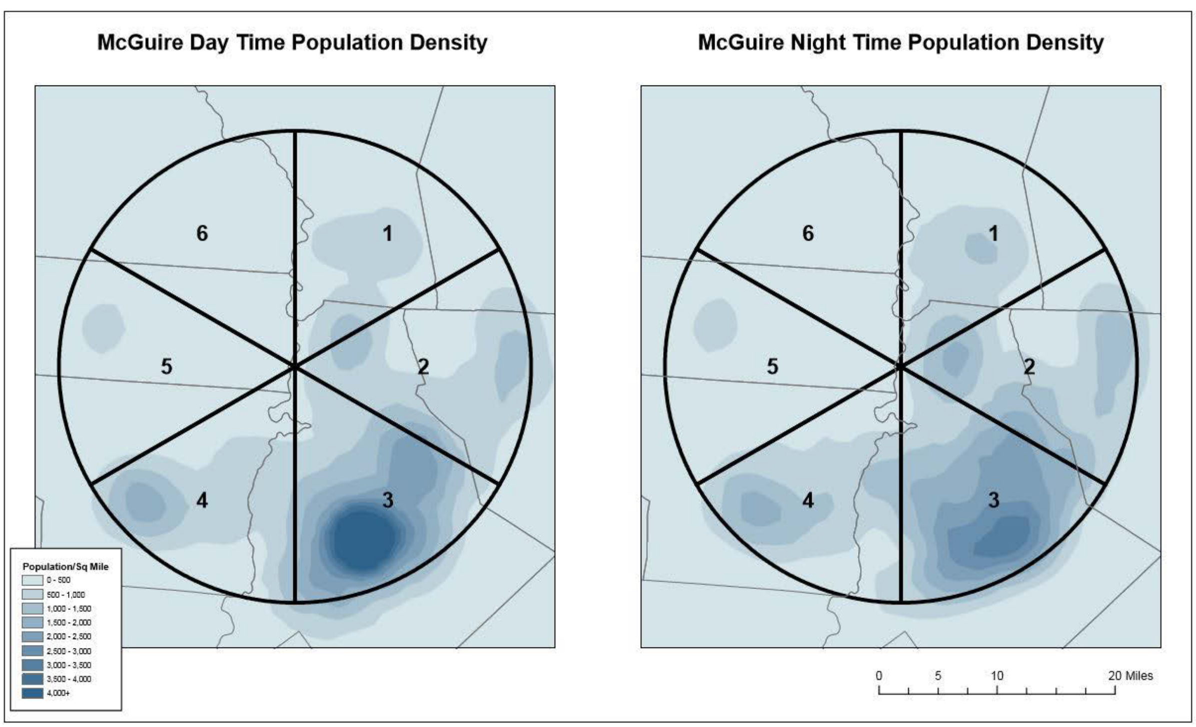
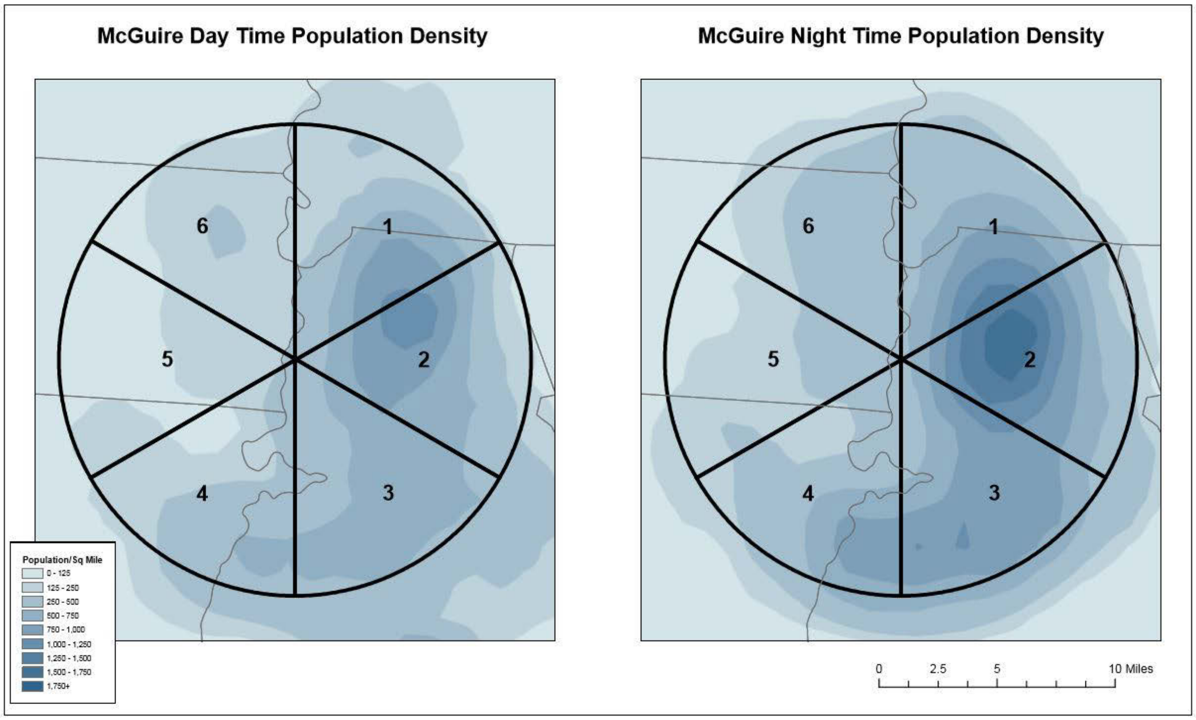


Figure 3-89: Population Density Changes 10 Miles Surrounding McGuire Nuclear Plant



The following tables list all municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Iredell Wilkes Rowan Davidson Davie Forsyth Yadkin Lincoln Mecklenburg Catawba	Lexington Statesville Salisbury	Bermuda Run Cooleemee Mocksville Harmony Cleveland Yadkinville Davidson Mooresville Troutman Davidson Landis	Clemmons

Wedge 2

Counties	Cities	Towns	Villages
Cabarrus Anson Montgomery Stanly Rowan Davidson Randolph Union Iredell Mecklenburg	Lexington Salisbury Albemarle Locust Charlotte Concord Kannapolis	Denton East Spencer Faith Granite Quarry Rockwell Spencer Badin New London Richfield Midland Mount Pleasant Stanfield Oakboro Red Cross Harrisburg Cornelius Davidson Huntersville China Grove	Misenheimer

Wedge 3

Counties	Cities	Towns	Villages
Anson Union Cabarrus Mecklenburg Stanly Gaston	Charlotte Monroe Mount Holly Monroe	Waxhaw Fairview Midland Mint Hill Pineville Fairview Hemby Bridge Indian Trail Stallings Unionville Weddington Matthews Harrisburg Huntersville Peachland Marshville Mineral Springs Wingate	Lake Park Marvin Wesley Chapel

Wedge 4

Counties	Cities	Towns	Villages
Mecklenburg Gaston Cleveland Lincoln	Charlotte Kings Mountain Bessemer City Gastonia Lowell Belmont Mount Holly	Cramerton Dallas McAdenville Ranlo Spencer Mountain Stanley Grover Huntersville	n/a

Wedge 5

Counties	Cities	Towns	Villages
Cleveland Rutherford Burke Gaston Lincoln Catawba Burke Mecklenburg	Morganton Kings Mountain Shelby Bessemer City Cherryville Gastonia High Shoals Lincolnton	Belwood Casar Fallston Kingstown Lattimore Lawndale Polkville Waco Dallas Dellview Stanley Boiling Springs Earl Grover Mooresboro Patterson Springs Bostic Ellenboro Forest City	n/a

Wedge 5

Counties	Cities	Towns	Villages
Iredell Wilkes Catawba Burke Caldwell Alexander Lincoln Mecklenburg	Morganton Hickory Lenoir Statesville Claremont Conover Newton	Taylorsville Connelly Springs Drexel Rhodhiss Rutherford College Valdese Cajah's Mountain Gamewell Granite Falls Hudson Sawmills Long View Love Valley North Wilkesboro Wilkesboro Hildebran Brookford Catawba Maiden	Cedar Rock

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-57: Number and Value of Building Vulnerable to Nuclear Accident at McGuire Nuclear Plant

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	222,548	$25,912,608,925	55,780	$11,789,238,724	16,756	$5,502,454,626
2	216,139	$30,250,605,052	79,264	$17,790,277,638	22,437	$6,884,027,575
3	357,743	$96,023,235,395	143,205	$48,044,104,739	21,768	$5,037,453,322
4	156,111	$19,950,179,881	116,855	$14,245,462,969	18,698	$3,539,609,251
5	177,920	$20,199,280,078	57,046	$9,438,365,834	11,206	$3,026,259,723
6	240,180	$27,530,012,006	42,602	$6,433,551,384	11,908	$3,345,729,662
Totals	1,369,949	$216,413,623,573	494,380	$104,607,776,283	102,594	$24,739,981,985

Source: NCEM

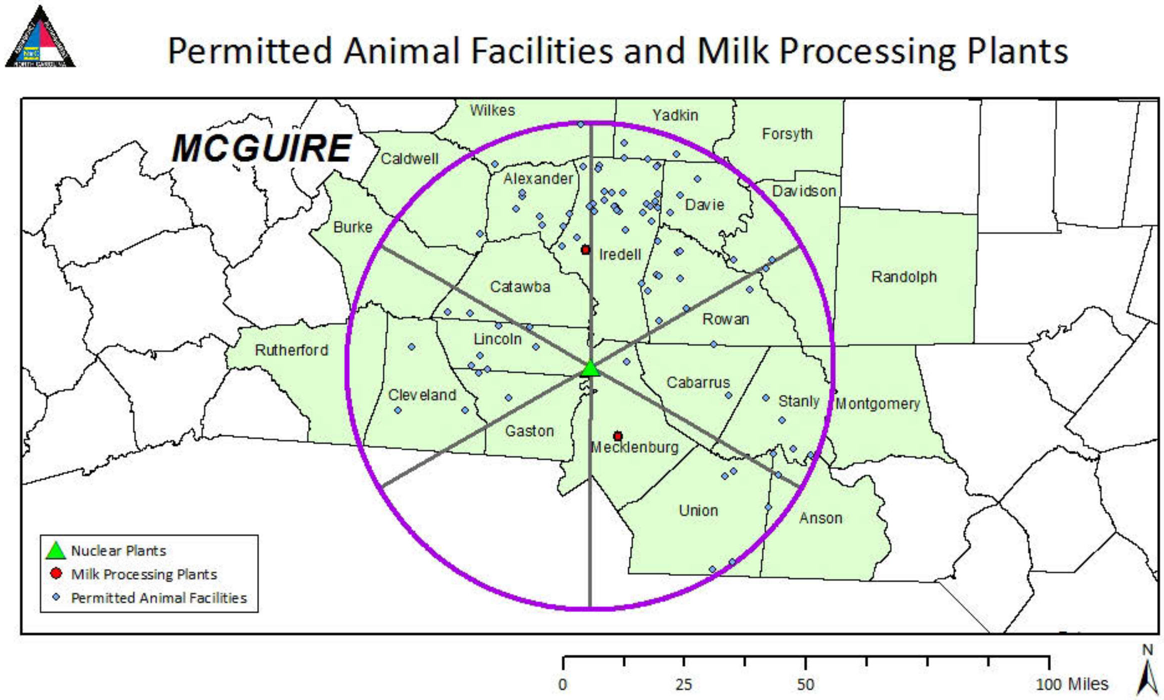
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the McGuire Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 1.

Table 3-58: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at McGuire Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Beef Cattle	2
	Dairy	249
2	Dairy	7
	Swine	4
	Poultry	3
3	Dairy	1
	Swine	3
	Poultry	1
	Milk Processing Plant	1
5	Beef Cattle	2
	Dairy	20
6	Beef Cattle	3
	Dairy	25
	Swine	1
	Milk Processing Plant	1

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

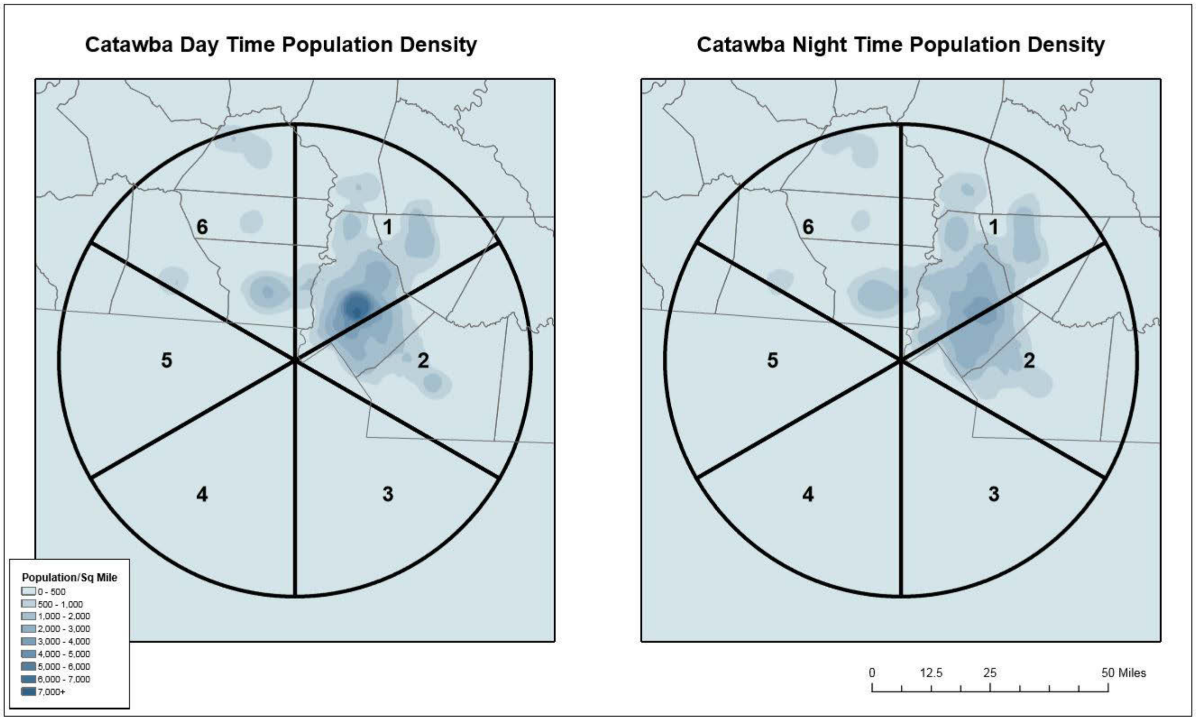
Figure 3-90: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at McGuire Nuclear Plant



Catawba Nuclear Station

Figure 3-91 depicts the location of the Catawba Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-59. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Catawba Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Charlotte in Wedge 1.

Figure 3-91: Population Density Changes in Areas Surrounding Catawba Nuclear Station



The 2 maps below depict population density changes in the 20-mile and 10-mile buffer zones around the plant's center, respectively.

Figure 3-92: Population Density Changes 20 Miles Surrounding Catawba Nuclear Station

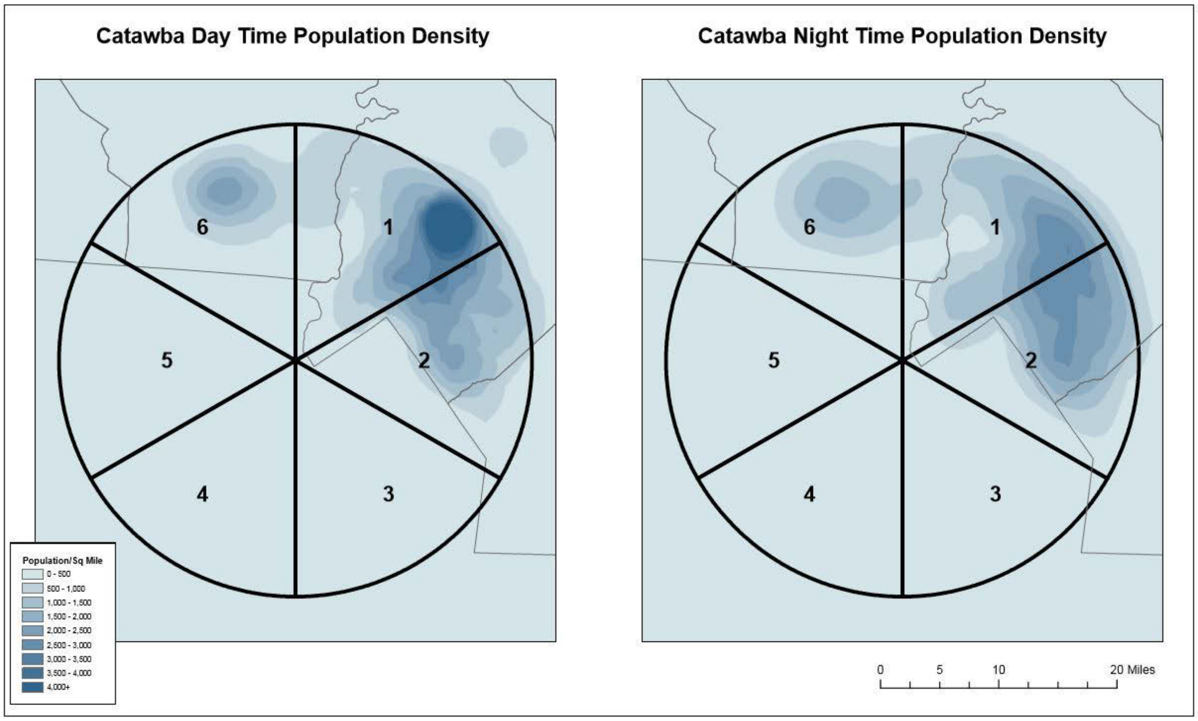
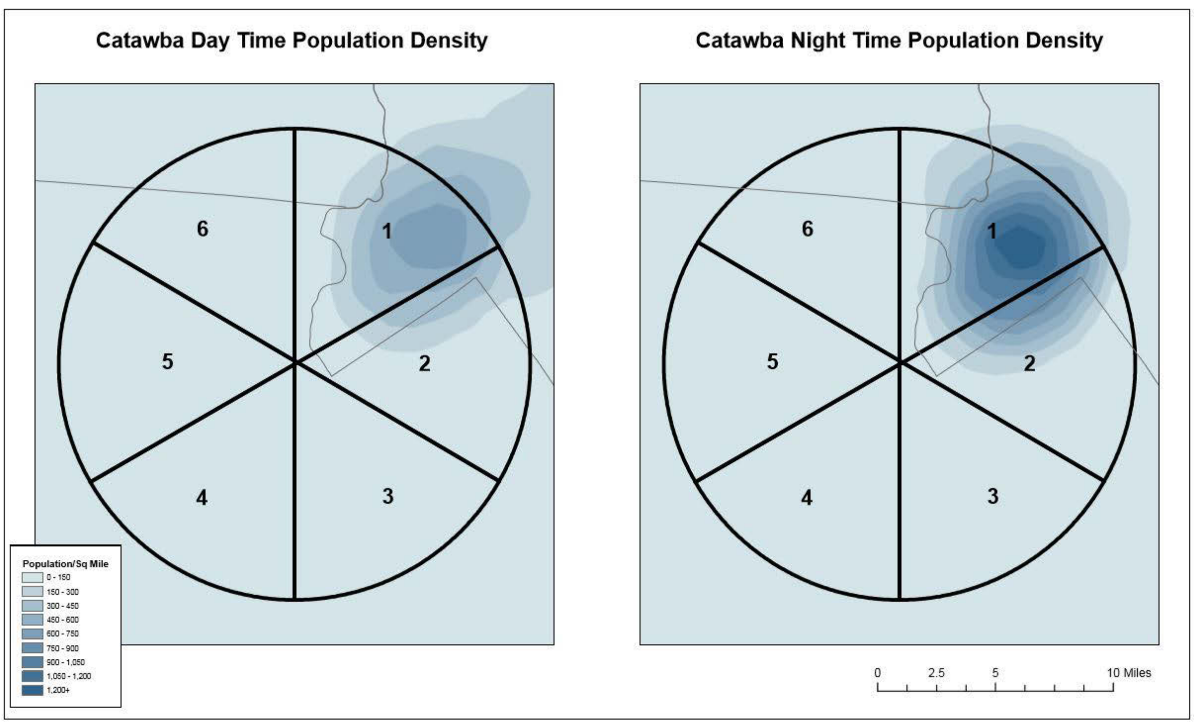


Figure 3-93: Population Density Changes 10 Miles Surrounding Catawba Nuclear Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Mecklenburg	Belmont	Cramerton	n/a
Gaston	Mount Holly	McAdenville	
Lincoln	Charlotte	Stanley	
Cabarrus	Concord	Huntersville	
Iredell	Kannapolis	Harrisburg	
Stanly	Salisbury	Mount Pleasant	
Rowan	Statesville	Cornelius	
		Davidson	
		China Grove	
		Faith	
		Rockwell	
		Catawba	
		Davidson	
		Mooresville	
		Troutman	
		Landis	

Wedge 2

Counties	Cities	Towns	Villages
Mecklenburg	Charlotte	Polkton	Lake Park
Union	Monroe	Fairview	Marvin
Cabarrus	Locust	Midland	Wesley Chapel
Anson		Mint Hill	
Stanly		Pineville	
		Hemby Bridge	
		Indian Trail	
		Stallings	
		Unionville	
		Waxhaw	
		Weddington	
		Matthews	
		Mount Pleasant	
		Stanfield	
		Red Cross	
		Mineral Springs	
		Wingate	

Wedge 3

Counties	Cities	Towns	Villages
Union	n/a	Waxhaw	n/a

Wedge 5

Counties	Cities	Towns	Villages
Rutherford	Kings Mountain	Bostic	n/a
Gaston	Shelby	Forest City	
Cleveland		Grover	
		Earl	
		Lattimore	
		Mooresboro	
		Patterson Springs	
		Ellenboro	

Wedge 6

Counties	Cities	Towns	Villages
Rutherford Gaston Cleveland Lincoln Catawba Burke Iredell	Kings Mountain Bessemer City Gastonia Lowell Shelby High Shoals Lincolnton Claremont Conover Newton Hickory	Cramerton Dallas McAdenville Ranlo Spencer Mountain Stanley Belwood Casar Fallston Kingstown Lattimore Lawndale Polkville Waco Dellview Brookford Catawba Long View Maiden Hildebran	n/a

The following table lists the number of buildings and value of those buildings located within each 60-degree wedge in the 50-mile, 20-mile, and 10-mile radius around the plant's center.

Table 3-59: Number and Value of Building Vulnerable to Nuclear Accident at Catawba Nuclear Station

Wedge	# of Buildings w/in 50 Miles	Value of Buildings ($)	# of Buildings w/in 20 Miles	Value of Buildings ($)	# of Buildings w/in 10 Miles	Value of Buildings ($)
1	424,709	$98,271,121,086	120,634	$37,398,697,819	17,316	$5,501,323,272
2	244,544	$51,748,608,344	93,909	$30,605,071,527	4,315	$1,586,462,022
3	3,290	$318,709,390	196	$14,070,714	-	-
4	-	-	-	-	-	-
5	29,674	$2,883,319,615	272	$29,287,977	-	-
6	300,182	$28,325,710,580	90,221	$7,029,078,318	3,196	$160,710,507
Totals	**1,001,986**	**$181,242,672,516**	**305,008**	**$74,824,871,840**	**24,763**	**$7,134,706,496**

Source: NCEM

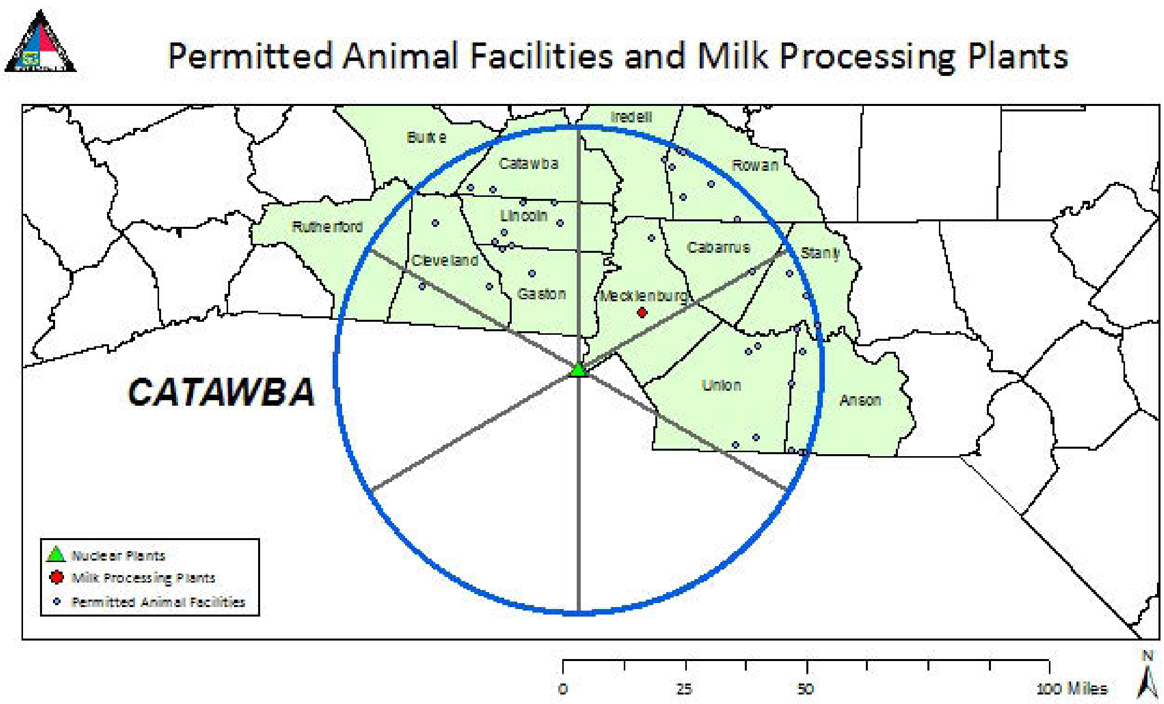
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Catawba Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 6.

Table 3-60: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Catawba Nuclear Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Dairy	9
	Milk Processing Plant	1
2	Dairy	3
	Swine	9
	Poultry	4
5	Beef Cattle	1
6	Beef Cattle	1
	Dairy	34

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

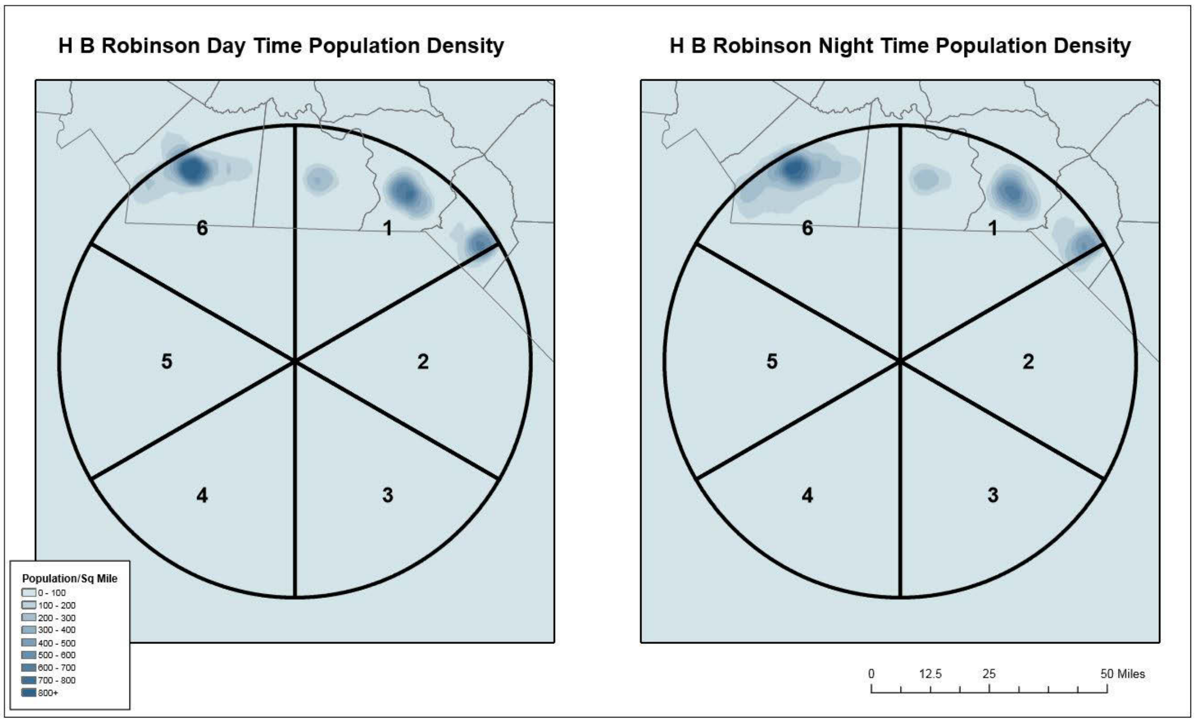
Figure 3-94: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Catawba Nuclear Station



H.B. Robinson Nuclear Generating Station

Figure 3-95 depicts the location of the H.B. Robinson Nuclear Generating Station and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-61. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the H.B. Robinson Nuclear Generating Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most apparent in Union County.

Figure 3-95: Population Density Changes in Areas Surrounding H.B. Robinson Nuclear Generating Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Anson Scotland Richmond	Hamlet Laurinburg	Ansonville Lilesville McFarlan Morven Wadesboro Dobbins Heights East Laurinburg Gibson	n/a

Wedge 2

Counties	Cities	Towns	Villages
Robeson Scotland	Laurinburg	Rowland	n/a

Wedge 6

Counties	Cities	Towns	Villages
Anson Union	Monroe	Polkton Waxhaw Marshville Mineral Springs Unionville Wingate	Wesley Chapel

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-61: Number and Value of Building Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Generating Station

Wedge	# of Buildings within 50 Miles	Value of Buildings ($)
1	48,041	$8,388,703,177
2	3,820	$448,177,927
3	-	-
4	-	-
5	-	-
6	53,017	$5,288,671,922
Totals	**104,868**	**$14,123,090,840**

Source: NCEM

The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the H.B. Robinson Nuclear Generating Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, it is clearly evident that the highest concentration of facilities are located within Wedge 1.

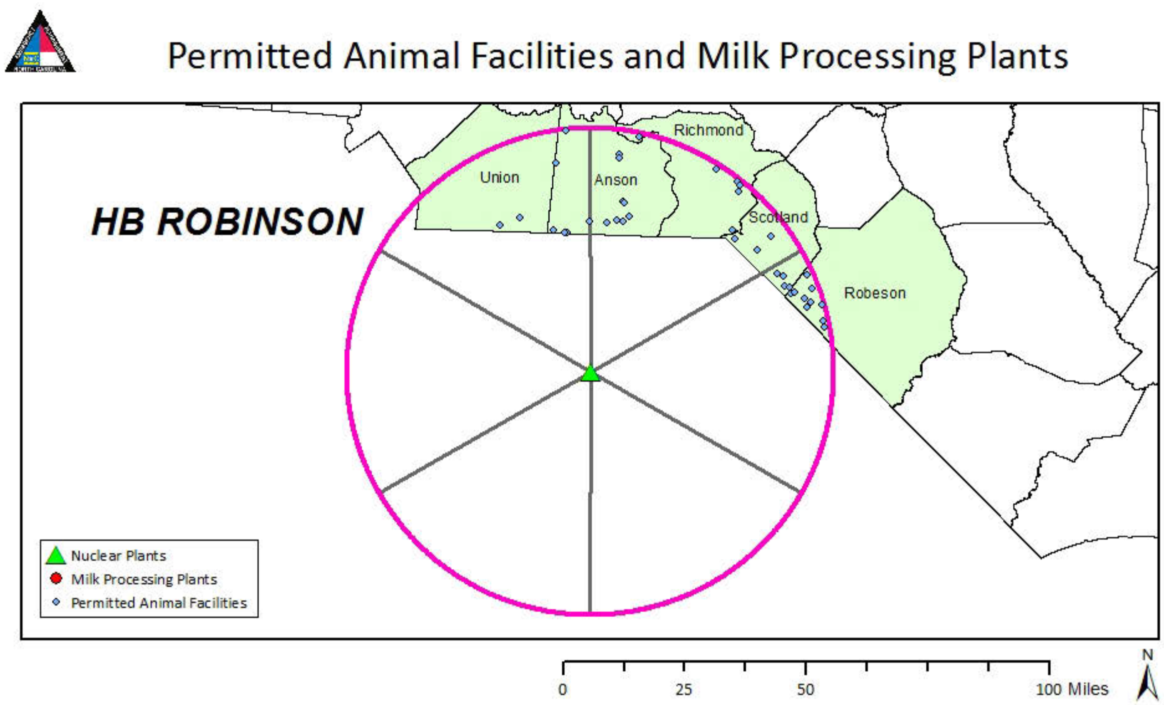
Table 3-62: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Plant

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Swine	18

2	Swine	14
6	Dairy	2
	Swine	5
	Poultry	1

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

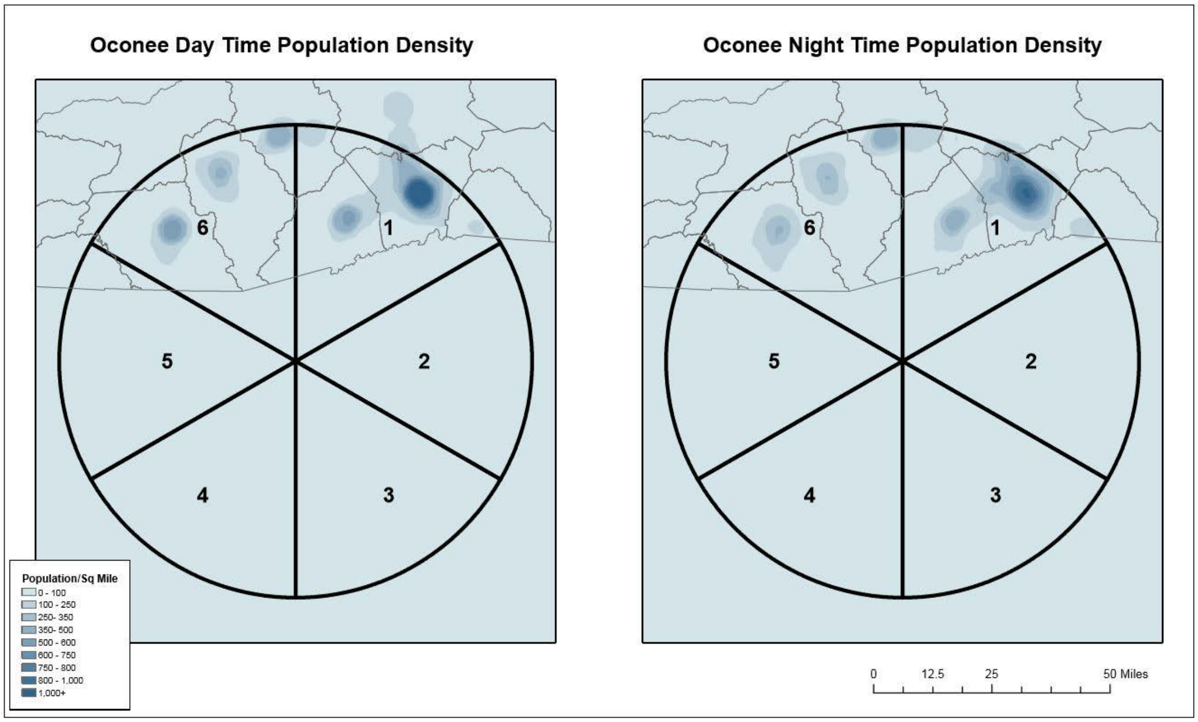
Figure 3-96: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at H.B. Robinson Nuclear Generating Station



Oconee Nuclear Station

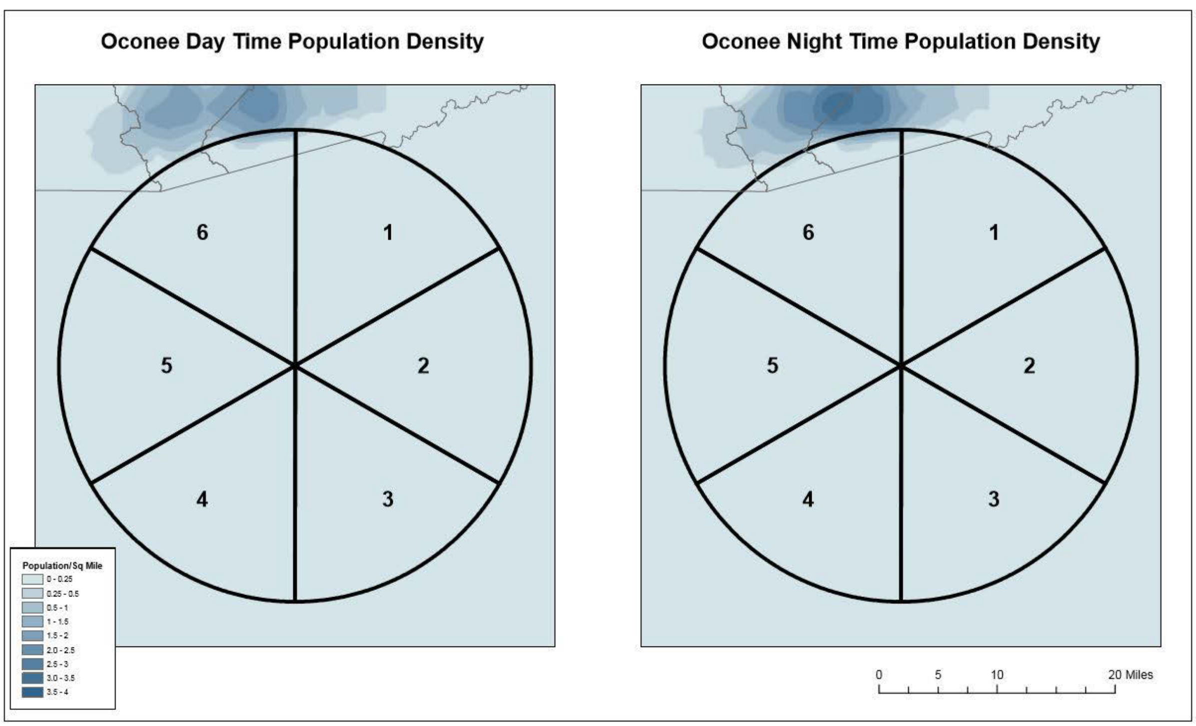
Figure 3-97 depicts the location of the Oconee Nuclear Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-63. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Oconee Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is most apparent near Henderson County.

Figure 3-97: Population Density Changes in Areas Surrounding Oconee Nuclear Station



The map below depicts population density changes in the 20-mile buffer zone around the plant's center, which just barely lies in North Carolina.

Figure 3-98: Population Density Changes 20 Miles Surrounding Oconee Nuclear Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Jackson Transylvania Henderson Polk Haywood Buncombe	Asheville Hendersonville Saluda Brevard	Canton Fletcher Laurel Park Mills River Columbus Tryon Rosman	Flat Rock

Wedge 5

Counties	Cities	Towns	Villages
Macon Clay	n/a	n/a	n/a

Wedge 6

Counties	Cities	Towns	Villages
Jackson Transylvania Macon Clay Haywood Swain	n/a	Maggie Valley Waynesville Highlands Sylva Webster Franklin Highlands	Forest Hills

The following table lists the number of buildings and the value of those buildings located within each 60-degree wedge in the 50-mile and 20-mile radius around the plant's center.

Table 3-63: Number and Value of Building Vulnerable to Nuclear Accident at Oconee Nuclear Station

Wedge	# of Buildings within 50 Miles	Value of Buildings ($)	# of Buildings within 20 Miles	Value of Buildings ($)
1	80,031	$12,522,796,981	68	$9,930,992
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-
5	2,183	$264,738,559	-	-
6	61,367	$11,732,606,952	157	$17,732,793
Totals	**143,570**	**$24,518,653,332**	**225**	**$27,663,785**

Source: NCEM

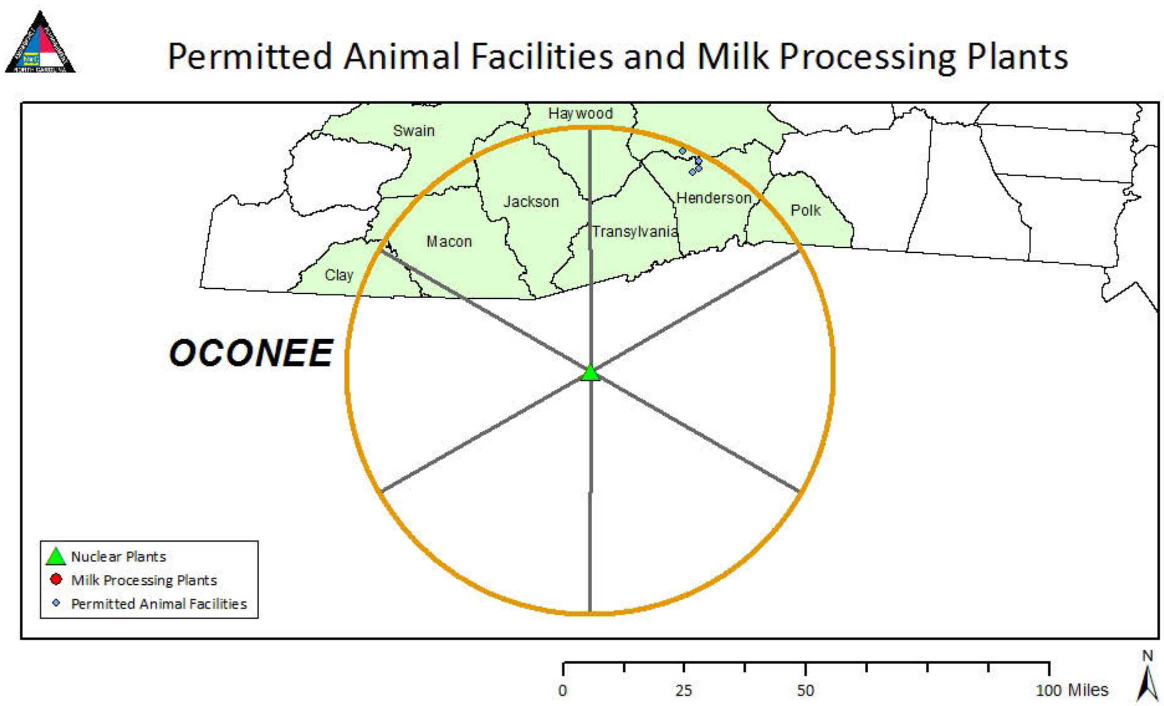
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Oconee Nuclear Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, the only facilities are located in Wedge 1 and mostly lie within Henderson County.

Table 3-64: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Oconee Nuclear Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
1	Dairy	5

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

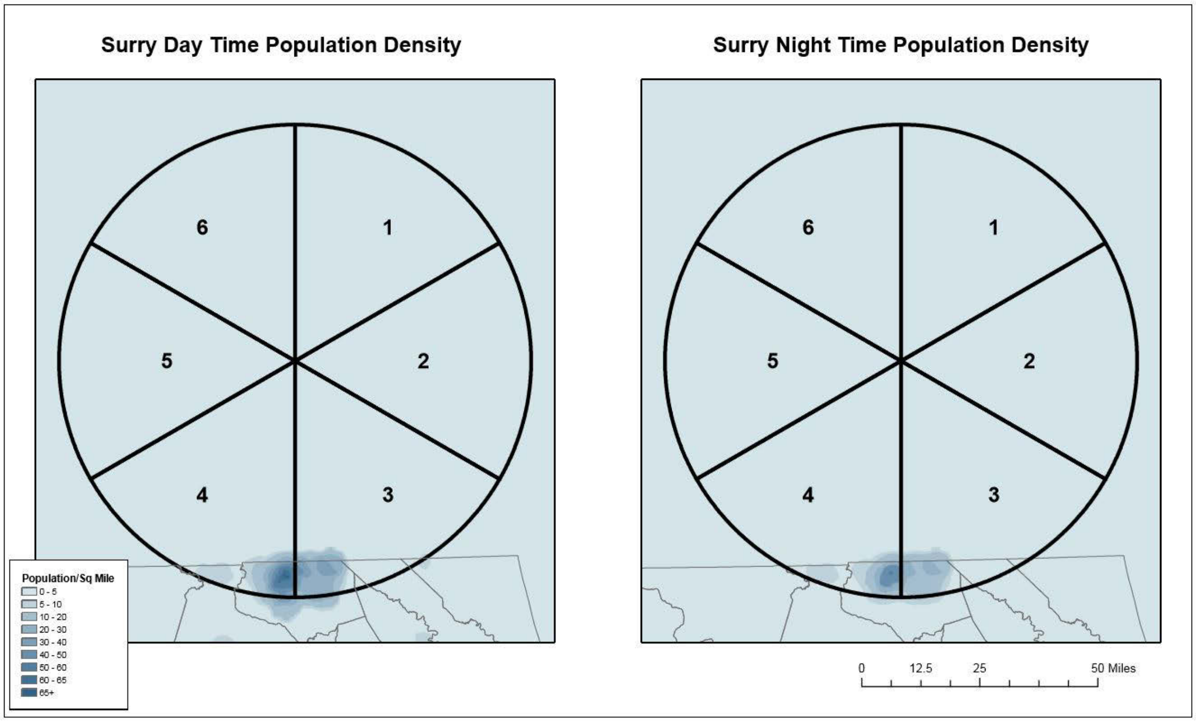
Figure 3-99: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Harris Nuclear Plant



Surry Power Station

Figure 3-100 depicts the location of the Surry Power Station and the surrounding counties. The map also indicates the 10 mile, 20 mile and 50 mile zones that were used to evaluate vulnerability to potential nuclear accidents captured in Table 3-65. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Surry Power Station in North Carolina are more likely to be at their homes and therefore more vulnerable to a plant emergency during the day time hours. The population change is visible in Gates County.

Figure 3-100: Population Density Changes in Areas Surrounding Surry Power Station



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 3

Counties	Cities	Towns	Villages
Camden Gates Currituck Pasquotank	n/a	n/a	n/a

Wedge 4

Counties	Cities	Towns	Villages
Gates Northampton Hertford	n/a	Como	n/a

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-65: Number and Value of Building Vulnerable to Nuclear Accident at Surry Power Station

Wedge	#of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	-	-

3	2,262	$189,727,036
4	2,299	$181,492,366
5	-	-
6	-	-
Totals	**4,559**	**$370,984,653**

Source: NCEM

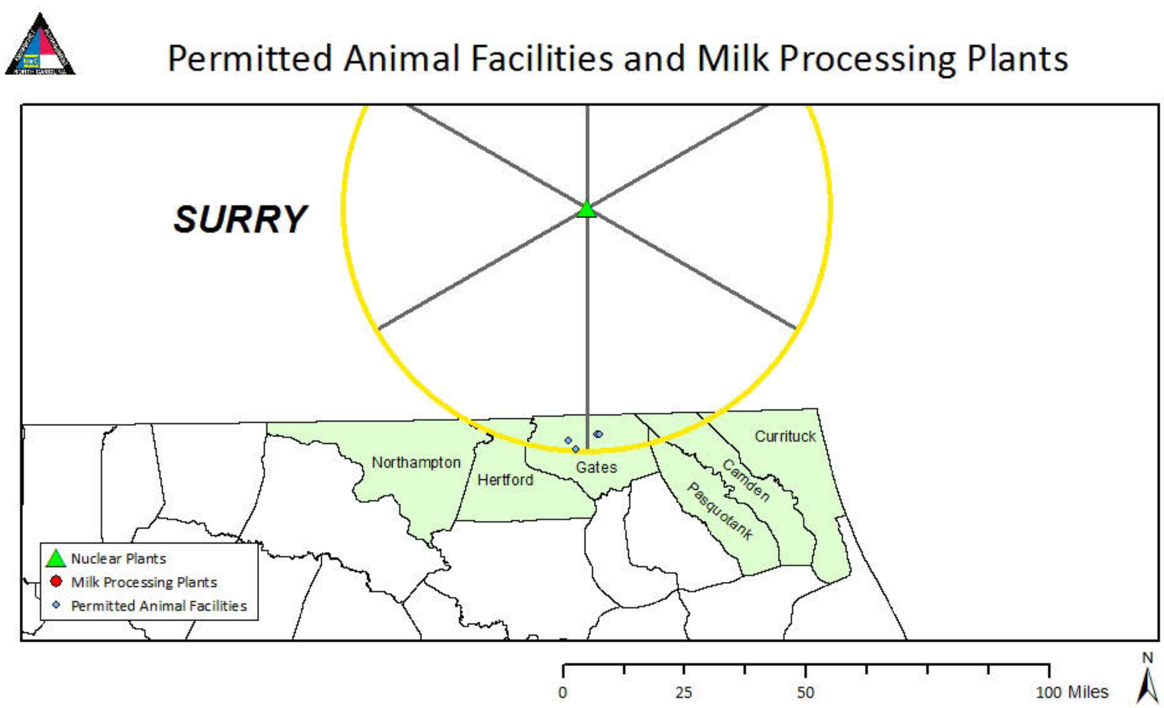
The following table displays the number of permitted animal facilities and milk processing plants located within each wedge of the Surry Power Station, based on data from the NC Department of Environmental Quality (DEQ). This data shows which wedges would be more agriculturally vulnerable to negative impacts from a disaster. Beneath the table is a graphic representation of these facilities. Based on the data, the only facilities are located in Gates County.

Table 3-66: Number of Permitted Animal Facilities Vulnerable to Nuclear Accident at Surry Power Station

Wedge	Type of Permitted Facility	Number of Permitted Facilities
3	Swine	2
4	Swine	2

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

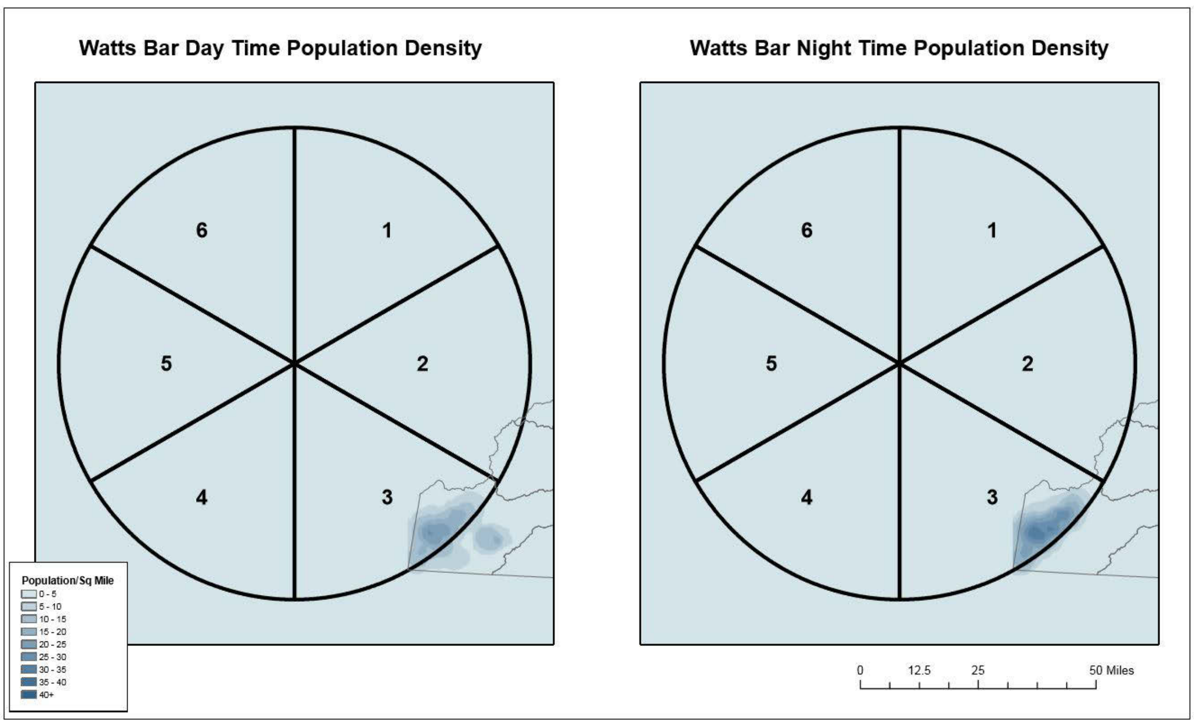
Figure 3-101: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Surry Power Station



Watts Bar Nuclear Plant

Figure 3-102 depicts the location of the Watts Bar Nuclear Plant and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-67. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Watts Bar Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most apparent in Wedge 3 in Cherokee County.

Figure 3-102: Population Density Changes in Areas Surrounding Watts Bar Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 2

Counties	Cities	Towns	Villages
Cherokee Graham Swain	n/a	n/a	n/a

Wedge 3

Counties	Cities	Towns	Villages
Cherokee Graham	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-67: Number and Value of Building Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant

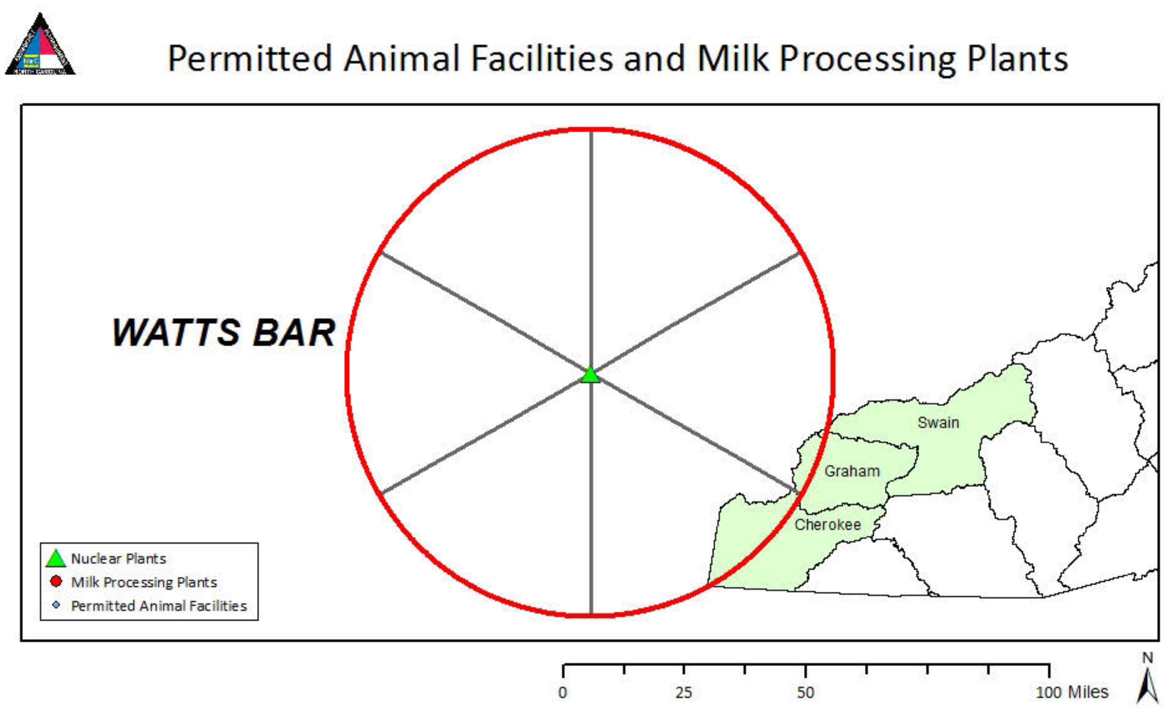
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	39	$504,062,668
3	3,227	$269,120,119
4	-	-
5	-	-
6	-	-
Totals	**3,280**	**$774,028,847**

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

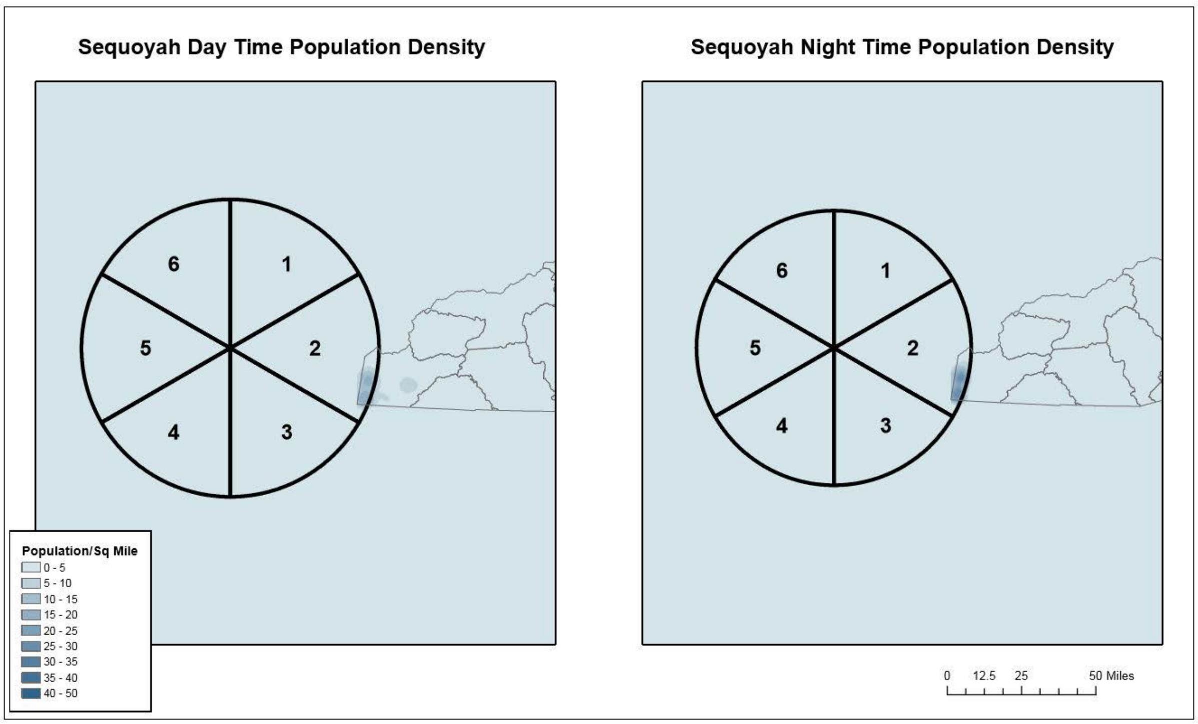
Figure 3-103: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



Sequoyah Nuclear Plant

Figure 3-104 depicts the location of the Sequoyah Nuclear Plant and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-68. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the Sequoyah Nuclear Plant are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is most visible in Wedge 2 in Cherokee County.

Figure 3-104: Population Density Changes in Areas Surrounding Sequoyah Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 2

Counties	Cities	Towns	Villages
Cherokee	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-68: Number and Value of Building Vulnerable to Nuclear Accident at Sequoyah Nuclear Plant

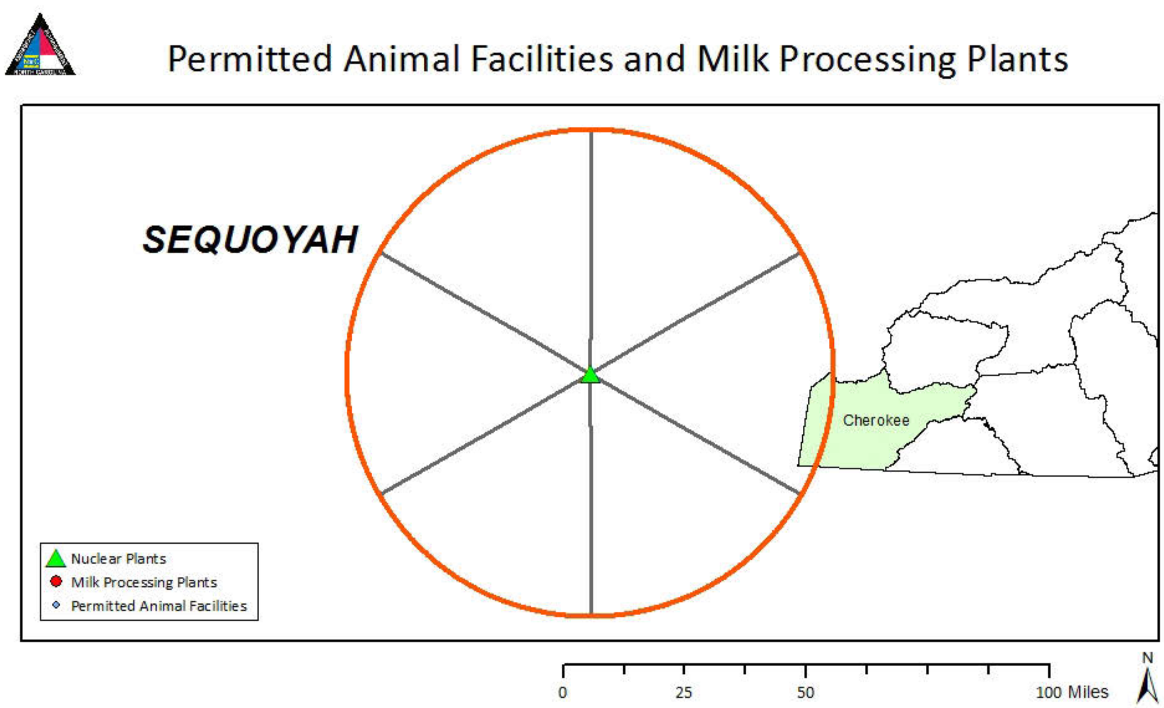
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	-	-
2	1,756	$135,743,112
3	-	-
4	-	-
5	-	-
6	-	-
Totals	**1,756**	**$135,743,112**

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

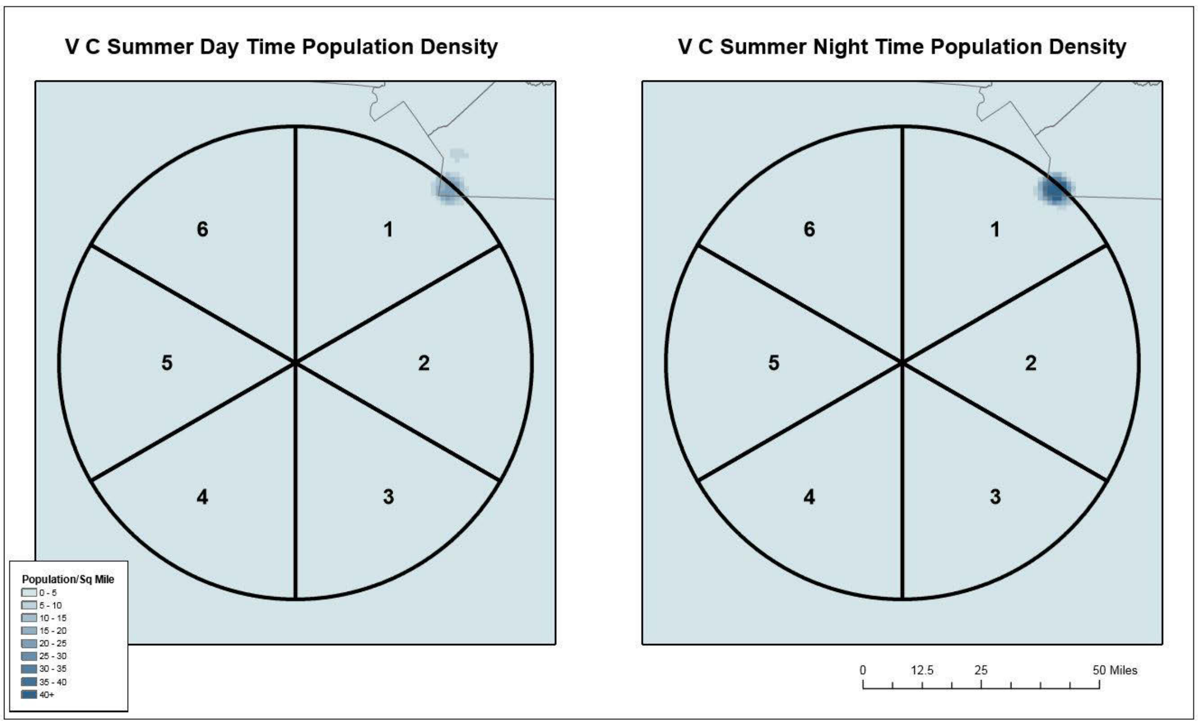
Table 3-69: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



V.C. Summer Nuclear Plant

Figure 3-105 depicts the location of the V.C. Summer Nuclear Station and the surrounding counties. The map also indicates the 50 mile zone that was used to evaluate vulnerability to potential nuclear accidents captured in Table 3-70. The wedges (each one 60 degrees and labeled 1-6) indicate areas of potential wind plumes and therefore how vulnerability to a nuclear accident can change. Finally, the map also indicates the surrounding area's synthetic population to show how vulnerability changes at different time periods. Pre-existing data of the population's residences, schools, and workplaces was analyzed based on commuting patterns, and shows how the population density changes from day to night. Based on the findings, it is apparent that population of people living within the 50-mile buffer around the V.C. Summer Nuclear Station are more likely to be at their homes and therefore more vulnerable to a plant emergency during the night time hours. The population change is visible in Wedge 1 in Union County.

Figure 3-105: Population Density Changes in Areas Surrounding V.C. Summer Nuclear Plant



The following tables list all North Carolina municipalities located within each 60-degree wedge.

Wedge 1

Counties	Cities	Towns	Villages
Union	n/a	n/a	n/a

Source: NCEM

The following table lists the number of buildings and the value of those buildings in North Carolina that located within each 60-degree wedge in the 50-mile radius around the plant's center.

Table 3-70: Number and Value of Building Vulnerable to Nuclear Accident at V.C. Summer Nuclear Plant

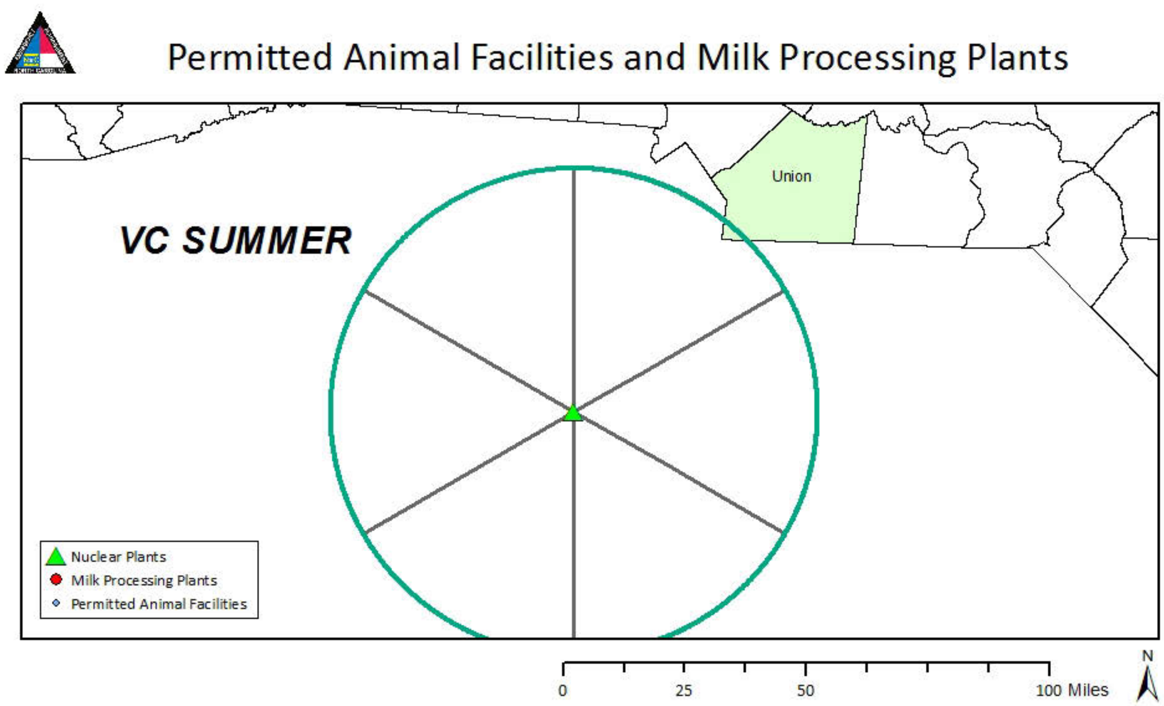
Wedge	Number of Buildings within 50 Miles	Value of Buildings ($)
1	718	$63,354,482
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
Totals	**718**	**$63,354,482**

Source: NCEM

Based on data from the NC Department of Environmental Quality (DEQ), there are no agricultural facilities in North Carolina that fall within a 50-mile radius of the plant's center and therefore vulnerable to a potential emergency.

Sources:
https://www.dairyfoods.com/search?commit=Submit&datatype=directory&exclude_datatypes%5B%5D=video&exclude_datatypes%5B%5D=file&ip=168.215.136.42&page=2&q=%22North+Carolina%22&taxonomy=Dairy+Plants+USA&utf8=%E2%9C%93
https://deq.nc.gov/about/divisions/water-resources/water-resources-permits/wastewater-branch/animal-feeding-operation-permits/animal-facility-map

Figure 3-106: Permitted Animal Facilities and Milk Processing Plants Vulnerable to Nuclear Accident at Watts Bar Nuclear Plant



3.5.6.3 Terrorism Hazard Vulnerability

Terrorism Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	High	In addition to the clear impacts that terrorism can have on human life and safety, there are a number impacts on the public that will be more widespread if major events take place. As seen after the attacks on September 1, 2001 in New York City and Washington, D.C., there can be significant impacts far away from the site of the incident. Fear and worry about additional attacks or for loved ones in areas affected are just a couple examples of impacts that could occur. Other impacts include discrimination or changed interactions between people of differing nationalities depending on the nature and intent of the attack(s) and who perpetrated the attack(s). During and after a terrorism event, the public will be expecting services to be provided despite the uncertainty of any existing hazards or further impacts. The partnership and involvement of the media is crucial not just for providing public guidance, but also for keeping the public informed of the efforts underway or of any obstacles or concerns hindering response efforts. Although public confidence will almost certainly be shaken, agencies and organizations in the government working together in an efficient and effective way will provide for the best chance of positive public perception of the government.
Responders	High	The danger to human life in a terrorist event is dependent on the form of attack utilized as well as its location, severity, and scope (see Section 3). In any terror incident, responders must conduct a scene size-up to determine hazards to themselves and others. Decisions must be made about how to handle victims and those in close proximity that may have been victimized or exposed. If hazardous materials are present, it could change the strategy as well. Fear and panic will be significant in the case of a terrorist act, whether it occurs in North Carolina or elsewhere in the nation. As front-line government officials, responders will be at a significant risk during an attack and may even be the object of the attack in some cases. Depending on the location, the scope, and the nature of the event(s), response efforts could last hours, days, or potentially longer. Collaboration at all levels can provide for the most stable, effective, and efficient effort in returning to normal activities and operations. Identification of further threats and open communication lines can prevent further harm or detriment to response operations.
Operations/Continuity of Operations	High	A terrorist event would likely have a high impact on continuity of operations, especially due to the disorder that would result and the unpredictability of this kind of event. Emergency personnel may be directly affected or targeted, which would cause definitive harm to maintaining continuity of operations. Furthermore, continuity of operations can be impacted by personnel. Equipment, and/or consumables being exhausted or depleted.

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Moderate	Major Events/Centers Often terrorist events are targeted at major events or at large event centers in an attempt to create widespread loss on a large number of people. Therefore, large arenas, convention centers, and event spaces may be at higher risk of a terrorist attack than most other buildings. Likewise, churches and schools are soft targets and are often targeted as such. Similarly, prominent or symbolic structures may also be at an elevated risk for targeting. Critical Facilities At hospitals, the primary concern with a terrorism event is the influx of patients requiring care. Terrorism may pose a specific hazard to a hospital structure itself, but it is more likely to be impacted when in close proximity to a target. Many patients could be injured or their medical condition worsened by the impacts of a terrorism event. In general, emergency services buildings are not considered high probability targets for terrorists to strike. In other countries, ambulance services and 9-1-1 centers have been targets; however, that pattern has not been seen here in the United States. Alternate locations should be set up so that emergency operations can continue if an emergency services facility was affected or targeted by a terrorism event. Shelters may need to be activated in a terrorism event to house and care for displaced individuals. Transportation Systems Bridges found throughout the interstate system may be targeted by terrorism. Not only would the actual structural failure affect those on, under, or near the bridge, but the loss of its functionality would also significantly hinder travel and commerce. Past experiences with terrorists using airplanes for terrorist activity suggest a need for planning and collaboration with all parties of interest at airports including local, state, and federal agencies. In terms of railway transportation, the most likely means of disrupting these lines would be the derailing of a train, primarily by sabotage of the rail or the switching control system. Using explosives would be more likely because hacking into systems to cause collisions and other undesired actions to moving rail cars would be more complex operations. In addition to disrupting rail traffic, a derailing can impact other means of travel such as a nearby road or airport. The rail cars involved in an incident could contain hazardous materials, which would add an element of complexity to the situation. Utilities Damage to high voltage lines or power plants structures could disrupt power distribution for a large area, affecting emergency response and other facets of government and business. The economic impacts may also be significant as extended outages can be costly. Natural gas lines are also a concern as a target for terrorists. Major pipelines run through the state, but natural gas itself must be exposed to oxygen before it could cause an explosion. Most natural gas explosions are small and rarely deadly. The real concern is in shutting off natural gas to end consumers.

Category	Impact Rating	Description of Impacts
		Sabotage of a pipeline could disconnect a significant number of homes and businesses for considerable periods of time. Other Structures Single-family dwellings and small businesses or industries are not likely to be targets for terrorism. However, areas that have high concentrations of people could be vulnerable to an attack. These areas of assembly tend to be soft targets and are easily accessible. Buildings in close proximity to a targeted event center may also be more likely to experience indirect impacts. Depending on the method of attack, impacts could include stray bullets or debris from explosions. These could affect people, electrical systems, water systems, cause structural collapse, or fires. Also, the presence of chemical agents can create health hazards through dangerous reactions with water sources or building materials.
Economy	Moderate	The economic impact of a terrorist attack can vary from minimal to severe. If the incident occurs in North Carolina, it could hinder the state's economy but may not have an impact at the national level. Tourism and some commerce could decline significantly if people, events, or businesses are hesitant to come to the area following an incident. An incident in a major city or a financial hub could affect the entire country. For example, the events of September 11, 2001 had an immediate impact on local, state, and national economies. This event and other large-scale attacks like it can drastically alter the economy in both the short- and long-term. Note: Charlotte, North Carolina is the second largest financial hub in the nation. Major Events/Centers Terrorism can occur in city centers during large public gatherings or during business hours to cause the most harm and promote the most fear. Political gatherings would be high priority targets as well. Arenas can be targeted by terrorism, particularly during events that may have some form of political, cultural, or historical value, or simply any event with a large number of people in attendance. These could all have a negative impact economically on the state.
Environment	Moderate	Impacts on the environment depend on the type of attack utilized by terrorists. A biological, chemical, radiological or other hazardous material can have impacts on human, animal, and plant populations alike. The impacts can vary depending on the particular hazard(s) at play, but there will certainly be at least some negative impacts from a terrorist attack including potentially the release of smoke, chemicals, or debris into the environment.

3.5.6.4 Civil Disturbance Hazard Vulnerability

Civil Disturbance Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)		The number of people exposed to a civil disturbance depends on the size of the disturbance and the population density of the disturbance location. Increases in visiting populations or hosting of major political, economic, or social events may increase the likelihood and severity of a

Category	Impact Rating	Description of Impacts
		civil unrest incident. Civil disorder incidents can lead to injury and/or death for all involved persons, innocent bystanders, and responders. This can occur regardless of intent. People may also face criminal charges and arrest during these events. It is not uncommon for individuals and communities to experience grief reactions and anger after an incident of community violence. People may experience the loss of their sense of safety, their trust in those who live in their neighborhood, or their trust in local government.
Responders		Police, fire departments, and medical teams are most likely to respond to and be impacted by civil disturbances. Authorities may become overwhelmed and only able to acknowledge reports of fires, looting and vandalism. This may strain limited services, particularly in rural communities. Blocked streets, large congregations of people or a lack of adequate resources can disrupt the ability to respond to emergencies. Depending on the nature or severity of the gathering, responders may be exposed to violence during highly charged events or riots. Given the frequent tension between police and protesters, police may be vulnerable to antagonization and violence.
Operations/Continuity of Operations		Systems most likely impacted during and immediately following an event are police, fire departments, and emergency medical teams. Blocked streets, large congregations of people or a lack of adequate resources can disrupt the ability to respond to emergencies. Protests and other civil disruptions often interrupt continuity of government activities, especially if the disturbance is political in nature. Activists may gather at state or city facilities, blocking or disrupting the entrances of government buildings. Transportation systems may also be impacted if transit routes are blocked, such as major corridors through the state, or if disturbances have rendered part of a city unsafe. Curfews may be put in place in some towns or cities that prevent people from typical evening or nighttime activities.
Built Environment (Property, Facilities, Infrastructure)		Civil disturbances can occur anywhere, potentially impacting any structure or infrastructure across the state. Government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather, especially if the disturbance is political in nature. Facilities, such as, businesses, and other public common areas are vulnerable to civil disturbance. Depending on the scale of the incident, damages may range from broken windows to fires and destruction of major pieces of infrastructure.
Economy		Civil disturbances often occur in populated, or urban areas – storefront properties and other businesses can be subject to fire, looting and vandalism. This type of damage

Category	Impact Rating	Description of Impacts
		can have direct economic impacts to business owners, towns, and cities. It can also disrupt employment and lead to relocation or closure of businesses. Depending on the extent of the disruption, a sense of danger may linger and discourage investment or discomfort from visitors. Society, as a whole, pays for the costs of violence - if not directly as a victim, but then indirectly through the justice process toward the perpetrator(s), and physical damage sustained in the community.
Environment		There may be risks posed to the natural environment because of a civil disturbance event. Any damages, such as the destruction of vegetation or the contamination of waterways, would likely be incidental to the physical intrusion of protestors

3.5.6.5 Cyber Attack Hazard Vulnerability

Cyber Attack Hazard Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The aim of a cyber attack is typically to corrupt or exploit protected information. Depending on the target of the ploy, a significant number of people can be victims of identity theft, fraud, or other forms of technology-based crime. Anyone with an account, membership, or other relationship with an entity that requires storage of information is vulnerable. An individual/user must rely on the entity of affiliation to create and maintain safeguards against the intrusion of computerized systems. However, even the strongest of safeguards can be corrupted or evaded. Continual monitoring of attempted or successful attempts at cyber attacks is warranted to lessen the potential impacts. Public confidence in the response of government organizations may be impacted by a cyber attack based upon societal expectations and media influence with respect to cyber attacks. There may be an expectation that government entities should do a better job of patrolling cyber crime and hold those responsible accountable. Public confidence may be impacted by media interpretation and reporting of the event, positive or negative.
Responders	Low	Cyber attacks may be used to try to intrude into electronic safety equipment or systems. This may increase call volume, block systems, or otherwise hinder emergency operations. Although responders are not likely to be at risk to a cyber attack in a physical sense, they may be impacted financially or through identity theft, much like members of the public.
Operations/Continuity of Operations	Moderate	In the event of a cyber attack, continuity of operations could be impacted if many of the services (such as internet or other IT programs) that are required to maintain daily operations are shut down by the attack. This could cause considerable disruption to normal operations in the state and could make the state potentially vulnerable to other events that may be occurring simultaneously.

Category	Impact Rating	Description of Impacts
Built Environment (Property, Facilities, Infrastructure)	Low	Cyber attacks may have the effect of disrupting life sustaining equipment or systems in hospitals or medical facilities by causing technological disruptions. These attacks may also sabotage information networks and communications equipment that could disrupt services within medical facilities. Normal operations in communications equipment such as telephones, cell phones, and internet could all be severely impacted by a cyber attack which would impact large numbers of people including critical facilities operators.
Economy	High	Freezing, redirecting, or stealing financial assets can have drastic impacts on a business. Banking and credit institutions are commonly affected or targeted by fraudulent activities and often store a great deal of information on businesses, so large-scale intrusions can have significant impacts on the local economy. Large employers are more likely to be targeted by cyber attacks than individuals or small businesses. Larger businesses generally have greater assets to exploit and store more personal information on private individuals or employees.
Environment	Low	Because cyber attacks occur in cyberspace and would not truly have any impacts outside of the physical sphere, there are no expected environmental impacts from this type of event.

3.5.6.6 Electromagnetic Pulse (EMP) Hazard Vulnerability

Electromagnetic Pulse (EMP) Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	The entire State of North Carolina's population is vulnerable to the impacts of an EMP/geomagnetic storm, regardless of the measured magnitude, although most low-classification events will not have any noticeable impact on the daily lives of people. If a large event were to occur and cause widespread power outages or communications systems disruptions, there may be a panic and people may temporarily be unable to undertake normal activities such as cooking or using mobile devices. Consumer electronics may also be damaged, including HVAC systems, newer model appliances, radios, and televisions. EMP/geomagnetic storms have some likelihood of affecting public confidence due to their highly visible impacts and the fact that most members of the public are unaware of the hazard and may be confused about the cause of loss of power/communications systems.
Responders	High	Responders could be critically affected by an EMP/geomagnetic storm event as response personnel rely heavily on communications equipment to carry out their normal operations. If a large event were to occur that knocked out communications equipment for several hours or possibly more than a day, this would significantly hinder responders' abilities to perform their duties. Additionally, other electronic equipment or devices used by responders may be damaged by an EMP/geomagnetic storm further impacting their ability to respond to emergencies following an event.

Category	Impact Rating	Description of Impacts
Operations/Continuity of Operations	High	Continuity of operations would potentially be impacted in many ways by a major EMP/geomagnetic storm. As mentioned above, if communications equipment is disrupted, it would be challenging for government officials to coordinate with one another and respond to citizen needs such as emergency medical care. It is also possible that some satellites will be damaged, affecting satellite-based communications. Additionally, if power is lost, there would be a disruption to normal operations, though there are generally plans in place to maintain continuity of operations in this case as several operations centers have backup power systems.
Built Environment (Property, Facilities, Infrastructure)	Moderate	Critical Infrastructure The primary impact on the built environment from an EMP/geomagnetic storm would be on communications and power infrastructure. Most of the built environment (e.g., homes, buildings, roadways) would not be impacted in any way by this type of event. However, if power or communications systems are damaged or temporarily shut down, some aspects of the built environment will be impacted such as traffic lights, street lights, and cell phone towers. Additionally, electronic equipment and control systems could also be damaged and water and wastewater systems, gas stations, and pipelines may be shut down throughout the state.
Economy	Moderate	An EMP/geomagnetic storm can impact any area of the State of North Carolina at any time and may bring with it an interruption of service for local businesses as well as governments that lose power or cannot utilize communications systems. As a result, there will be significant disruption of the local economy as long as the effects (such as power or communications loss) of the EMP/geomagnetic storm remain in place. ATMs, credit card processing, and other electronic financial transactions may also be disrupted, further impacting the economy.
Environment	Low	There will likely be relatively minimal impacts on the environment from an EMP/geomagnetic storm. These types of events do not directly impact plants or animals and typically do not have any effect on water systems or other natural areas. There may be indirect impacts if, for example, power systems are damaged at facilities that house hazardous materials, causing releases into the environment. However, the likelihood of this occurring is relatively low.

3.5.6.7 Food Emergency Hazard Vulnerability

Food Emergency Risk, Vulnerability, and Consequence Analysis

Category	Impact Rating	Description of Impacts
People (The Public and Public Confidence)	Moderate	A food emergency could occur at any point from food production on a farm to consumption – including pre-harvest production, processing, distribution, and retail sales. Contamination and spoilage or a food-borne disease can impact human health or result in a public health threat. Disruptions to food production and/or distribution can impact people's access to certain products or limit the overall availability of food. Public health or food-related illnesses may cause people to mistrust government and other food oversite agencies.

Category	Impact Rating	Description of Impacts
Responders	Low	Depending on the cause for the emergency, responders may need to dispose of large quantities of food products, which may need to be handled as hazardous materials. Identification of alternative sources of food may be required. Identification and disinfecting of affected locations and equipment may be needed. Responders will need training and personal protective equipment to protect their health and safety during these activities.
Operations/Continuity of Operations	Low	Significant response efforts involving multiple state and local agencies may be required during a food emergency. A food emergency is not likely to affect the continuity of operations of these agencies.
Built Environment (Property, Facilities, Infrastructure)	Low	There are no direct impacts to the built environment or infrastructure. Depending on the extent and type of event food retail stores may experience an influx of customers or depleted inventory of food-related products.
Economy	High	Food and agricultural production, processing and retail systems are a multi-billion dollar industry in NC and employs about 20% of the workforce. Incidents affecting the food chain can impact the multi-billion dollar system. Consumption of contaminated food items could result in human illness which could cost between $10-83 billion per year in the U.S.
Environment	Moderate	Any disease or vector outbreak spread through crops or animals may warrant increased monitoring of air and water quality to ensure natural resources outside of the food production system are not contaminated.

3.5.7 Critical Asset Vulnerability

3.5.7.1 State and Local Critical Assets

For the purposes of this plan, NCEM Hazard Mitigation Branch staff identified the following as critical assets:

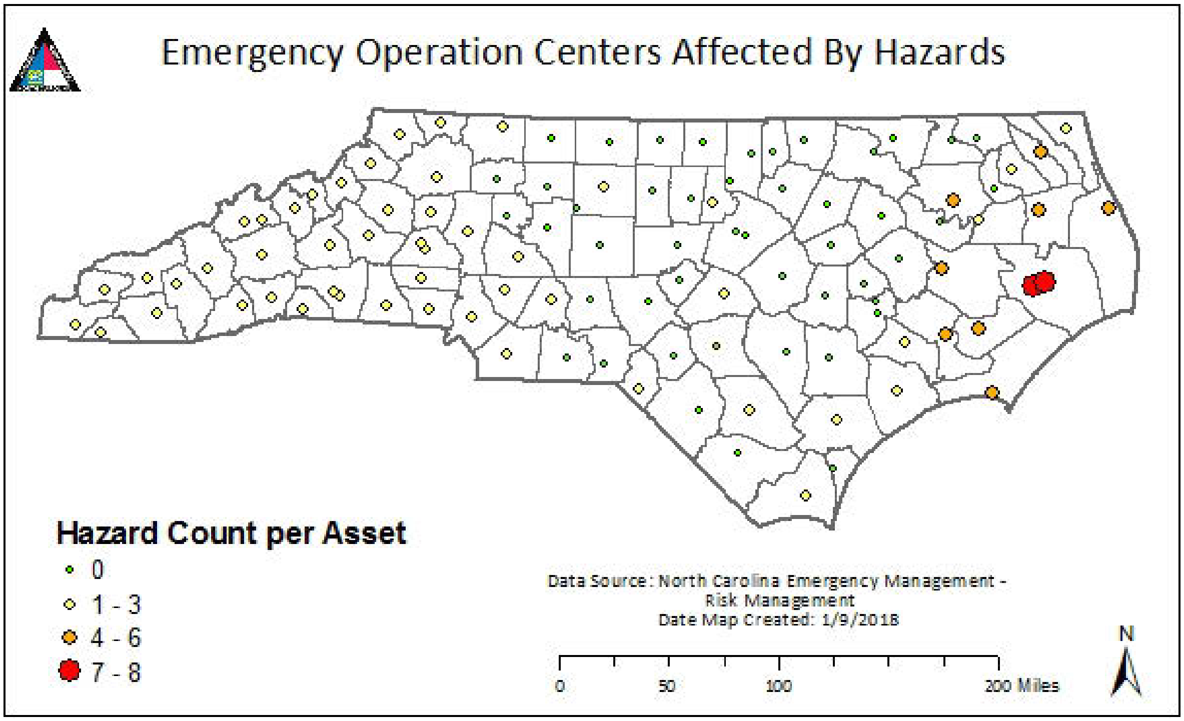
1. Emergency Operations Centers
2. State Police (Trooper) Stations
3. Local Police stations
4. Local Fire Stations
5. Hospitals
6. Shelters

The following table and associated maps present a summary of the critical assets located in North Carolina and a graphical representation of whether or not those facilities are vulnerable to natural hazards. The critical assets that intersect with the most hazard zones are depicted with the largest symbols and are colored red. The critical assets that are exposed to no hazards are depicted with the smallest symbols and are colored green.

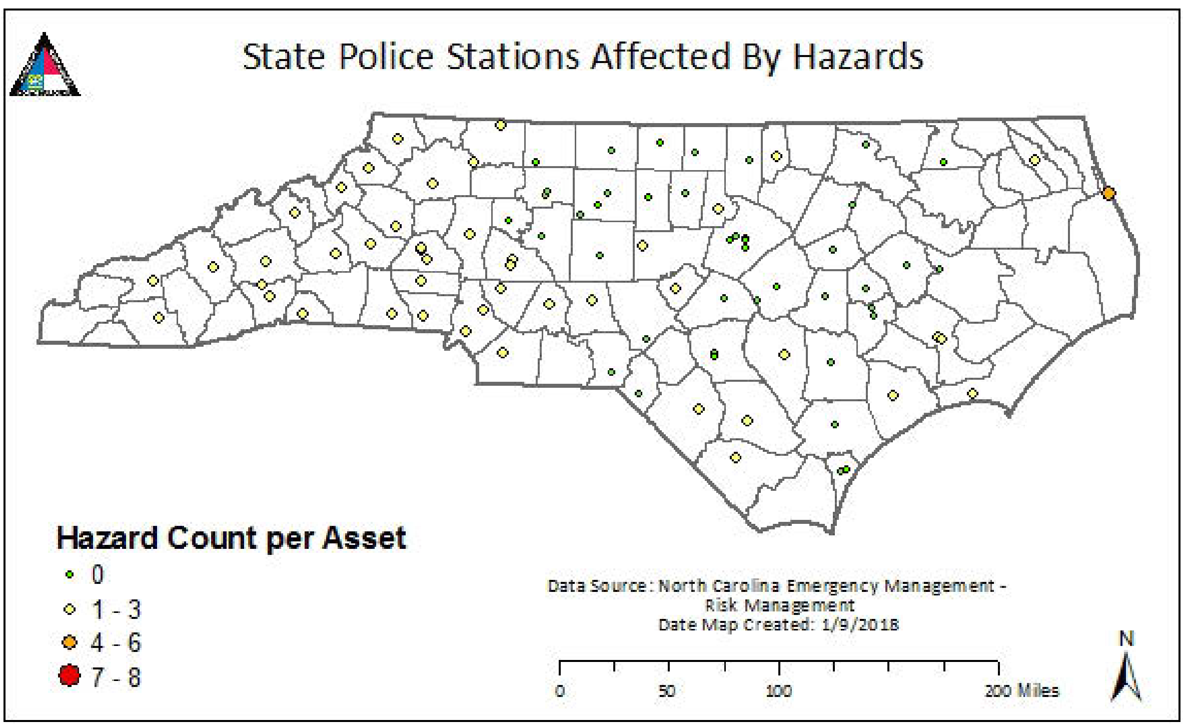
Table 3-71 Critical Assets and Hazard Zones

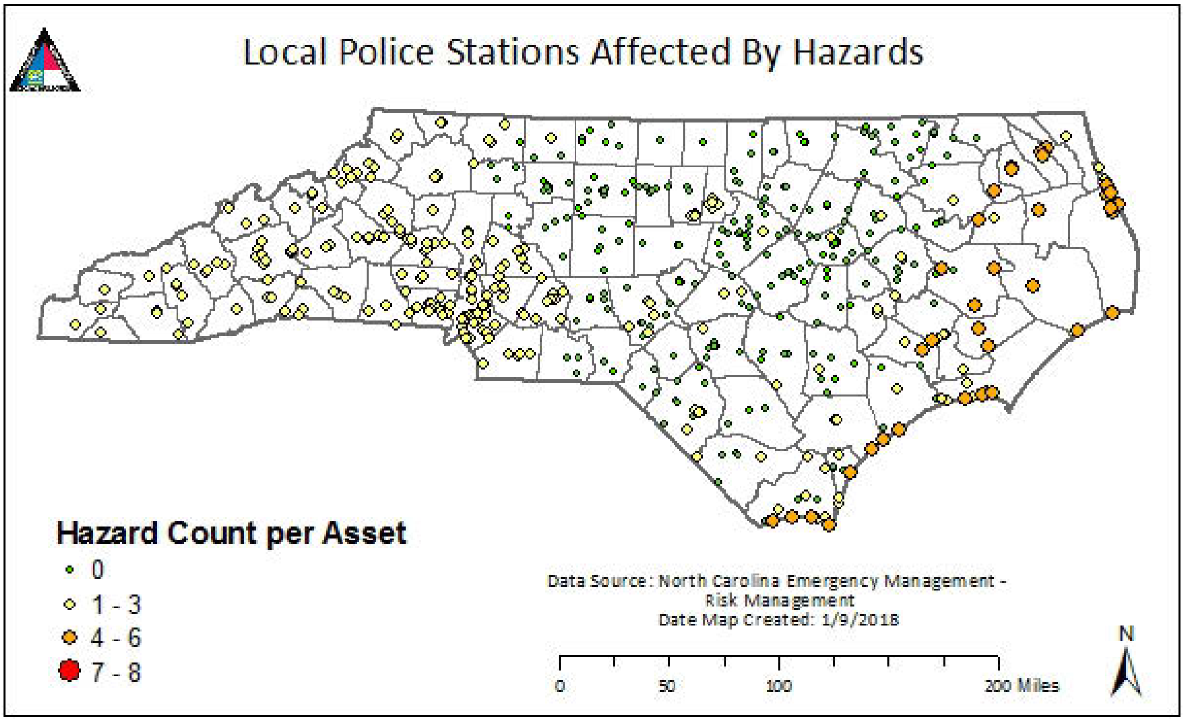
		Hazard Zones										
Critical Assets	**Total Assets Statewide**	**Flood**		**Surge**					**Wildfire**	**Landslide**	**Winter Storm**	**Earthquake**
		1% ACH	**.2% ACH**	**Cat 1**	**Cat 2**	**Cat 3**	**Cat 4**	**Cat 5**	**High WUI (7-9)**	**Very High Risk**	**Western Branch**	**High Risk (8-15% g)**
Fire Stations	3463	167	87	45	101	166	217	271	374	488	963	49
Hospitals	125	0	1	0	0	2	4	6	6	27	50	2
Sheriff's Office	101	10	9	2	6	7	10	13	7	15	34	4
Public Schools	2107	49	34	10	33	54	81	107	175	378	729	19
Police Stations State	91	2	2	0	0	2	6	6	7	17	30	1
Police Stations Local	584	39	26	10	32	45	53	64	31	104	192	8
EOCs	111	9	8	2	9	11	15	16	5	16	37	4
Shelters	1156	43	16	2	9	14	24	39	82	272	569	25

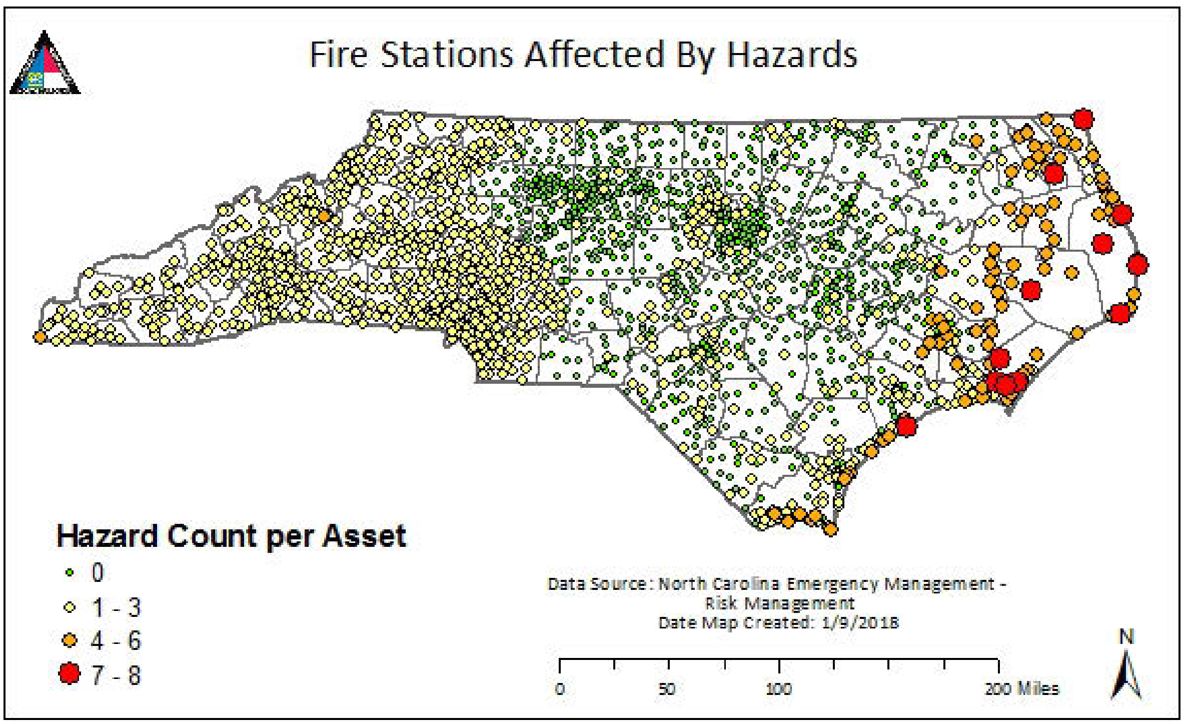
Source: NCEM
Note: There were no critical assets within 50 yards of either existing sinkholes or eroding shorelines.

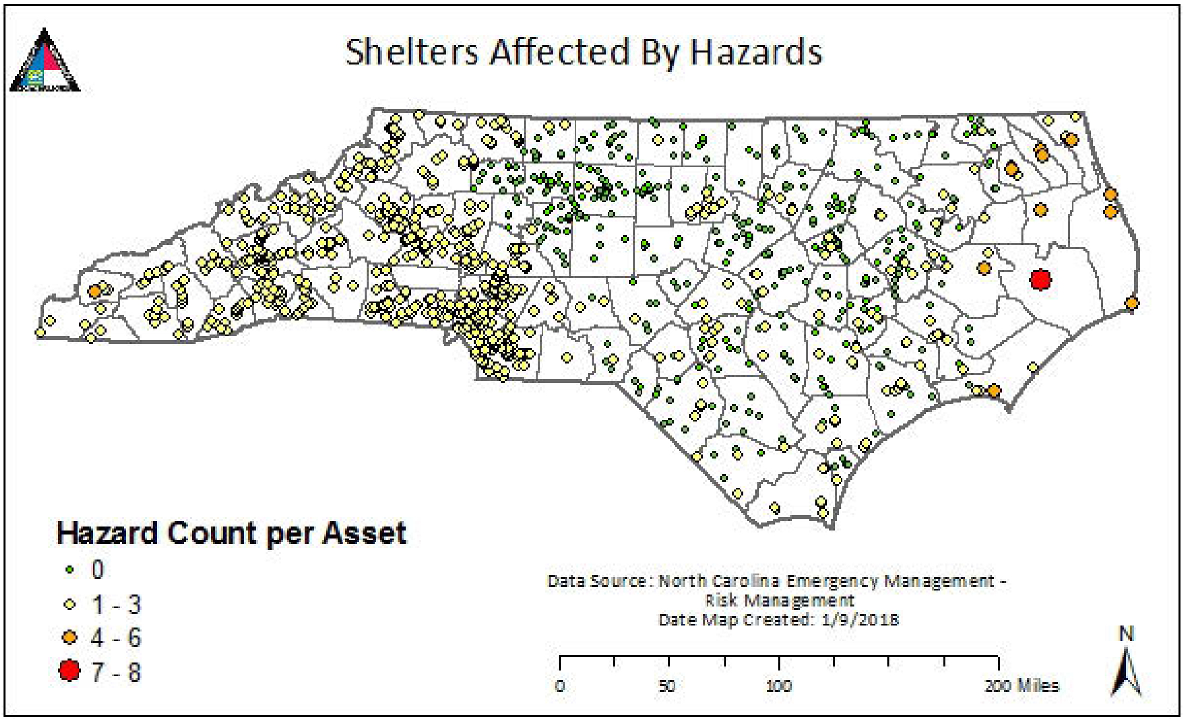


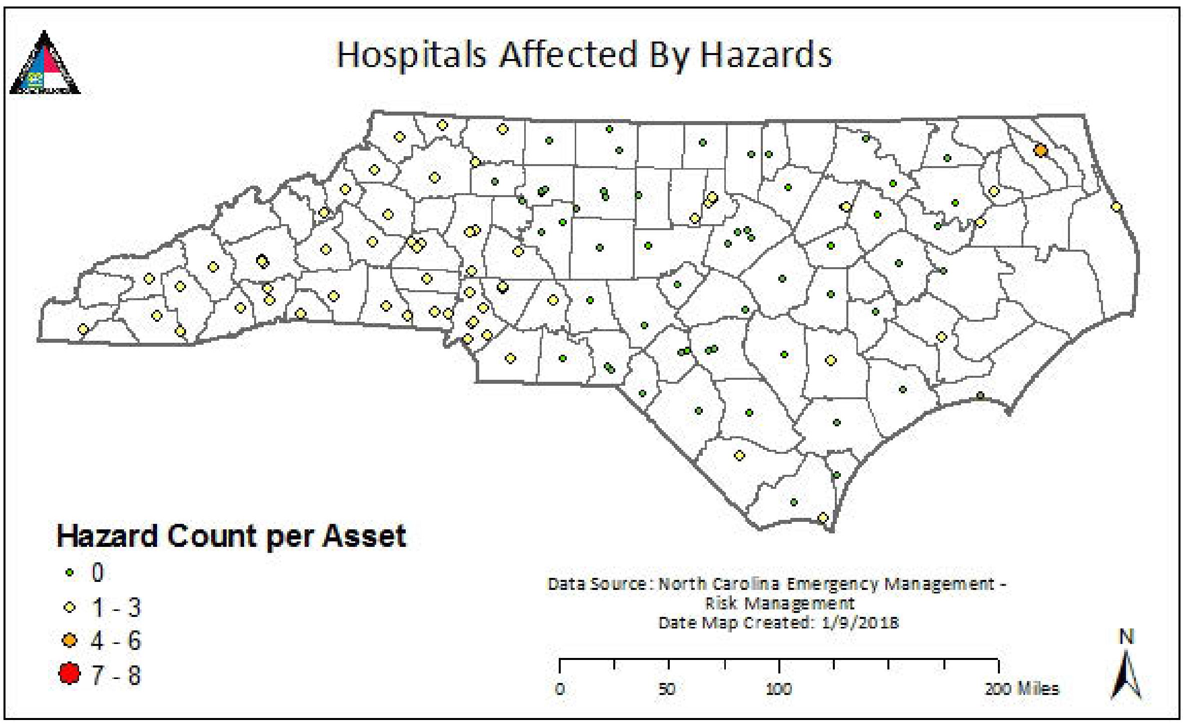
Note: This map includes the State Emergency Operation Center in Raleigh and the NCEM Branch Offices located in Conover (Western Branch), Butner (Central Branch) and Kinston (Eastern Branch). The Eastern Branch Office also serves as the State's backup EOC.

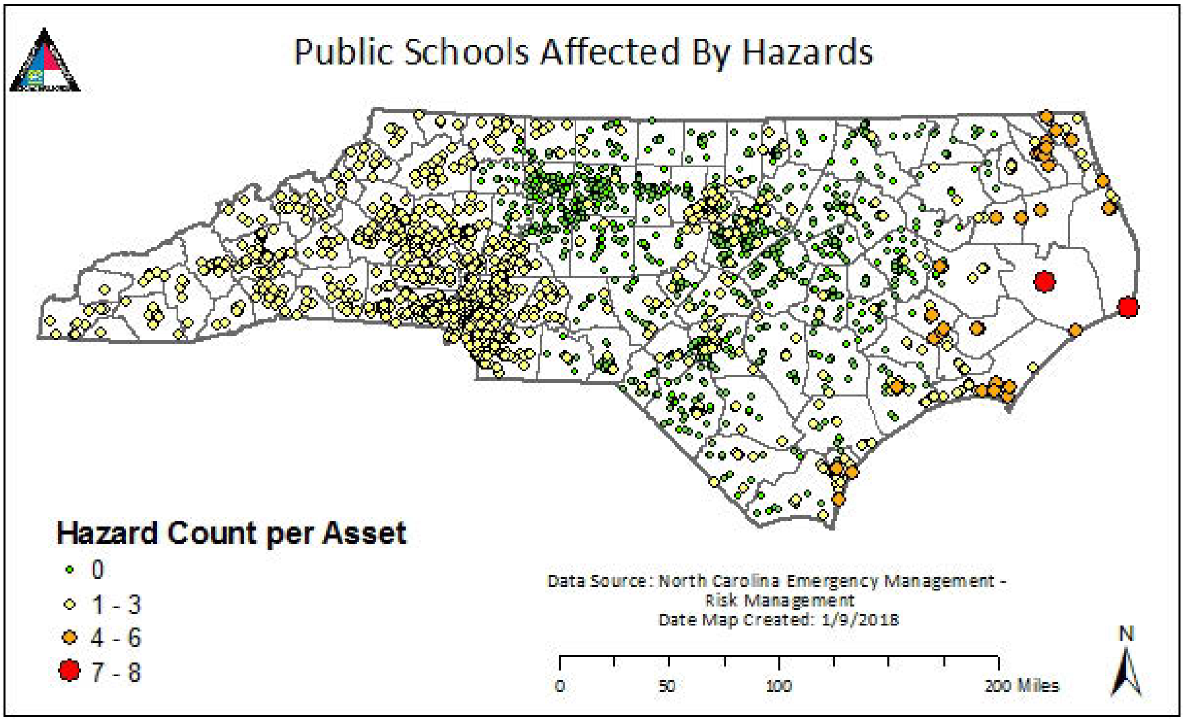



Local Police Stations Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management -
Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Fire Stations Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management -
Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Shelters Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management - Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N


Hospitals Affected By Hazards
Hazard Count per Asset
0
1 - 3
4 - 6
7 - 8
Data Source: North Carolina Emergency Management - Risk Management
Date Map Created: 1/9/2018
0
50
100
200 Miles
N



3.5.8 Risk and Vulnerability Summary

3.5.8.1 Summary of Annualized Losses

The following tables provide summary information on hazard vulnerability in North Carolina. Table 3-72 provides statewide annualized loss estimates. For flood, hurricanes, earthquakes and tornadoes, the annualized loss estimates were calculated using the methodologies used by NCEM's iRISK program. For winter storm, drought, and thunderstorms, annualized losses were calculated using NCEI data.

Table 3-73 provides building exposure totals for all buildings located in hazards zones. For wildfire, that includes the high WUI vulnerability zone. For landslide, that includes the very high landslide risk zone based on USGS data, for sinkholes that includes buildings within 50 yards of existing sinkholes (per North Carolina Geological Survey) and for coastal erosion that includes buildings within 50 yards of eroding shorelines (per North Carolina Division of Coastal Management).

Table 3-72 Summary of Statewide Annualized Losses

Hazard	Statewide Annualized Loss Totals
Flood	$120,618,328
Hurricanes	$1,706,637,980
Winter Storm	$56,283,245
Earthquake	$36,593,358
Drought	$5,297,055
Tornado	$86,182,710
Thunderstorm	$5,665,515

Source: NCEM and NCEI

Table 3-73 Summary of Statewide Building Exposure

Hazard	Building Exposure to Hazard Zones	Notes
Wildfire	$129,521,418,846	Value of All Buildings in High WUI Zones (Zones 7-9)
Landslide	$4,791,240,596	Value of All Buildings in USGS High and Very High Landslide Zones
Sinkholes	$946,356,142	Value of All Buildings within 50 yards of existing sinkhole
Coastal Erosion	$125,195,028	Value of All Buildings within 50 yards of eroding shoreline

Source: NCEM

3.5.8.2 Most Vulnerable Jurisdictions

According to the annualized loss estimates and exposure data for all of the natural hazards presented in this section, the following counties demonstrate a higher vulnerability to hazards when compared to other counties in the State:

Table 3-74 Counties with Highest Annualized Loss Estimates and Building Exposure to Hazards

County	High Annualized Losses for the Following Hazards	High Exposure to the Following Hazards
Mecklenburg	Hurricane, Earthquake, Tornado	Wildfire, Landslide
Wake	Hurricane, Earthquake	Wildfire
New Hanover	Hurricane	Wildfire, Sinkhole, Coastal Erosion
Onslow	Hurricane	Wildfire, Sinkhole, Coastal Erosion
Buncombe	Flood, Earthquake	
Dare	Hurricane	Coastal Erosion
Brunswick		Sinkhole, Coastal Erosion
Cumberland	Earthquake	Wildfire

Section 4. MITIGATION CAPABILITIES

44 CFR Reference

Requirement §201.4(c)(3)(ii): [The State mitigation strategy shall include a] discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas [and] a discussion of State funding capabilities for hazard mitigation projects; a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

Requirement §201.3(c)(5): Provide technical assistance and training to local governments to assist them in applying for HMGP planning grants, and in developing local mitigation plans.

Requirement §201.4(c)(4)(i): A description of the State process to support, through funding and technical assistance, the development of local mitigation plans.

Enhanced Plan Requirements:

44 CFR §201.5(b)(1): Demonstration that the plan is integrated to the extent practicable with other State and/or regional planning initiatives (comprehensive, growth management, economic development, capital improvement, land development, and/or emergency management plans) and FEMA mitigation programs and initiatives that provide guidance to State and regional agencies.

44 CFR §201.5(b)(4): Demonstration that the State is committed to a comprehensive state mitigation program, which might include any of the following:

(i) A commitment to support local mitigation planning by providing workshops and training, State planning grants, or coordinated capability development of local officials, including Emergency Management and Floodplain Management certifications.

(ii) A statewide program of hazard mitigation through the development of legislative initiatives, mitigation councils, formation of public/private partnerships, and/or other executive actions that promote hazard mitigation.

(iii) The State provides a portion of the non-Federal match for HMGP and/or other mitigation projects.

(iv) To the extent allowed by State law, the State requires or encourages local governments to use a current version of a nationally applicable model building code or Standard that addresses natural hazards as a basis for design and construction of State sponsored mitigation projects.

(v) A comprehensive, multi-year plan to mitigate the risks posed to existing buildings that have been identified as necessary for post-disaster response and recovery operations.

(vi) A comprehensive description of how the State integrates mitigation into its post-disaster recovery operations.

44 CFR §201.5(b)(2)(i): Documentation of the State's project implementation capability, identifying and demonstrating the ability to implement the plan, including: Established eligibility criteria for multi-hazard mitigation measures.

44 CFR §201.5(b)(2)(ii): A system "to rank the measures according to the State's eligibility criteria. A system to determine the cost effectiveness of mitigation measures, consistent with OMB Circular–94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

44 CFR §201.5(b)(2)(iv): A system and strategy by which the State will conduct an assessment of the completed mitigation actions and include a record of the effectiveness (actual cost avoidance) of each mitigation action.

44 CFR §201.5(b)(3): Demonstration that the State effectively uses existing mitigation programs to achieve its mitigation goals.

This section provides an overview of the State's capabilities and integration of other planning and operational functions into implementation of the Mitigation Strategy. It includes an overview of North Carolina Emergency Management planning integration, an identification, review, and analysis of the current resources for reducing hazard impacts including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation and development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

This section consists of the following subsections:

- State Planning Functions and Integration
- State Agency Mitigation Capabilities
- Mitigation Programs Evaluation
- Mitigation Funding
- Local and Tribal Mitigation Capabilities
- Mitigation Planning
- Mitigation Grants Management
- Summary

Governor's Executive Order 80

On October 29, 2018, Governor Roy Cooper signed Executive Order No. 80 titled, "North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy." This executive order provides detailed and comprehensive goals and honors the state's commitment to support the 2015 Paris Agreement. Per the Order by, 2025 the state plans to:

- Reduce the statewide greenhouse gas emissions to 40% below 2005 levels,
- Increase the number of registered zero-emission vehicles (ZEVs) to at least 80,000,
- Reduce energy consumption per square foot in state-owned buildings by 40% from fiscal year 2002 – 2003 levels.

The order requires state agencies to evaluate climate change impacts on their programs and integrate climate change adaptation and mitigation practices into their programs and operations, and encourages Council of State members, higher education institutions, local governments, and private businesses to do the same.

Under EO 80, the North Carolina Department of Environmental Quality (DEQ) has developed a Clean Energy Plan aimed at utilizing clean energy resources such as solar, wind, and energy storage. The Department of Transportation has developed a Zero Emissions Vehicle plan in coordination with DEQ to increase the number of ZEVs in the state. The Department of Commerce (DOC) will support the expansion of clean energy businesses as well as technology investment. They will evaluate current and projected workforce demands in North Carolina's clean energy and clean transportation sectors. They will recommend actions to help North Carolinians acquire the needed skills and education required for execution of the Order.

Executive Order 80 provides a catalyst for greater coordination between North Carolina state agencies for advancing statewide mitigation and resilience goals. This section has been revised significantly to capture those synergies.

North Carolina Climate Risk Assessment and Resilience Plan

The NC Climate Risk Assessment and Resilience Plan (2020 Resilience Plan) was created as a result of Executive Order 80 (EO80), direction for integration of climate adaptation and resilience planning into cabinet agency policies, programs, and operations. In response, NCDEQ, with support of many other agencies and stakeholders, developed resilience strategies that support communities and sectors of the economy most vulnerable to the effects of climate change and to enhance the state government's ability to protect human life and health, property, natural and built infrastructure, cultural resources, and other public and private assets of value to North Carolina from the impacts of Global Climate Change. The North Carolina Climate Risk Assessment and Resilience Plan established the North Carolina Resilience Strategy, which is a compilation of documents organized into four elements:

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 Plan (EHMP).

The 2020 Resilience Plan provided important findings describing our best understanding of the projected change in the climate; climate justice considerations; climate change-related impacts on state infrastructure, assets, programs and services within 11 critical sectors that are vulnerable and at risk to climate and non-climate stressors. It identifies preliminary actions currently underway, or which could be feasibly taken to reduce the risk for at least three example vulnerability areas; and provides recommendations for nature-based solutions to enhance ecosystem resiliency and carbon sequestration in the state's Natural and Working Lands (NWL) Action Plan[1] (see Section 4.3.2.4).

[1] https://files.nc.gov/ncdeq/climate-change/natural-working-lands/NWL-Action-Plan-FINAL---Copy.pdf

The 2020 Resilience Plan also calls for greater integration of climate change and resilience into the State Hazard Mitigation Plan. The 2023 update of the NCEHMP represents the initial opportunity for such integration. Future updates of this plan will work to build upon the efforts demonstrated in this update and will demonstrate compliance with new FEMA mitigation planning guidance concerning climate change impacts on natural hazards and the demonstration of efforts to achieve equity in planning, program delivery and outcomes for historically underserved populations.

4.1 NCEM PLANNING FUNCTIONS AND INTEGRATION

This subsection provides an overview of other planning functions within NCEM and how the various plans have been integrated among the NCEM sections. This is a key component of ensuring the planning function across NCEM are consistent and do not contradict each other in any way. This also promotes effective use of funding streams across the agency to avoid duplication of efforts, e projects, data collection, or studies of a similar nature being performed within NCEM.

NCEM Hazard Mitigation staff worked during this update to ensure that the State Hazard Mitigation Plan is integrated to the extent practicable with other State and/or regional planning initiatives including:

4.1.1 North Carolina Emergency Operations Plan

The North Carolina Emergency Operations Plan (NCEOP) guides the state's pre- and post-disaster capabilities[2]. The NCEOP is built on the all-hazards principal. The NCEOP contains Emergency Support Function (ESF) and other annexes that identify operating procedures for other tasks and hazards. These annexes have been developed considering the frequency of regional occurrence, the potential impact of hazards and the need for response procedures for certain hazards.

The North Carolina Enhanced Hazard Mitigation Plan contains the hazard identification and risk assessment (HIRA) for all hazards and suggests mitigation policies, programs, and strategies that will lessen both current and future vulnerability across the state. All hazards identified in the NCEOP are also identified in the NCEHMP and evaluated for risk. When hazards are added to either of the two documents, there is coordination between the Planning, Homeland Security and Hazard Mitigation Sections to ensure plan integration is maintained throughout the different planning functions.

4.1.2 Emergency Management Accreditation Program (EMAP)

In 2008, NCEM initiated the EMAP assessment process that includes an analysis of all its policies, programs, and capabilities. The accreditation is valid for a period of five years and then the agency must be re-accredited. EMAP provides NCEM with a baseline for continuing

[22] *The current NCEOP is based upon guidelines contained in the National Response Plan (NRP) and the Comprehensive Preparedness Guide (CPG) 101 version 2.*

assessments that will be considered across the range of plans and future plan r and updates. NCEM was re-accredited in 2013, and 2018 and is preparing for the 2023 re-accreditation process.

4.1.3 Threats Hazards Identification and Risk Assessment/State Preparedness Report

The Threats Hazards Identification and Risk Assessment (THIRA) is an all-hazards capability-based assessment tool suited for use by all jurisdictions. The THIRA allows a jurisdiction to understand its threats and hazards and how their impacts may vary according to time of occurrence, season, location, and other community-specific factors. Results are reflected in the Uniform Reporting Tool (URT) housed on the Max.gov portal. The collected knowledge allows jurisdictions to establish informed and defensible capability targets and commit appropriate resources drawn from the whole community for closing the gap between target capabilities and current capabilities and sustaining existing capabilities.

The hazards addressed in the THIRA are all hazards identified in the HIRA section of this plan. The Hazard Mitigation Section has been coordinating closely with the Plans and Homeland Security Sections for this fifth update of the Enhanced State Hazard Mitigation Plan to ensure that the hazards in the THIRA are included in the North Carolina Enhanced Hazard Mitigation Plan.

4.1.4 North Carolina State Homeland Security Strategy (NCSHSS)

The State Homeland Security Strategy outlines North Carolina's strategy and goals for enhancing the State's overall preparedness and resiliency against identified natural, human, and technological threats and hazards. North Carolina is dedicated to ensuring the public safety of its residents and communities through collaborative efforts with private, local, State, and Federal partners to prevent, protect, mitigate, respond to, and recover from those the identified hazards by aligning state efforts with the National Preparedness System (NPS) and National Preparedness Goal (NPG).

The North Carolina Homeland Security Strategy (NCHSS) is based on a shared responsibility for preparedness and cooperation whereby everyone contributes to reducing risk and fostering resilience when threatened by any hazard. The NCHSS uses a five-phase approach: Analyze, Develop, Design, Implement and Evaluate. Success is dependent upon active communication and collaboration between stakeholders from the public and private sectors and all levels of government. The NCHSS establishes seven interconnected goals which are:

1. Strengthen intelligence and information sharing capabilities;
2. Strengthen counterterrorism capabilities;
3. Enhance cybersecurity capabilities;
4. Expand critical infrastructure protection;
5. Strengthen public health and medical emergency preparedness;
6. Advance interoperable and emergency communications; and,
7. Strengthen an all-hazards preparedness capability at the local and state level.

4.1.5 Continuity of Operation Plan

The Continuity of Operations Plan (COOP) establishes procedures for the Continuity of North Carolina Emergency Management and the State Emergency Response Team (when activated). It describes essential functions that must continue in order to ensure the continued functioning of the department. The overarching continuity requirements for agencies are to:

- identify essential functions;
- determine on order of succession for assumptions of senior agency offices during an emergency;
- identification for delegations of authority for making policy determinations and decisions;
- planning for continuity of facilities or "alternate facilities" which cover not only other locations of operations, but also non-traditional options, such as telecommuting and mobile-office concepts;
- ensure the continuity communications to perform essential functions;
- vital records management for the identification, protection, and ready availability of electronic and hard copy documents, references, records, information systems, data management software and equipment needed to support essential functions;
- identify human capital for activation of emergency employees and other special categories of employees to perform assigned response duties;
- tests, training, and exercises (TT&E) which provide measures that ensure an agency's continuity plan is capable of supporting the continued execution of the agency's essential functions throughout the duration of a continuity event;
- the devolution of control and direction which determines capability to transfer statutory authority and responsibility for essential functions from primary operating staff and facilities to other agency employees and facilities; and,
- reconstitution to determine the process by which surviving and/or replacement agency personnel resume normal agency operations.

The North Carolina COOP could be activated in response to a wide range of events or situations – from a natural disaster; to the threat or occurrence of a terrorist attack. Any event that makes it impossible for employees to work in their regular facility could result in the activation of the COOP.

4.2 STATE AGENCY MITIGATION CAPABILITIES

This section provides an overview of North Carolina state agencies that play a role in advancing the State's mitigation goals and the Mitigation Strategy. Each agency listed below is a partner in contributing to the resiliency of North Carolina by implementing programs, policies, procedures and plans that collectively reduce the impacts of future hazard events in North Carolina.

4.2.1 North Carolina Department of Agriculture

The N.C. Department of Agriculture and Consumer Services' divisions have responsibilities in regulatory and service areas covering agronomy; animal health; weights and measures; gas and oil inspection; crop and livestock statistics; USDA commodity distribution; state farm operations; food, drug and cosmetic testing for purity; agricultural marketing and promotion; agricultural marketing grading; international agricultural crop and livestock marketing; operation of the North Carolina State Fair and North Carolina Mountain State Fair; operation of four state farmers markets; research station operations; seed and fertilizer inspection; nursery and plant pest eradication activities; regulation of the structural pest control and pesticide industries; agricultural environmental issues; soil and water conservation; forest management and protection; state and federal agricultural legislation; and agricultural economic analysis.

4.2.1.1 North Carolina Forest Service

The North Carolina Forest Service (NCFS), a Division of the N.C. Department of Agriculture and Consumer Services (NCDA&CS), operates under a mandate to protect, manage, and develop the millions of acres of forestland throughout the state. The Division is directly involved with forest management assistance, reforestation services, forest fire prevention and suppression, insect and disease control, and emergency response along with a host of other services and programs. The programs under the Forest Protection section of the NCFS are aimed at private forest landowners, homeowners, volunteer fire departments, communities, and the general public to increase their awareness of wildfire risk, educate them about fire safety and preventative measures, and to suppress wildfires quickly and safely. The Division also encourages the involvement of the private sector including builders and developers as well as the insurance and forestry industries to engage in widespread wildfire mitigation efforts and information dissemination. The NCFS also coordinates with the National Weather Service to forecast fire weather around the state. A more refined approach to collaboration would enhance the real-time risk assessment capabilities of the NCFS. As a leader of wildfire response in the United States, the Division would benefit from increased funding to allow more aggressive outreach and public education campaigns to communities at risk from wildfire. The Division supports integration of the Wildland Fire Management Cohesive Strategy into all Statewide wildfire planning and prevention efforts.

4.2.2 North Carolina Office of Recovery and Resiliency

NCEM's partner agency, the North Carolina Office of Recovery and Resiliency (NCORR), was established in the wake of Hurricane Florence in 2018. The agency leads the state's efforts in rebuilding following disaster events with an emphasis on long-term disaster recovery and increasing the state's ability to adapt to the effects of climate change. The goal is to rebuild stronger and smarter in an effort to heighten the state's resilience in the face of climate change. NCORR manages nearly $1 billion in U.S. Department of Housing and Urban Development (HUD) funding in Community Development Block Grant – Disaster Recovery (CDBG-DR) funds and Community Development Block Grant – Mitigation (CDBG-MIT) funds.

Additional non-Federal funding is provided through the State Disaster Recovery Acts of 2017 and 2018, and the Storm Recovery Act of 2019.

Hope Program

The NC Housing Opportunities and Prevention of Eviction Program (HOPE) is managed by the N.C. Office of Recovery and Resiliency, a division of the state Department of Public Safety. HOPE provides rent and utility assistance to low-income renters who have been financially impacted by the COVID-19 pandemic. The program is committed to helping North Carolina renters stay safe in their homes by preventing evictions and loss of utility services. HOPE Program funding was provided to the state through U.S. Department of Housing and Urban Development Community Development Block Grant – Coronavirus Relief and U.S. Department of Treasury Coronavirus Relief Fund allocations, and the Emergency Rental Assistance Program established by the US Consolidated Appropriations Acts 2021.

Strategic Buyout

ReBuild NC provides eligible property owners located in areas that are prone to repeated flooding the opportunity to sell their property and relocate to safer land. The Strategic Buyout Program has worked with small governments to identify areas with the greatest risk of damage from future hurricanes and floods. These areas are known as disaster risk reduction areas or buyout zones, and are determined to be "Most Impacted and Distressed" (MID). HUD and the state identify these MID counties. NCORR identifies buyout zones in HUD-determined MID counties as a priority before moving to state MID counties. Properties purchased by the Strategic Buyout Program will be demolished, cleared, and permanently maintained through deed restriction as green space owned by the local government.

Homeowner Recovery

The Homeowner Recovery Program assists eligible North Carolina residents whose primary y residences were directly or indirectly impacted by recent hurricane events (Matthew and Florence). The term "Homeowner Recovery Program" collectively refers to all forms of assistance that are available to eligible applicants as part of the ReBuild NC Programs delivered directly to eligible homeowners, including rehabilitation, reconstruction, manufactured home unit (MHU) repair and replacement program, reimbursement (prior to July 2022), temporary relocation assistance (TRA), and flood insurance assistance (FHA).

Resiliency

The Resiliency Program works to build a stronger North Carolina, where communities, economies and ecosystems rebound, adapt, and thrive amid changing conditions and challenges, including disasters and climate change. NCORR Resiliency advises state agencies and decisionmakers on climate adaptation and resilience policy and partners with local governments, state agencies and community organizations to improve resilience in social and financial systems that drive prosperity, human-made and nature-based infrastructure, ecosystems and natural habitats that provide critical services and assets, and health and well-being of North Carolinians statewide. Program staff coordinate: the State Disaster Recovery Task Force, which brings together experts from many organizations and disciplines to advise state agencies on recovery and resiliency; the Interagency Resilience Team, a working group of state agency staff from all cabinet agencies, as well as the Department of Agriculture and Consumer Services; the Intergovernmental Working Group on Stream Management and Flooding Reduction; and other interagency and intergovernmental resiliency bodies. The Resiliency program is currently partnering with DEQ to develop a digital resilience clearinghouse, to provide state agencies, local governments, and the public with a one-stop online resource for climate adaptation and resilience data, modeling, and information.

North Carolina Resilient Communities Program - Regions Innovating for Strong Economies and Environment (RISE)

Regions Innovating for Strong Economies and Environment (RISE) is a partnership between NCORR and the NC Rural Center. RISE aims to support resilience primarily in the storm-impacts regions of North Carolina by providing coaching and technical assistance to regional partners to support community vulnerability assessments, identify priority actions to reduce risks, and enhance resilience in their regions, and (3) hosting regional leadership training workshops that emphasize resilience as a tool for community development.

Through RISE, NCORR is facilitating development of regional resiliency portfolios for nine regions in the Eastern part of the state. The portfolios will identify vulnerable areas within the regions and identify solutions to reduce those vulnerabilities with an emphasis on selecting projects that are implementable. Each regional partnership will create two final products: A vulnerability assessment and a regional resilience portfolio. The Vulnerability Assessment stands alone, but is also appropriate for integration into regional and local plans, grant applications, public presentations, and other planning and outreach tools. The regional resilience portfolio will include goals, a summary of the vulnerability assessment, selected priority projects, and implementation plans for the priority projects. The RISE program is a partner program to the DEQ Resilient Coastal Communities Program.

Resilient Communities Guidebook

NCORR Resilience is also developing the Resilient Communities Guidebook to empower local and regional decision makers, government officials, business, nonprofit and community leaders to understand their climate vulnerability and develop shared priorities for action. The guidebook will have two components: a Playbook and an Idea Book. The Playbook will guide users through the process of building a team, analyzing vulnerabilities and assets, brainstorming and prioritizing actions, and identifying implementation steps. The Idea Book will provide case studies of projects, programs, and policies that improve resilience across social, economic, and environmental domains.

4.2.3 North Carolina Department of Environmental Quality

The Department of Environmental Quality (DEQ) is the lead stewardship agency for the protection of North Carolina’s environmental resources. The organization administers regulatory programs designed to protect air quality, water quality, and the public’s health, and also works to advance a comprehensive energy strategy. DEQ offers technical assistance to businesses, farmers, local governments, and the public encouraging responsible behavior with respect to the environment through education programs provided at DEQ facilities and through the state's school systems. DEQ also chairs the Climate Change Interagency Council, which helps the state cabinet agencies evaluate the impacts of climate change on their programs and operations and integrate climate change mitigation and adaptation practice into their activities. This action was directed by the governor's EO80 to develop strategic plans in key action areas and to create the 2020 Resilience Plan.

4.2.3.1 Division of Air Quality

The Division of Air Quality (DAQ) works with the state's citizens and industries to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all. The DAQ operates a statewide air quality monitoring network to measure the level of pollutants in the outdoor air; develops and implements plans to meet future air quality initiatives, assures compliance with air quality rules, and educates, informs and assists the public about air quality issues.

4.2.3.2 Division of Coastal Management

The Division of Coastal Management (DCM) works to protect, conserve and manage North Carolina's coastal resources through an integrated program of research, planning, permitting, education and outreach. DCM carries out the state's Coastal Area Management Act (CAMA), the Dredge and Fill Law and the federal Coastal Zone Management Act (CZMA) of 1972 in the 20 coastal counties, using rules and policies of the N.C. Coastal Resources Commission, known as the CRC. In 2019, the DCM built an online Coastal Adaptation and Resilience Clearinghouse to help local governments find information, tools, and technical resources (i.e., geospatial data, policy guidance, case studies, and funding opportunities) to build resilience.

4.2.3.2.1 CAMA Land Use Plans

The NCEM Hazard Mitigation Section provides courtesy reviews of Coastal Area Management Act (CAMA) Land Use Plan updates for the 20 coastal counties upon request from DEQ. The review is designed to ensure that CAMA plans are consistent with local hazard mitigation plans and the State Hazard Mitigation Plan. The NCEM Hazard Mitigation Section coordinates with the Division of Coastal Management (DCM) on planning and the development of project and funding proposals in designated CAMA counties to insure consistency with. CAMA regulations.

4.2.3.2.2 North Carolina Resilient Coastal Communities Programs

The North Carolina 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 through the 20 coastal counties will be eligible to apply for direct technical assistance to complete a community engagement process, risk and vulnerability assessment, and develop a resilience portfolio project for implementation. This work has been partially funded by NCORR's Community Development Block Grant program and is a sister program to NCORR's RISE program.

4.2.3.3 Division of Energy, Mineral, and Land Resources

The Division of Energy, Mineral, and Land Resources (DEMLR) seeks to promote the wise use and protection of North Carolina's land and geologic resources. The division regulates and provides technical assistance related to mining, dams, sediment and erosion control and stormwater management.

4.2.3.3.1 Dam Safety

The Dam Safety Program is housed in the North Carolina Department of Environmental Quality's (NCDEQ) Division of Energy, Mineral, and Land Resources (DEMLR). The Dam Safety Program oversees more than 6,000 regulated dams statewide and a staff member of the Dam Safety Program serves on the Risk Management Coordinating Council (RMCC).

The Dam Safety Program administers the Dam Safety Law of 1967 as amended (N.C.G.S. 143-215.23 et seq.). The Dam Safety Law provides for the certification and inspection of dams in the interest of public health, safety, and welfare reducing the risk of dam failure; preventing injuries to persons including loss of life, damage to downstream property, and loss of reservoir storage.; The law establishes and protects minimum stream flows to maintain water quantity and quality below dams. The Dam Safety program has the authority to levy fines against dam owners who violate the law and administrative code and in eminent threat situations has the authority to initiate and complete the draining and/or breach of a dam.

The Dam Safety Program makes use of state-of-the-art web-based and wireless inventory tools, which are increasing its mitigation capability and efficiency. These include the creation of and implementation of semi-quantitative risk analysis of dams, a webapp inspection report system, DamWatch implementation for all dams in NC, and GIS based data tools. While the Program receives some federal funding to carry out Emergency Action Plan permitting and inspections duties, funding from FEMA has been reduced over the past several years which has inhibited some of this work. FEMA projects funding increases over the next three to five years to help supplement this work and emergency and mitigation planning.

There are more than 6,000 dams in North Carolina, approximately half of which are regulated by the Dam Safety Program. Approximately 85 percent of the regulated dams are privately owned and maintained. Under the administrative rules enforced by the Dam Safety Program, all dams are classified as High, Intermediate, or Low hazard potential. A dam failure involving dams classified as "Low Hazard" would entail minimal interruption of road service on low volume roads and less than $30,000 in economic damage. A dam failure involving dams classified as "Intermediate Hazard" would entail damage to highways, interruption of service, and economic damage of $30,000 to $200,000. A "High Hazard" dam failure would involve the loss of one or more human lives or economic damage totaling more than $200,000. If the dam is a publicly owned utility, such as a municipal water supply dam, the cost of dam repair and loss of services is included in the economic loss estimate. Approximately a quarter of all dams in North Carolina are classified as high hazard.

The Coal Ash Management Act of 2014 (Session Law 2014-122) also amended the State Dam Safety Law and requires that all owners of high and intermediate hazard dams in North Carolina submit and maintain an approved Emergency Action Plan. These plans greatly facilitate response procedures for these dams.

One goal of the Dam Safety Program is to assess dam failure probability and vulnerability in inundation areas for high hazard dams in North Carolina. Increased levels of coordination with North Carolina Emergency Management with funding from the General Assembly have augmented the accuracy and efficiency of this effort. NC has been able to produce inundation maps for dam failures for High and Intermediate Hazard dams. The State Dam Safety Program has also developed semi-quantitative risk analysis (SQRA) for dams in NC which has been applied to approximately 76 of our dams at this time with the agency currently assessing best methods to continue this work and setting priorities for order and completion. At this time, earthquake risk and seismic design standards are only incorporated for coal combustion residual dams per state law and rules.

The majority of dams in North Carolina have private owners, some of whom have limited incomes. Others are owned by homeowners' associations with limited assets. Very limited state and federal funding is available to assist private property owners with repairs and modifications to dams to bring them into safety compliance. Therefore, some dams in the state are neglected by their owners. The Dam Safety Program has been provided an emergency fund by the General Assembly for emergency use for draining or breach of dams. Unspent funds revert back to the NC Emergency Management General Fund in July of 2023.

The Dam Safety Program coordinates with local emergency management officials to communicate emergency management (EM) responses and assists with warnings and appropriate response protocols. Local emergency management officials are often not trained in dam failure response, and some local emergency agencies lack the hardware and software needed to use the dam hazard data that is available from the State. The Dam Safety Program prepared training for local EM available upon request and participates with Local and State EM in tabletop exercises specific to dam safety.

Recently the Dam Safety Program acquired a number of Unmanned Aerial Vehicles (UAVs) and is in the process of training both central and regional staff to use the UAVs and obtain the necessary licenses. The equipment will be staged in the eastern, central, and western parts of the state to ensure rapid response times as needed. The use of UAVs will aid general inspection activities and emergency response by enabling visual inspection of areas that are hard to reach or otherwise too dangerous to access.

The Dam Safety Program recently embarked on a cooperative venture with NCEM. By integrating data received from the Dam Safety Program into the weather forecast system of the National Weather Service. This new system has the capacity to overlay dam locations in an online GIS application with weather radar, precipitation, river gauge information, and other relevant data. This project holds great potential for predicting weather system impacts on dams in specific locations around North Carolina.

Other new ventures for the Dam Safety Program include the development and distribution of hydrology and hydraulic overtopping studies of approximately 525 dams in the Neuse, Lumber and Cape Fear River Basins. The information is available to Local EM planners to address certain large and very large dams and to feed information into the online GIS applications mentioned previously as well as the SQRA to develop relative risk potential of dams.

4.2.3.3.2 Mining Program

The North Carolina Mining program is housed in the NC Department of Environmental Quality's Energy, Mineral, and Land Resources Division, and regulates the environmental permitting and operation of mines under the authority of the NC Mining Act of 1971. The purpose of the NC Mining Act of 1971 is to ensure that mining is conducted in such a way as to minimize its effects on the surrounding environment. Furthermore, proper reclamation of mined land is necessary to prevent undesirable land and water conditions that would be detrimental to the general welfare, health, safety, beauty, and property rights of the citizens of the State.

The state has around 750 active mine permits that extract various mineral resources including sand and gravel, phosphate, feldspar, and lithium, among others. Some of these sites are located either partially or entirely within the FEMA designated 100-year flood plain. Mine pit excavations at sites within the floodplain could potentially serve as temporary flood storage reducing flooding in other areas. Fill associated with mining operations placed in the floodplain (screening berms, temporary stockpiles, waste piles, etc.+. could potentially increase flooding elsewhere by reducing the storage capacity of the floodplain. The Mining Program requires applicants seeking new permits or modification of existing permits to provide notice of their application to the local jurisdiction's floodplain administrator where the operation is located.

The Mining Program recently published the location of all active and released (previously mined, reclaimed and released from further reclamation responsibility) permits on the Mining Program webpage. This web-based GIS mapping application is available to all members of the public and provides spatial representation of the location of mines throughout North Carolina. The data is also available as a layer through ArcGIS online and can be added to other maps for analysis of the relationship of mines to potential hazards, such as land slide hazard areas, high hazard dams or floodplains.

The link for the Mining program website is provided here: https://data-ncdenr.opendata.arcgis.com/datasets/nc-mining-permits/explore?location=35.506874%2C-79.425354%2C8.18.

4.2.3.3.3 North Carolina Geological Survey Advisory Committee

The North Carolina Geological Survey Advisory Committee provides comments and recommendations on the mission, goals, objectives, and projects of the North Carolina Geological Survey (NCGS), as presented by the State Geologist and staff members. Overall, the mission of the NCGS is to provide unbiased and technically accurate applied earth science scientific information to address societal needs. This includes geologic maps, mineral resource and geochemical information, topographic maps and digital products, and earth science education initiatives.

4.2.3.4 Division of Mitigation Services (DMS)

The Division of Mitigation Services (DMS) is a state Department of Environmental Quality Division that restores and protects wetlands and waterways for future generations and offsets unavoidable environmental impacts from development projects by DMS through the implementation of high-quality restoration projects elsewhere that satisfy mitigation requirements. DMS operates four In-Lieu fee (ILF) mitigation programs designed to assist private and public entities in meeting state and federal compensatory mitigation and nutrient offset requirements. DMS's ILF mitigation programs are:

1. NCDOT Stream/Wetland Program
2. Statewide Stream/Wetland Program
3. Riparian Buffer Program
4. Nutrient Offset Program

DMS was recently tasked with developing a state-wide Flood Resiliency Blueprint, which will provide a watershed-based approach to understanding flooding impacts in North Carolina. When complete, the Blueprint will enable decisionmakers at the state and local levels to make evidence-based decisions to prioritize projects to mitigate flooding impacts in their communities.

4.2.3.5 Natural and Working Lands Action Plan

The North Carolina Natural and Working Lands Action Plan (NWL Action Plan) identifies and creates opportunities and outlines specific projects for North Carolina's natural and working lands (NWL) that sequester carbon, build ecosystem and community resilience, provide ecosystem benefits, and enhance the economy. The NWL Action Plan helps identify and prioritize short-term, cost-effective, and pragmatic solutions, as well as identifying longer-term actions that require more effort and funding, including potential legislative or programmatic changes.

4.2.3.6 Coastal Habitat Protection Plan

The N.C. Coastal Habitat Protection Plan (CHPP) is a long-term enhancement of coastal fisheries through habitat protection and enhancement efforts. The document provides information on the habitat's distribution and abundance, ecological functions and importance of fish production, status and trends, threats to the habitats, and includes recommendations to address threats.

4.2.3.7 Albemarle-Pamlico National Estuary Partnership

The mission of the Albemarle-Pamlico National Estuary Partnership (APNEP) is to identify, protect, and restore the significant resources of the Albemarle-Pamlico estuarine system. APNEP pursues this mission with guidance and support from its overarching Comprehensive Conservation and Management Plan (CCMP), the Management Conference (advisory groups) and regional partners. APNEP was among the first of 28 National Estuary Programs established by the Clean Water Act in the late 1980's. The Partnership is a cooperative effort currently hosted by NC DEQ under a cooperative agreement with the U.S. Environmental Protection Agency and works closely with the Commonwealth of Virginia. APNEP's program area extends across both states, from its headwaters in the Virginia mountains and North Carolina Piedmont, through a broad coastal plain and out to the string of barrier islands bordering the sounds.

APNEP's staff works closely with diverse stakeholder committees whose members include citizens, local business leaders, environmental organizations, and local, state, and federal agencies. APNEP engages citizens and organizations through its committees to ensure a coordinated approach to managing the Albemarle-Pamlico estuarine system. By facilitating communication and collaboration among different organizations throughout the region, APNEP seeks to leverage its resources and those of its partners to accomplish more together than any individual organization could alone. This, combined with our ecosystem-based management approach, positions APNEP to identify and fill regional gaps and to address pressing issues confronting the region.

As authorized in N.C. Governor's Executive Order #26 (2017), APNEP staff is advised by a Management Conference composed of a Leadership Council, Science and Technical Advisory Committee, and an Implementation Advisory Committee. APNEP's guiding plan is its 2012-2022 Comprehensive Conservation and Management Plan (CCMP), which was created in a stakeholder-driven process with an ecosystem-based management approach.

APNEP also engages in planning and outreach work with partners such as the North Carolina Commission of Indian Affairs and Tribal governments in North Carolina to increase ecosystem and community resilience in the Coastal Plain.

4.2.3.8 Environmental Justice

The Environmental Justice Program at DEQ works to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.

The Department and its staff adhere to policies and programs for enhanced public participation and nondiscrimination. The law provides that no person shall, on the grounds of race, color, national origin, sex, age, or disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under Title VI of the Civil Rights Act of 1964, the Civil Rights Restoration Action of 1987, the Rehabilitation Act of 1973, and all other pertinent nondiscrimination laws and regulations.

DEQ strives to incorporate this perspective into the core mission of the department, along with the legal and scientific lens guiding how DEQ employees pursue their work now. DEQ's mission, "Provide science-based environmental stewardship for the health and prosperity of all North Carolinians," can only be accomplished if fighting for Environmental Justice is part of every DEQ activity.

4.2.3.9 Division of Marine Fisheries

The North Carolina Division of Marine Fisheries (DMF) is responsible for the stewardship of the state's marine and estuarine resources. The DMF's jurisdiction encompasses all coastal waters and extends to 3 miles offshore. Agency policies are established by the nine-member Marine Fisheries Commission and the Secretary of the Department of Environmental Quality. North Carolina is a member of the Atlantic States Marine Fisheries Commission, the Mid-Atlantic Fishery Management Council and the South Atlantic Fishery Management Council.

4.2.3.10 State Energy Office

The State Energy Office is dedicated to ensuring a sustainable energy future for the citizens of North Carolina. To achieve this, the office encourages "leading by example" with programs, services and technical expertise focused on energy efficiency in the public sector, encouraging the growth and development of the state energy economy and making North Carolina a leader in the creation of green jobs. The Office works to increase the use of renewable energy, alternative fuels and energy efficiency throughout the state, serving as the principal source of information for these energy areas.

4.2.3.11 Division of Waste Management

The Division of Waste Management (DWM) protects public health and the environment by assuring that solid and hazardous wastes and underground storage tanks are managed properly, and that existing contamination is cleaned up. This is accomplished through the Hazardous Waste, Solid Waste, Superfund, and Underground Storage Tank Programs. In addition, the Brownfields Program promotes redevelopment of abandoned, idle and/or under-utilized sites.

4.2.3.12 Division of Water Infrastructure

The North Carolina Division of Water Infrastructure provides financial assistance for projects that improve water quality. Programs within the division fund many types of projects, including sewer collection and treatment systems, drinking water distribution systems, water treatment plants, stormwater management systems, and stream restoration.

4.2.3.13 Division of Water Resources

The Division of Water Resources is responsible for the environmental protection and quality of the State's surface water and groundwater, and to ensure safe drinking water for its residents. This authority is granted in accordance with laws, policies and rules established by the U.S Environmental Protection Agency, the N.C. General Assembly, the Environmental Management Commission, and the Commission for Public Health.

Staff issue pollution-control permits, monitor compliance and conduct regulatory enforcement for environmental violations. Additionally, staff evaluate environmental water quantity and quality via field sampling and two in-house chemical laboratories; develop water quality standards, rules and management strategies; and provide educational awareness.

4.2.4 North Carolina State Climate Office (NCSCO)

The North Carolina State Climate Office (NCSCO), housed at North Carolina State University, is the state's climate data and knowledge center. The office has a three-pronged mission of research, extension, and monitoring. The NCSCO serves all 100 counties in North Carolina, by developing original tools and research for climate-sensitive sectors. The NCSCO works closely with North Carolina state agencies to help them understand climate risks. The NCSCO is home to the NOAA-funded Carolinas Collaborative on Climate, Health, and Equity (C3HE), one of NOAA's 11 Regional Integrated Sciences and Assessments (RISA) centers in the nation. The C3HE connects Carolinas communities with climate and health expertise to help implement community-level resilience solutions.

4.2.4.1 North Carolina Climate Science Report

The North Carolina Climate Science Report is a scientific assessment of historical climate trends and potential future climate change in North Carolina under increased greenhouse gas concentrations. The report includes quantitative projections for temperature, precipitation, and sea level rise. These projections indicate significant changes in North Carolina's climate, that will impact both the magnitude and frequency of natural hazards. Therefore, findings from this report were utilized to inform the plan update to adequately address changing conditions.

4.2.4.2 Cardinal Data Retrieval System

The Cardinal Data Retrieval System is a database built by the NCSCO office, which provides weather and climate data in an all-in-one system. Users can search by close proximity, or within exact coordinates, to a requested location measured by requested parameters and have climate and weather data available from reported weather monitoring stations in the area.

4.2.5 North Carolina Pandemic Recovery Office

The North Carolina Pandemic Recovery Office (NCPRO) was established to oversee and coordinate the fiscal response to the COVID-19 pandemic. NCPRO is responsible for overseeing the distribution of the $3,6 billion in Coronavirus Relief Funds (CRF) from the U.S.

Treasury to provide support to state agencies, local governments, nonprofits, hospitals, educational institutions, and research organizations.

In addition to CRF, NCPRO is responsible for oversight, administration, and federal reporting for three additional COVID-19 recovery programs:

1. Governors Emergency Education Relief (GEER) Program
2. Emergency Rental Assistance (ERA)
3. Homeowners Assistance Fund (HAF)

These programs provide assistance to all 100 North Carolina Counties and residents who may have been negatively affected by the pandemic. The NCPRO programs address assistance to households that were unable to pay rent and utilities due to pandemic-related loss of income or other financial hardship   to prevent homeowner delinquencies, defaults, and foreclosures.

4.2.6 North Carolina Department of Transportation

The North Carolina Department of Transportation (NCDOT) is responsible for building and maintaining the state's transportation network. There are ten divisions within the department including: Aviation, Global TransPark, Rail, Bicycle & Pedestrian, Highways, Turnpike Authority, DMV, Ports Authority, Ferry, and Public Transportation. The N.C. Department of Transportation has an annual budget of approximately $4.7 billion, with 80 percent of that coming from state revenue sources and 20 percent from federal funds.

The North Carolina Department of Transportation is committed to responsiveness, efficiency, performance, oversight, restructure, and transparency. DOT REPORT program supports the primary objectives of:

1. Increasing transparency and responsiveness to improve the conditions of our roads by quickly addressing structural problems and other reported road hazards;
2. Adopting procedures to streamline project delivery and establish a baselines unit for pricing for transportation goods;
3. Increasing transparency and responsiveness to the public and Department employees via an annual survey of measuring the level of satisfaction with transportation services and employee satisfaction;
4. Increasing budget transparency to allow for greater legislative and citizen oversight of programs and operations;
5. Improving the efficiency and effectiveness of operations aligning operations and staffing with the strategic goals set by the department; and
6. Increasing public access to the department's available information on highway and bridge projects.

NCDOT created a number of innovative, nationally recognized tools that support hazard mitigation and resilience efforts of North Carolina. These are discussed in further detail below.

The Flood Inundation Mapping Alert Network for Transportation (**FIMAN-T**) is a web-based tool used to provide the North Carolina Department of Transportation and other emergency stakeholders real-time and forecasted flood inundation depths along roads, bridges, and other NCDOT assets.

Bridge Watch is a software that monitors flood conditions of priority bridges and culverts across North Carolina. Eventually, the North Carolina Department of transportation intends to monitor all 15,500 facilities throughout the state.

Bridge Watch compares the results against other NCDOT data to determine if a bridge or roadway is likely to be affected or has been affected by current flood conditions, Bridge Watch is expected to help NCDOT better track the condition of its infrastructure over time.

FIMAN-T Surge focuses on the effects to the state’s coastal roadways from storm surges associated with the landfall of hurricanes. Developed by North Carolina Department of Transportation in partnership with the U.S. Department of Homeland Security’s Coastal Resilience Center of Excellence at the University of North Carolina at Chapel Hill, FIMAN-T Surge is designed to predict the locations and extent of storm surges approximately 48 hours before a hurricane makes landfall on the state’s coast. The system relies in part on the result of a hydrodynamic modeling tool, known as Advanced Circulation (ADCIRC) that is operated by researchers at UNC at Chapel Hill.

Resilience Analysis Framework for Transportation (RAFT) is a web-based gateway to various digital applications supporting the NCDOT, NCEM and the Statewide Risk and Resilience Strategy, by providing either real-time or planning level information to help NCDOT and emergency planners prepare for and respond to threats from natural hazards, to help ensure a safe and resilient transportation system.

North Carolina Crash Reporting Information System (CRIS) is a data system for collecting, storing managing, and analyzing high quality crash data. The system is designed to produce solutions that will use current technology to mine motor vehicle crash data and image collections to enhance the crash system’s ability to generate precise reports concerning traffic safety, engineering analysis, and safety prediction systems in a highly automated and user-friendly format.

The **Roadway Inundation Tool (RIT)** is a tool that provides high-level overview of the potential inundation effects from river crossings along primary routes. Each crossing leverages detailed hydraulic model data provided by NCEM to show water surface elevations for the 10, 25-, 50-, 100- and 500-year flood frequencies. This tool allows the user to see potential overtopping depths and flood effects at each primary road crossing and quantify potential effects,

4.2.7 North Carolina Department of Health and Human Services

The North Carolina Department of Health and Human Services (DHHS) manages the delivery of health – and human-related services for all North Carolinians. The Department works closely with healthcare professionals, community leaders and advocacy groups: local, state, and federal entities; and many other stakeholders. DHHS is divided into 33 divisions and offices. The divisions fall under six broad service areas – Health, Opportunity and Well-being, Medicaid, Operational Excellence, Policy and Communications and Health Equity. DHHS also oversees 14 facilities: development centers, neuro-medical treatment centers, psychiatric hospitals, alcohol and drug abuse treatment centers, and two residential programs for children.

The Division of Public Health promotes disease prevention, health services and health promotion programs that protect communities from communicable disease, epidemics, and food and water contamination. The Division of Public Health is on the forefront of the response against the COVID-19 pandemic. North Carolina relies on science, timely data, and key metrics to guide its pandemic response. The North Carolina COVID-19 Dashboard can be viewed here: https://covid19.ncdhhs.gov/dashboard.

4.3 MITIGATION PROGRAMS EVALUATION

This subsection provides an overview of the State's pre- and post-hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas. This section also provides an overview of how North Carolina administers federal mitigation funding in keeping with the requirements of 44 CFR 201.4 (3) (ii) and associated FEMA guidance.

4.3.1 North Carolina's Administration of Federal Government Pre- and Post-Hazard Management Policies, Programs, Funding, and Capabilities

4.3.1.1 The Stafford Act/Disaster Mitigation Act of 2000

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, (Public Law 93-288, as amended by Public Law 100-707) is intended by Congress "… to provide an orderly and continuing means of assistance by the federal government to state and local governments in carrying out their responsibilities to alleviate … suffering and damage which result from … disasters." Section 401(f) of the Act sets up the procedures for Disaster Declaration and the assistance that follows. Title 44, Chapter I, Part 206 (44 CFR 206) contains relevant regulations implementing the Stafford Act. In the event of a major disaster declaration by the President, the NC Director of Emergency Management assumes the role of the Governor's Authorized Representative and the State Coordinating Officer.

On October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 (DMA 2000) (Public Law 106-390) to amend the Stafford Act. This legislation reinforces the importance of pre-disaster mitigation planning to reduce the

Nation's disaster losses, and it is intended to systematize I and streamline the administration of federal disaster relief and mitigation programs.

The federal assistance programs established by the Stafford Act and the DMA 2000 deliver assistance to disaster survivors and local governments to begin recovery through disaster housing grants and individual assistance in the form of grants and loans and to assist government agencies in recoupment of disaster expenses and losses. The financial programs are traditionally a cost share between the federal government and non-federal participants. Many of the disaster programs involve a hazard mitigation component and are valuable to North Carolina in reducing losses and increasing resiliency to natural hazards in many communities.

NCEM administers the Hazard Mitigation Grant Program (HMGP), established in Section 404 of the Stafford Act. HMGP provides a federal cost-share for cost-effective and feasible mitigation measures to states and local governments following a declared disaster. Because the State of North Carolina recognizes the importance of these funds for local mitigation efforts, and because many communities, especially those located in more rural areas, do not have sufficient resources to provide matching funds, the State has a long-standing tradition of providing the required match for local communities that apply for HMGP planning and project funds.

Section 406 of the Stafford Act establishes the Public Assistance (PA) Program, also administered by NCEM. The Public Assistance Program provides supplemental aid for disaster recovery to state and local governments and certain private non-profit organizations. PA grants are available for the repair, restoration, and replacement of that portion of facilities damaged by a declared major disaster, and may include some cost-effective hazard mitigation measures.

Section 203 of the Disaster Mitigation Act of 2000 established the Pre-Disaster Mitigation (PDM) program to provides technical and financial assistance to states and local governments on an annually funded, competitive basis. This program was superseded by the Building Resilient Infrastructure and Communities (BRIC) program in 2019.

Building Resilient Infrastructure and Communities

The Building Resilient Infrastructure and Communities (BRIC) program supports states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks of natural hazards. The Disaster Recovery Reform Act (DRRA) of 2018 amended Section 203 of the Stafford Act. Through DRRA Section 123, National Public Infrastructure Pre-Disaster Hazard Mitigation, FEMA implemented the amended authority in Section 203 by discontinuing the PDM grant program and establishing the BRIC program with implementation materials, and notices of funding opportunity (NOFOs).

NCEM has the authority and responsibility for soliciting and reviewing BRIC program sub-applications, prioritizing and recommending technically feasible and cost-effective proposals to FEMA for competitive review and selection, and providing pass-thru funding for FEMA-approved grants to eligible sub-applicants. The BRIC program supports communities through capability and capacity building, encourages and enables innovation, promotes partnerships, enables large-scale projects. In addition to project selection, the BRIC Program offers help to communities through non-financial Direct Technical Assistance (DTA). DTA provides subject matter expertise and partnership collaboration to help develop successful community projects.

BRIC aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. BRIC projects demonstrate innovative approaches to partnerships. Through BRIC, FEMA continues to invest in a variety of mitigation activities with an added focus on infrastructure projects and Community Lifelines. FEMA developed the community lifelines construct to increase effectiveness in disaster operations and better position the agency to responds to catastrophic incidents. Community lifelines are the most fundamental services in a community that, when stabilized, enable all other aspects of society; and, when disrupted, decisive intervention is required. FEMA has identified seven Community Lifelines that includes: Safety and Security; Health and Medical; Communications; Hazardous Materials; Food, Water, Shelter; Energy (Power & Fuel); and, Transportation.

Project grants are available for projects that improve climate resiliency and improve public safety, such as:

- Natural hazard risk reduction activities mitigating risk to public infrastructure in disadvantaged communities;
- Projects that mitigate risk to one or more community lifelines;
- Projects that incorporate nature-based solutions; and
- Adoption and enforcement of the latest published building codes.

To be eligible, a project must meet the following criteria:

- Be cost-effective;
- Reduce or eliminate risk and damage from future natural hazards;
- Meet either of the two latest published editions of relevant consensus-based codes, specifications and standards’
- Align with the applicable hazard mitigation plan; and
- Meet all environmental and historic preservation (EHP) requirements.

The BRIC program is one of several federal agency programs participating in Justice40, a Biden-Harris administration initiative to prioritize federal investments benefitting disadvantaged communities. FEMA set a baseline to achieving the Justice40 initiative goals which prioritize delivering at least 40% of the overall benefits to disadvantaged communities. Examples of FEMA’s commitment to prioritize equity in North Carolina include:

Duhart Creek Restoration

Duhart Creek is located along the east side of Gastonia. Frequent and increasingly severe rain events have left the creek vulnerable to flooding and caused significant erosion along the banks. Continued heavy rain events, and resulting erosion, have caused nuisance flooding and threatens to jeopardize the integrity of critical infrastructure lines. This federal grant funding will strengthen Duhart's Creek by restoring the stream, stabilizing the creek bank and realigning critical water and power infrastructure. This design approach emphasizes nature-based solutions and materials to control matting, and native plantings. The goal is to reduce the severity of erosion and encroachment from future flood events.

Blood Run Pump Station Relocation

This project consists of streambank enhancement work, including an area of Loves Creek that the town of Siler City, located in western Chatham County in a historically agricultural area, completed previous floodplain rehabilitation efforts. The pump station is currently located in the floodplain of the Blood Run Stream and has been damaged in the past by flooding. The project includes the demolition and reconstruction of the pump station outside the 100-year floodplain at a higher elevation to mitigate future flood damage. Large portions of the outfall and main interceptor are in the floodplains of Blood Run Stream and Loves Creek. These sewer mains will be replaced with larger pipes based on the Town's Capital Improvements Plan and anticipated growth in the community.

Building Elevations to Restore the Pollocksville Commercial Corridor

The small community of Pollocksville is located in southeastern North Carolina just west of low-lying beach communities and the Outer Banks, and is in the process of recovering from historic flooding from Hurricane Florence in 2018. The business district along Main Street suffered catastrophic damage. In response, the Pollocksville Community Floodprint Plan utilizes a combination of "green" and "gray" infrastructure improvements that will mitigate the risk of repetitive flood damage to the downtown. Over the long term, mitigating damage and losses due to flooding will allow the community and its businesses to continue to operate. The project will provide immediate benefits of building the area back in a resilient manner post-Hurricane Florence.

A total of ten North Carolina projects were designated for funding totaling almost $50 million in the nationwide BRIC competition, more projects than any other state, and sixth in the nation for total BRIC funding in FY2021.[3]

The Flood Mitigation Assistance (FMA) program is a pre-disaster federal grant program is designed to reduce claims against the National Flood Insurance Program by providing annual funding assistance to NFIP-participating communities for flood mitigation activities including acquisition, elevation or relocation of NFIP-insured structures, and the creation of flood

[3] *Governor Roy Cooper Joins FEMA Administrator in Gastonia to Announce Resiliency Flooding. North Carolina Governor's Office. Retrieved on September 14, 2022 from: https://governor.nc.gov/news/press-releases/2022/08/12/governor-roy-cooper-joins-fema-administrator-gastonia-announce-resiliency-funding#:~:text=The%20agency%20expects%20to%20award,from%20BRIC%20and%20FMA%20funding.*

mitigation plans. The program prioritizes assistance for structures that have experienced repetitive losses and that have received multiple claims against NFIP policies.

These programs are implemented through NCEM with the main objectives of:

- Prevention of future losses of lives and property due to disasters
- Implementation of state or local mitigation plans
- Enabling implementation of mitigation measures during a state or community's immediate recovery from a disaster
- Providing funding for mitigation measures identified in local and regional Hazard Mitigation Plans that benefit the disaster area.

Of the programs administered by FEMA, the most useful funding source for mitigation projects in North Carolina communities that have experienced a recent declared disaster has been the HMGP. Communities that have not received disaster-related funds have made some use of BRIC and FMA funding, but access to these grants is limited by their nationally competitive nature pf the grants and until recently narrower latitude for project types and activities. More recent offerings from the BRIC and HMGP programs have broadened the scope of eligible activities to include capability and capacity building grants that enable wider participation. More details about various funding programs are available later in this section.

Mitigation Planning Under DMA 2000 and SB 300

In addition to providing funds for mitigation projects, Section 322 of the Disaster Mitigation Act provides a new and revitalized approach to mitigation planning at both the state and federal levels. Section 322 specifically calls for the following:

- Establishes a new requirement for local and tribal mitigation plans
- Authorizes up to 7 percent of the Hazard Mitigation Grant Program (HMGP) funds available to a state to be used for development of state, local, and tribal mitigation plans
- Provides for states to receive an increased percentage of HMGP funds (from 15 percent to 20 percent) if, at the time of the declaration of a major disaster they have in effect an approved Enhanced State Mitigation Plan.

In June of 2001, the North Carolina General Assembly passed Senate Bill 300: An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, this bill requires that local governments have an approved hazard mitigation plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004). The Bill also requires that communities be participants in good standing in the National Flood Insurance Program (NFIP) to receive public assistance for flood-related damage.

Both Senate Bill 300 and the Disaster Mitigation Act of 2000 set forth a requirement for local governments to have an approved and adopted hazard mitigation plan as a condition of participation in various state-funded disaster mitigation and relief programs. This illustrates that North Carolina takes seriously the need for comprehensive all-hazard mitigation plans and planning. With planning requirements tied to mitigation and public assistance funding, the sense of urgency was created throughout the State to complete the task of maintaining plans that not only meet minimum criteria, but also work toward reducing vulnerability to natural hazards. In 2005, NCEM began prioritizing use of mitigation planning funds toward communities that expressed interest in joining neighboring municipalities and counties in a regional approach to Hazard Mitigation Planning. As of this update, approximately 180 single-jurisdiction plans have been replaced by 27 regional plans and 3 single county multi-jurisdictional plans. (For more details on local hazard mitigation planning in North Carolina, see discussion of the Hazard Mitigation Planning Initiative below as well as the Local and Tribal Mitigation Capabilities Section of this Capability Assessment.)

Hurricane Recovery Act of 2005

Following the impact of Hurricanes Francis and Ivan on Western NC during a ten-day period, the North Carolina General Assembly obligated $247 million through Senate Bill 7 toward the development and implementation of a variety of projects in the region that addressed mitigation, recovery and preparedness needs of the local communities. Obligation of these funds allowed completion of essential work to sustain local communities while building local capacity and implementing mitigation measures as part of the recovery and reconstruction process.

Hurricane Matthew Resilient Redevelopment Plans

In December 2016, the North Carolina General Assembly established the North Carolina Resilient Redevelopment Planning (NCRRP) program as part of the 2016 Disaster Recovery Act (*Session Law 2016-124*). The purpose of the program is to provide a roadmap for community rebuilding and revitalization assistance for the communities that were damage by Hurricane Matthew, as well as Tropical Storms Julia and Hermine. The primary goals were to: develop strategic plans and actions; and define any unmet funding needs required to implement those actions after other funds are used. The resulting redevelopment plans serve as the foundation for any supplemental funding received from Congress, the North Carolina General Assembly and other funding sources. These plans also provide the basis for the state's Recovery Action Plan required by the U.S. Department of Housing and Urban Development heeded to spend funds allocated through the CDBG – Disaster Relief program. The program is facilitated by NCEM for development of regional redevelopment plans for four "prosperity zones" as identified by the North Carolina Department of Commerce.

Prosperity zones were created by the North Carolina General Assembly in 2015 for the following purposes:

- Facilitate collaborative and coordinated planning and use of resources;
- Improve cooperation with other governmental and nonprofit entities at the local and regional level;
- Facilitate administrative efficiencies within State government;

- Receive advice on economic development issues by local boards established by a North Carolina nonprofit cooperation with which the Department of Commerce contracts; and
- To the extent feasible, establish one-stop sources in each region for citizens and businesses seeking State services at the regional level.

4.3.1.2 Unified Hazard Mitigation Assistance

The Federal Emergency Management Agency is the lead federal agency responsible for providing technical and financial assistance to both state and local governments for disaster mitigation planning and the implementation of mitigation projects. There are several different mitigation grant programs available from FEMA to the State and to communities in North Carolina, including UHMA program which includes the Hazard Mitigation Grant Program (HMGP), the Building Resilient Infrastructure and Communities (BRIC) and the Flood Mitigation Assistance (FMA) program. These are described in detail here.

The objectives of FEMA's various mitigation grant programs are as follows:

- To prevent future loss of life and property due to disasters
- To implement state and local mitigation plans
- To enable mitigation measures to be implemented following a state's or community's immediate recovery from a disaster
- To provide funding for previously identified mitigation measures that benefit the disaster area or the state as a whole

The programs under the Unified Hazard Mitigation Assistance program offer a source of funding for local governments that have experienced a recent declared disaster and also, provide communities that have not received disaster-related funds to make use of UHMA non-disaster program funding. A significant number of jurisdictions in North Carolina have benefited from the implementation of mitigation activities utilizing Declared Disaster and Non-Disaster Funding.

To summarize, current sources of FEMA Funding utilized by NCEM are:

- Flood Mitigation Assistance Program (FMA)
- Building Resilient Infrastructure and Communities (BRIC)
- Hazard Mitigation Grant Program (HMGP)
- Public Assistance Program (PA)

4.3.1.3 High Hazard Potential Dam Program

The High Hazard Potential Dam (HHPD) Program is a grant program authorized in 2016 and funded annually beginning in 2019 under FEMA's National Dam Safety Program. It is managed at the state level by the DEQ Dam Safety Program. Section 5006 of the Water Infrastructure Improvements for the Nation (WIIN) Act amends the National Dam Safety Program Act to direct FEMA to establish a program to provide technical, planning, design, and construction assistance grants for rehabilitation of eligible high hazard potential dams. This program is currently available to eligible local governments for remediation of high hazard dams in poor or unsatisfactory condition owned by local or state government entities and non-profit organizations. The intent of the program is to mitigate unsafe conditions for these qualifying dams in order to reduce risk to downstream populations

4.3.1.4 National Flood Insurance Program/Community Rating System

The National Flood Insurance Program (NFIP)

The Federal Insurance and Mitigation Administration (FIMA) administers the National Flood Insurance Program, a self-supporting program requiring no taxpayer funds to pay claims or operating expenses. The National Flood Insurance Program (NFIP) was enacted in 1968 through the National Flood Insurance Act. This act made federally subsidized flood insurance available to property owners in municipalities and counties that agree to participate in the NFIP.

Floodplain Management Under the NFIP

There is no cost to participate in the NFIP. However, to participate in the program a community must make application through FEMA to join., adopt a resolution of intent to abide by the program regulations, and adopt and administer a local flood damage prevention ordinance that meets criteria established in 44 CFR 60.3. These criteria include:

- Require and maintain permits for all development within designated floodplains
- Review development plans and subdivision proposals to determine whether proposed sites will be reasonably safe from flooding
- Require protection of water supply and sewage systems to minimize infiltration of floodwater
- Obtain, review, and utilize all base flood elevation data
- Assure the maintenance of flood carrying capacities within all watercourses

Model documents and specific instructions to assist local communities to enroll in the program are available from NCEM.

The North Carolina Floodplain Mapping Program maintains a process for continuously updating all the Flood Insurance Rate Maps in North Carolina. These maps (FIRMS) coupled with Flood Insurance Studies and Local Flood Damage Prevention Ordinances are the central regulatory tools of the NFIP.

These tools contain valuable information to be used for floodplain regulation and management of floodplain development activities.

Participation by communities with identified special flood hazard areas in a variety of state and federal mitigation and disaster recovery programs is contingent on participation in the NFIPl and enforcement of related ordinances and regulations. Federal guidance requires purchase and maintenance of NFIP coverage for all properties financed with mortgages provided by Federally insured lending institutions.

The Link Between NFIP Compliance and Federal Assistance

While participation in the NFIP is voluntary, federal and state restrictions apply to non-participating communities. Some of these restrictions include:

- Flood insurance may not be purchased through the NFIP by anyone living within a non-participating community's jurisdiction. A homeowner's policy does not cover damages resulting from rising waters or floods.
- No federal disaster assistance, including SBA, FMHA, VA, etc., may be provided in areas which have been identified as flood prone within the community if the damage was caused by flooding.
- No FDIC or FSLEC guaranteed lender may make a loan with property as collateral to anyone owning property in the floodplain unless insurance is purchased and maintained for the life of the loan. Lenders do have the option of making a conventional loan.
- Public assistance to recover from flood damage is not available to local governments for state-declared disasters. FEMA PA funds are limited in cases where flood-damaged public buildings in the special flood hazard area are not eligible for NFIP coverage. If otherwise eligible properties are NOT covered by an NFIP policy and damaged by a flood, the Public Assistance Program will ONLY cover that portion of the damage that would NOT have been covered by an in-force NFIP policy.
- The community is not eligible to apply for hazard mitigation grants for flood-related mitigation projects.

Floodplain Manager Training and Education

Following Hurricane Fran, FEMA developed a self-contained home-study course designed to educate local floodplain managers in North Carolina about the regulatory permitting processes of the NFIP, requirements for compliance, and other aspects of the Program. The study course is modeled on FEMA's Emergency Management Institute (EMI) course for local floodplain managers, with the addition of elements relevant to floodplain management in North Carolina. Introductory workshops are also held to help local communities get started in the NFIP process as well as more technical workshops for enrolled communities. Completion of this coursework followed by passing an examination administered by the North Carolina Association of Floodplain Managers earns Certified Floodplain Manager (CFM) credentials for state and local operatives and officials with floodplain management responsibilities.

The NCEM Hazard Mitigation Section works with the North Carolina Association of Floodplain Managers in the administration of the home-study course and for certifying completion by floodplain managers in order for them to earn Certified Floodplain Manager status. NCEM also regularly administers the FEMA L 273 Course—Managing Floodplain Development through the NFIP. NCEM keeps a current database of local floodplain managers who have earned the designation. Floodplain management training and education programs are an ongoing process; it is a goal of the NC NFIP that all local floodplain managers receive the technical training necessary to build local administrative capacity for comprehensive floodplain management.

Lender and Insurance Agent Training and Education

Flood insurance is required whenever financial assistance from a federally regulated institution is used to purchase or construct a building in a SFHA. With many insurance companies issuing NFIP policies, agents require specific knowledge and skill in floodplain management principles. The NFIP contracts with H2O Partners, Inc. to offer agent training through Insurance Agent workshops given by regarding the Flood Insurance Program, rates, regulations, and basic underwriting guidelines.

The workshop also addresses stipulations related to provision of insurance within Coastal Barrier Resource System units (CoBRA Zones). The Coastal Barrier Resources Act (CBRA) of 1982 and their related regulations established provisions for development in undeveloped and high-hazard coastal areas. The act stipulates a ban on selling federally backed flood insurance for structures built or substantially improved after October 1, 1983, in a CBRA zone. For those CBRS units added in 1990 by the Coastal Barrier Improvement Act (CBIA), the ban applies to those structures built after November 1, 1990.

Increased Cost of Compliance

Increased Cost of Compliance (ICC) is an endorsement to NFIP policyholders' standard flood insurance policy. It applies to all new and renewed flood insurance policies effective on and after June 1, 1997. ICC is available to help owners whose homes or businesses are damaged beyond 50% of their market value by flood to cover excess repair costs related to meeting current building code and other requirements imposed by the local floodplain management ordinances to reduce the likelihood of future flood damage. Flood insurance policyholders in high-risk areas (Special Flood Hazard Areas) can get up to $30,000 to help pay the additional costs of bringing their home or business into compliance.

There are four options offered through ICC to help policyholders comply with the local floodplain management ordinance and help them reduce future flood damage: elevation, relocation, demolition, or flood proofing (available primarily for non-residential buildings). Claims may be filed for Increased Cost of Compliance coverage in two instances. 1) If the community determines that the home or business is damaged by flood to the point that repairs will cost 50 percent or more of the building's pre-damage market value ("substantial damage"); or 2) If the community has a repetitive loss provision in its floodplain management ordinance and determines that the home or business was damaged by a flood two times in the past ten years, where the cost of repairing the flood damage, on the average, equaled or exceeded 25 percent of its market value at the time of each flood ("cumulative damage"). Additionally, there must have been flood insurance claim payments for each of the two flood losses. At least 76 North Carolina communities have adopted cumulative damage provisions in the Flood Damage Prevention ordinance.

Community Rating System (CRS)

The Community Rating System (CRS) is a program administered under the National Flood Insurance Program (NFIP) that allows local governments to earn points resulting in a reduction of 5-45%in flood insurance premiums for residents of the community. The CRS issues credit points for various floodplain management activities conducted by the local jurisdiction. The number of credit points earned determines the amount of premium discount offered to NFIP policy holders in that community. Preparing a flood mitigation plan is one of the activities credited under the CRS.

North Carolina has one of the best national participation rates in the CRS, with 105 CRS communities out of 594 participating communities enrolled. The state boasts five Class 9 communities, forty-six Class 8 communities, twenty-six Class 7 communities, eleven Class 6 communities, seven Class 5 communities and one Class 3 community. Class 5 above receive at least a 25% discount on NFIP premiums for property owners.

Many of the local hazard mitigation plans that are being maintained by North Carolina communities through the Hazard Mitigation Planning Initiative can also qualify as Floodplain Management Plans to meet CRS requirements. Technical assistance materials are available to HMPI communities and include guidance on incorporating CRS planning elements into local all-hazards mitigation plans. This strategy reflects Federal Emergency Management Agency (FEMA) policy to integrate all the planning requirements for various federal assistance programs into one comprehensive set of criteria.

A study conducted by FEMA evaluated the effectiveness of flood mitigation activities in North Carolina following Hurricane Floyd. In the report, entitled “Evaluation of CRS Credited Activities During Hurricane Floyd” eight credited CRS activities were evaluated to determine their impact on flood losses. Among the findings were:

- Residents of CRS communities have a higher awareness of their local flood hazard, hold more flood insurance, and implement more flood protection measures.
- Preserving flood-prone areas as open space saves between $47,500 and $111,000 in losses per acre.
- Acquisition and relocation of flood-prone buildings is more effective in reducing flood losses than any other approach. Cost of relocation was paid back in damages and claims avoided within three years.
- Raising structures above the minimum required (base flood elevation) pays off, and the higher the building, the less flood damage it experiences.
- Homeowners who install flood protection measures prevent, on average, $9,900 in damage.

4.3.1.5 Risk MAP and Cooperating Technical Partner

Risk MAP is one of the primary FEMA-sponsored programs providing communities with flood risk data to drive actions by helping inform hazard mitigation plans developed at the state and local level in North Carolina.

NCEM manages the implementation of FEMA’s Risk MAP (Mapping, Assessment & Planning) program in North Carolina through the North Carolina Floodplain Mapping Program (NCFMP). According to FEMA, “Risk MAP provides high quality flood maps and information, tools to

better assess the risk from flooding, and provides planning and outreach support to communities to help them act to mitigate flood risk. Each Risk MAP project is tailored to the needs of the community and involves different products and services."
The Risk MAP program also tracks national statistics for how many mitigation actions are identified or advanced as a result of Risk MAP involvement through meetings, data, or other touch points.

Through FEMA's Cooperating Technical Partnership (CTP) initiative, North Carolina was designated as the first Cooperating Technical State (CTS) on September 15, 2000.r. As a CTP, the State assumes primary ownership and responsibility of the floodplain mapping processes for all North Carolina communities participating in the National Flood Insurance Program. (NFIP) CTP activities include data collection, flood hazard analyses and production and update of digital FIRMs (DFIRMs). The State of North Carolina believes that accurate, up-to-date flood hazard information is crucial to protect the lives and property of its residents. Historically, FEMA's limited mapping budget has not permitted an adequate response mapping update need, and many communities nationwide lack the necessary resources to take on this responsibility themselves. As a CTP, the State of North Carolina appropriates funding, coordinates with participating communities, and leverages technology advancements to enhance the quality and quantity of data used in risk assessment and mapping for a range of products including the Flood Rate Insurance maps.

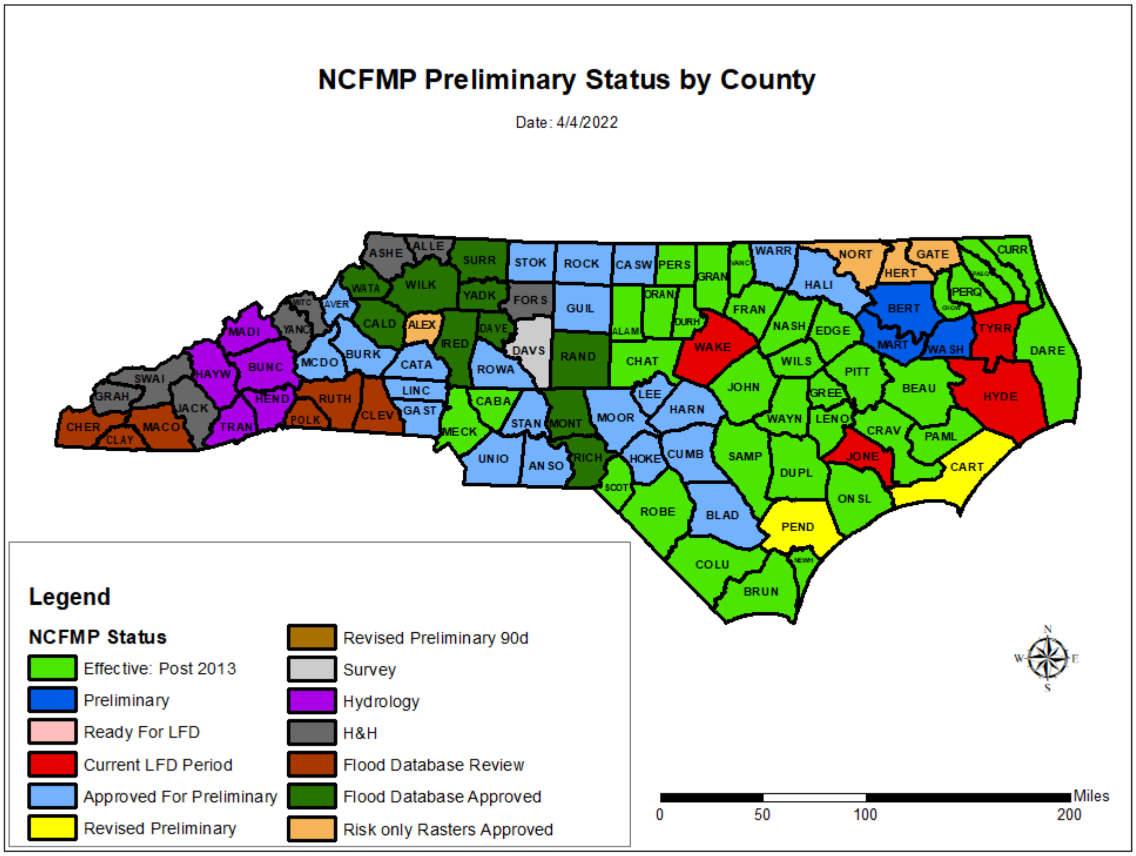
The goals of the North Carolina Floodplain Mapping Program include:

- compiling current, accurate flood hazard data for sound development and design decisions.
- minimizing long-term flood losses through better floodplain management.
- making FIRMs cheaper, more accurate, and faster to update and providing them in digital format to more easily and efficiently alert property owners of the need for flood insurance.
- using digital data to make more precise flood risk determinations.
- providing 24-hour online access to GIS analysis and planning tools.
- making Digital Elevation Models (DEMs) available for a wide variety of engineering or planning application.

County flood studies are updated every 10-15 years. The updated study data provides more accurate information for North Carolina communities and helps inform resilient development practices and mitigation approaches, helps with design and rebuilding decisions after flood disasters and for construction of new buildings and infrastructure of retrofitting of existing buildings and infrastructure.

The following figure demonstrates (as of 4/4/2022) the current status of flood mapping and flood risk data and mapping for the State. This represents the second, and in some cases third, update of flood maps for the counties since 1999.

Figure 4-1 Status of Floodplain Mapping in North Carolina



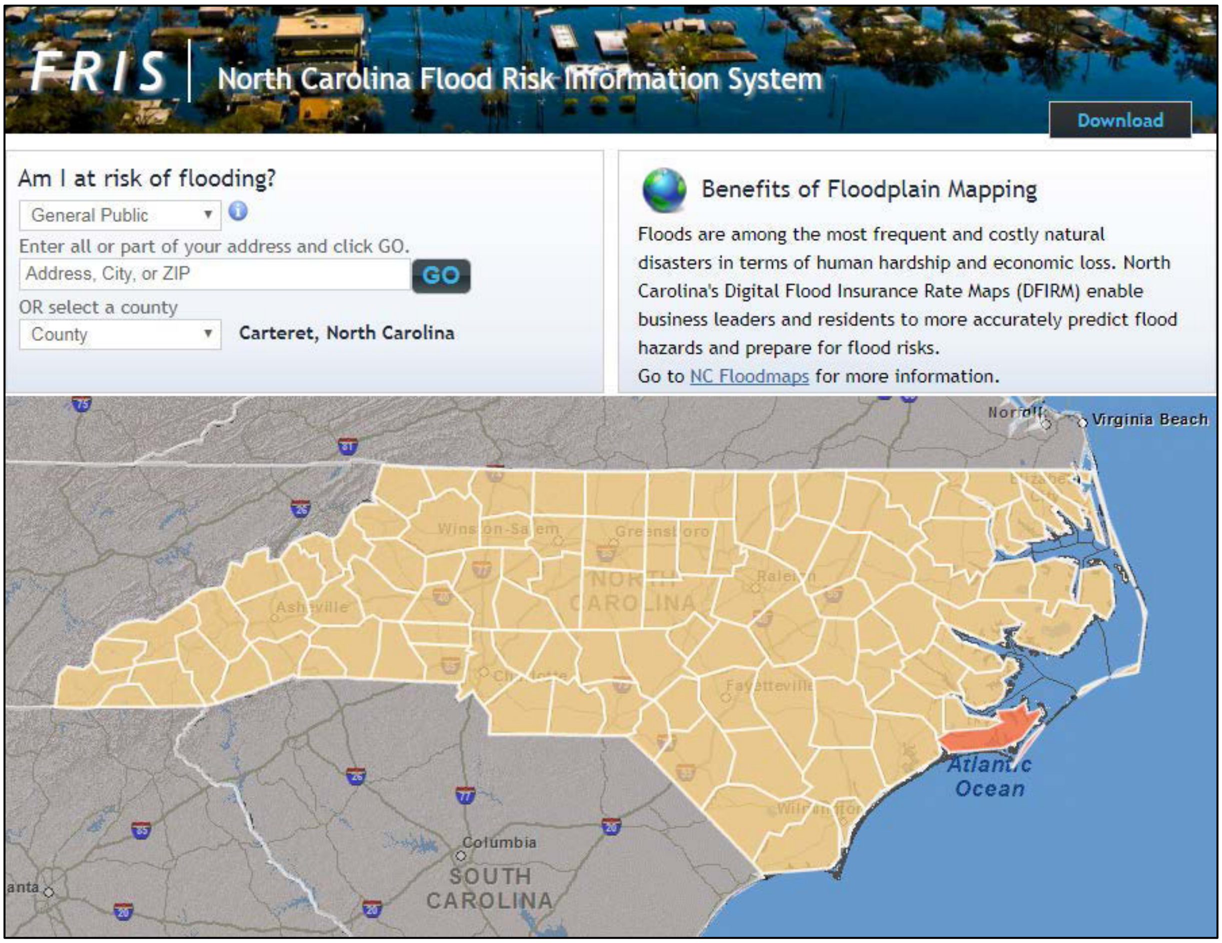
The data created through Risk MAP projects is leveraged by state and local agencies to aid in decision making and planning. The data supports the identification of hazard mitigation opportunities, prioritization, and application development as well as the enforcement of building codes and local floodplain management ordinances. Using this data, the State of North Carolina has created several online mechanisms for sharing information for local use, including the Flood Risk Information System (FRIS), Flood Inundation Mapping and Alert Network (FIMAN), and Flood.nc.gov.

Flood Risk Information System (FRIS)

The State of North Carolina provides the Flood Risk Information System (FRIS) website as a public service to the citizens of North Carolina which contains accessible flood hazard data, models, maps, risk assessments, and reports that are database driven. This site also provides geospatial base map data, imagery, LiDAR data, and hydraulic and hydrologic models that are available for download and use. Additional flood risk information can be found at http://fris.nc.gov/fris/.

The FRIS website presents information targeted to two audiences: the general public and advanced users. The general public can identify the level of flood risk and estimated damage and loss associated with their property. Searchable by address, users can locate property and view the flood hazard and risk information associated with it including flooding source, flood event water surface elevation, and applicable flood zone. Advanced users, (floodplain managers and government officials,) have the opportunity to download flood hazard data to identify levels of flood risk for buildings in the community.

Figure 4-2 North Carolina Flood Risk Information System

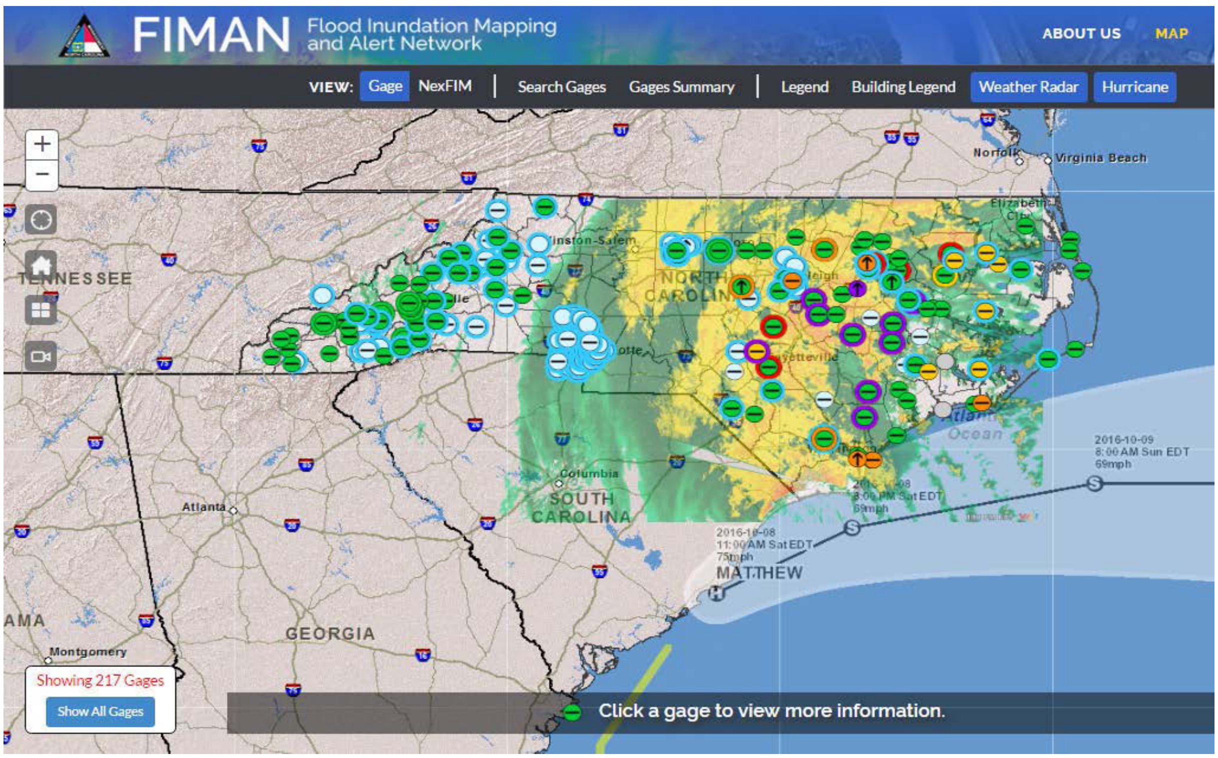


Flood Inundation Mapping and Alert Network (FIMAN)

The North Carolina Flood Inundation Mapping and Alert Network (FIMAN) provides actual storm-specific stream/flood information based on a system of stream gages) located throughout the state. This system integrates gages operated by USGS and other agencies with State-maintained gages, resulting in a growing network of approximately 480 gages. Data collected at the gages is transmitted by radio, cellular or satellite signals, and processed by special software and stored on an enterprise GIS database. The FIMAN web application uses responsive design and consistent modeling techniques to display real-time and forecast flood information accessible from any desktop, laptop, or mobile device. Gage readings are typically recorded and transmitted every 15 to 30 minutes. The goal of the FIMAN system is reduction of the loss of life and flood-related property damage by providing emergency managers and the public with timely, detailed, and accurate information.

FIMAN has been successfully used to display real-time flooding scenarios across the state of North Carolina for different flooding events. This resource is helpful to emergency management officials as they plan for evacuation and rescue efforts before, during, and after a significant storm event. The alerting system of the FIMAN website reported real-time gage readings during Hurricane Matthew (see Figure 4-3) and has been adopted by the media for use in weather reports.

Figure 4-3 Real-Time FIMAN Response During Hurricane Matthew



NCEM plans to expand the FIMAN system to densify the gage network in FIMAN and to build upon the network in order to provide coverage and alerts for a greater portion of the State. Currently 71 new water level gauges are being installed throughout the state and EM continues to work with local communities to integrate their new gauge data into FIMAN.

Flood Inundation Mapping and Alert Network for Transportation (FIMAN-T)
In 2020, NCDOT and NCEM partnered to develop FIMAN for transportation (FIMAN-T) to provide real-time (and forecasted where available) flooding impacts to roads, bridges, and other NCDOT assets in support of risk-based decision-making during flooding events. The goal of the tool is to provide visualization and metrics for roadway inundation, bridge hydraulic performance, and identifying potentially impacted NCDOT assets. This enhances

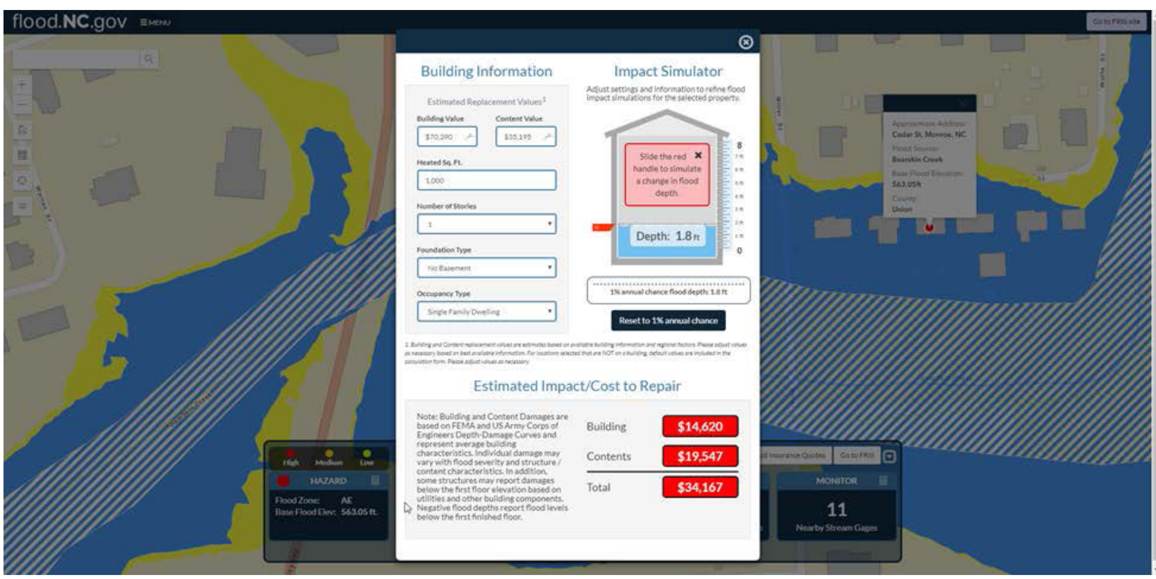
NCOT's responsiveness during flooding events by generating data and reports for use in disaster response and planning.

FIMAN-T leverages the real time, 3D inundation mapping coupled with LIDAR derived roadway elevation layers to compute flooding depths over roadways for current and forecasted conditions. The application features an interactive dashboard allowing users to navigate between current conditions, modeled scenarios, and forecasted scenarios where available. The dashboard provides access to detailed information including Stream Elevation, an interactive stage hydrograph, and Forecasted Peak. In addition, the Road Affected feature provides a summary table of all impacted roads within the inundation extent of the selected gage, or a sortable table showing all impacted roadway segments.

Flood.nc.gov

The NCFMP has been providing this information online for over 21 years and in 2018 upgraded and revamped their public-facing website for the entire NCFMP program: https://flood.nc.gov/ncflood/. This site combines all the information various stakeholders need for flood hazard risk information. Users can quickly access flood hazard risk information for their specific property, insurance agents and engineers can get connected with the documentation and data they need, and future information about the NCFMP itself is also posted on this site.

Figure 4-4-4: Example of interactive, risk communication tools available in the updated web application



4.3.1.6 Emergency Management Program Grant (EMPG)

The EMPG Program provides states with federal funds to sustain and enhance all-hazards emergency management capabilities. North Carolina uses EMPG to enhance its ability and to help counties support emergency management activities while simultaneously addressing issues of national concern as identified in the National Priorities of the National

Preparedness Guidelines. A statewide comprehensive emergency management program begins at the local level; that is why NCEM coordinates EMPG activities through its 100 counties and the Eastern Band of Cherokee Indians.

EMPG Program funding is dependent upon the federal availability of funds and the total funding varies from year to year. EMPG has a 50 percent federal and 50 percent state cost-share cash or in-kind match requirement. The in-kind match is also a requirement of the state's EMPG sub-grants to its counties and the Eastern Band of Cherokee Indians.

North Carolina's EMPG program provides its counties and the Eastern Band of Cherokee Indians an opportunity to apply for baseline and supplemental funding. To align efforts between the State and local emergency management, specific programmatic deliverables are identified and agreed to by both parties. To be eligible for baseline funding, applicants must agree to complete certain universal programmatic deliverables during a specified period of performance. To be eligible for EMPG supplemental funding, applicants must have applied for baseline funding and agreed to complete at least one optional program activity during the specified period of performance.

4.3.1.7 Public Assistance

For a description of how the Public Assistance Program is administered by the State of North Carolina, please see the *Mitigation Funding* Section of this Capability Assessment.

Section 406 of the Stafford Act authorizes the Public Assistance (PA) Program, which is administered by FEMA. This post-disaster program provides aid to help communities save lives and property in the immediate aftermath of a disaster and help a community rebuild damaged facilities. Grants cover eligible costs associated with the repair, replacement, and restoration of facilities owned by state or local governments and non-profit organizations.

Four categories of assistance are available after a major disaster declaration:

- Debris removal provides 75 percent of funds to state or local governments or private non-profit organizations to eliminate threats to life, public health, or property. Debris may be removed from private property when in the public interest.
- Emergency work or protective measures to eliminate threats to life, public safety, or property. This includes ensuring emergency access, removal of public health and safety hazards, demolition of structures, establishment of emergency communication links, and emergency public transportation.
- Repair, restoration, relocation, or replacement of damaged facilities to return public and non-profit facilities to their pre-disaster condition. Grantees must comply with certain insurance purchase requirements.
- Community disaster loans to units of local government that lose a substantial part of their tax base because of a disaster.

Minimum standards for all repairs and reconstruction done under the PA program may include hazard mitigation standards and can be in place at the time of the disaster or can be adopted prior to the approval of a particular reconstruction project. Thus, improved standards that are adopted by a state or local government prior to FEMA's approval of the repair or replacement of the damaged portion of a facility may become eligible for Federal funding under the PA program. Under the PA program, the cost of bringing a facility up to current codes, specifications, and standards is an eligible cost.

The Public Assistance program also authorizes funding for appropriate cost-effective hazard mitigation measures related to damaged public facilities. The Regional Director may authorize hazard mitigation measures that are not required by codes, specifications, and standards if the measures are in the public interest, fulfilling the following criteria:

- The mitigation measures must substantially alleviate or eliminate recurrence of the damage done to the facility by the disaster.
- The measures are feasible from the standpoint of sound engineering and construction practices.
- The measures are cost-effective in terms of the life of the structure, anticipated future damages, and other mitigation alternatives.
- Floodplain management and applicable environmental regulations are met.

Communities can use the hazard mitigation planning process to identify potential mitigation measures for funding under the Public Assistance Program. The Hazard Mitigation Survey Team or Interagency Hazard Mitigation Team can be particularly useful in this regard. In addition, the Damage Survey Reports used by inspectors to make site-specific recommendations for repairs following a disaster can also serve to identify mitigation opportunities.

4.3.1.8 Integration of the Plan with Federal Mitigation Programs and Initiatives

NCEM Hazard Mitigation staff have worked during this update to ensure that the State Hazard Mitigation Plan is integrated to the extent practicable with Federal Mitigation programs and initiatives that provide guidance to State and regional agencies. This has been done through the following activities:

- NCEM administers all FEMA Hazard Mitigation grant programs and coordinates with local governments and other State agencies to promote and implement FEMA programs.
- Other agencies clearly support mitigation programs, including Department of Insurance (NFIP) and State Fire Marshall (Building Codes)
- NCEM maintains a program of comprehensive coordination and outreach to State and Federal partners through the RMCC. This ongoing committee and permanent working group is designated to evaluate, monitor and update the State Hazard Mitigation Plan on a regular basis.

4.3.1.9 The American Rescue Plan Act (ARPA)

The American Rescue Plan Act (ARPA) of 2021 was passed to facilitate the United States recovery from the devastating economic and health effects of the COVID-19 pandemic. The overall impact of the plan is to mix efforts to mitigate the economic effects of the pandemic with strategies to fight the virus itself. The ARPA is the latest stimulus package to be considered by Congress during the COVID-19 pandemic, which follows in the wake of the $2 trillion Coronavirus Air, Relief, and Economic Security (CARES) Act of 2020 and the nearly $900 billion stimulus included in the Consolidated Appropriations Act (CAA) of 2021, passed in December 2020. ARPA extends some aspects of those bills while also creating new recovery strategies.

North Carolina will directly receive more than $5.7 billion. These funds will be provided over two distributions. Local governments (county and municipal) will receive $3.2 billion, and all large counties and large municipalities (>50,000) will receive funds directly from the federal government while smaller municipalities will work the NCPRO to draw down their federal allotment. A general overview of what these funds are provided to state, local, territorial, and Tribal governments with a substantial infusion of resources to meet pandemic response and rebuild a stronger, more equitable economy as the country recovers from the ongoing COVID-19 pandemic.

Recipients may use Coronavirus State and Local Fiscal Recovery Funds to:

- Support public health expenditures, by funding COVID-19 mitigation efforts, medical expenses, behavioral healthcare, and certain public health and safety staff'
- Address negative economic impacts caused by the public health emergency, including economic harms to workers, households, small businesses, impacted industries, and the public sector;
- Replace lost public sector revenue, using this funding to provide government services to the extent of the reduction in revenue experienced due to the pandemic;
- Provide premium pay for essential workers, offering additional support to those who have been borne and will bear the greatest health risks because of their service to critical infrastructure sectors; and,
- Invest in water, sewer, and broadband infrastructure, making necessary investments to improve access to clean drinking water, support vital wastewater and stormwater infrastructure, and to expand access to broadband internet.

Every North Carolina County and municipality is eligible to receive these funds.

4.3.2 Other Pre- and Post-Hazard Management Policies, Programs, Funding, and Capabilities

In addition to the programs described in Section 4.1.1, there are also additional key programs outside NCEM that are closely associated with advancing mitigation throughout the State which are discussed below.

4.3.2.1 Community Development Block Grant – Disaster Recovery

The United States Department of Housing and Urban Development makes funding available for disaster recovery through a program called the Community Development Block Grant – Disaster Recovery program (CDBG-DR). The funding is intended to be used to address unmet needs for disaster relief in a post disaster environment and support long-term recovery, restoration of infrastructure, housing, and economic development. In recent events, the funding has been required to be spent in the counties most impacted by the event. Most recently, North Carolina received $236.5 million dollars in CDBG-DR funding for Hurricane Matthew.

CDBG-DR funding is being managed at the State level by North Carolina Office of Recovery and Resiliency.

National Fish and Wildlife Foundation (grants)
The National Fish and Wildlife Foundation (NFWF) protects and restores the United States wildlife and habitats. Chartered by Congress in 1984, NFWF directs public conservation dollars to environmental needs and matches those investments in private contributions[4]. The NFWF works with government, nonprofit and corporate partners to find solutions for the most intractable conservation challenges. Over the last thirty years, they have funded more than 4,500 organizations and committed more than $3.5 billion to conservation projects. The NFWF grants library for North Carolina projects can be viewed here: https://www.nfwf.org/grants/grants-library?title=North%20Carolina.

4.3.2.2 North Carolina Sentinel Landscapes Program

North Carolina Sentinel Landscapes Program is an innovative partnership focused on collaboration and coordination between farmers and foresters, conservationists, and military installations in order to provide mutual benefits to protect the state's two largest economic sectors – Agriculture and Defense. The program spans nearly 11 million acres across a 33-county region in North Carolina's Coastal Plain and Sandhills.[5]

The sentinel landscape is home to five key military installations and ranges: Fort Bragg, Dare County Range, Marine Corps Base Camp Lejeune, Marine Corps Air Stations Cherry Point and New River, and Seymour Johnson Air Force Base. Behind agriculture, military-related activity is the second largest economic driver in the state. The program has worked to support endangered species recovery, while simultaneously strengthening the military mission and energizing local agricultural economies.

The partnership has developed and implemented several initiatives for eastern North Carolina including:

- Innovative Conservation Strategies
- Local Foods and Fuels
- Working Lands Conservation
- Agricultural Development and Farmland Preservation

[4] *National Fish and Wildlife Foundation. Land Trust Bird Conservation Initiative. Retrieved on September 16, 2022 from https://www.birds.cornell.edu/landtrust/national-fish-and-wildlife-foundation-nfwf/.*
[5] *Eastern North Carolina Sentinel Landscape. Sentinel Landscapes. Retrieved on September 17, 2022 from https://sentinellandscapes.org/landscapes/eastern-north-carolina/.*

4.3.2.3 North Carolina Natural and Working Lands

North Carolina's natural and working lands offer opportunities to build ecosystem resilience and sequester carbon while continuing to deliver economic growth. DEQ called upon expert stakeholders, including land management experts, non-profit organizations, and key stakeholders representing universities, federal, state, and local agencies working in conservation, forestry, agriculture, and coastal and urban planning to develop the Natural and Working Lands Action Plan. The plan builds on a wide range of actions and measures that protect, restore, and enhance the land and coastal areas that provide vital health, social, economic, and environmental benefits. The stakeholder recommendations prioritize short-term, cost-effective, and pragmatic solutions as well as identify longer-term actions that require more effort, funding, and agency or legislative support.

The NWL Stakeholder Group will identify opportunities for natural and working lands, develop pathways for public and private lands to implement these opportunities, and identify policy, financial mechanisms and incentives needed to execute the various pathways. Listed below are the shared goals for this effort:

- Enhance the ability of land to sequester carbon and mitigate GHGs
- Build resilience in ecosystems and communities
- Provide public health and ecosystem co-benefits
- Create economic opportunities for agri-business, recreation, and tourism
- Ensure implementation of any action is a socially equitable process

Land management experts, non-profit organizations, and key stakeholders representing universities, federal, state, and local agencies working in conservation, forestry agriculture and coastal planning are supporting this initiative. Stakeholders were divided into 6 Land Sector Subcommittees for the development of this report:

- Forestry
- Floodplains & Wetlands
- Pocosins
- Coastal Habitats
- Agriculture
- Urbans Lands

The Nichols Institute at Duke University[6] has collaborated closely with the NWL stakeholder group to help develop maps and recommendations for the NWL Action Plan related to managing lands in the state to enhance carbon and resilience benefits. This data will be evaluated for consideration in future updates of this plan.

[6] https://nicholasinstitute.duke.edu/project/north-carolina-natural-and-working-lands

4.3.2.4 Organizations Providing Local Government Support

In addition to support given to local governments for mitigation planning and project implementation from state and federal agencies, a wide variety of organizations provide local government support for all sorts of mitigation activities. Some of these organizations are non-profit or non-government organizations. Others are associations of professionals or officials that exist to assist their clients or to promote a specific agenda. Although not comprehensive, a sample of some of these organizations is listed below.

- Association of County Commissioners
- League of Municipalities
- North Carolina Emergency Management Agency
- North Carolina American Planning Association
- Councils of Government
- American Red Cross
- AmeriCorps National Preparedness and Response Corps
- Habitat for Humanity
- North Carolina Association of Floodplain Managers
- North Carolina Smart Growth Alliance
- North Carolina Voluntary Organizations Active in Disaster
- Institute for Business and Home Safety
- North Carolina Rural Economic Development Center

4.4 MITIGATION FUNDING

4.4.1 State Funding for Mitigation

North Carolina General Statute 166A-19.42 established the State Emergency Response and Disaster Relief Fund as a reserve in the State's general fund. General Statute 166A-19.41 defines some of the ways that funding can be used and includes mitigation as an option.

The General Assembly also provides post-event appropriations. Most recently, the Disaster Recovery Act of 2016 following Hurricane Matthew provided over $200,928,370 in state dollars for recovery efforts which included implementing mitigation projects. An additional $100 million in state funding was allocated for disaster relief through the Disaster Recovery Act of 2017.

Additionally, the Hurricane Florence Recovery Act in 2018 (over $850 million), the Storm Recovery Act of 2019 ($258 million) and the state budget of 2021 all further demonstrated the State of North Carolina's commitment to its citizens and communities by providing substantial flooding to implement recovery, mitigation and resilience projects. Many of those programs are discussed in further detail below.

Additionally, the State has traditionally provided funding to local governments to meet the 25% match for HMGP grants.

4.4.1.1 Golden LEAF Foundation

The State of North Carolina provided funds to the Golden LEAF Foundation to award funds to units of local government for public infrastructure projects for flood mitigation. Funds may only be awarded to units of local government. Local governments for all 100 counties are eligible. For purposes of the program, units of local government include counties and cities and their boards, agencies, commissions, authorities, and institutions. Funds may be used to construct new or improve existing publicly owned stormwater infrastructure, repair existing stormwater infrastructure that was damaged or destroyed by flooding with improvements to mitigate against future flooding, and engineering expenses related to planning and development of flood mitigation solutions.

4.4.1.2 State Programs

4.4.1.2.1 Flood Resiliency Blueprint

NCDEQ's Division of Mitigation Services (DMS) is developing the first North Carolina Flood Resiliency Blueprint. The Blueprint is a statewide watershed-scale planning effort to establish a framework and tools to assist local communities in decision-making related to reducing flood risk and increasing resilience. As required by Session Law 2021-180, DMS will select an organization to develop the blueprint and deliver an initial draft no later than December 31, 2023. The Division of Mitigation Services plans a comprehensive approach to identify problems, address barriers, and prioritize solutions working with interagency partners and stakeholders. The primary goals of the Blueprint will be to identify sources and types of flooding, account for existing resilience programs and stakeholder funding sources, and make recommendations for statewide implementation.

4.4.1.2.2 Natural Infrastructure Flood Mitigation Program

The 2021 state budget allocated funding to be managed by NCDEQ DMS for flood mitigation projects to be implemented in priority watersheds. The funding will be used to implement natural infrastructure flood mitigation projects and develop scaling solutions to enhance community resilience across North Carolina.

4.4.1.2.3 Land and Water Fund Flood Risk Reduction Grant Program (DNCR)

The North Carolina Land and Water Fund was appropriated $15 million in the FY 2021-22 State budget to establish a flood risk reduction grant program. The goal is to reduce flood risk through design, implementation, and preservation of nature-based infrastructure. Additional consideration will be given to projects that also deliver other ecosystem services or public benefits, demonstrate readiness to begin implementation, and benefit economically distressed communities.

4.4.1.2.4 North Carolina Flood Mitigation Program (Golden Leaf)

The State of North Carolina provided funds (through 2021 Senate Bill 105) to the Golden LEAF Foundation to award funds to units of local government for public infrastructure projects for flood mitigation (up to $250,000 per project). Eligible project types include:

- Construction of new or improvement of existing publicly owned stormwater infrastructure, including natural drainage infrastructure and flood control equipment.

- Repair, including improvements to mitigate against future flooding.
- of existing stormwater infrastructure damaged or destroyed by flooding. Engineering expenses related to planning and development of flood mitigation solutions.

4.4.1.2.5 Emergency Management Disaster Relief and Mitigation Fund (NCEM)

As part of the 2021 state budget, the Emergency Management Disaster Relief and Mitigation Fund ($15 million) was established for state agencies, units of local government, and nonprofit corporations for use in flood mitigation efforts. Projects are 100% funded with no cost share and are paid on a reimbursement basis. Funds may be used for flood mitigation efforts to stabilize areas and reduce future damage, or for predevelopment assistance to provide small and underserved communities with technical assistance to identify and design shovel-ready projects related to disaster relief and flood mitigation.

4.4.2 The State's Use of Federal Funding Sources

The State integrates FEMA programs into its mitigation strategy and actions whenever possible and wherever practicable. NCEM is responsible for administering FEMA mitigation programs and initiatives as well as serving as the lead agency for the State in disaster mitigation efforts, affording the State the opportunity to better coordinate the mitigation grant application process for the programs listed in this section. NCEM has primary responsibility for FEMA grant programs, including:

- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance Program (FMA)
- Building Resilient Infrastructure and Communities (BRIC)
- Public Assistance (PA) Program
- Public Assistance ("406") Mitigation Program
- Assisting with implementing the High Hazard Potential Dams (HHPD) Program[7]

The objectives of FEMA's various mitigation grant programs are:

- to prevent future losses of lives and property due to disasters.
- to implement state or local mitigation plans.
- to enable mitigation measures to be implemented during a state's or community's immediate recovery from a disaster.
- to provide funding for previously identified mitigation measures that benefit the disaster area.

4.4.2.1 UHMA

During FY2009, FEMA developed the Hazard Mitigation Assistance Unified Guidance Program (HMA) to consolidate all FEMA mitigation activity grant programs (formerly Flood Mitigation Assistance, Severe Repetitive Loss, Repetitive Flood Claim, Building Resilient Infrastructure and Communities, and Hazard Mitigation Grant Program) into one streamlined portfolio. The BRIC and FMA programs now share guidance and application periods. The SRL

[7] *This program was previously discussed in Section 4.2.2.2.1*

and RFC programs were rolled under the FMA program. HMGP also falls under HMA, but it is activated post-disaster and application periods are dependent upon disaster declarations.

Flood Mitigation Assistance Program (FMA)

FEMA's Flood Mitigation Assistance Program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FMA is a pre-disaster grant program.

The goals of FMA are to:

- reduce the number of repetitively damaged structures and the associated claims on the National Flood Insurance Program.
- encourage long-term, comprehensive mitigation planning.
- respond to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development review and permitting.
- complement other federal and state mitigation programs with similar long-term mitigation goals.

FMA is available to states on an annual basis. This funding is only available for planning, projects, and other assistance related specifically to NFIP insured structures impacted by flooding. NCEM administers the FMA program and serves as the grantee, providing the funds to local communities. NCEM sets mitigation priorities, provides technical assistance to communities applying for FMA funds, and evaluates grant applications based on eligibility criteria. NCEM is responsible for selecting projects for funding from the applications submitted by all communities within the State and forwards selected applications to FEMA for a competitive eligibility and selection determination. NCEM enters into grant agreements with the local community after FEMA approval and ensures that all community recipients are aware of their grant implementation and management responsibilities.

FMA is a cost-share program in which FEMA may contribute from 75 to 100 percent of the total eligible costs. Any required match must be provided by a non-federal source. If a match is required, no more than one half of the match may be provided as an in-kind contribution from a third party. Selection and funding priorities address properties showing multiple claims against the NFIP.

Project grants are available for projects that reduce the risk of flood damage to structures insured under the NFIP. Eligible activities include:

- elevation of insured structures.
- acquisition of insured structures and real property.
- relocation or demolition of insured structures.
- dry floodproofing of insured structures.

- minor, localized structural projects that are not fundable by state or federal programs which protect groups of structures, the majority of which are covered by an in-force NFIP policy.

Communities eligible for FMA Project Grant consideration must meet the threshold criteria as determined by FEMA and the State of North Carolina.

To be eligible, a project must meet the following criteria:

- Be cost effective.
- Be cost beneficial to the National Flood Insurance Fund.
- Be technically feasible.
- Be physically located in a participating NFIP community or must reduce future flood damages in an NFIP community.
- Conform with the State's Flood Mitigation Plan.
- Does not encourage development in Special Flood Hazard Areas.
- Communities with mapped flood hazard areas that wish to submit a project for review must participate in good standing with the National Flood Insurance Program.
- Addresses a property currently covered by an in-force NFIP Policy
- The proposed project must conform to the community's comprehensive plan, Flood Mitigation Plan, or Community Rating System Plan where such plans exist.
- The project must conform to all Federal, State, and local regulations, including National Flood Insurance Program regulations, NC Coastal Area Management Act (CAMA) regulations, building codes, and local plans and ordinances. In addition, the community must enforce applicable regulations.

This funding stream remains valid as of this plan update, September 2022.

The Hazard Mitigation Grant Program

The Section 404-Hazard Mitigation Grant Program (HMGP) is the historic foundation of the state's mitigation efforts. The program was created in November 1988 through the Robert T. Stafford Disaster Relief and Emergency Assistance Act that amended the Federal Disaster Relief Act of 1974. The Hazard Mitigation and Relocation Assistance Act that amended Section 404 of the Stafford Act on December 3, 1993, to set the proportion of federal funds allotted to the HMGP at 15 percent of the federal funds spent on the Individual and Public Assistance Programs for each disaster. The Disaster Mitigation Act of 2000 (DMA 2000), which amended the Stafford Act, was enacted in 2000 to establish a national pre-disaster mitigation program as well as better control federal costs of disaster assistance through streamlining the disaster relief administration. DMA 2000 also increased HMGP funding on a sliding scale (ranging from 7.5 percent to 15 percent) based on the overall disaster assistance funding for states with a standard plan and up to 20 percent for states with an approved Enhanced State Hazard Mitigation Plan.

The HMGP is administered by NCEM. Eligible applicants include state agencies, tribal governments, and local governments and eligible private, non-profit organizations participating in approved and adopted local or regional hazard mitigation plans. Funds are available for implementation of long-term mitigation measures identified in local hazard mitigation plans following major disaster declarations. Eligible projects must independently mitigate risks and be environmentally sound and cost-effective. Eligible project costs are limited to 75 percent Federal cost share with a 25 percent non-federal match (which has historically been paid by the state of NC on behalf of local governments.).

NCEM mitigation staff solicits, reviews, evaluates, and prioritizes HMGP applications after an eligible disaster event. Based on these evaluations and funding recommendations, NCEM coordinates with FEMA for approval. Typical proposals include acquisition/demolition, flood retrofit, wind retrofit, education and outreach, localized flood reduction measures, utility protection, warning devices and systems, provision of backup power for critical public facilities, and mitigation planning. HMGP is a major funding component for implementation of actions identified in State and local hazard mitigation plans.

4.4.2.2 U.S Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is an engineer formation of the United States Army that provides vital public and military engineering services; partnering in peace and war to strengthen our nation's security, energize the economy and reduce the risks from disasters. USACE civil works missions are primarily planning, designing, building, and operating locks and dams; design and construction of flood protection systems through various federal mandates; and environmental regulation and ecosystem restoration.[8] USACE provides programs that may help resolve water resource problems and technical assistance with special emphasis on Small Cost Shared Projects, which include: Flood Plain Management Services and Planning Assistance to States.

Flood Plain Management Services (FPMS)

The U.S. Army Corps of Engineers (USACE), authorized by Section 206 of the 1960 Flood Control Act, provides FPMS technical services and planning guidance that is needed to support effective flood plain management. General technical assistance efforts under this program includes determining:

- site-specific data on obstructions to flood flows,
- flood formation, and timing;
- flood depths,
- stages or floodwater velocities;
- the extent, duration, and frequency of flooding;
- information on natural and cultural flood plain resources;
- and flood loss potentials before and after the use of flood plain management measures.

---

[8] *U.S. Army Corps of Engineers Headquarters Website. United States Army Corps of Engineers. Retrieved on October 15, 2022 from https://www.usace.army.mil/Missions/.*

FPMS studies are generally conducted at 100 percent Federal expense, for a requesting states or community and are typically less than $150 thousand which can be completed within 12 months.

FPMS assistance begins after the state, regional, local government, or Native American Indian Tribe requests USACE assistance under the program. When funding is available, USACE will work with the requesting organization to develop a scope of work and assemble the appropriate study team for the effort being requested. At their option, the requesting organization may provide voluntary contributions toward the requested services to expand the scope or accelerate the provision of those services. All requestors are requested to furnish available field survey data, maps, historical flood information, etc., to help reduce the cost of services.

Planning Assistance to States (PAS)

USACE provides PAS to states, local governments, other non-Federal entities, and eligible Native American Indian Tribes in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. PAS is provided by Section 22 of the Water Resources Development Act of 1974. Typical studies are only planning level of detail; they do not include detailed design for project construction. The program, can encompass many types of studies dealing with water resources issues. Types of studies conducted in recent years under the program include the following:

- water supply/demand,
- water conservation,
- water quality,
- environmental/conservation,
- wetlands evaluation/restoration,
- dam safety/failure,
- flood damage reduction,
- coastal zone protection;
- and harbor planning.

There are two types of efforts available through the PAS program: Comprehensive Plans and Technical Assistance.

Comprehensive plans

Comprehensive plans include planning for the development, utilization, and conservation of water and related resources of drainage basins, watersheds, or ecosystems located within the boundaries of that State, including plans to address water resources challenges such as the state water plan. Comprehensive planning activities through the PAS program are cost shared at 50 percent with the study partner, and voluntarily contributed funds in excess of cost share may be provided by the non-Federal partner.

Technical Assistance

Technical Assistance includes support of planning efforts related to the management of state water resources, including the provision and integration of hydrologic, economic, or environmental data and analysis in support of the State's water resources management and related land resources development plans identified in the state water plan or other water resources management related state planning documents, such as state hazard mitigation, preparedness, response, and recovery plans and plans associated with changing hydrologic conditions, climate change, long-term sustainability, and resilience.

4.4.2.3 Public Assistance Categories C-G and Individual Assistance

The Public Assistance Program reimburses expenses to eligible State and local governments, and certain private non-profits (PNPs), to assist with the extraordinary costs of responding to and recovering from disasters. There are four building blocks of eligibility for public assistance, COST as reasonable and necessary; WORK and FACILITY which is the legal responsibility of an applicant in the declared area as a direct result of a declared disaster; and eligible APPLICANTS which include State and local government entities, federally recognized Indian Tribes, and certain private non-profits. There are two categories of work: Emergency Work includes debris removal and emergency protective work, and Permanent Work including repair/replacement projects for the damaged portions of roads and bridges, water control facilities, buildings and equipment, utilities, parks, and other public facilities or infrastructure. Both of these categories have different established start times from the onset of the declaration. All requests for public assistance must be submitted within 30 days of the declaration date and must be supported by credible documentation.

4.4.2.4 Cooperating Technical Partner

The CTP Program is an innovative approach to creating partnerships between the Federal Emergency Management Agency (FEMA) and participating NFIP communities, regional agencies, state agencies, tribes and universities that have the capacity to become more active participants in the FEMA flood hazard mapping program.[9] North Carolina has a Cooperating Technical State agreement with FEMA. As a CTP, NCEM receives funding from FEMA to develop, maintain and update flood insurance rate maps. These flood maps are integral for advancing hazard mitigation in North Carolina as they provide the basis for regulating areas of high hazard risk to flooding and help local floodplain administrators make informed decisions about future growth and development. As a CTP, North Carolina's responsibilities regarding flood map development are a key capability as state staff are well-integrated into the process of floodplain mapping, which giving them greater understanding and insight into the implications of floodplain management for local governments and citizens in the state.

4.4.2.5 EMPG

The State of North Carolina uses Emergency Management Program Grant funding to support advancing the State's mitigation strategy in several ways. A primary means is the provision of funds to support staff positions in Emergency Management and hazard mitigation. These

[9] *Cooperating Technical Partners Program. FEMA. Retrieved on December 20, 2017 from: https://www.fema.gov/cooperating-technical-partners-program*

positions at the state level are integral in assisting local governments with project development and implementation, mitigation planning, and other tasks critical to promoting response, recovery and mitigation in the state. EMPG funding supports purchase and installation of stream gauges throughout the state that support the State's flood warning system (FIMAN). This system is crucial to providing both advance warning of impending flood events and real-time inundation maps for local emergency managers and planners for response and risk-reduction purposes.

4.4.2.6 CAP SSSE Funding

The State of North Carolina uses Community Assistance Program – State Supportive Services Element (CAP SSSE) funding to support advancing the mitigation strategy. The program supports provision of technical assistance to communities in the National Flood Insurance Program (NFIP) in evaluation of community performance in implementing NFIP floodplain management activities. CAP-SSSE helps to:

- ensure that the flood loss reduction goals of the NFIP are met.
- build state and community floodplain management expertise and capability.
- leverage state knowledge and expertise in working with their communities.

4.4.2.7 Wildfire Mitigation Grants

The State of North Carolina uses various Wildfire Mitigation Grants to support wildfire risk mitigation strategies in a number of ways. A primary example is the United States Department of Agriculture's Forest Service Community Grant Program. Through this program, the North Carolina Forest Service received funding to develop Community Wildfire Protection Plans throughout the state. NCFS practitioners also mitigate hazards through use of prescribed fire and mechanical fuels reduction within 10 miles surrounding of the national forests in the state. The Community Firewise Grant process has morphed from a pure planning activity into an applicant-friendly Fuels Removal Program. These programs are carried out in conjunction with local communities, landowners, and other stakeholders at the local and federal level in the implementation of community-scale mitigation and prevention projects that reduce risk.

4.4.2.8 Earthquake Consortia Grant

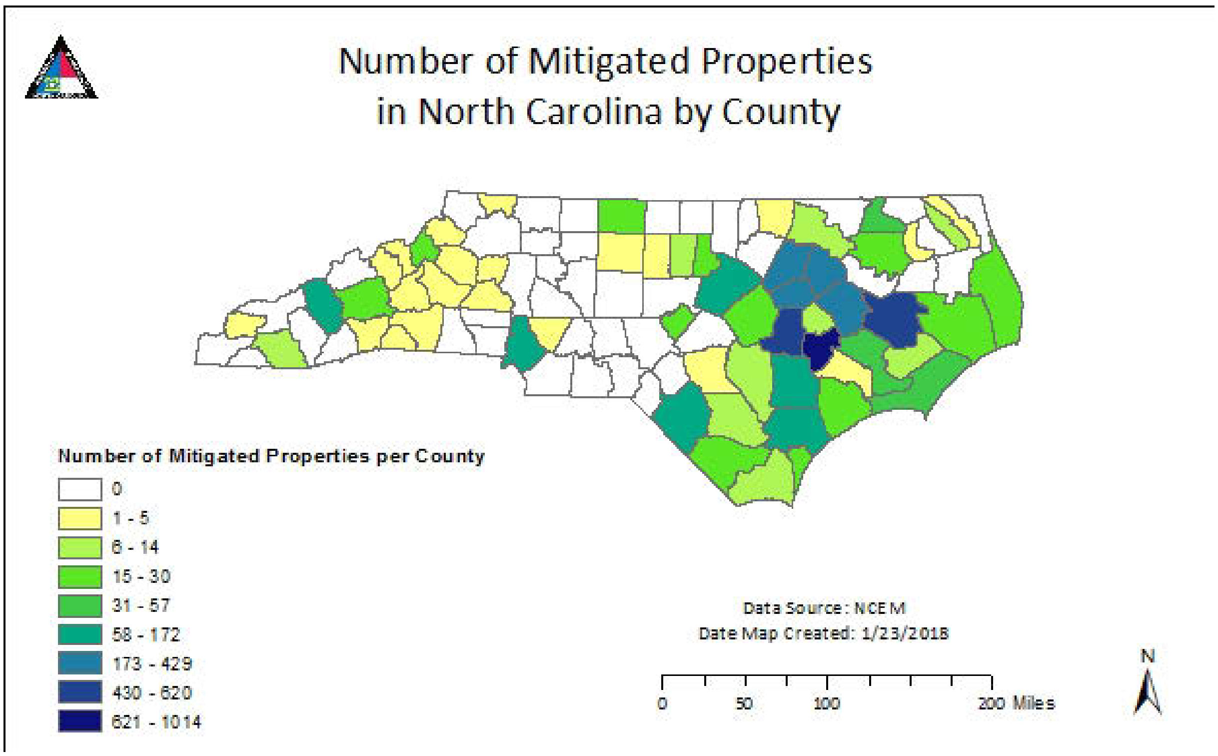
The State of North Carolina has used Earthquake Consortia Grants to support advancing the mitigation strategy. In 2019, North Carolina was removed from eligibility for EQC grants based on an identified MODERATE risk of earthquake damage in order to provide assistance to states at higher risk. Previous funding examples include:

- Developing and demonstrating non-structural EQ hazard assessment and identification of non-structural mitigation measures for private and critical public structures and facilities.
- Working with the State Geologist to develop and deliver an earthquake awareness and earthquake science seminar offering earth science teaching aids and continuing education credits for NC Science Teachers

4.4.2.9 Summary of Successes and Documented Losses Avoided

With 25 years of implementing large-scale hazard mitigation projects, North Carolina has a rich history of mitigation success. As part of the 2018 plan update, the Hazard Mitigation Planning Branch within the North Carolina Division of Emergency Management worked to collect and establish a master list of mitigated properties in North Carolina. These properties are stored in an excel spreadsheet and have been uploaded into ArcGIS as a point layer. This point layer was then used to generate the map below. It is important to note that the properties included in the map were funded under grants that are now closed. Any projects that are funded under grants that have not been closed are not included in this map. Please find this map below which illustrates the number of mitigated properties by county. The maps are searchable and provide information on specific projects down to the parcel level. Efforts are underway to update and maintain the lists as grants are closed out and to create a public-facing portal to share the mitigation message.

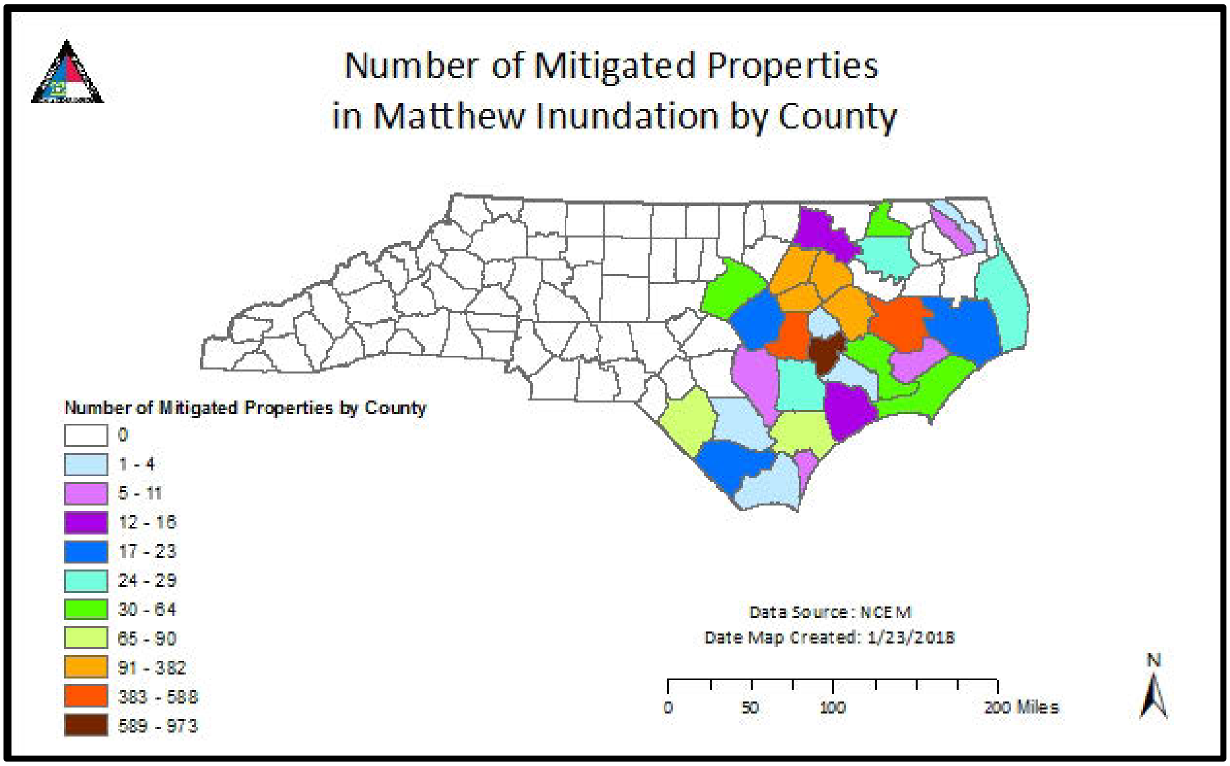
Figure 4-5 Summary Map of Mitigated Properties in North Carolina



In order to analyze the effectiveness of the Hazard Mitigation Program, NCEM conducted a "losses avoided" study in 2018 for parcels in the Hurricane Matthew inundation area. In order to develop this data, NCEM ran an intersect in ArcGIS to see which of the properties from the mitigated properties layer fell within the inundation zone from the storm. The map below illustrates the number of structures for which losses were avoided during Hurricane Matthew due to previous mitigation efforts by county.

NCEM HM Planning conducts loss avoided assessments on individual properties as subsequent hazard impacts have presented evidence of success. These individual property assessments generally show a return (loss avoided) in excess of the 6:1 ratio frequently expressed in academic studies of the nationwide cost effectiveness of hazard mitigation projects.

Figure 4-6 Documented Losses Avoided from Hurricane Matthew



The list below provides a summary of additional mitigation accomplishments in North Carolina over the past five years. More information about each project can be obtained by contacting NCEM Hazard Mitigation staff.

- Yadkin Valley Sewer Authority – (NC IMPACT Oct, 2020) cross-community efforts to improve reliability and capacity of infrastructure—mitigation measure for future BRIC proposals
- New Bern and Dare Advance Assistance 2019 –Capability and Capacity Building funds were applied toward assembling panels of interested stakeholders for participation in a “"deeper dive” into local mitigation plans with a goal of identifying and developing viable mitigation proposals backed by science and engineering studies shing feasibility and cost-effectiveness.
- NCEM created the capability to map and view recent aerials/satellite photos of all mitigated properties to support the surveillance and requirements of 44 CFR 80.19
- Recent Losses avoided studies

Post-Tropical Storm Fred
Charlotte Mecklenburg Risk Assessment and Risk Reduction)

- Princeville Elementary School wet floodproofing
- UNCP-air filters

4.4.3 Prioritization of Mitigation Funds

Prioritizing Local Assistance for Planning Grants

As NC's local plans became due for update in 2005 and 2006, availability of Federal and State grant funding for mitigation planning was limited. Therefore, NCEM prioritized funds for mitigation plan updates on the availability of funds and the desire and capacity of local to complete plan updates. In an effort to reduce the financial and workload impacts and the effectiveness and consistency of the plan update process, worked with local governments on a strategy to convert some 120 approved and adopted local plans into regional plans based on similarities of hazard exposure, capability, and existing regional partnerships. At the beginning of the 2010 update cycle, NCEM prioritized HMGP and other program funds (PDM) to communities that were willing to take a Regional or at least multi-Jurisdictional planning approach. With the 2015 planning update cycle, NCEM became both grantee and subgrantee for Plan Update Grants by securing 3 planning grants covering each of NCEM's 3 branch offices (West, Central and East) and through a competitive bid process secured the services of three prime contractors under the supervision of NCEM Mitigation Planning to lead the update process for each regional plan. By 2020, these actions reduced the total number of Hazard mitigation plans to 30 (27 multi-county regional plans and 3 single-county-multijurisdictional plans.) In 2022, NCEM and FEMA completed the final review and approval of all of the regional plans and NCEM developed a new funding proposal using The HMGP planning set-aside to begin the state-driven update process again for all plans expiring before November of 2025.

This se State prioritizes local mitigation funding proposals under the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, Building Resilient Infrastructure and Communities (BRIC) program, and other available funding programs using the following guidelines:

To allow flexibility in the distribution of mitigation funds, the following general guidelines have been developed. These guidelines will be viewed comprehensively when evaluating distribution of funding.

- NCEM/Hazard Mitigation Branch will consider whether or not the community participates in the National Flood Insurance Program (NFIP).
- NCEM/Hazard Mitigation Branch will consider the number of insured repetitive loss structures in the community (and actions taken to reduce the number of RL claims).
- The jurisdiction is experiencing significant growth, and development pressures may cause increases in vulnerability in undeveloped hazard areas.
- Results of the State and local risk assessment will be reviewed to determine if the level of susceptibility to natural hazards has increased in that jurisdiction.
- The jurisdiction must satisfy the criteria for the specific source of the funds.

Prioritizing Local Assistance for Project Grants

At the time of the 2023 update, 100 percent of counties and nearly 98% of local jurisdictions in the state have approved and adopted mitigation plans. As a result, nearly every jurisdiction is eligible to apply for and receive federal/state dollars to implement mitigation projects. Therefore, the state has had to implement a process for the prioritization of these dollars and it has been an extremely successful process that will continue to be implemented in the future as disasters affect the state.

NCEM's Hazard Mitigation Branch currently participates in all UHMA programs—the disaster-based HMGP as well as the non-disaster-based BRIC and FMA programs. From Hurricanes Fran through Ophelia (2005), the majority of UHMA funding was made up of the HMGP. As the Branch completed projects in these disasters in the years that followed, the large majority of funding between FY08 and FY11 switched to non-disaster grant funding streams as well as small disasters including Tropical Storm Hanna, the 2008 Winter Storm, and Tropical Storm Nicole. This included the start of the RFC and SRL FEMA funding streams in FY08. In 2011, North Carolina received two major disaster declarations—the April 2011 tornadoes and Hurricane Irene. With these funding streams, NCEM's funding emphasis has once again started coming primarily through the HMGP program. This has more or less continued with several other federally declared disasters in the last 5 years including severe storms and flooding in 2013, severe winter weather in 2014, and perhaps most notably, Hurricane Matthew in 2016. Table 4-1 shows the UHMA funding sources that have been used since the last plan update was approved in 2013,

Table 4-1 Summary Table of UHMA Funding in North Carolina Since 2013

Program	Year	Number of Projects	Amount Obligated ($)	Amount Expended to Date ($)
PDM	2013	4	$190,633.32	$178,144.72
PDM	2014	9	$656,522.91	$506,900.15
PDM	2015	7	$824,679.05	$313,975.93
PDM	2016	Not reported	Not Reported	Not reported
PDM	2019	3	$21,220,000.00	$12,730,000.00
FMA	2013	6	$4,344,696.40	$2,757,710.09
FMA	2014	9	$10,187,670.56	$5,219,283.16
FMA	2015	14	$5,151,830.47	$0
FMA	2016	14	$4,237,686.42	$0
FMA	2019	3	$25,650,000.00	$15,390,000.00
FMA	2020	2	$12,850,000.00	$7,710,000.00
BRIC	2020	6	$87,510,000.00	$24,290,000.00
HMGP 4146	2013	3	$1,150,774.00	$125,000.00
HMGP 4153	2013	4	$579,806.00	$500,483.91
HMGP 4167	2014	13	$6,457,245.00	$1,122,995.06
HMGP 4285	2016			

Program	Year	Number of Projects	Amount Obligated ($)	Amount Expended to Date ($)
HMGP 4393	2018	96 submitted, 60 awarded to date	$210,650,000.00	$148,950,000.00
HMGP 4412	2019	5 submitted, 2 awarded to date	$4,210,000.00	$3,710,000.00
HMGP 4465	2019	17 submitted, 2 awarded to date	$17,930,000.00	
HMGP 4543	2020	6 submitted, 0 awarded to date		
HMGP 4568	2020	9 submitted, 1 awarded to date		
HMGP 4587	2020	TBD	$0	$0
HMGP 4488	2021	12 submitted, 0 awarded to date	$0	$0
HMGP 4617	2021	TBD	$0	$0

To begin the process of prioritization, outreach is conducted through a Letter of Interest process with local governments. The Letter of Interest is essentially a Request for Proposals from local governments citing requested project types and identifying the properties or projects requesting mitigation. The LOI process is supported through field visits, Mitigation Opportunities Assessments, and public outreach meetings. The LOI, an official document signed by the local government, is the basis for conducting Benefit Cost Analysis, prioritization and other activities related to project development.

From 2007-2017 (project development for non-disaster funding streams and small disasters), the HM Branch also used a Letter of Interest process. For the SRL and RFC programs, NCEM aggressively targeted Repetitive Loss and Severe Repetitive Loss properties based upon the Rep Loss (RL) and Greatest Savings to the Fund (GSTF) lists provided by FEMA.

During the 2010-2013 period, the Mitigation Branch pursued intensive outreach to communities through the SRL and RFC programs. This included field visits, face-to-face meetings, public meetings, letters, and phone calls to discuss properties on the RL and GSTF lists. Despite a concentrated effort to address over 200 SRL properties statewide, only a small fraction of these projects ended up being cost effective—even with the GSTF methodology. During this time Benefit Cost Ratio was the ultimate driver of project development, rather than number of repetitive flood claims. While Repetitive Loss factored into project prioritization and dictated NCEM's participation in the FMA, RFC, and SRL programs, it was the benefit cost ratio of all structures which was the biggest driver, not the end number of claims. This made it extremely difficult for the state to implement these programs.

During the 2010-2013 period (DR-1969, DR-4019, and non-disaster programs), the balance of the work flow shifted back to the HMGP, with non-disaster grant programs "filling in the gaps" of other program types (i.e., NC will only pursue tornado safe rooms under the PDM program) or "overflows" of cost-effective properties, should the HMGP funding streams run out of funding. For the HMGP, please note that, per the 404 Admin Plan for Hurricane Irene, priority for mitigation is framed in terms of repetitive loss among the six cascading priorities for residential acquisition and elevation (Hurricane Irene 404 Admin Plan, p. 13, "Priorities.")

In the 2013-2017 period, there has been a continual use of Benefit-Cost Analysis when evaluating projects at the state level. However, in August of 2013, FEMA issued guidance allowing for projects to forego the standard BCA rules for project eligibility if they met certain criteria. Namely, that if a structure could be acquired for less than $275,000 or elevated for less than $175,000, the BCA requirement on that property would be waived. That is to say, the structure would not have to exceed a BCR of 1.0 in order to be eligible. This has had a major impact in that meeting BCA is no longer the greatest hurdle to implementing projects. This has opened up many more properties to eligibility under the UHMA programs, which has caused a different sort of challenge. Because so many more structures are eligible under these new rules, there have been more properties than funding available to carry out these buyouts and elevations. As such, the greatest challenge changed from meeting BCA to lack of funding availability.

One additional factor that has recently played a part in project prioritization is based on the state's recent experiences in Hurricane Irene and Hurricane Matthew. In the aftermath of these events, many homeowners whose homes were destroyed were forced into temporary housing after the storms. After Irene, many took up residence in FEMA's Temporary Housing Units (THUs) located on their own property, while after Matthew many had to relocate to other forms of temporary or transitional housing. Staff at NCEM recognized that if properties owned by these affected homeowners were eventually going to be bought out through the voluntary acquisition program, it would make sense to implement this buyout as quickly as possible to reduce the time citizens would have to spend in temporary housing and the cost the federal government would incur from paying for temporary living space. Since acquisition of high-risk properties is one of the Mitigation Branch's highest priorities, the strategy of acquiring these properties was given additional emphasis and a high prioritization in the wake of these events.

Another notable addition to the prioritization criteria came from the federal level where FEMA's evaluation criteria during the FY17 cycle was, among other changes, much less focused on acquisition, elevation, and reconstruction projects than in past years. FEMA's criteria in this funding cycle tended to emphasize prioritizing stormwater projects under FMA and non-flood related projects under PDM. These changes caused NCEM to evaluate projects that were submitted through its Letter of Interest process in a new light and adjust its submission package to these competitive programs accordingly.

4.4.3.1 Repetitive Loss and Severe Repetitive Loss Properties Prioritization

Analysis of the repetitive loss communities and properties with the greatest financial losses will be utilized to identify and prioritize areas for mitigation projects. Eighty-eight (88) counties in the state have repetitive loss properties and are regularly identified during funding cycles to assist with the prioritization of areas for mitigation projects. Project Managers on the Grants team will work closely with these communities to determine the potential for project development. SRL program and individual project development criteria will adhere to the SRL guidance released by FEMA on October 1, 2017, or as amended.

Areas identified as high priority are selected based in part on whether there are repetitive or severe repetitive loss properties in the area. The Repetitive Loss Mitigation Strategy for North Carolina is geared to encourage local communities to prioritize mitigation of Repetitive Loss and Severe Repetitive Loss properties and remove the financial strain imposed upon the National Flood Insurance Program (NFIP) for claims that compensate homeowners who have suffered repeatedly from flood losses.

The North Carolina Repetitive Loss and Severe Repetitive Loss strategy meets the directives of the US Congress as outlined in the Federal Register and reflects FEMA's guidelines for the RL and SRL programs. The RL/SRL strategy for the state is as follows:

- The state will include the presence of severe repetitive loss structures and repetitive loss structures and the extent to which they are mitigated as an evaluation criterion in the review process for applications for disaster and other hazard related assistance. Localities will be encouraged to include these properties in their proposals and applications.
- The state will require that local mitigation plan update identify severe repetitive loss properties and repetitive loss properties and include appropriate mitigation actions.
- The state will require that local mitigation plan updates identify undeveloped areas in the floodplain and appropriate mitigation actions to help avoid repetitive losses in the future.
- The state will require that each local mitigation plan update consider mitigation actions such as prevention, property protection, and natural resource protection to address existing repetitive loss properties. These actions will assist with avoiding recurring losses from natural hazards in the future.

Project Eligibility

NCEM will review any eligible project proposal that demonstrates cost-effectiveness in the mitigation of RL or SRL properties with an emphasis on the following:

- RL or SRL identified properties with the greatest dollar value of claims.
- RL or SRL identified properties with the greatest number of claims.
- All properties evaluated for a proposed project will be ranked from highest to lowest based on the FEMA Benefit-Cost Analysis (BCA) module. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects.
- Acquisition (includes the worst of the worst residential properties) (requires a high benefit to cost ratio).
- Relocation (residential properties) (requires a high benefit to cost ratio).
- Elevation (residential properties) (requires a high benefit to cost ratio).
- Mitigation reconstruction (if traditional elevation cannot be implemented).

- Minor physical localized flood reduction projects (requires a high benefit to cost ratio).
- Dry Flood proofing (commercial or historic properties only) (requires a high benefit to cost ratio).

Project Selection Criteria

The State's priorities are a major consideration in the selection of projects for funding. Projects will be selected according to how well they satisfy all FEMA eligibility criteria and their support of the NCHMP RL and SRL mitigation strategy.

- Upon receipt of Notice of Funds Availability, NCEM will forward the notice to local governments with an overview of funding criteria and priorities and will also offer to provide, upon receipt of written request from the jurisdiction, a copy of the most recent NFIP RL and SRL information. NCEM has access to RL and SRL information via Bureau Net, and generally twice per year requests a spreadsheet containing all RL and SRL data for NC from FEMA.
- The Hazard Mitigation Branch, which is responsible for project development, will work closely with the community to develop a RL and SRL Plan of Action to prioritize and mitigate the most vulnerable structures.
- The selection of a priority RL or SRL property will be determined by ranking the houses/structures in the state based on the greatest losses and claims to the NFIP. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects. Mitigation action type (Acquisition, Elevation, etc.) will also play a role in the ranking process.
- The RL and SRL program will include eligible priority projects for Elevation, Acquisition, and Relocation and Retrofitting of facilities.
- RL and SRL properties identified in the priority ranking may be identified for funding from several NCEM-administered disaster and non-disaster programs. The HMGP, BRIC, and FMA programs are potential funding sources to mitigate flood hazard properties. In general, NCEM will determine which project requests get submitted to which funding stream based on programmatic and state priorities.
- Other programs that provide funding for mitigation activities include:
  - 406 mitigation under FEMA's Public Assistance program.
  - HUD Disaster Assistance grants, including CDBG-DR.
  - SBA Loans following disaster declarations.
  - local government incentives.
  - homeowner insurance-based products to include ICC funds that are administered at the local level.

NCEM provides technical assistance to ensure the structures that are substantially damaged and are in the Special Flood Hazard Area are repaired in accordance with current NFIP regulations.

4.4.3.2 High Hazard Potential Dam Program

The North Carolina Department of Environmental Quality's Dam Safety Program Administers the HHPD Program. When the program was first introduced, prioritization for funding through the program was based on a standards-based approach that considered the following:

- Component-level philosophy
- Load cases
- Deterministic analyses
- Design load conditions
- Simplistic consideration of consequences of failure
- Sensitivity analyses to evaluate uncertainties

The program is in the process of transitioning to a risk-informed approach for prioritization that will consider the following:

- Systems-level philosophy
- Potential failure modes
- Probabilistic analyses
- Loads beyond design basis
- Detailed consideration of consequences of failure
- Robust consideration of uncertainties

This transition is still taking place and will be discussed in more detail in the 2028 plan.

4.5 LOCAL AND TRIBAL MITIGATION CAPABILITIES

4.5.1 Summary and Evaluation of Local and Tribal Mitigation Capabilities

Governments In North Carolina: Building Capacity

Prior to July of 2019, there was no statewide land use, growth management, or development planning, nor is planning mandated at the local level (with the notable exception of local governments in the coastal zone where County-level CAMA Plans including a Land Use Plan are required). Decisions of where to locate infrastructure, when and where to allow subdivisions to occur, and even whether or not to enact zoning and other land use regulations are largely left to the discretion of local government in North Carolina. These are fundamental decisions that can profoundly impact a community's level of risk. In July of 2019, the General Assembly passed legislation requiring ALL local governments who have or wish to develop and enforce zoning ordinances to develop, adopt and maintain a comprehensive land use plan no later than July 1, 2022. Recognizing the burden imposed by this amendment to NCGS 160D, in July of 2022, the General Assembly authorized an extension of the deadline for communities with a population under 1500 until July 1, 2023. Chapter 160D requires North Carolina municipalities to adopt a Comprehensive Plan or Land Use Plan by July 1, 2022. Either plan type can satisfy the requirement; **communities are not required to have both to be compliant.** There are no specific requirements for the chosen plan's contents or organization, but the goal remains to create clear, concise, and seamless ordinance and land use documents

For purposes of the State Hazard Mitigation Plan, the term "local government" refers to those legal subdivisions of the state that are defined by political boundaries. There are 100 counties and approximately 640 incorporated jurisdictions in North Carolina. North Carolina is home to eight Native American tribes located throughout the State, although only one—the Eastern Band of the Cherokee Indians—is federally recognized as a Sovereign Indian Nation at this time. North Carolina also has 18 active Councils of Government (COGs) that were established by the NC General Assembly in 1972 as voluntary organizations of county and municipal governments within a region. Although the COGs have no regulatory powers, they provide many valuable services to the communities in their region.

Many local governments in North Carolina are exceedingly proactive when it comes to planning to mitigate the impacts of natural hazards. Largely through the Hazard Mitigation Planning Initiative (HMPI) conducted by NCEM, local communities throughout the State have embraced the principles of mitigation to reduce losses and increase resiliency to natural hazards.

While the State provides ample guidance and technical assistance to prepare hazard mitigation plans, each community is encouraged to participate in and implement a plan that is tailored and meets the specific hazard conditions and mitigation needs and capabilities of that locality. NCEM recognizes that there is no one-size-fits-all solution to every community's hazard exposure. Communities in North Carolina demonstrate broad diversity in demographics, topography, climate, economics, natural resources, hazard exposure, and political and cultural milieu. North Carolina has large affluent metropolitan areas that are experiencing growth pains and unchecked sprawl. There are also isolated rural communities who's agricultural or manufacturing economic base is declining and whose populations are shrinking. There are mountain communities that must deal with the constraints of steep terrain and coastal communities that experience frequent violent storms. Some communities are progressive and promote a liberal agenda, while others are more conservative and espouse laissez faire attitudes related to zoning and land use planning. Some local governments aggressively regulate land uses within their jurisdiction, and others vehemently oppose government interference with private property rights. While this diversity contributes to the richness of the State's social fabric, it also means that HMPI coordinators must tailor their approach to help all communities meet their individual mitigation desires and needs.

Fiscal Capability

Because communities are unique, it is impossible to make accurate generalizations about the fiscal capability of local governments in North Carolina to carry out mitigation objectives. Financial resources, local government workforce and technical resources are critical for planning and implementing community-scale mitigation projects. Large metropolitan areas such as Charlotte-Mecklenburg (the largest urban area in the State), the Raleigh-Durham-Chapel Hill Triangle area, and the Winston Salem-Greensboro-High Point Triad have sizable resources and a vast array of technical and financial opportunities. These areas also have a larger and typically more robust tax base. Many of the larger communities also demonstrate highly functional planning, funding and implementation capabilities. At the other extreme, many smaller, more rural communities in North Carolina have very limited fiscal and personnel resources that reduce the ability to engage in complex hazard mitigation activities without significant assistance from the State and Federal government.

The North Carolina Department of Commerce classifies all 100 counties in the state into one of three tiers, with Tier 1 representing the most economically disadvantaged and Tier 3 the most prosperous. Tiers 1, 2, and 3 may be deemed “distressed” based on various economic and demographic characteristics. Counties that are designated as distressed gain easier access to certain funds from the federal and State governments and waivers of some of the local matching fund requirements that accompany many federal and State grants. For counties that fall outside the lower tiers, but which nonetheless are struggling to meet service needs, fiscal capability is often quite limited.

Local elected officials must balance many competing interests when allocating limited resources. Highly visible problems, such as roads, schools, housing, and health services, often grab the immediate attention of constituents. Many communities in North Carolina, like the rest of the nation, are currently experiencing an economic downturn and historically high unemployment, factors which strain local government coffers as the need for government services increases. However, many local governing boards throughout North Carolina have come to realize that money invested in hazard mitigation activities can save millions of dollars in property damage by reducing losses from inevitable natural hazards. Keeping businesses open, residents in their homes, and basic services operating following an emergency demonstrates resilience in economic security and social stability for local communities. Residents in many North Carolina localities have seen the devastation that can occur from hurricanes and hurricane-related flooding firsthand as well as impacts of other natural hazards, including severe winter storms, drought, forest fires, flash flooding, and pandemic illness. Because of these experiences, many North Carolinians have learned that mitigation efforts can help prevent some degree of future devastation and build resilience.

State and Federal aid is a critical part of many local governments’ revenue stream, especially at the county level. Grants and other aid programs help local governments meet specific needs, including disaster recovery and hazard mitigation. Usually, conditions are attached to grants; North Carolina requires that all local governments with identified flood hazards participate in the National Flood Insurance Program (NFIP) in order to receive mitigation grant funds for flood related projects.

Many government grant programs, in the FEMA suite of mitigation programs, require a nonfederal match in order to receive the funds. Local, state or any non-federal funds can be used to meet the match. Community Development Block Grant (CDBG) funds can also be applied as a match (CDBG funds, although they are issued by the U.S. Department of Commerce, lose their federal status when allocated to the state level).

Local government applicants can also meet the nonfederal match with in-kind contributions instead of cash outlays. In-kind resources can be labor, materials or salaries paid to staff to carry out the approved mitigation activities. Eligible matches include compensation of project managers, attorneys, appraisers, planners, engineers, public works crews, etc. In-kind contributions from third parties can also constitute some of the nonfederal share and may include donated services, supplies, equipment, and space in buildings. Communities have quite a bit of leeway in developing sources of in-kind matches. The State Hazard Mitigation Section encourages local governments to incorporate specific mitigation actions with identified funding and implementation resources into their Hazard Mitigation Plans.

While outside sources of funding pay for the bulk of many current local mitigation programs and projects in North Carolina—especially expensive large-scale projects such as massive buy-outs of flood-prone properties—many creative local governments are becoming more self-reliant when it comes to financing mitigation activities. As described more fully later in this section, some of the powers and authorities that enhance the fiscal capability of many North Carolina jurisdictions include:

- capital improvement funding (including withholding spending in hazard-prone areas).
- authority to levy taxes and special assessments.
- fees for utilities (water, sewer, gas, electricity).
- stormwater management fees
- impact fees for homebuyers or developers of new housing subdivisions.
- incurring debt through general obligation bonds or other bonds.
- regulatory fees.

Some of the most effective mitigation strategies may require no additional money at all, just a shift in thinking. There are many practical activities that can improve community resilience to natural hazards, including mitigation policies and retrofitting programs that local governments can initiate without the benefit of state or federal aid. There are also many useful budgeting practices for leveraging local mitigation funding to avoid losses attributable to non-action.

A large part of creating and updating a plan is process-oriented. When the state has been advising local governments on updating their plans, there has been a focus on process improvement. If there are many stakeholders from different departments involved in the plan update (the process of updating the plan), hazard mitigation strategies can be better integrated into other planning and regulatory mechanisms, such as Capital Improvement Plans and Land Use Plans.

Technical Capability

In order to develop mitigation plans and to carry out mitigation activities, local governments must have adequate technical capability, including competent personnel and administrative support. As with other types of capability, there is a wide range of technical ability throughout North Carolina. Some urban areas have very large planning departments and have the staff, budget, and equipment to engage in sophisticated growth management, floodplain regulation, stormwater management, and comprehensive planning. Other communities have less experience with land use regulation and development management and take a more laissez faire approach to land use. Coastal counties have been required by the North Carolina Coastal Area Management Act to engage in planning for over forty years, and most coastal counties have institutionalized the concept of land use planning to a degree that otherwise might not have occurred.

Most local communities in North Carolina, except the very smallest of villages or unincorporated areas, do have a planning department, with a staff educated and credentialled in land development and land management practices. There is a wide range of expertise among professionals trained in engineering and construction practices related to buildings and infrastructure. In some rural areas, several jurisdictions may share personnel to fulfill roles of building inspectors, engineers, and planners; these positions are often filled at the county level. Regional Councils of Government often assist local governments with planning issues and grants writing and management (see discussion on COGs below). All counties in North Carolina are required to have an Emergency Management Office, which have been the point of central contact for the State’s Hazard Mitigation Planning Initiative.

Technological Capability

The technological capability of local governments in North Carolina to predict, analyze, map, and mitigate against natural hazards also varies widely throughout the state. The majority of local communities have digital mapping and records systems, primary and secondary phone systems, and access to the Internet, although this is by no means universal.

In many areas of rural North Carolina there is less computer use and internet connectivity than in some of the more urban areas. The kind of infrastructure necessary for widespread technological growth and development has been lacking in rural areas. As with other utilities and services, rural areas are often the last to be served because of the higher price of doing business. However, great efforts have been made to increase access, and this increase throughout North Carolina is beginning to greatly enhance the technological capacity of local governments to engage in more sophisticated hazard analysis and mitigation planning.

Most NC Counties use geographic information systems (GIS) but expertise varies. Many 911 emergency contact services and county tax information operate within a GIS system, but other local departments and services within that same jurisdiction may not have access to the data or a means of using it for other applications.

State Support for Local Plan Development and Implementation

This section details a few of the support programs that the State of North Carolina makes to local governments to assist them in preparing a local Hazard Mitigation Plan that will meet the planning criteria set by FEMA and NCEM. Many of the same support mechanisms are available for plan implementation. Local governments are encouraged to seek out additional resources (monetary and otherwise) to augment the support made available by the State.

The State also encourages local governments to look to existing sources of revenue, during annual budget reviews, to identify surpluses that can be directed to either one-time or ongoing mitigation activities.

Prioritizing Local Assistance

It is the policy of the State of North Carolina to assist as many local governments as possible to prepare and implement high quality mitigation plans. NCEM has advertised the planning requirements, plan criteria, funding availability, and the State deadline for plan completion through a variety of means, including posting the information on the NCEM website; by direct mailings to local government planners, managers, emergency management personnel, and local government elected officials; professional associations, and during workshops and training sessions.

The League of Municipalities, the North Carolina Association of County Commissioners, the North Carolina Association of Emergency Managers, and the North Carolina Chapter of the American Planning Association have also disseminated information on behalf of the Division to their respective members and clientele. Division leaders are confident that that all eligible local governments have been made aware of the availability of funding and other assistance for plan development.

4.5.2 Effectiveness of Local Mitigation Capabilities

North Carolina demonstrates a wide disparity in local capabilities across the State. Typically, jurisdictions with the largest populations and revenues have the highest capabilities. In contrast to the larger cities and counties, some county and municipal jurisdictions in North Carolina with rural populations have very limited revenue resources. Consequently, capabilities in rural counties are typically lower, but there are some notable exceptions. Many rural North Carolina towns have little or declining growth and might have a staff of two or three housed in a small-town hall, with no plans, building codes, zoning, or other regulatory means to implement mitigation measures. These small communities depend on support from their county governments, which generally have greater means to lend support in pursuit of hazard mitigation goals.

The overall state of local capabilities in North Carolina points to the need for a strong State program to support and increase the capabilities of rural communities and sustain and strengthen the capabilities of larger jurisdictions. NCEM fully recognizes these needs for continuing mitigation planning support and has been actively taking steps to expand its technical support and working with local governments to identify funding opportunities. The State intends to increase support for localities for hiring professional planning and engineering services for hazard mitigation. This will be accomplished through continuing coordination with county EMAs and our FEMA and other partners to obtain planning and capacity-building funds (e.g., BRIC, CDBG, HMGP, etc.) available to improve and expand local mitigation capabilities. As part of the State’s Enhanced Plan initiatives, technical and funding support programs will be examined and now developed to improve local capabilities among all levels and types of jurisdictions throughout the State.

Table 4-2 provides a summary of the various capabilities that local governments can utilize to implement mitigation techniques. The table provides descriptions of capabilities in the categories of regulatory powers, land use regulations, taxation, spending, and services and planning. Following each capability description is a brief discussion on the effectiveness of the capability for local governments in North Carolina. Finally, there is an indication of whether or not the capability is helpful in facilitating reduction of repetitive loss and severe repetitive loss properties.

Table 4-2 Summary Table of Local Capabilities including Descriptions and Evaluation of Effectiveness

Category: Regulatory Powers	
Local Capability	General Police Power
Description	Because local governments have broad regulatory powers, statutes allow police power to enact and enforce ordinances to structure public health, safety, and welfare. Ordinances are adopted and regulated to ensure that counties are creatures of Legislature. This legislation must be up to par with State rules.
Effectiveness	In North Carolina, the ultimate authority in all regulation is the NC General Assembly, which has the power to strip zoning and other local regulatory powers from local governments if necessary.
Local Capability	Building Code Enforcement and Building Inspection
Description	Building codes ensure that buildings and facilities are resilient to impacts from natural hazards. Strict adherence to these codes, along with proper and regular inspections, creates safer buildings that save lives and properties during disasters.
Effectiveness	North Carolina generally adheres to state building codes; however, some counties are known to be less rigorous in carrying out routine inspections. Until recently, a partnership in NC called Project Blue Sky created one of the first model homes to research hurricane-resilient construction practices and promoted voluntary standards that exceeded code specifications in Southern Shores. In some towns, such as Nags Head on the Outer Banks, have building moratoria that are activated following a disaster.

Category: Land Use Regulations	
Local Capability	Land Use Regulations
Description	The State grants local governments regulatory powers, which serve as the most basic manner in controlling land use. Local governments regulate the use of property to protect the physical environment, to encourage economic development, and to protect the public's health and safety.
Effectiveness	While land controls are not required by the State, two-third of all counties have some sort of policy in motion.
Local Capability	Zoning
Description	Zoning is the traditional method of controlling land use and addresses type of use, as well as minimum specifications for use. Zoning can be used to keep inappropriate building out of hazard-prone areas, to control construction, and to designate certain areas for low-intensity or high-intensity uses.
Effectiveness	All of North Carolina's larger cities and towns have zoning regulations that the city council has adopted by ordinance, and 80 counties have implemented at least partial zoning, making zoning an effective hazard mitigation strategy in the state.
Local Capability	Flood Hazard Regulation
Description	The Flood Hazard Prevention Act authorizes local governments to prohibit landfills, hazardous waste and chemical storage facilities, and junkyards in the 100-year floodplain. This process relies heavily on up-to-date floodplain mapping, which is being managed by the NC Flood Mapping Program.
Effectiveness	Many local governments in North Carolina have stringent flood damage prevention ordinances. However, regulating flood hazard areas is dependent on precise mapping, which is not as readily available or as broad in coverage in some of the smaller rural communities.
Local Capability	Subdivision Regulation

Description	Subdivision regulation intends to prevent developing land that cannot support development to ensure adequate streets and drainage. They typically contain standards for stormwater management and erosion control.
Effectiveness	About two thirds of North Carolina counties have enacted subdivision regulations, especially in more conservative areas of the state.
Local Capability	Stormwater Management
Description	The National Pollutant Discharge Elimination System Program was established in 1972 to regulate stormwater management practices. Ordinances regulate existing development, future developments, and construction activities to prevent careless pollution of surface waters.
Effectiveness	In North Carolina, there are six Phase 1 communities that require permit coverage for municipalities that have populations of 100,000 or more. Obtaining this permit has shown to be costly and challenging.
Local Capability	Acquisition
Description	Often the most effective method of "hazard proofing" property is for the government to acquire the land to eliminate or reduce inappropriate development. These projects consist of purchasing a property from the owner, removing the structure(s) and reverting the land back to an open or non-intensive use area.
Effectiveness	In North Carolina, the use of eminent domain is infrequently used for acquisition of hazard-prone areas. After many severe hurricanes, many communities have made use of Hazard Mitigation Grant Program funds for major buyouts in flooded areas. Local NC governments have also used Pre-Disaster Mitigation and Flood Mitigation Assistance program funds from FEMA to acquire hazard-prone property. NCEM monitors the reuse of acquired property to ensure that the space remains undeveloped once title to the land is taken by local governments. NC acquisition projects are considered model projects and have accomplished the goal of removing thousands of peoples and buildings out of harm's way.

Category: Taxation	
Local Capability	Taxation
Description	Taxation extends beyond the mere collection of revenue and can give government power to influence which lands are affordable, while providing disincentives for developing on hazardous lands. Tax abatements can also encourage landowners to integrate proper mitigation measures into new developments.
Effectiveness	
Local Capability	Property Tax
Description	Property taxes are often the largest single source of revenue for local governments and are based on property value assessments. Preferential taxation can be used for mitigation purposes to reduce development on hazardous areas. There are some restrictions on the use of property tax funds.
Effectiveness	In North Carolina, more than 95% of all property owners pay their taxes, making property taxes an effective way of generating local revenue. Because of the state's agricultural capabilities, North Carolina allows preferential taxation of farm and forestland. Historic properties are also eligible for preferred tax rates.
Local Capability	Land Transfer Tax
Description	Transfer taxes are assessed against sellers of land devoted to certain designated uses. They can discourage conversion to higher density, slow rapid growth rates, and discourage speculation, but may be ineffective in long term protection.
Effectiveness	A few local governments in North Carolina have the authority to impose transfer taxes as determined by a local act passed by the General Assembly. This tax has potential to be effective in acquiring open space and preventing development in high-hazard areas.
Local Capability	Occupancy Taxes

Description	Some local governments are authorized to levy taxes on hotel and motel room occupancies. Most often, these proceeds are used only for tourist or visitor-related purposes, such as in coastal communities.
Effectiveness	In North Carolina, issues of adequate protection of tourist visitors, including dissemination of public information concerning hurricane awareness, issuance of storm warnings, and evacuation can be addressed with funds derived from occupancy taxes.
Local Capability	Gas Tax (Powell Bill)
Description	NC has a separate tax on the sale of gasoline. Part of this tax, called Powell Bill Funds, can be used to construct or maintain city streets in municipalities.
Effectiveness	Since its beginning in 1951, the Powell Bill has allocated $4,372,331,765[10] to 508 municipalities in North Carolina.
Local Capability	User Fee
Description	Local governments can charge user fees to use services, such as public water and sewer systems, or trash collection. After property taxes, this is the largest source of local government revenue.
Effectiveness	The City of Charlotte has raised millions of dollars for mitigation purposes by charging a stormwater management fee on local residents. This has been effective in enabling the city to afford GIS applications and state-of-the-art flood damage reduction strategies.
Local Capability	Special Assessments
Description	Assessments may be levied against owners who directly benefit from a specific public improvement, which shifts financial burden for improvement of the general public to those who directly benefit. Examples include improving water and sewer systems, streets, watersheds, and water resource projects.
Effectiveness	Assessments may be used in temporary projects to raise revenue for specific improvements, to fund indefinite projects. Charges may or may not discourage development in the assessment district, but they do transfer some cost of living or doing business in a hazard-prone area to those who chose to do so.
Local Capability	Impact Fees
Description	Impact fees require new developments to share in the financial burden that their arrival imposes on a community. They are usually a one-time charge and can be linked to environmental impact analyses.
Effectiveness	Studies have shown that communities prefer to insure against losses rather than to assess hazard-prone impact fees and pass cost of service along to developers.

Category: Spending and Service	
Local Capability	Local Government Services
Description	All local governments have power to make expenditures in the public interest. County governments are responsible for providing social, public health, mental health, and emergency services. In addition to the mandated services they must provide, counties are also responsible for improving their services.
Effectiveness	As of 2017, almost all cities and towns in North Carolina have public water and sewer systems, paved streets, and police and fire protection. In North Carolina, most services are available to all county residents, whether they live inside or outside a city or town.
Local Capability	Public Schools
Description	Public schools are both a state and local responsibility, but local entities are responsible for adopting budgets and capital costs. Major decisions regarding location and construction of schools are made at the county level, and schools often serve as shelters in the event of emergencies.

[10] *https://connect.ncdot.gov/municipalities/State-Street-Aid/Powell%20Bill/2017%20State%20Street-Aid%20to%20Municipalities%20October.pdf*

Effectiveness	There are 114 school systems within North Carolina. Careful site selection and construction of public schools are important; after Hurricane Floyd, many schools in eastern North Carolina were closed for months due to severe flooding.
Local Capability	Emergency Management Services
Description	Each county is mandated to form a local emergency management office that is responsible for providing emergency management planning, administration, coordination, training and support for local governments. Personnel cooperate with other governmental agencies, volunteer organizations, and private sector organizations to maintain emergency management capabilities at the local level.
Effectiveness	Local emergency management personnel attend NCEM planning workshops to increase local knowledge and coordination.
Local Capability	Emergency Shelters
Description	Local governments must make facilities available to protect or reduce exposure to hazards that must be designed to withstand impacts of most types of hazards in that area. Most shelters serve another purpose during non-disaster times.
Effectiveness	Presently, each county in North Carolina has the capacity to provide some type of mass care support and shelter 23,000 citizens. The Information and Planning branch of NCEM is conducting a three-year shelter retrofit project to develop new shelters and retrofit existing shelters.
Local Capability	Mutual Aid Agreement
Description	The NC General Assembly allows cities and towns to enter inter-local agreements. This allows one local government to offer and another receive assistance cooperatively in times of disaster. The idea behind the agreement is to efficiently provide assistance by having conditions worked out in advance.
Effectiveness	Mutual Aid Agreements have been effective in local government coordination since Hurricane Fran struck North Carolina in September 1996. Approximately 40% of towns, cities, and counties in the state have executed the agreement, and NCEM maintains a current listing of all participating local governments.
Local Capability	Capital Improvement Programming
Description	Hazard mitigation principles can be a routine part of local government spending decisions when programmed into a time table of providing municipal services. Capital improvement plans have been used to secure hazard-prone areas for low risk uses and can effectively direct growth away from hazardous areas.
Effectiveness	North Carolina does not prohibit local governments from providing capital improvements in hazardous areas, nor from withholding spending for infrastructure in hazardous areas.
Local Capability	Economic Development
Description	Many counties have formed economic development commissions to improve local economies by keeping businesses in their communities. Continuing development is especially important in touristic areas.
Effectiveness	There are more than 60 counties in North Carolina with economic development commissions. Since tourism is a big economic draw in the mountains and the coast, economic development allows local decision-makers to consider efforts to make their communities more attractive to tourists in the safest way.

Category: Planning	
Local Capability	Land Use/Comprehensive Plans
Description	Land use plans serve as the basis for much of the regulation of property use. Plans prepare maps that show how various areas may be developed or used in the future, and approved plans become part of the community's Comprehensive Plan. Plans do not set regulation, but local officials can use the plans to guide decisions of future construction.
Effectiveness	Comprehensive plans are effective as a hazard planning tool because they guide other local measures, including capital improvement plans, and zoning or subdivision ordinances. In

	North Carolina, all but the smallest cities and towns have land use plans and 80 Counties enforce at least partial land use restrictions.
Local Capability	Hazard Mitigation Plans
Description	Local governments can create their own plans strictly regarding hazard mitigation as part of the Hazard Mitigation Planning Initiative (HMPI).
Effectiveness	Since 1996, North Carolina has been one of the leading states of promoting and strengthening hazard mitigation planning at the local level. HMPI has provided funding, outreach, education, and training that have greatly enhanced local government capabilities.

With respect to effectiveness of the local mitigation policies, programs and capabilities listed above and their applicability to high hazard potential dams, the following have a direct impact on mitigating potential consequences associated with dam incidents:

- The ability of local governments to enact land use regulations in areas downstream of dams,
- The ability of local governments to participate in mitigation grant programs that fund programs such as acquisitions,
- The ability of local governments to develop and implement emergency management plans (such as Emergency Operations Plans that address dam failure, and the Emergency Action Plans that are specific to the dams themselves) that specifically address high hazard potential dams.

Some of the challenges to implementing local mitigation policies, programs and capabilities to reduce vulnerabilities to and from high hazard potential dams are that not all local governments have the capacity to implement the tools mentioned above. This specific challenge can be overcome by providing more direct technical assistance to these local governments to help them implement such tools and to help the local government develop mitigation actions to reduce risks to and from high hazard potential dams through local capabilities.

4.5.3 Tribal Capabilities

The Eastern Band of Cherokee Indians (EBCI) is the only federally-recognized Native American tribal government in North Carolina. The EBCI participates in a regional local hazard mitigation plan called the Smoky Mountain Regional Hazard Mitigation Plan which was last updated in 2020. The EBCI's participation in that plan meets all FEMA requirements for Tribal plans and includes an assessment of Tribal capabilities. Detailed information on the EBCI's capabilities can be found in the plan, and indicates that the EBCI has fairly extensive administrative, technical, and fiscal capabilities in place for implementing hazard mitigation. The EBCI is the only Tribal Nation to have received a direct-to-tribe Disaster Declaration (DR 4013 in March of 2013).

On April 26, 2021 a bill was introduced to the North Carolina Congress for the recognition of the Lumbee Indian Tribe of North Carolina titled, "Lumbee Tribe of North Carolina Recognition Act". Although the Lumbee Tribe were recognized by the federal government with the Lumbee Act of 1956, they were barred from receiving benefits available to other federally recognized tribes. The bill was introduced to provide federal recognition to the Lumbee Tribe and make its members eligible for the services and benefits provided to members of federally recognized tribes. As of August 2022, the bill was still being considered by the Committee on Indian Affairs. The Lumbee Nation adopted the Bladen Columbus Robeson Regional Hazard Mitigation Plan along with a supplement covering the additional Tribal Plan requirements and has thus been recognized as an eligible subgrantee for FEMA programs. The Tribe submitted a BRIC grant application for consideration during the 2020 application cycle. These efforts demonstrate a strong commitment to increasing their capabilities related to hazard mitigation.

4.6 MITIGATION PLANNING

4.6.1 Description

In June 2001, the North Carolina General Assembly passed Senate Bill 300 (SB 300): An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery Commission. Among other provisions, Senate Bill 300 requires that local governments have an approved hazard mitigation plan in place in order to receive State Public Assistance funding. In order to be eligible for federal mitigation assistance, local governments must have a completed, approved, and adopted hazard mitigation plan that meets the requirements of the federal Disaster Mitigation Act of 2000 (DMA 2000).

The Hazard Mitigation Planning Initiative (HMPI) started by NCEM in 1996 placed North Carolina squarely on the leading edge of promoting and strengthening hazard mitigation planning at the local level. Since its inception following Hurricane Fran, and the subsequent expansion of HMPI after other declared disasters, the outreach, education, training, and funding provided through HMPI has greatly enhanced the capability of local governments throughout the state to engage in hazard mitigation planning.

Since 2005, state and local personnel have recognized that the original goal of pushing plans and planning activities as far down to the community level resulted in certain inefficiencies and placed undue burdens on certain communities with smaller EM or Planning staffs or other reduced capabilities. In addition, NCEM noted that only a small percentage of the communities with mitigation plans were applying for mitigation funding through the various programs. As a result of these observations, NCEM began a concerted effort to assist with the process of consolidating single-jurisdictional plans into county-level plans and started to explore the possibility of combining several contiguous county-level plans into regional hazard mitigation plans.

From 2005 until 2013, efforts were made to begin to consolidate municipal-level plans into county-level plans and to subsequently (or simultaneously) incorporate those county-level plans into regional plans that consist of multiple counties working together to develop and maintain a plan. The intent was to allow local governments to pool their resources and develop higher quality, more effective plans. Through the end of 2022, this effort has been very successful as 27regional plans have been approved and adopted by local governments. There are no municipal/single jurisdiction plans remaining and only 3 county-level multi-jurisdictional plans remaining. During the 2018-2021 update period, two of these county-level plans joined a contiguous regional plan during update. This effort allowed NCEM staff to focus more of its technical assistance efforts on fewer plans, enhancing the quality of both the experience and the plans themselves.

The State Hazard Mitigation Officer recognizes both the authority of local governments to create and maintain individual plans and some benefits of specialization but suggests the benefits in efficiency and uniformity in a more regional approach should not be overlooked. In all cases, the state has provided technical assistance to local governments throughout the state as outlined below:

- NCEM provides mitigation planning guidebooks/publications/research information, risk assessment data, links to other mitigation partners websites, etc. on the NCEM Hazard Mitigation website. Local governments, sister State agencies, and other mitigation partners can view relevant legislation, learn about new funding options, develop Unified Hazard Mitigation Grant Program project and planning grant applications, learn how to join the National Flood Insurance Program, link to model ordinances and regulations, and much more through the mitigation pages of North Carolina Emergency Management's website.
- NCEM assists with identifying risk assessment planners and grants project managers from NCEM staff to act as the primary points of contact and providers of technical assistance for each county. Examples of technical assistance include attending local mitigation planning meetings, consultations with local staff responsible for developing the local plans, reviewing sections of plans during development and project grant applications and providing feedback, relaying information from FEMA on current interpretations and policies, identifying information sources at State and national levels, interpreting State and Federal guidelines, and distributing model ordinances and approved plans.
- NCEM provides planning grants through the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC) program, and Flood Mitigation Assistance (FMA) program. The money that had, in the past, been targeted towards individual planning grants is now being targeted to encourage local governments to develop regional plans and to develop implementation strategies through the Capability and Capacity Building grant opportunities associated with the HMGP and FMA. HMGP Planning funding is now prioritized as an incentive for counties and their municipalities to work together to maintain regional plans. In 2016, NCEM began to pursue a strategy of serving as grantee/subgrantee on all mitigation planning grants and entered into a prime contract with three consulting firms that provide mitigation plan update services across the state. Participants in Mitigation Planning Grants are offered a choice of which particular firm serves as their consultant, and if a firm they wish to us is not among the prime contractors, they may choose to pay their consultant of record or choice, or have that contractor enter into a sub-contractor

agreement with one of the Prime firms to complete a plan update. This approach is that it gives the state a supervisory relationship with contractors working on updates and allows the state to provide guidance and instruction directly to contractors as required.

- The Hazard Mitigation Branch has a well-established working relationship with the North Carolina Division of Coastal Management, the agency that oversees development and implementation of local land use plans for the 20 coastal counties as mandated by the North Carolina Coastal Area Management Act (CAMA). These two agencies continue to work together to integrate requirements imposed by CAMA for hazard mitigation elements of the coastal land use plans with the requirements for hazard mitigation plans imposed by the State and FEMA. Although greater integration needs to occur, these two agencies strive to ensure consistency and avoid redundancy for local hazard mitigation planning.
- The Hazard Mitigation Branch of NCEM serves as a technical advisor to the development of an Integrated Hazard Risk Management and Communications tool and the Risk Management Tool that have been previously discussed.
- NCEM and NCORR staff serve as Subject Matter Experts on a number of state boards, commissions and recovery support functions, as well as contributing heavily to the development and maintenance of the North Carolina Climate Change Resilience Plan

4.6.2 Training

NCEM provides outreach to communities and conducts seminars and presentations on local plan development based on current guidance released by FEMA in October 2011. And will begin rollout of new materials related to the FEMA Mitigation Planning and Policy Guides updated in April of 2022. NCEM also conducts stand-alone seminars, providing local training sessions on request, and participates in twice-annual meetings of the North Carolina Emergency Management Association and the North Carolina Floodplain Manager's Association to provide plan update seminars. The result of this planning and outreach is recognition of successful local plan updates over the past five years in which most communities faced few challenges in plan update process.

4.6.3 Technical Assistance

NCEM provides guidance and leadership to help improve the quality and utility of hazard mitigation plans and participates in local and national conferences and seminars and on FEMA workgroups and discussion panels. While many communities in NC are capable of developing, maintaining, and implementing high quality plans and projects, a number of communities are experiencing difficulties due to constraints on time and public resources. The Hazard Mitigation Branch provides technical assistance to local governments with Hazard Analysis, Mitigation Opportunities Assessment, Mitigation Plan Maintenance and Amendment, Project Development, Benefit Cost Analysis, and Project Implementation and closeout. NCEM's goal is to continue to be an active participant in the national dialogue concerning hazard mitigation and resilience plans and projects.

4.6.4 Review of Local Plans

NCEM Hazard Mitigation Planning Branch uses a database to track the status of all hazard mitigation plans in the state down to the municipal level. The Hazard Mitigation Planning Branch reviews upcoming funding needs at every funding opportunity including all programs under Unified Hazard Mitigation Assistance. Due to the unpredictability of the annual UHMA programs local governments are encouraged to begin applying for funding to update their plan in years two and three of their approved status. When plans cross the one-year anniversary of plan approval Hazard Mitigation Planning staff begin to reach out to the local governments about funding opportunities.

Hazard Mitigation Planning staff work with the local government to inform them of the preferred timeline for updating hazard mitigation plans. This is generally accomplished during training classes, EM forums, through regular emails and is also pushed down through the field staff. The timeline used is as follows: apply for plan update funding in years two and three, six to eight months from close of the application period to receive award letters from FEMA, three to four months for the local procurement process to hire a contractor to assist in the update, twelve months to update the plan through the planning process and six months for NCEM and FEMA review period. The process is generally thirty months from the time the funding application is submitted to FEMA.

The review process for NCEM is accomplished by electronic submittal of the plan to NCEM. The plan is assigned to a planner to review against the current FEMA Local Plan Review Tool. This process generally takes two to three weeks to accomplish. If the plan meets all of the requirements it is forwarded to FEMA for review and approval. If plans do not meet the requirements, the deficiencies are clearly and concisely identified in the plan review tool. The plan reviewer will provide advice on how to correct the deficiencies and meet the requirements. The contractors make the revisions and return the revised plan to NCEM. The key to keeping the NCEM review process to a minimal time is the planner's intimate knowledge of the review process and ability to identify the deficiencies in the plan review to clearly explain what needs to be changed or added to meet the requirement.

The FEMA review process is usually the longer of the two reviews. As per the 44 CFR §201.6, FEMA has 45 days, when possible, to review the plan. When they have reviewed the plan the review tool is sent back to NCEM with either an "Approval Letter", "Approvable Pending Adoption Letter", or "Needs Revisions Letter". If the plan needs revisions NCEM will review all FEMA comments and the plan. If NCEM concurs with the comments the planners will work with the contractor to identify how to meet the requirement. If NCEM finds the comments to be in error the planners will work with FEMA to resolve the issue. The FEMA review timeframe is very fluid in nature and has taken up to 90 days. Hazard Mitigation Planning Branch also tracks the time the plan is mailed to FEMA to receipt of a letter back. If plans have been at FEMA for review for longer than thirty days the Hazard Mitigation Planning Supervisor makes contact with the state planning lead about the status of the plan.

Upon either "Approval or Approvable Pending Adoption" the plan review tool and letter are sent back to the contractor for distribution to the local governments and the local adoption process is initiated. This process can take several months due to the meeting schedule and priorities of the local governments. This is particularly the case between the months of April through August when local governments are focused on budgets for the new fiscal year (1 July through 30 June of the following year) and in NC some local elected officials do not meet during the months of July and August. Once the resolution is approved and signed by the local government it is then forwarded to the Hazard Mitigation Planning Branch. Hazard Mitigation Planning staff will hold resolutions until several are collected unless the community is at risk of expiring. They are then sent to FEMA for processing. FEMA will in turn send an "Approval Letter" to NCEM who distributes it accordingly.

4.7 MITIGATION GRANTS MANAGEMENT

Beginning in 2018 with a pilot program associated with Hurricanes Florence, Dorian and Michael, the State of North Carolina migrated their management of hazard mitigation grants to a "State-centric" program. This first of its kind program for FEMA HMGP allows Counties and municipalities to opt-in to having the state to manage and pay for contract work to complete all grants awarded and assists the counties by removing the financial and management burden of completing all the work awarded under each grant. What's more, the local government does not lose the management costs paid to the local government under the grant agreement. It only speeds the process for homeowners in need by centralizing the project management.

When the state/sub-applicant is awarded a Hazard Mitigation grant, the state will promptly begin the work required to meet the scope of work (SOW) of the grant. The state will obtain the contractors, oversee all project work, pay all invoiced work and close out the projects on our sub-applicant's behalf. The state will work with each sub-applicant's staff to communicate with homeowners so they are informed and have predictability when work will be completed on their homes. The state will also direct contractors to hire local as much as possible so funds are directed into the sub-applicant's communities. The state will also still provide management costs to sub-applicants for any work their employees do assisting the HM staff working in their counties. In the end, it is a win-win for everyone because the state will use its contracting powers to complete work quickly. Since the state will be managing the contracts, sub-applicants will not need to budget money to pay contractors and wait for reimbursements. The state will do all of the project management reducing project management burdens on local governments with limited staff. Finally, the state's efforts will negate a sub-applicant's need to contract for consultants to do the grant's scope of work at a potential higher cost than the management cost funds awarded under the grant.

If the sub-applicant selects to OPT-OUT, they must also prepare correspondence to the Secretary of the Department of Public Safety, through the Executive Director of NCEM. This correspondence must be a business plan showing how the sub-applicant will manage the grant's scope of work and identify the primary sub-applicant point of contact the HM Section will work with to complete all grant related work. Finally, the business plan must show the sub-applicant possesses the financial and staff capability to complete the awarded grant work within the 3-year period of performance.

The goal of the Grants Management Team is:
To provide effective assistance to local governments in all phases of the grants management cycle across all FEMA-funded UHMA programs and to conduct outstanding grants management and fiscal stewardship operations to support the mission of the Branch, Section, and Division.

Services which the Grants Management Team provides include technical assistance for:

1. Project Development
   - Eligibility determinations
   - Data collection
   - Benefit cost analysis
   - Project site visits
   - Environmental review
   - Public meetings
   - Town/city council meetings
   - Grant writing and editing

2. Project Implementation
   - Coordinating of multiple/complimentary funding source
   - Public meetings
   - Grants management
   - Compliance with all federal reporting requirements
   - Grant closeout

3. Project Closeout
   - Effective administration closeout within FEMA periods of performance and post-implementation liquidation periods
   - Sound fiscal stewardship

4.8 SUMMARY

The capability of North Carolina's State Government to implement mitigation project, policies, and procedures has long been one of the strongest in the country. This capability has continued to improve over the years as stronger ties are made between hazard mitigation and the day-to-day activities of multiple State agencies as described in this section.

Areas to Target Improvements

The capability of local governments in North Carolina varies. Some communities and counties have high capabilities and some have very low capabilities. NCEM will continue to promote increasing local capabilities to the extent practicable through training, funding, and technical assistance.

Through continued implementation of the State's Mitigation Strategy, both state and local capabilities should improve as more mitigation projects, policies, and procedures are implemented.

Section 5. MITIGATION STRATEGY

44 CFR Reference

(3) A Mitigation Strategy that provides the State's blueprint for reducing the losses identified in the risk assessment. This section shall include:

(i) A description of State goals to guide the selection of activities to mitigate and reduce potential losses.

(ii) A discussion of the State's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; a discussion of State funding capabilities for hazard mitigation projects; and a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

(iii) An identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.

(iv) Identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.

(v) A State may request the reduced cost share authorized under § 79.4(c)(2) of this chapter for the FMA and SRL programs, if it has an approved State Mitigation Plan meeting the requirements of this section that also identifies specific actions the State has taken to reduce the number of repetitive loss properties (which must include severe repetitive loss properties), and specifies how the State intends to reduce the number of such repetitive loss properties. In addition, the plan must describe the strategy the State has to ensure that local jurisdictions with severe repetitive loss properties take actions to reduce the number of these properties, including the development of local mitigation plans.

5.1 MITIGATION STRATEGY OVERVIEW

The Mitigation Strategy Section is comprised of goals, objectives, and actions/activities that the State of North Carolina's agencies will strive to achieve in order to make North Carolina the most resilient state in the United States and reduce risk to both natural and technological/man-made hazards. Overall, these goals, objectives, and actions make up the state's Mitigation Strategy. When viewed holistically, this structure can be viewed as a combination of broad and specific aims of the state, which in turn form both interim- (less than 5 years to completion) and long-term (more than 5 years to completion) strategies that are meant to achieve the state's vision for mitigation.

For the 2023 update, Hazard Mitigation Planning staff reviewed the mitigation actions and made recommendations for revisions to the primary responsible agency through the RMCC members, various subject matter experts, and other stakeholders. After discussion with the responsible agencies, some actions have been identified for deletion and some new actions have been added. The deleted actions have been removed from the "Active" actions and put below in a new sub-section specifically for deleted actions.

5.2 MITIGATION GOALS

5.2.1 Aligning State Goals and Changes Since Last Update

The 2023 goals for the North Carolina Enhanced State Hazard Mitigation Plan continue to align with the overall goals and strategies of the North Carolina Department of Public Safety, NCEM, and the North Carolina State Homeland Security Strategy. The goals are based on six of the seven core capabilities in the mitigation mission area of the National Preparedness Goals. These core capabilities have been identified as the priorities of the Secretary of North Carolina Department of Public Safety, the State Emergency Response Commission, and the Director of North Carolina Emergency Management.

The overarching goals of the North Carolina Department of Public Safety, the North Carolina Emergency Management Division, and the North Carolina State Homeland Security Strategy are as follows:

1. Prevent - We are the model for preventing and reducing crime.
2. Protect - North Carolina is safe for living, working and visiting.
3. Prepare - We are leaders in public safety readiness, communication and coordination.
4. Perform - We excel in every facet of our work – Law Enforcement, Emergency Management, National Guard, Adult Correction and Juvenile Justice and Administrative Services.
5. People - We will value each other like family.
6. Vision - To provide the finest safety and security services for all North Carolinians

The six priority core capabilities in the mitigation mission area of the National Preparedness Goals are:

1. Mitigation Planning
2. Public Information and Warning
3. Community Resilience
4. Long-Term Vulnerability Reduction
5. Threats and Hazard Identification
6. Risk and Disaster Resilience Assessment

Another key component of developing this strategy is the Hazard Mitigation Branch's outreach to local communities. Through this outreach, the state describes our various grant funding programs and asks that communities send in "Letters of Interest" which describe mitigation activities that they would like to pursue within specific funding streams. Each year, once FEMA Hazard Mitigation Assistance Guidance has been published for that year, the

Hazard Mitigation Branch, sends out a mass mailing to all local Emergency Management, Planning, and Storm Water services staff across the state describing programmatic goals and priorities and announcing the beginning of that year's non-disaster assistance grant cycle.

State staff may travel to communities to meet in person with public officials and municipal or county staff to explain grant guidance and eligibility requirements and discuss potential mitigation projects for that grant cycle. Communities typically have ideas as to what specific mitigation actions they would like to pursue, so the Hazard Mitigation Branch requests communities provide "Letters of Interest" and offers them technical assistance in areas such as cost-benefit analysis, interpretation of FEMA guidance, and Environmental Review[1], as they develop their projects.

The Hazard Mitigation Branch use the Letters of Interest and feedback from technical assistance provided to ensure the goals and objectives in the local plans align with the goals and objectives in the state's plan. When they do not, appropriate steps are taken to evaluate both plans and make amendments where necessary as part of the plan maintenance process. This process also helps state officials understand local needs and shapes the overall statewide mitigation strategy.

Finally, the goals, objectives, and actions that make up this mitigation strategy are also based on the findings of the statewide risk assessment which is laid out in Section 3. During the 2023 update, after completing the risk assessment portion of the plan, the planning team evaluated what areas of concern (e.g. hazards, geographic areas, etc.) were most pertinent to mitigate in the state. Encompassed within this review, major changes in development that occurred between the 2018 and 2023 were also identified and analyzed. The mitigation strategy was then updated according to these areas of concern and changes in development, and was therefore influenced heavily by the risk assessment.

Additionally, during the 2023 plan update, the goals, objectives and actions were further reviewed, evaluated and, in some cases revised to reflect the change in Statewide priorities related to hazard mitigation, climate resilience, equity, environmental justice and social vulnerability. The Guiding Principles of the North Carolina Climate Risk Assessment and Resilience Plan were included within this review to ensure core objectives of the 2023 plan update are in alignment with other state plans. These principles included: (1) Act quickly and decisively to reduce the most harmful impacts of climate change, (2) Act thoughtfully and collaboratively to develop equitable solutions for the most socially challenging effects of climate change, (3) Invest in safe, affordable, and connected communities, (4) Strengthen regional economies, (5) Support healthy communities, local identity, and recreational access to nature, and (6) Implement resilience best practices. This continuity enhances approach, and overall, provides a comprehensive understanding of the state's values and goals.

1 Natural Heritage Program (NCNHP) datasets should be used for environmental review components of this effort – datasets include rare species, natural communities, nature preserves, managed lands, and natural areas.

5.2.2 Goals

Through a process of aligning the NCDPS goals and core capabilities and aligning with the North Carolina Climate Risk Assessment and Resilience Plan, the NCHMP goals have been established as follows:

1. Support mitigation planning at all levels of government, including all Tribal Nations, in North Carolina to ensure every community has the opportunity to participate in an equitable, systematic mitigation planning process and has an approved and adopted hazard mitigation plan.
2. Provide the public with proper risk information and availability of early warning systems for events to the extent possible.
3. Ensure community level resilience through empowering individuals and communities to make informed decisions to facilitate actions as necessary to adapt to, withstand, and quickly recover from future incidents and climate change.
4. Achieve a measurable decrease in the long-term vulnerability of North Carolina against all hazards and consider climate change when identifying mitigation projects.
5. Identify all threats and hazards most likely to impact North Carolina based on sound science, future climate projections, and through coordination and collaboration with local, state, and federal agencies.
6. Complete risk and disaster resilience assessments at the local level, defining localized vulnerabilities in the face of climate change and consequences associated with potential hazards and climate projections.
7. Prioritize socially vulnerable communities (i.e. elderly, limited mobility, homeless, limited English proficiency) when evaluating state and local mitigation goals, objectives and actions.
8. Use state policy, programming and investments to advance the state's resilience to natural hazards and climate change in a coordinated manner.
9. Implement resilience best practices to ensure that all actions taken embody the most up to date best practices in building resilience and combating climate change.

Overall, when viewed jointly, these new goals continue to address the intent of the single, original goal of the original North Carolina State Hazard Mitigation Plan: "To reduce the State's vulnerability and increase resilience to natural hazards, in order to protect people, property and natural resources." However, the new goals provide a more distinct vision for the state to follow as it attempts to further reduce risk and improve quality of life for the public.

5.2.2.1 Repetitive Loss and Severe Repetitive Loss Specific Goals

Although many of the goals above apply to repetitive loss and severe repetitive loss properties, the planning team felt that it was also important to identify some goals that were specifically aimed at addressing repetitive and severe repetitive loss properties. In short, the state will adhere to two primary goals when addressing repetitive loss properties:

1. Reduce the overall number of repetitive loss and severe repetitive loss properties by utilizing available mitigation funding and prioritizing funds to address repetitive loss properties when appropriate.
2. Minimize the number of additional properties that may become repetitive loss properties through the implementation of proactive mitigation action.

5.3 MITIGATION OBJECTIVES

While the FEMA Guidance does not contain a requirement to have objectives, it is a requirement of the Emergency Management Accreditation Program. The updated goals and objectives have been designed to align with other plans maintained by NCEM as well as the overarching goals of NCDPS and NCEM. The plan's goals will be pursued through the identification of more specific, but still necessarily broad Objectives that apply collectively to the identified hazards. These objectives outline in greater detail how the state will achieve its goals and also provide some organization for the state's mitigation actions (see below). These objectives are focused on creating measurable outcomes and milestones for the state as it attempts to address the goals laid out in the plan. The following objectives have been identified:

- Hazards: Continuously identify new hazards and address each of the hazards identified in this plan through at least two actions.
- Data: Collect spatial data on each of the hazards outlined in this plan and collect exposure data concerning people, property, and other features likely to be impacted by all identified hazards. Integrate the latest climate science from partners such as NOAA, the State Climate Office, FEMA and others.
- Applications: Develop new, and maintain/enhance existing applications and software to assist local officials, state officials, and other stakeholders in reducing risk.
- Risk Assessments: Carry out risk assessments for each of the hazards identified in this plan and help local governments use this information to mitigate these hazards. Integrate climate science into these assessments where feasible.
- Training/Outreach: Provide technical assistance and training to local governments and other state agencies to help utilize state tools and information and conduct outreach to receive feedback from these stakeholders.
- Technology: Emphasize the use of technology to identify risk, advance mitigation goals, and improve the implementation of mitigation actions.
- Nature Based Solutions: Emphasize the use of Nature Based Solutions and Green Technologies, where feasible to reduce the impacts of natural hazards on people and property.

5.4 MITIGATION ACTIONS

5.4.1 Identification of Potential Mitigation Actions

The plan's objectives will be achieved through the implementation of individual Actions that will describe specific and measurable activities to be undertaken in pursuit of the overall Objectives and Goals. The Mitigation Action Tables are the primary tool that will be used by the state to implement and monitor the actions that have been identified to reduce the impact of hazards across the state. In these tables, the planning team has identified a number of actions that it intends to take or support in the coming years.

Progress toward actions is noted in each table and any action items that have been completed are marked "completed" and will be removed in the next plan update. Similarly, actions that are no longer applicable or were combined with other actions have been marked "deleted" and will be removed in the next plan update. All other existing actions have been updated with an explanation of progress towards completion.

5.4.1.1 Identification Process

As alluded to above, many of the existing actions from previous plan updates have not been fully completed. To identify which actions would remain in place during the 2023 update, the planning team carried out a thorough review of each of the existing actions from the 2018 update. Each action was marked as completed, deleted, or incomplete/deferred. Any actions that fell into the latter designation were identified as actions that would remain in the 2023 update of the plan.

In addition to completing a thorough review of existing actions, the planning team also worked in conjunction with the RMCC to identify new actions. This process was made up of two parts. First, the planning team worked within the Hazard Mitigation Branch and the NCEM organization overall to identify actions that were important priorities for mitigation in the state that were not already included in the plan. A number of these were connected to actions being undertaken by other groups within NCEM, but many were also new ideas for projects that had been developed within the Hazard Mitigation Branch over the past five years.

The second part of the process of identifying new actions involved getting feedback from members of the RMCC on any priorities that they wanted to include in the plan. Feedback from these stakeholders was received through the RMCC meetings that were held during the process, the Key State Stakeholder interviews and by directly contacting designated representatives from other stakeholder groups who may not have been able to attend RMCC meetings.

Through this process of evaluating existing actions and identifying new actions, a comprehensive set of mitigation actions was developed to support risk reduction statewide.

5.4.1.2 Assessment of Effectiveness of Actions

During the 2023 update, the planning team carried out an evaluation of the effectiveness of existing actions. Encompassed in this evaluation, the team drastically reduced the number of existing actions that had been carried over from past plan updates by marking actions completed or deleted. As a result, the actions that were kept in place were systematically evaluated in terms of their effectiveness. Through this process, the planning team was able to get a sense of what actions were working to reduce risk and mitigate hazards most effectively and use that knowledge as a guide to develop additional actions and to prioritize actions. While all of the existing actions that were kept in the plan have the effect of mitigating risk to hazards, some of these actions do so more effectively than others. This evaluation of effectiveness was critically important because it helped the planning team determine where to focus future funding and effort to maximize risk reduction across the state.

5.4.2 Prioritization, Changes in Priorities, and Funding of Actions

5.4.2.1 Prioritization of Actions

Prioritization of actions in the plan can be challenging, as various interests may have differing views on what criteria should be given the most weight and which actions should be prioritized. For instance, cost may be a major concern for some stakeholders, while ease of implementation may be the primary concern for others. The planning team took into account a number of different factors when prioritizing and based prioritization of the proposed mitigation actions on the following seven factors:

- Effect on overall risk to life and property
- Ease of implementation
- Political and community support
- A general economic cost/benefit review[2]
- Funding availability
- Continued compliance with the NFIP
- Benefits underserved communities[3]
- Use of Nature Based Solutions
- Impact on/Resilience from Climate Change impacts

The planning team coordinated the prioritization process by reviewing each action and working with the lead agency/organization responsible to determine a priority for each action using the seven factors listed above. Using these criteria, actions were classified as high, moderate, or low priority.

5.4.2.2 Changes in Priorities

Overall, the general intent of the plan and its priorities remains the same as during the last plan update, which in short is to protect the life, safety, and welfare of the citizens of North Carolina, their property, and the state's natural resources by reducing vulnerability to hazards. However, given the major overhaul of the mitigation strategy, including reshaping goals and objectives and efforts to re-focus actions on areas that can have the greatest positive impact, it is clear that priorities have changed to some degree. Although there are a number of priorities for the state, the planning team elected to emphasize several that seemed to be major priorities going forward.

One of the major areas of focus during this update was on considering climate change in the Risk Assessment and Mitigation Strategy and equity in the Planning Process, Mitigation Strategy and being mindful of underserved communities as part of the prioritization criteria

---

2 Only a general economic cost/benefit review was considered through the process of selecting and prioritizing mitigation actions. Mitigation actions with "high" priority were determined to be the most cost effective and most compatible with the state's unique needs. Actions with a "moderate" priority were determined to be cost-effective and compatible with state needs, but may be more challenging to complete administratively or fiscally than "high" priority actions. Actions with a "low" priority were determined to be important needs, but several potential challenges were identified in terms of implementation (e.g. lack of funding, technical obstacles). A more detailed cost/benefit analysis may be applied to particular projects prior to the application for or obligation of funding, as appropriate.

3 Benefit to underserved communities as a priority was added during the 2023 update.

for the Mitigation Strategy. The State is also continuing to prioritize maximization of technology and producing high quality data in the area of risk and vulnerability assessments. The state identified this as a primary priority in previous version of the plan since it is critical to have accurate and useful information before real mitigation efforts can be implemented. The most substantive mitigation actions take place at the local level, but most local governments do not have the resources available to produce high quality data that can inform them of their risk. Therefore, the state views itself as a key resource for local governments in this regard and plans to emphasize its development of new data and technology to provide local governments with the best available information and to support their use of that information to implement actions that reduce risk.

Another major area of focus for the state going forward will be in training and outreach to local governments. As mentioned, the state views local governments as the most effective conduit for the implementation of mitigation actions, so open communication and outreach to the local level is key. Although training and outreach has always been identified as a component of the state's mitigation strategy, the state needs to continue to play a prominent role in ensuring local governments are well-supported in their efforts to implement mitigation action.

5.4.2.3 Potential Funding Sources of Actions

Funding of mitigation actions is often a challenge due to the limited resources that are available broadly. However, there are a number of sources of funding that are aimed specifically towards mitigation actions and projects, primarily through the federal government. These are described below and represent the most commonly used sources of funding for mitigation projects in the state.

Hazard Mitigation Grant Program (HMGP):

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local government's overall mitigation strategy and comply with program guidelines. Eligibility for funding under HMGP is limited to state and local governments, certain private nonprofit organizations, institutions that serve a public function, and authorized tribal organizations. These organizations must apply for HMGP project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding, administering the program, and assuring that local projects are consistent with the state's mitigation plan.

After a presidential disaster declaration, local governments conduct community outreach meetings. At these meetings, federal and state officials provide information and answer questions about state and federal assistance. Property owners interested in acquisition, elevation, or reconstruction projects must submit a completed owner interest form to the local government. Local governments may also request guidance and information on submission of proposals for other mitigation project types such as protection of critical public facilities. Based on the outcome of these meetings and proposals, the Risk Mitigation Branch establishes priorities for the allocation of disaster-related mitigation funds. The outcome of this process is reported in the State Administrative Plan.

Once this process is complete, NCEM solicits or completes project applications for selected projects. NCEM reviews applications for congruence with local mitigation plans, examines any environmental issues that may be encountered in association with NEPA, and also conducts a benefit-cost analysis for each submitted project, if applicable.

NCEM's responsibilities are limited to ensuring that the Enhanced State Hazard Mitigation Plan, Regional Hazard Mitigation Plans and Local Hazard Mitigation Plans address dam failure hazards and note the presence of High Hazard Dams identified by NCDEQ and that plans are consistent with RHHPD Programmatic Guidance.

Non-Disaster Mitigation Programs

NCEM also annually solicits letters of interest from local governments for two non-disaster HMA programs: Building Resilient Infrastructure and Communities (BRIC)[4] and Flood Mitigation Assistance (FMA). Local governments have responded in a positive manner to this approach. Since they now know when to expect solicitations, they can do a better job of planning for participation and a better job of providing NCEM with accurate and appropriate documentation for application development.

For purposes of selecting and prioritizing proposals for non-disaster related projects, NCEM uses either program-specific guidance (which may change somewhat from year to year) and/or relies on a traditional prioritization of cost effective projects.

Availability of funds is made known to NCEM's local mitigation partners including local emergency management coordinators, local elected officials, and local planning community development staff upon receipt of FEMA guidance. Project proposals are solicited and technical assistance is provided in development of applications for funding of eligible projects.

Generally, emphasis is also placed on identifying and addressing properties that meet the repetitive loss and severe repetitive loss designations of FEMA's non-disaster funding sources. Special outreach is usually conducted when each funding opportunity is made available to encourage participation in projects by property owners and local governments. Outreach may include direct contact, special mailings, public meetings and public service announcements published by North Carolina Emergency Management, the Department of Public Safety, and other partners in North Carolina's mitigation effort.

Other Factors Pertaining to Mitigation Funding

It should be noted that for prioritization of cost effective projects across all UHMA funding streams, the State integrates specific criteria into its analysis. This includes, but is not limited to, an assessment of the impacts of development pressures (i.e. geographic areas experiencing significant growth) and the increased potential beneficial impact the mitigation project may have on its community.

Furthermore, all of our grant programs require an environmental review as mandated by the National Environmental Policy Act (NEPA). This environmental assessment is conducted

4 The BRIC program replaced the PDM program in 2020.

during the application process for any grant application and includes NCEM coordination with other state and federal agencies to notify them of potential projects. Other agencies have the opportunity to comment on these projects and notify NCEM if there is an area of concern which might require further action in order to make it an environmentally sound project.

Repetitive Loss and Severe Repetitive Loss Funding

All of the aforementioned funding sources (HMGP, BRIC, FMA) have been used by the state to address repetitive loss properties. Historically, FMA has been targeted most directly at addressing repetitive loss and severe repetitive loss properties since federal priorities have often emphasized that purpose. However, the state also utilizes both HMGP and BRIC to address these types of properties. These programs will continue to serve as the primary funding source for addressing repetitive loss and severe repetitive loss properties in the future.

Rehabilitation of High Hazard Potential Dam Program

The Rehabilitation of High Hazard Potential Dam Program (HHPD) is a new grant program under the National Dam Safety Program Act which was amended by the Water Infrastructure Improvements for the Nation (WIIN) Act on December 16, 2016. The amendment directed FEMA to establish a grant program that provides technical, planning, design, and construction assistance for eligible rehabilitation activities that reduce dam risk and increase community preparedness. A state or territory with an enacted dam safety program, the State Administrative Agency, or an equivalent state agency, is eligible for the grant. The Department of Energy, Mineral, and Land Resources (DEMLR) Dam Safety Program is the administrator for this FEMA grant program. It is DEMLR's duty to identify qualifying "at-risk" dams and to work with the owners through the repair approval to improve safety and future resilience of these qualifying dams.

5.4.2.4 Repetitive and Severe Repetitive Loss Specific Priorities

The repetitive loss and severe repetitive loss strategy for North Carolina is geared towards encouraging local communities to prioritize mitigation of repetitive loss and severe repetitive loss properties and removing the financial strain imposed upon the National Flood Insurance Program (NFIP) for claims that compensate homeowners who have suffered repeatedly from flood losses.

The North Carolina strategy meets the directives of the United States Congress as outlined in the Federal Register and reflects FEMA's guidelines for the program. To this end:

- In the review process for applications for disaster assistance, the state will review the number of repetitive loss and severe repetitive loss structures in a community and the extent to which they are mitigated. Local governments will be encouraged to include these properties in their proposals and applications for mitigation projects.
- The state will require that local mitigation plan updates identify the number of severe repetitive loss properties and repetitive loss properties in each community covered by the plan.
- The state will require that each local mitigation plan update consider mitigation actions to address existing repetitive loss properties. These actions will assist with avoiding recurring losses from natural hazards in the future.

- The state will require that local mitigation plan updates identify undeveloped areas in the flood plain and appropriate mitigation actions to help avoid building structures that will become repetitive loss properties in the future.

Project Eligibility

NCEM will review any eligible project proposal that demonstrates cost-effectiveness in the mitigation of repetitive loss and severe repetitive loss properties, with an emphasis on the following:

- Severe repetitive loss and repetitive loss properties with the greatest dollar value of claims
- Severe repetitive loss and repetitive loss properties with the greatest number of claims
- Properties will be evaluated for a proposed project based on the FEMA Benefit-Cost Analysis (BCA) module. Cost effective properties with the highest Benefit Cost Ratio (BCR) will become priority projects.
- These properties may be mitigated through a number of techniques including, but not limited to:
- Acquisition
- Elevation
- Mitigation Reconstruction
- Minor physical localized flood reduction projects
- Dry Floodproofing (commercial structures only)

Project Selection Criteria

The State's priorities are a major consideration in the selection of projects for funding. Projects will be selected according to how well they satisfy FEMA eligibility criteria and their support of the state's overall mitigation strategy.

The Grants Section which is responsible for project development will work closely with the community to develop a severe repetitive loss and repetitive loss plan of action to prioritize and mitigate the most vulnerable structures. The selection of properties will be determined by ranking the structures in the state based on the greatest losses and claims to the NFIP.

As mentioned above, properties with the highest Benefit Cost Ratio (BCR) will also be prioritized. Projects will be examined and the state will work with local governments to determine the most appropriate type of mitigation action to implement (elevation, acquisition, etc.). After this, applications will be submitted in the program that is determined to give the project the best chance of funding success.

5.4.3 Mitigation Actions

As explained previously, the state's mitigation actions provide a functional plan that is designed to achieve the mitigation goals and objectives outlined above. Each proposed mitigation action has been identified as an effective means of reducing hazard risk, and these actions will be reviewed on a regular basis according to the plan's maintenance procedures.

Each action is listed in conjunction with information detailing the action such as hazard(s) addressed, relative priority, and potential funding sources to implement the action. Most importantly, implementation mechanisms are provided for each action, including the designation of a lead agency or department responsible for carrying the action out, as well as a timeframe for its completion. These implementation mechanisms ensure that the plan remains a functional document that can be monitored for progress over time. These mitigation actions are laid out on the following pages.

Action Number	NC-1
Action Description	Develop a robust network of tools and systems throughout the state to help local and state officials better prepare for and respond to flooding events. This would include: • Increase the number of stream-flow gauges and dam impoundment water level gauges statewide • Collect stream gauge data, rainfall data, and high-water mark data regularly • Provide information to communities on real time flood inundation • Develop flood warning and alert system • Develop Dam Safety early warning system and priority response tools using "Dam Watch." • Continue development of Dam Overtopping studies of large and very large dams.
How Action Contributes to Risk Reduction	Improving data collection, real time flood information, and flood warnings will allow more preparation for and better response to flood events, reducing potential loss of life and property damage.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Flooding
Priority	High
Goal	2, 3
Objective Addressed	2, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NCEM-Hazard Mitigation with NCDEQ-Dam Safety
Other Contributing Agencies	National Weather Service, NCDEQ-Division of Water Resources, NC Wildlife Resources Commission, and NC Natural Heritage Program (NCNHP)
Completion Date	2027 (Interim and Long-Term Strategy)
Current Progress	North Carolina Flood Inundation Mapping and Alert Network (FIMAN) is a public facing website that displays flood gauge data. FIMAN produces maps in real-time that depict areas of inundation as well as flood forecast maps that show areas that are expected to become inundated hours and days into the future. There are more than 480 gauges across the state that are connected through FIMAN. Local and state level officials have begun using the network during major events such as Hurricane Matthew in 2016 to help communities identify key facilities or areas that may be flooded during the event.
Anticipated Future Progress	Currently there are many areas of the state where there are no stream or dam impoundment gauges or the number and location of gauges makes it challenging to produce data for some localities. The state is currently installing 71 new gauges to further expand the data available to local governments using this program.

Action Number	NC-2
Action Description	Carry out projects that qualify under the most current version of Unified Hazard Mitigation Assistance program (at this time includes HMGP, BRIC, FMA grant programs), FEMA Resilience Grants (such as Rehabilitation of High Hazard Potential Dam (HHPD)), National Dam Safety Program (NDSP) State Assistance Grant Program, etc to protect/mitigate risk to people and personal property such as residences and businesses. Where possible, a primary focus of these programs will be on repetitive loss and severe repetitive loss properties. Project types that fall under this action could include, but are not limited to: Acquire properties that are located in areas vulnerable to hazards. Elevate properties that are located in areas vulnerable to flooding. Structural retrofits for structures that are vulnerable to wind events. Non-structural retrofits for structures that are vulnerable to earthquakes/geological events. Analyze building stock to identify potential structures that could be mitigated. Provide funds for purchase of conservation easements or purchase of land within floodplain. Identify properties to be acquired that will support mitigation by coordinating with other entities (such as the Clean Water Task Force) to leverage other funding sources for acquisition to support additional state mandated goals. Develop funding source (with hazard funds) targeted to areas most vulnerable to earthquakes, sinkholes, and landslide/geochemistry for acquisition and/or conservation easements. Promote safe room construction and help provide safe havens/rooms in areas with extremely vulnerable populations. Projects that include dam safety training for state personnel, increase in the number of dam inspections, increase in the submittal and testing of dam Emergency Action Plans, more timely review and issuance of permits, improved coordination with state emergency preparedness officials, identification of dams to be repaired or removed, conducting dam safety awareness workshops and creation of dam safety videos and other outreach materials. Projects to provide technical, planning, design and construction assistance for rehabilitation of eligible high hazard potential dams. Encourage applications for Advance Assistance funding and Capability and Capacity Building funding to allow communities to secure assistance with identifying and quantifying problems and solutions with the goal of preparing quality funding proposals/applications
How Action Contributes to Risk Reduction	Completing mitigation projects, such as acquisition, elevation, retrofits, etc., will reduce the number of people and properties located in vulnerable areas, improve structures' ability to withstand damage from future hazard events, and increase safety for vulnerable populations, reducing potential loss of life and property damage.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	3, 4, RL-1, RL-2
Objective Addressed	2, 3, 6
NPG Core Capability	Community Resilience, Long-Term Vulnerability Reduction, Housing, Economic Recovery
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM- Hazard Mitigation
Other Contributing Agencies	NC DEQ, Local governments

Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	The state has remained active in all of the UHMA related funding streams, annually (and successfully) applying for funding from non-disaster programs such as FMA and BRIC, and utilizing HMGP to the greatest extent possible. The state has especially been active at acquiring and elevating properties through these grant programs, but has also begun to diversify and submit applications for some of the other projects listed above. Leveraging these programs and funding sources will continue to be a major priority for the state's mitigation program going forward. NCDEQ-Division of Mitigation Services acquires conservation easements and fee simple title to many lands within the floodplain. Often, due to stream, wetland, buffer, and nutrient offset regulatory constraints, DMS is limited in the amount of floodplain that is purchased. There is significant opportunity to leverage external funds with DMS's compensatory mitigation dollars to expand floodplain acquisitions, improve flood storage, water quality, and habitat functions, while also reducing flood hazards. As stated above, there are also opportunities to use identified priority lands as a component in the DMS project selection criteria. The new Natural Infrastructure Flood Mitigation Program may also provide a primary vehicle for floodplain acquisition if the program receives legislative appropriations or other funding. NCDEQ Division of Mitigation Services is developing modeling to aid in identification, assessment of feasibility, cost-effectiveness and design of Nature Based Flood Mitigation Measures to assist local governments in flood mitigation and project development activities.
Anticipated Future Progress	There are still a large number of projects across the state that may be eligible for funding through the UHMA programs so the state will continue to work with local governments and other stakeholders to ensure these projects are implemented through UHMA when possible.

Action Number	NC-3
Action Description	The state will provide training and publications to local governments, state agencies, and other organizations on emergency management and mitigation. Encompassed in this, the state will develop and implement an outreach program to receive feedback on mitigation programs and policies. These efforts may include: • Train local emergency managers on various mitigation activities and funding opportunities. • Educate public and private organizations on the theory and practice of hazard mitigation, and help them to identify how mitigation can become incorporated into their own routine functions or activities. • Conduct interactive "Mitigation Planning Workshops" to local governments including use of GIS in Hazard Mitigation Planning. Potentially partner with Institute of Government to develop. • Develop and conduct county-wide educational programs for local officials on wildfire programs such as Firewise Communities, Ready, Set, Go!, and Fire Adapted Communities, and on flood risk including flood mapping, new DFIRMs, flood insurance, etc. • Develop and maintain a variety of widely-adaptable mitigation PowerPoints, brochures, publications, newsletters, and other information. • Promote Wildfire Risk Reduction through the National Fire Plan and other funding sources to create landscape-level change across North Carolina (prescribed fire and hazard fuel reduction projects). • Gain insights from local public officials on what additional products or services could assist them in developing local mitigation plans. • Develop, publicize, and provide a wide variety of risk assessment products and planning services to assist local officials in their planning and risk reduction activities. • Promote 406 mitigation through discussion and presentations with various state and federal partners. • Participate in expositions and symposiums such as the North Carolina Aquariums Earth Day Expo, host booth(s) at county and state fairs, coordinate with county Cooperative Extension Services on events. • Develop Bi-lingual mitigation messages. • Conduct direct outreach on non-structural mitigation measures at Local, Tribal, and State agencies as well as with citizens. • Train local EMs on Dam Safety Fundamentals, Emergency Action Plans and through use of tabletop exercises for mitigation and emergency response. • Train local governments on benefits of adopting higher standards in their Flood Damage Prevention Ordinance.
How Action Contributes to Risk Reduction	Improving training, education, and outreach on emergency management and mitigation for local governments, state agencies, and other organizations will increase the implementation of mitigation activities, resulting in overall risk reduction.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 3, RL-1, RL-2
Objective Addressed	1, 2, 3, 4, 5, 6
NPG Core Capability	Public Information and Warning, Community Resilience
Funding Source(s)	Federal and State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM

Other Contributing Agencies	NC DEQ, NC FS
Completion Date	2024 (Interim and Long-Term Strategy)
Current Progress	NCEM has provided a number of workshops (such as the June 16, 2022 workshop held at the Joint Forces Headquarters) and opportunities for local governments related to mitigation (such as the Hazard Mitigation newsletter) and has maintained a wide array of outreach materials on mitigation. Additionally, other state agencies have also been active in mitigation outreach over the past several years. For example, NCDEMLR-Dam Safety has held and participated in tabletop exercises with local governments, State of South Carolina and Federal Dam Owners to cover dam safety issues and mock emergencies to improve education and workflow in the case of disaster events. In addition, the NC Forest Service continues to provide hundreds of presentations annually. There is a statewide Firewise exhibit at the state fairgrounds that engages thousands of visitors throughout the 10-day event. NCFS receives federal pass through USFS funding for Fire Adapted Communities work to be completed in 4 NC Resource Conservation and Development Districts, the Appalachian RC&D FAC Coalition. These support funds will allow the RC&D's to assist in expanding the FAC Concept across multiple States along the Appalachian Mountain range initially from Georgia into North Carolina and Virginia. Each of the North Carolina RC&Ds (4) received $32,000 of funding to encourage a grassroots effort for Fire Adapted Communities. This effort began in January 2017 in Western NC. There are 24 Nationally-recognized Firewise Communities in NC that are scattered throughout the state (see map of current communities in good standing: http://nfpa.maps.arcgis.com/apps/Viewer/index.html?appid=c4a788340df748f18d98d8363145bb67). Community Wildfire Mitigation Best Management Practices class will be held in November 2023 in Asheville, NC, as the pre-workshop for the Wildland Fire Management Cohesive Strategy Workshop. This is a National-level course which leads to more effective wildfire mitigation for practitioners. The Appalachian FAC is still active in the four RC&D territories and has driven the number of Firewise USA recognized communities to 38 in the state. They coordinate all outreach activities with the local County Ranger and NCFS mitigation staff. Ashe County successfully applied for BRIC grant from FEMA and has begun the first round of contracted project work.
Anticipated Future Progress	Training and outreach will continue to be a critical task for the state to carry out in terms of mitigation. NCEM will lead efforts to help local governments with grant funding opportunities and planning, as well as maintaining a public face to help inform citizens about the benefits of mitigation. Training and outreach will continue as new methods and strategies become available to implement. NCFS will work collaboratively with partners to identify educational outreach opportunities that have a landscape-scale impact on wildfire risk reduction across the state. Those without a dedicated staff member for wildfire mitigation risk will be attempting to do so, via CWDG applications.

Action Number	NC-4
Action Description	Evaluate emerging technologies and upgrade through hardware/software acquisition and training where appropriate and feasible.
How Action Contributes to Risk Reduction	Developing new technologies and software will improve the ability to evaluate risk and make better risk reduction decisions, minimizing potential loss of life and property damage.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 5, 6
Objective Addressed	3, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Improved and Prioritized Emergency Response
Funding Source(s)	State and Federal resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM- Risk Management
Other Contributing Agencies	NCGS, Forest Resources, NC Dam Safety, Local Governments, State Climate Office
Completion Date	2027 (Interim and Long-Term Strategy)
Current Progress	NCEM is one of the leading developers of new technology and software in the country in terms of risk and vulnerability assessment. Indeed, one of the primary objectives of the RMCC is to focus on leveraging new technology to evaluate risk in the state. As new technologies have been developed within the state, staff have been trained to integrate these technologies into existing programs to ensure the most advanced and up to date information and data is being used. In addition, state staff keep up to date on using other technologies like "Dam Watch" that have been developed outside of the state. NCDEQ-DEMLR's Dam Safety Program has supplemented this effort by performing overtopping studies on 525 dams and NCEM is in the process of installing 130 dam impoundment water level gauges that are being tied into the "Dam Watch" tool efforts to develop an early warning system for emergency agencies which will also help to focus and prioritize emergency response. Other efforts include the development of a uniform web-based inspection process that ties into a newly developed semi-quantitative risk analysis process for dams to develop relative dam risk among NC's dams North Carolina Forest Service is actively developing applications for wildfire risk mitigation. The #ResistWildfireNC initiative and website have been developed and are being utilized. The #ResistWildfireNC Neighbor 2 Neighbor Tool is a visualization tool and interactive mapping application designed to illustrate a home's defensible space (ignition zones surrounding your home) and connections between one person or family's defensible space in relation to their neighbor's defensible space. The collaborative and continuous CWPP application will utilize modern technology to help contributors create plans to reduce wildfire risk. NCFS serves on the Southern Wildfire Risk Assessment Portal (SouthWRAP) Steering Committee. All Wildfire Risk Assessments are completed using Community Assessor for the South (within SouthWRAP). The Neighbor 2 Neighbor tool has been developed with Emergency Management and is nearing readiness for launch to the public. Timmons Group, with input from NC, SC and TX has completed discovery stage for a Living CWPP collaborative document writer/tracker.
Anticipated Future Progress	The state will continue to leverage technology going forward in an attempt to make the best possible decisions on risk reduction and minimizing damage to people and property across the state. As new technologies are constantly emerging, this is an area where there will

	often be quick developments and a need for constant vigilance to ensure the best available information is being used. The General Assembly has recently funded continued use of "Dam Watch" as a tool for NCEM and DEQ. This new tool should move into use in the third quarter of 2022. Further development of current applications will occur. The #ResistWildfireNC Neighbor 2 Neighbor Tool will be publicly accessible via a ESRI Story map. SouthWRAP will integrate new geospatial LANDFIRE data. As more new technology become available, it will be utilized to implement wildfire risk reduction in NC.

Action Number	NC-5
Action Description	Standardize technology between partners, determine software compatibility, linear referencing, inventory of DOT facilities.
How Action Contributes to Risk Reduction	Standardizing technology will ensure the most up to date information is available to support risk reduction decision making.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 5, 6
Objective Addressed	3, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM
Other Contributing Agencies	None
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	Over the past several years, there have been great efforts made by NCEM to standardize technology with partners across other state and federal agencies by working to determine software capabilities and create common inventories of assets and features.
Anticipated Future Progress	This is a process that requires frequent updating to ensure the most up to date information is included in databases and so the focus of this action going forward will be to regularly evaluate the information within these databases and integrate new information where possible. This process may also necessitate new systems for organizing the data and these will be implemented when identified.

Action Number	NC-6
Action Description	Work with local communities to promote changes in local policies, regulations, and activities such as: • Promote benefits of adopting higher standards in local Flood Damage Prevention Ordinances • Re-assess tree trimming policies of municipalities and power companies • Ensure that tree trimming policies of local governments have been reassessed to comply with industry standards • Promote updating Building Codes in hazard-prone areas • Update Building Code to reflect hazard mitigation building techniques. • Encourage local governments to use their risk and historical hazard data for purposes of modifying regulations, standards, ordinance to minimize their vulnerability. • Promote river basin wide planning of flood hazard • Promote consideration of future build-out conditions when establishing land use and floodplain management regulations. • Promote and support recognition programs, such as the Community Rating System • Promote improvement of storm drainage systems.
How Action Contributes to Risk Reduction	Promoting change and improvements in local policies, regulations, and activities, such as tree trimming policies, building codes, land use and floodplain management regulations, etc., will protect infrastructure, critical facilities, and other buildings, reducing potential vulnerability and property damage.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 3, 4, 6
Objective Addressed	1, 2, 3, 4, 5
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Local resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	Local Governments
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	Since the last update of the plan, the state has taken a fairly proactive approach and has even implemented stronger language related to freeboard standards into the state building code. Many local governments have likewise implemented stricter standards, regulations, and policies aimed at mitigating risk over the past several years and state officials have worked to help craft these policies and regulations when asked. NCDEQ DMS conducts river basin watershed plans for each of the 17 river basins in North Carolina. The river basin plans are conducted in coordination with the Division of Water Resources Basinwide Planning efforts. Watershed planning is a core function of DMS to ensure that DMS uses its limited dollars to select and implement the best stream and wetland compensatory mitigation projects for North Carolina. One of DMS' legislative components is the "restoration and monitoring of projects or land acquisitions that create or restore flood storage capacity." DMS works with other agencies, local governments, and other partners as part of this process. DMS would

	welcome coordinated efforts with other entities that are working on river basin planning of flood hazards. The North Carolina Flood Resiliency Blueprint should provide a primary means to promote basinwide flood hazard planning.
Anticipated Future Progress	Where feasible, the state will continue to work with local governments going forward on improving these regulations and policies at the local level as new ideas are implemented and successful policies are identified. The DEQ has also been working with the US Army Corps of Engineers in development of River Basin Flood Risk Management Feasibility Studies in the Lumber, Neuse, and Tar-Pamilco river basins. DEQ has also petitioned USACE and have petitioned the USACE through the 7001 process to perform a similar study in the Cape Fear river basin. This work will help gain support and authorization for future projects and grant funding in the state and local communities in the areas found feasible by these studies.

Action Number	NC-7
Action Description	Develop and present series of seminars on NC's earthquake hazard and risk for various audiences.
How Action Contributes to Risk Reduction	Improving outreach and education on the earthquake hazard will increase awareness and knowledge of risk and actions that can be taken to reduce vulnerability.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Earthquake
Priority	Moderate
Goal	1, 4
Objective Addressed	4, 5
NPG Core Capability	Public Information and Warning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	NEHRP Grants, Earthquake Consortia Grants
Primary Federal Agency	FEMA
Primary State Agency	NCDEQ
Other Contributing Agencies	NCGS, NCEM-Hazard Mitigation
Completion Date	2028 (Interim Strategy)
Current Progress	In 2018 NCEM partnered with NCDEQ to deliver an earthquake training program to elementary school science teachers. In 2019, NC was removed from funding eligibility for the NEHERP program because of our "moderate" risk rating for earthquake. NCDEQ continues to monitor earthquake risk and participates in post-event damage assessments and evaluations.
Anticipated Future Progress	NCDEQ continues to monitor earthquake risk and participates in post-event damage assessments and evaluations.

Action Number	NC-8
Action Description	Look into new mapping of geologic indicators and use this information to inform local and state level risk assessments
How Action Contributes to Risk Reduction	Utilizing new and updated information and data on geologic hazards will improve risk assessments and understanding of existing geologic risks.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	Earthquake, Geological
Priority	Low
Goal	1, 3, 5, 6
Objective Addressed	1, 4, 5, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	USGS
Primary State Agency	NC Geological Survey
Other Contributing Agencies	NCEM
Completion Date	2028 (Interim Strategy)
Current Progress	USGS and NC DEQ are frequently gathering and analyzing additional data and producing maps that contain risk-related information. As of 2022, there are a number of new or updated sources of information that can be integrated into state and local level risk assessments. The latest reference tool produced by NCGS Landslide Mapping Program is the web-based interactive landslide mapping tool that has identified not only the location and scope of existing landslides but also provides high and significant risk assessments of areas that have already been studied. The reference link for that new tool can be found here: Landslides Hazard Website (arcgis.com) Landslides Hazard Website (arcgis.com) The state has integrated this data to some degree, but further evaluation of this data needs to take place.
Anticipated Future Progress	State officials will analyze the many sources of information that the USGS provides through its mapping to determine the most effective means of mitigating geologic hazards. As new data becomes available over the coming years, this data will also be used when possible, to improve risk management. In partnership NC Geodetic Survey will establish two Continuously Operating Reference Stations (CORS) and use Global Navigation Satellite System (GNSS) to monitor ground movement in the Sparta, NC earthquake area.

Action Number	NC-9
Action Description	Provide wildfire mitigation funds to identified communities at risk to implement wildfire mitigation projects after they have been identified by the Southern Wildfire Risk Assessment Portal (SouthWRAP), Community Wildfire Risk Assessments, and Community Wildfire Protection Plans.
How Action Contributes to Risk Reduction	Increasing wildfire mitigation funding for at risk communities will allow those communities to develop CWPPs and identify areas of concern and mitigation measures to reduce vulnerability to wildfire.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Wildfire
Priority	Low
Goal	3, 4, 6
Objective Addressed	2, 4, 5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	US Forest Service
Primary State Agency	NC Forest Service
Other Contributing Agencies	NCEM
Completion Date	2028 (Interim Strategy)
Current Progress	Over 899 CWPPs have been completed and more are in some stage of development (CWPPs are completed at the fire district level). The NCFS applied for and received USFS funding through the National Fire Plan and Wildland Fire Management and Cohesive Strategy to move initiatives further. NCFS is also actively seeking funding for wildfire risk reduction implementation through FEMA grants. The NCFS was granted $300,000 for initial stage of development of the collaborative and continuous CWPP application, which the proof of concept was developed in partnership with North Carolina, South Carolina, and Texas.
Anticipated Future Progress	CWPP are in various stages of their life span. Although they were intended to be living documents, many of them are in need of rewrite or update, due to their age. Some plans are over 10 years old. NCFS will work with current partners and seek new partners to assist in updating and creating CWPPs. The CWDG funding is available for annual applications beginning October of 2022. In addition to the aforementioned CWPP update capacity, there will be a competitive process for implementing action items laid out in existing plans less than 10 years old. This would include FEMA-approved countywide all hazard mitigation plans as well.

Action Number	NC-10
Action Description	Develop and distribute custom Dam Safety Manual for the 100 counties in North Carolina, with data specific for each county and enhance the "Workbook" for local planning officials to include more information on dam failure mitigation activities and recommendations from local planners.
How Action Contributes to Risk Reduction	Distributing county-specific Dam Safety Manuals will improve awareness of local dam failure risk and mitigation activities that can be implemented to reduce vulnerability.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Dam Failure
Priority	Low
Goal	1, 2, 3, 5
Objective Addressed	1, 2, 4, 5, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources, National Dam Safety Program State Assistance Grant Program
Primary Federal Agency	US ACE
Primary State Agency	NC DEQ
Other Contributing Agencies	NCEM
Completion Date	2027 (Longterm Strategy)
Current Progress	Dam Safety officials have been working on updating Dam Safety Manuals and given the issues caused by dam failures during Hurricane Matthew in 2016, there is an increased awareness among state officials that it is critical to work with local officials and dam owners to ensure they are well-educated about dam safety and measures that can be implemented to mitigate future risk of failures.
Anticipated Future Progress	Dam Safety plans to continue to work on developing educational materials that increase awareness of the risks of dam failure throughout the state. Although a manual is certainly one of those tools and will continue to be going forward, the state also plans to work on developing other outreach and education techniques in the future.

Action Number	NC-11
Action Description	As part of its role in mitigation, the state would like to emphasize advocating for additional funding for important mitigation-related programming including: • Find a source of funds targeted for repairs to high hazard dams. • Promote full funding of NC Flood Mapping Program to complete new Flood Insurance Studies for entire state. • Provide state funding to the State Climate Office; funding not currently coming from Legislative Sources. (MH) (-60% from UNC System and remainder from grants) • Ask for assistance/supplemental funding into The Dam Safety Emergency Fund to keep that emergency account available to the program in NCDEQ in the time of emergency response or need to drain a dam impoundment or to breach a dam as required under law.
How Action Contributes to Risk Reduction	Increasing funding for mitigation-related programming will advance mitigation efforts and implementation, reducing overall risk and vulnerability.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 2, 3, 4, 5, 6
Objective Addressed	1, 2, 3, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	NC-DEQ
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	One of the state's primary roles in mitigation has been as an advocate for programs across the state that advance mitigation efforts. The state has been a strong advocate for the allocation of funding to a number of programs that are related to mitigation and, in many cases, has been a major contributor to those programs. The NC Dam Safety Program has recently become the lead agency for the FEMA High Hazard Potential Dam (HHPD) mitigation grant which is available to eligible high hazard dams that are in Poor or Unsatisfactory condition owned by local or state government agencies or by non-profit organizations. This grant is ongoing and it is anticipated that additional funding will be provided for several more years. The NC General Assembly has also provided a temporary Dam Safety Emergency Fund to be used by the program within NCDEQ to address emergency response and mitigation of dams to cover costs to the state for draining of dam impoundments and/or breach of dams under the Dam Safety Law. Currently, this fund will revert unspent funds to the NCEM General Fund in late 2023. Work is needed to establish this fund permanently within DEQ. NCEM provides support for the HHPD program by working with local governments to identify potential projects for proposal and confirming compatibility with HHDRP Mitigation Planning Requirements. During this planning period, NCEM provided 12 Regional Hazard Mitigation Plan amendments which were adopted into the State 322 Plan and into relevant Regional Hazard Mitigation Plans to insure eligibility. NCEM also coordinates with NCDEQ in an annual State/FEMA Dam Safety Program Review.
Anticipated Future Progress	In the future, the state will continue to act as an advocate for mitigation-related programs from the state legislature, federal government, and numerous other agencies and

	organizations. The need for funding to implement mitigation projects and programs will likely continue to exist and so this action will continue to be a priority for the state.

Action Number	NC-12
Action Description	Calculate dam failure flood inundation areas for all high hazard dams.
How Action Contributes to Risk Reduction	Determining dam failure flood inundation areas will improve dam failure risk assessments and understanding of existing risk.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	Dam Failure
Priority	High
Goal	1, 3, 4, 5
Objective Addressed	1, 2, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA, US ACE
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	NC DEQ
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	Dam inundation areas have been completed for all high and intermediate hazard dams in the state. NC has recently studied inundation for around 1,500 dams. Some counties have all of these dam inundation areas loaded and available to State and Local Emergency Management and NCDEQ's Dam Safety Program in SERA. NCEM is still working toward quality control on the remainder of these maps prior to being loaded for emergency agency access for use. It is anticipated that this should be completed in 2023. This is a priority for the state going forward, especially in the wake of Hurricanes Matthew and Florence where dam failures were a significant issue for many communities. It should be noted that the NC Dam Safety Program also has access for use of Decision Support System for Water Infrastructural Security Web known as DSS-WISE for use of quickly modeled dam breaches that can be used by state and local emergency response agencies. NC Dam Safety is also making this tool available to local governments for their use on an as needed basis.
Anticipated Future Progress	NCEM completed dam failure inundation mapping in 2022 using state disaster funds and has shared all data with NC DEQ Dam Safety. NCDEQ and NCEM will be discussing with FEMA and the University of Mississippi on updating DSS-WISE capabilities using NCEM's statewide available Lidar to improve the accuracy of the developed breach models by the DSS-WISE system.

Action Number	NC-13
Action Description	The state and localities need to improve the existing system for assessing drought risk and understanding drought impacts. There are a number of ways to advance this system overall including: • Conduct a study on developing drought frequency data to provide to local governments. • Increase monitoring of precipitation and ground/surface water supplies. • Perform a drought economic impact study analyzing drought through surveys to local communities, state agencies, and industry farmers and other affected parties. • Coordinate all drought mitigation activities with the NC Drought Management Advisory Council.
How Action Contributes to Risk Reduction	Improving the ability to assess drought risk will increase understanding of impacts and vulnerability, making it possible to identify necessary mitigation and reduce future loss.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	Drought
Priority	High
Goal	1, 2, 3, 4, 5, 6
Objective Addressed	1, 2, 4, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services, Natural and Cultural Resources
Funding Source(s)	State and Federal resources
Primary Federal Agency	US Department of Agriculture
Primary State Agency	NCEM
Other Contributing Agencies	State Climate Office
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	Weekly coordination with agencies and the US Drought Monitor on drought status. Active participant in the US Drought Early Warning System (DEWS). Investigating use of NC DPS reservoir level monitors to assess current storage.
Anticipated Future Progress	NCEM continues to coordinate with relevant agencies concerning drought surveillance, response and mitigation measures. As part of the stream and wetland restoration process, NCDEQ DMS and its vendors often install groundwater and precipitation gauges on our projects. This data could be shared to become part of a larger network of data to improve drought frequency studies. Similarly, DMS may be able to benefit from the work of other agencies that collect such data. DMS also has interest in knowing whether climate changes pose future risks to the long-term viability and success of our restoration projects. Consequently, DMS is actively looking into methods to improve project resiliency and long-term sustainability. NCDEQ Division of Water Resources has a Low-Flow Statistical and Public Water Boundary Area survey under way to update 20+year old data on drought conditions and profiles to aid in identifying drought conditions and assessing mitigation opportunities related to public waters. Funded with CDBG-Mit funding.

Action Number	NC-14
Action Description	One of the state's primary goals in mitigation is to provide useful data, studies and other products that can help local communities better understand their risks. To achieve this, the state will: • Continually upgrade statewide spatial data maintained in-house through multiple data sources. • Develop studies, collect, and analyze data on areas of risk to various hazards.
How Action Contributes to Risk Reduction	Enhancing available data and products will enable local communities to conduct better risk assessments and improve understanding of hazards and risk.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 5
Objective Addressed	1, 2, 3, 4, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State and Federal resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Risk Management
Other Contributing Agencies	CGIA, NCGS
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	NCEM's Risk Management has worked with a number of other state agencies to ensure the widespread availability of spatial data, especially in terms of data that can help assess and analyze risk. North Carolina has been one of the leading state's when it comes to spatial risk data production and this is still the case in 2022. This progress includes online tools for landslide mapping (public access) and dam safety breach models (emergency agency access) NCEM is pursuing HMGP funding to update statewide LiDAR data for use in risk assessments for flooding, landslide and wildfire. NCDEQ and NCORR have identified funding and are working with NOAA to update Atlas 14; this information, describing rainfall accumulation frequency as a function of intensity and duration, will help identify impacts of climate change on rainfall assumptions and will be useful for the analysis and design of stormwater management systems and assessment of other flood mitigation measures. The North Carolina Climate Office has a project under way to update statewide precipitation intensity/duration/frequency curves to assess impacts of climate change on future rainfall patterns in NC
Anticipated Future Progress	Future work will continue to improve existing and develop new tools for the public and emergency agencies.

Action Number	NC-15
Action Description	Engage Federal, State, and Local fire service resources to collaborate on Wildfire Risk and proposed mitigation solutions.
How Action Contributes to Risk Reduction	Collaborating on wildfire risk and mitigation efforts will increase implementation success and goal achievement, minimizing existing wildfire vulnerability.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	Wildfire
Priority	Moderate
Goal	1, 5, 6
Objective Addressed	1, 4, 5
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Fire Management and Suppression
Funding Source(s)	State and Local resources
Primary Federal Agency	US Forest Service
Primary State Agency	NC Forest Service
Other Contributing Agencies	NCEM
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	A Community Mitigation Assistance Team was brought in by the Pisgah Ranger district in September 2017 to encourage the formation of a McDowell County Partnership among community members and cooperators. An active partnership (Fire Safe Cherokee County) has been in place since 2010 among Federal, State, and County personnel, and local stakeholders in Cherokee County. Wildland Fire Suppression for Fire Departments and Ready, Set, Go! Train-the-Trainer courses are planned throughout the year, as well as other interagency training for risk reduction. Biennially, there is a cooperators meeting between state and federal agencies about wildland fire. The NCFS will host 3 Assessing Structure Ignition Potential from Wildfire (NFPA) in early 2018. NC Forest Service has developed proof of concept for a collaborative and continuous Community Wildfire Protection Plan application which would allow transparency in wildfire risk identification and scalable mitigation planning. The McDowell County Wildfire Network found a home and 2 years of grant money with Mountain Valleys RC&D. They've held quarterly meetings among Fed, State, County and FD resources to prioritize areas for mitigation work. There has also been a cost share program for homeowners to have tree pruning or shrub removal completed by a contractor. Fire Safe Cherokee hired an employee to assist with outreach mission in the county, before having them hired away by the local conservation trust. All Lands Strategy meetings are held twice a year, bringing all public agencies that burn and stakeholders to the table for updates and brainstorming.
Anticipated Future Progress	The state will continue to work with officials at both the local and federal level to ensure the best possible outcomes in terms of wildfire mitigation. The state intends to leverage existing relationships with local, federal, and other state agencies to collaborate and achieve common goals going forward in mitigation. The collaborative and continuous CWPP application will be fully developed and deployed allowing greater accessibility and participation among anyone who has an interest in wildfire risk reduction.

	Prescribed Burn Associations are the latest organizations to push for increased capacity for burning on private lands. These are organizations made up of landowners, consultants and mentors that are driving continued burning on private land past the initial hazard reduction burn. In the case of Community Protection Plan (CPP, formerly Stevens) burns, there is only funding for an initial and 1 follow-up burn. These PBAs will help to sustain reduction efforts of fuel loads into the future.

Action Number	NC-16
Action Description	Produce future volumes of NC measuring success publications documenting losses avoided – quantitatively and qualitatively.
How Action Contributes to Risk Reduction	Documenting losses avoided will improve the public's perception of mitigation, increasing support for future mitigation projects to further reduce vulnerability.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Low
Goal	4, 6
Objective Addressed	2, 5
NPG Core Capability	Planning, Public Information and Warning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Housing
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	None
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	During a number of past disaster events, the state has worked in conjunction with FEMA to develop losses avoided studies. This has been carried out both through quantitative and qualitative means. NCEM continues to develop loss avoided studies and statements following disaster impacts. TS Fred (August 2021) provided an opportunity to assess the success of mitigation actions carried out in western NC following flooding events in 2004-5. A "Mitigation Success Story" was shared with FEMA and with NCAFPM at Fall 2022 Conference. NCEM also participated in a best practices study concerning NCEM's Regional Hazard Mitigation Planning Initiative.
Anticipated Future Progress	Losses avoided studies are one of the primary means of producing evidence of the effectiveness of past mitigation projects. As a result, these studies are critical to both the public's perception of mitigation projects as well as the basis for demonstrating that similar future projects should be implemented. The state will continue to carry out these analyses whenever possible to ensure that projects that are being implemented have merit and are a worthwhile investment.

Action Number	NC-17
Action Description	Work with the NC DEQ Division of Coastal Management in developing the hazard mitigation portion of the revised planning guidelines under the Coastal Area Management Act (CAMA).
How Action Contributes to Risk Reduction	Integrating land use planning and hazard mitigation planning efforts will result in better coordination and consistency and improve overall resilience through regulation.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	Hurricanes and Coastal Hazards, Flooding
Priority	Low
Goal	1, 3, 4, 6, RL-2
Objective Addressed	2, 4, 5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	NC DEQ-Coastal Management
Completion Date	2028 (Interim Strategy)
Current Progress	NC DEQ did update of the planning guidelines for CAMA and unfortunately there was no coordination with NCEM. But based on conversations during this update cycle, NC DEQ and NCEM are going to try to work together on additional projects in the future, such as integrating CAMA planning with the mitigation planning cycle to promote consistencies across planning documents. NCDEQ Coastal Management Division Launched a 3-phase Resilient Coastal Communities planning effort. Phases one and two completed 2019-2022 with risk assessment and mitigation/resilience opportunities assessment. Phase 3, project development including engineering and design assistance to local governments underway. NCDEQ/DCM also recently completed an update to the Sea Level Rise Science Report. NCEM still provides courtesy reviews of CAMA Land Use Plans.
Anticipated Future Progress	As mentioned above, one of the biggest areas of focus going forward on this action is to try to improve coordination between NCEM and NC DEQ so that CAMA land use planning and hazard mitigation planning are not developed in separate silos, but instead are integrated processes that coordinate together. The main goal will be to try to line up the timing of these processes at the local level to facilitate integration and reduce inconsistencies across plans.

Action Number	NC-18
Action Description	Assist all counties and stakeholders in developing their fuel plans for back-up fuel statewide.
How Action Contributes to Risk Reduction	Developing and maintaining up to date fuel plans will ensure back-up fuel is available when necessary, increasing resilience during disaster events.
Years of Action Establishment	15+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 3
Objective Addressed	5
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Logistics and Supply Chain Management, Economic Recovery
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Logistics
Other Contributing Agencies	NC DEQ- State Energy Program
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	The state has worked with local counties on a continual basis to help them prepare their fuel plans and these have been completed for many of the communities in the state.
Anticipated Future Progress	These fuel plans require consistent updating, so the state will need to keep this action in place and continue to communicate with the counties to ensure fuel plans are up to date and accurate.

Action Number	NC-19
Action Description	Hold annual meetings with locals and utility entities on ice buildup, measurements, and related issues.
How Action Contributes to Risk Reduction	Holding annual meetings on issues related to severe winter weather will improve coordination and response during such events.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	Severe Winter Weather
Priority	Moderate
Goal	1, 3
Objective Addressed	1, 2, 5
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	National Weather Service
Primary State Agency	NCEM-Public Assistance
Other Contributing Agencies	NC Utilities Commission, Utility Companies, Local Governments
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	There were no significant ices storm impacts during this planning period. NCEM SERT continues to coordinate with cognizant agencies in planning for response, recovery and mitigation of severe winter weather events.
Anticipated Future Progress	The state would like to improve its attendance at these meetings going forward as there are often many coordination meetings at the local level that the state does not attend. These are critical opportunities for coordination on issues such as maintaining power during major events, so the state will re-focus on attending these meetings in the future when possible.

Action Number	NC-20
Action Description	Continued strategic growth of the NC ECONet, with new stations installed in areas that are lacking adequate climate and weather data.
How Action Contributes to Risk Reduction	Improving comprehensive weather and environmental monitoring will allow more preparation for and better response to hazard events, reducing potential loss of life and property damage.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 2, 5, 6
Objective Addressed	1, 2, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification,
Funding Source(s)	State resources
Primary Federal Agency	National Oceanic and Atmospheric Administration
Primary State Agency	State Climate Office
Other Contributing Agencies	NCEM
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	There is infrastructure for ECO-Net in place and it is all functioning correctly and at full capacity. There are now 44 ECONet stations in place across the state, two of which were added since 2018. The wording of this action was revised during the 2023 update.
Anticipated Future Progress	As mentioned above, the ECO-Net system is fully in place and functioning, but the remaining work that needs to be done entails setting up and integrating additional stations in North Carolina. The plan is to try to get additional stations in place where adequate climate and weather data are lacking.

Action Number	NC-21
Action Description	Implement projects that help provide early warning, data, and/or reduce functional downtime to the emergency management community and public. Explore provision of ice accumulation sensors on bridges and overpasses to collect real-time icing conditions.
How Action Contributes to Risk Reduction	Improving early warnings and reducing functional downtime will allow better and faster response to hazard events, reducing potential loss of life and property damage.
Years of Action Establishment	20+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	2
Objective Addressed	1, 3, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	FEMA Hazard Mitigation funding, State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	Local Governments
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	The state has a number of mechanisms in place to provide early warning information for local governments including the FIMAN, FIMAN-T and the Emergency Alert System (EAS). The state has also worked with local governments to provide early warning sirens and other alert systems to help reduce functional downtime for the public and local governments. The City of Fayetteville received a hazard mitigation grant to implement Phase 1 of a flood warning system and several other local governments have expressed interest in applying for future funding opportunities. State funding has also been used to fund warning system projects.
Anticipated Future Progress	In the future, the state will continually aim to improve the implementation of its early warning systems such as FIMAN, FIMAN-T and the EAS, so that citizens and local governments can respond to emergencies as quickly and effectively as possible. This may include integrating new technologies where possible and/or expanding systems in ways that help early warning messages reach additional people.

Action Number	NC-22
Action Description	Develop and maintain an Enhanced State Hazard Mitigation Plan to increase HMGP funding subsequent to Federally Declared Disasters.
How Action Contributes to Risk Reduction	Developing and maintain an Enhanced State Hazard Mitigation Plan will increase funding and implementation of the plan, reducing vulnerability and minimizing risk.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	High
Goal	1, 2, 3, 4, 5, 6, RL-1, RL-2
Objective Addressed	1, 2, 3, 4, 5, 6
NPG Core Capability	Planning, Public Information and Warning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Economic Recovery, Health and Social Services, Housing, Natural and Cultural Resources
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM-Hazard Mitigation
Other Contributing Agencies	All State Agencies
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	The state has worked to maintain all aspects of its Enhanced Plan over the past five years and, during the 2023 update, has attempted to improve on several of the gaps that existed during previous versions of the plan with regard to Enhanced Plan status. This update includes a major overhaul of the plan structure and content and one of the primary intents of this overhaul was to more explicitly address many weaknesses in past versions.
Anticipated Future Progress	In future updates, the state will continue to maintain the Enhanced Plan status that it has achieved and will ensure that the components of the mitigation plan are integrated into the state's overall mitigation program to achieve implementation of the plan whenever possible.

Action Number	NC-23
Action Description	Develop and conduct exercise models/exercises to continually update prevention measures, biosecurity recommendations and early response strategies to ensure that disease mitigation and response remain effective and efficient.
How Action Contributes to Risk Reduction	Developing and conducting exercise models/exercises will ensure disease transmission prevention and response are implemented effectively and new strategies are developed to reduce the spread of disease.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Infectious Disease
Priority	Low
Goal	1, 5
Objective Addressed	1, 2, 5, 6
NPG Core Capability	Planning, Intelligence and Information Sharing, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	The NC Department of Health and Human Services has conducted a number of exercises over the past several years which have been integral in helping the department identify prevention measures that could be implemented to reduce risk to infectious diseases and also to develop new strategies for early response. These exercises have included representatives from multiple partner state agencies, but were primarily led by NC DHHS.
Anticipated Future Progress	Going forward, NC DHHS plans to continue to conduct exercises and models to ensure ongoing vigilance regarding disease transmission prevention activities. Continuing to carry out these activities will allow state officials to interact and coordinate in scenarios that can help them understand potential real-world conditions and develop strategies to improve prevention practices. NC DHHS will work to include more stakeholders from other state agencies in future activities and generally broaden the number of officials who are trained in these activities.

Action Number	NC-24
Action Description	Increase State Lab capabilities to include ability to test for Foreign Animal Diseases (FADs) and Infectious Diseases (IDs) that most threaten North Carolina's citizens and animals.
How Action Contributes to Risk Reduction	Increasing capabilities to test for diseases will improve awareness of new threats and enable preventative measures to be implemented as necessary.
Years of Action Establishment	10+ years
Current Status of Action	In progress
Hazard Addressed	Infectious Disease
Priority	Low
Goal	1, 3, 5
Objective Addressed	1, 5, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Health and Social Services
Funding Source(s)	State resources
Primary Federal Agency	Centers for Disease Control and Prevention
Primary State Agency	NC Department of Health and Human Services
Other Contributing Agencies	NC Department of Agriculture, NCEM
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	As new technology and systems have been developed, they have been integrated into the State Lab's capabilities to test for diseases with a focus on those diseases that are most likely to affect citizens in North Carolina. Many improvements have been made over the past 5 years, especially as new threats have emerged in the state.
Anticipated Future Progress	In the constantly evolving environment of disease transmission, testing for diseases is a critical activity that the State Lab will continue to carry out on a regular basis. A major focus of this action is to stay aware of new threats as they emerge over the coming years and to ensure that these new threats are identified quickly and that preventative action can be taken by health officials at all levels. The State Lab will continue to be a key player in this activity and will continue to integrate new testing technologies and strategies when available. Future additional actions that can be implemented include expanding/addition of public health surveillance capabilities at sewage treatment plants.

Action Number	NC-25
Action Number in Previous Plan	New Action
Action Description	Meet annually with NC Housing Finance Agency to identify available funding that could be used for mitigation and discuss opportunities to collaborate.
How Action Contributes to Risk Reduction	Identifying available funding and opportunities for collaboration annually will increase implementation of mitigation activities, reducing vulnerability and minimizing risk.
Years of Action Establishment	2018
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 4, RL-1, RL-2
Objective Addressed	1, 2, 4
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment,
Funding Source(s)	State resources
Primary Federal Agency	N/A
Primary State Agency	NCEM
Other Contributing Agencies	NC Housing Finance Agency
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	Update pending
Anticipated Future Progress	The NC Housing Finance Agency may be a source of funding for many project types that overlap with mitigation, including elevation of residential structures. NCEM hopes to meet with the agency on an annual basis to discuss joint ventures that may be undertaken to reduce risk and improve the lives of citizens through these funding sources.

Action Number	NC-26
Action Number in Previous Plan	New Action
Action Description	Directly integrate mitigation actions from state hazard mitigation plan into RiskMAP program to ensure progress is being tracked and recognized.
How Action Contributes to Risk Reduction	Ensuring that mitigation progress is tracked and recognized will help identify obstacles for implementation and increase the likelihood of successfully completion of mitigation efforts.
Years of Action Establishment	2018
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	1, 4, 5
Objective Addressed	2, 4, 6
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	All State Agencies
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	North Carolina's RiskMAP program was recently assessed in annual FEMA/State Mitigation Program Evaluation. New NCEM Organization Chart places Risk Map under aegis of Hazard Mitigation Section; creating prospects for further coordination between HMP/NFIP and Risk Map efforts.
Anticipated Future Progress	In the past NCEM has tracked progress of action via RiskMAP, but this has not been consistent or coordinated with the mitigation plan's actions, so going forward the state would like to develop a more formalized process for tracking progress in RiskMap that coincides with the annual review of the state hazard mitigation plan.

Action Number	NC-27
Action Number in Previous Plan	New Action
Action Description	Encourage use of PA 406 Mitigation program after disasters to rebuild public infrastructure by identifying potential projects prior to storm events so they are ready to implement when structures/facilities are damaged.
How Action Contributes to Risk Reduction	Identifying potential projects for PA 406 Mitigation funding prior to storm events will ensure that infrastructure can be rebuilt with less risk following a disaster event.
Years of Action Establishment	2018
Current Status of Action	In progress
Hazard Addressed	All Hazards
Priority	Moderate
Goal	3, 4, 5, 6
Objective Addressed	1, 2, 4
NPG Core Capability	Planning, Community Resilience, Long-Term Vulnerability Reduction, Risk and Disaster Resilience Assessment, Threats and Hazards Identification, Critical Transportation, Infrastructure Systems, Economic Recovery
Funding Source(s)	State resources
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	NC DOT, All State Agencies
Completion Date	2028 (Interim and Long-Term Strategy)
Current Progress	NCEM and other state agencies have only infrequently used 406 Mitigation funding to help rebuild after disaster events because there is often pressure to rebuild quickly and identified measures to integrate mitigation techniques into the rebuilding process have not been defined ahead of time.
Anticipated Future Progress	The state would like to continue to work on improving the number of projects that use this funding so that infrastructure is not built back after a disaster with the same level of risk that it had prior to the disaster.

Action Number	NC-28
Action Number in Previous Plan	New Action
Action Description	Improve Coordination/Education/Outreach to better identify and assist underserved communities as identified in the FEMA Strategic Plan 2022-26
How Action Contributes to Risk Reduction	
Years of Action Establishment	2023
Current Status of Action	New action
Hazard Addressed	All
Priority	
Goal	
Objective Addressed	
NPG Core Capability	
Funding Source(s)	
Primary Federal Agency	FEMA
Primary State Agency	NCEM
Other Contributing Agencies	
Completion Date	2028
Current Progress	New Action
Anticipated Future Progress	

Section 6. PLAN MAINTENANCE, MONITORING AND IMPLEMENTATION

44 CFR Requirement

Requirement §201.4(c)(5) [The Standard State Plan Maintenance Process must include]

(i) An established method and schedule for monitoring, evaluating, and updating the plan.

(ii) A system for monitoring implementation of mitigation measures and project closeouts.

(iii) A system for reviewing progress on achieving goals as well as activities and projects identified in the Mitigation Strategy

This section of the plan provides an overview of the procedures that define how the State of North Carolina will monitor, evaluate and update this plan over time. This includes defining implementation procedures to be followed and ways that the plan can be enhanced in the future. This section also provides an overview of the system used to monitor implementation of mitigation measures and project closeouts. And finally, this section provides a summary of the system for reviewing progress made towards achieving goals, activities and projects identified in the Mitigation Strategy.

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

6.1.1 Effectiveness of the Past Process

During the 2018 plan update process, NCEM Hazard Mitigation staff reviewed the defined method for monitoring, evaluating, and updating the plan and decided that a completely new format for presenting those procedures was needed for the 2018 plan. This decision was made for the following primary reasons:

- the organizational structure changes that have been made in the last five years,
- the integration of the Floodplain Mapping Discovery process and the State Mitigation Advisory Group into the Risk Management Coordinating Council, and
- the need for a better-defined process based off of realistic expectation and needs

This revised process remained in place as of the 2023 update and was reviewed and evaluated as part of the plan update.

6.1.2 Agency and Section Responsible

As provided for in the North Carolina Emergency Management Act of 1977 (NCGS 166A-5 (3) (b)), the responsibility for preparation and maintenance of State Plans for technological or natural disasters resides within North Carolina Emergency Management (NCEM). The Hazard Mitigation Branch of NCEM will be responsible for developing and maintaining the State Hazard Mitigation Plan. The State Hazard Mitigation Officer is the individual responsible for overseeing this work.

6.1.3 Schedule

Monitoring the Plan

Regular monitoring of this Plan is essential for the document to be a true working document and is primarily accomplished through NCEM's efforts to track the implementation and relevance of the plan. NCEM's method for monitoring includes tracking implementation of actions found in the Mitigation Strategy. This helps ensure that the plan is being implemented over time. The mitigation actions listed within the Mitigation Strategy are measurable and time-bounded, and tracking implementation and progress is built-in to each action.

Other ways that NCEM monitors the relevance of the plan is through meetings with the RMCC and other stakeholders to ensure that the data and methodologies that go toward developing the capability and risk assessments remain current. This helps ensure that the plan itself continues to remain current and reflects changes to the statewide mitigation program.

The Hazard Mitigation Branch is responsible for conducting an ongoing monitoring progress made toward implementing the Plan.

Evaluating the Plan

In addition to monitoring of the plan, routine evaluation of the Plan helps provide information and data to measure progress and success in carrying out objectives identified within the Plan. Continued scrutiny of the document will help determine its overall effectiveness and ensure its ongoing relevance to advancing State's mitigation goals. The end result of evaluating the Plan will be to make necessary revisions and enhancements, keeping the Plan up-to-date with current information, and maintaining the Plan's functionality for the State. The evaluation criteria presented below were introduced in the 2018 update and remain the criteria currently used.

NCEM will conduct an annual evaluation of the plan, generally in the month of April. The evaluation will consider several basic factors including:

1. Changes in the level of risk to the State and its citizens.
2. Changes in laws, policies, or regulations at the State or local levels.

3. Changes in State agencies or their procedures that will affect how mitigation programs or funds are administered.
4. Significant changes in funding sources or capabilities.
5. Changes in the composition of the RMCC.
6. Progress on implementing mitigation actions (including project closeouts) and identification of new mitigation actions that the State is considering.
7. Major changes to local or multi-jurisdictional hazard mitigation plans and any new guidance documentation received from FEMA.

In regard to tracking mitigation actions, NCEM will email RMCC members each year, at a minimum, to determine if there are any changes in status for the mitigation actions. The RMCC will also be encouraged to submit new mitigation actions. If an agency reports changes or submits a new action, NCEM will be responsible for incorporating those changes into the Plan.

Additionally, NCEM will contact the County Emergency Management Agency Directors (or other individuals and organizations as appropriate) to determine if updates have been made to certain elements of the local plans as part of the annual review process. This is to ensure that local information about risk, goals, projects, and mitigation strategies included in the State Plan remains current.

If any party indicates that an update is warranted, outside of the required, five-year update schedule, then NCEM, in conjunction with the RMCC, will initiate the plan update process.

To further involve the RMCC in the ongoing mitigation planning process, the RMCC will be invited to attend NCEM's applicant briefing following a disaster. The RMCC will also be informed about disaster events via email. NCEM continues to advise agencies on how to incorporate mitigation into their planning efforts. Further, NCEM maintains regular contact with several members of the RMCC. This ongoing communication and relationship facilitates information sharing between agencies regarding mitigation activities.

Updating the Plan

The plan update criteria presented below were introduced in the 2018 update and remain the criteria currently used. The plan will be updated and re-submitted to FEMA for re-approval every five years, as required by law. The plan may also be subject to interim updates if any of the following conditions apply:

1. At the request of the Governor;
2. When significant new risks or vulnerabilities are identified; or
3. If the findings of the annual / post-disaster review and evaluation warrant.

The two sub-paragraphs below describe the procedures for interim and five-year updates, respectively.

Updates Resulting from Interim Evaluations

The nature of plan updates will be determined by the evaluation process described above. In general, NCEM will notify the RMCC that the Agency is initiating an interim plan update, and describe the circumstances that created the need for the update. NCEM will determine if the full RMCC should be consulted regarding the potential changes. If it is determined that the RMCC should be involved, the nature of the involvement will be at the discretion of NCEM.

When interim updates are completed, NCEM will advise all RMCC members that the plan has been updated, and describe the nature of the update.

Updates Related to the Required Five-year Plan Review (by FEMA)

As required by law, every five years the plan will be updated for re-submission and re-approval by FEMA. In those years, the evaluation process will be substantially more rigorous, and will examine all aspects of the plan in detail. It is anticipated that several meetings of the RMCC will be required to conduct a full update of the plan, and that the plan will be formally readopted by the State. Between 6 and 12 months prior to the update deadline, NCEM will initiate the plan update process by contacting RMCC members and other appropriate agencies and organizations to determine a schedule and process for updating the plan.

The update process will entail a detailed and structured re-examination of all aspects of the original plan, followed by recommended updates. The recommendations will be presented to the RMCC for consideration and approval. It is expected that the Director of NCEM will re-approve the plan and adopt as the Governor’s Authorized Representative.

The public will be invited to comment on the 322 plan six months prior to the beginning of a regular update cycle. If time allows, the draft update will be shared with the public for comment prior to submission to FEMA.

6.2 MONITORING IMPLEMENTATION OF MITIGATION MEASURES AND PROJECT CLOSEOUTS

6.2.1 System of Tracking Implementation

The implementation of mitigation grant funding programs including Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, and Building Resilient Infrastructure and Communities (BRIC) program, is managed and monitored by the Hazard Mitigation Branch of NCEM. When grant funding is approved by FEMA, the implementation phase begins with the signing of a grant agreement between the State of North Carolina (grantee) and the local government (subgrantee)[1].

---

[1] NCEM introduced the “State-centric” model for managing hazard mitigation grants in 2019. That system is discussed in more detail in Section 4: Mitigation Capabilities.

The State of North Carolina's current system for monitoring implementation of mitigation measures and project closeouts and emphasizes the development and implementation of projects that can be tracked to demonstrate progress in reducing our vulnerability to disasters. The State typically receives more qualified grant applications than it can fund after each disaster. Through continuous implementation of the measures identified in all previous editions of the state plan, the impact of natural hazards on people and property in the state is measurably being reduced.

NCEM is currently using a software program specifically developed to manage all grant projects called EM Grants Pro. The Hazard Mitigation Branch uses EM Grants Pro to manage all aspects of project grants including monitoring mitigation measures and closeouts. In addition, NCEM simultaneously maintains a legacy Hazard Mitigation Project Tracker for all grants that have been awarded.

Project Implementation

The NCEM Hazard Mitigation Branch is committed to providing technical assistance, monitoring, and tracking of implementation project activities identified in the state and local plans. Prior to project commencement, NCEM conducts an implementation meeting with all subgrantees to ensure that policies and procedures for implementing the grant are explained within the context of program and administrative requirements. The following documents are provided to the subgrantee at this meeting:

- Copy of approved application
- Copy of grant agreement or draft grant agreement
- NCEM Mitigation Standard Operating Procedures
- Getting to Open Space guide
- Citizenship verification forms
- Guide to cost and progress reports with project manager's contact information
- Computer disk including the following:
    - Project Cost Tracking Spreadsheet
    - Progress report form
    - Spreadsheet for determining budget info for cost report

For state or federally funded projects, subgrantees are required to submit progress reports on a monthly basis. Periodic site visits and telephone and email correspondences between the subgrantee and the state reinforces the technical assistance the state provides, and supplements the information stream to verify that projects are on track. In addition, grant managers track requests for reimbursement which provide information on project progress. Hazard Mitigation grant programs are generally operated on a reimbursement basis. At the local level, the subgrantee manages the various phases of the project as outlined in the scope of work. As communities implement projects, they can be reimbursed for project expenditures by submitting invoices and receipts to the state. This entire process must be accomplished within the bounds of the Federal Code of Regulations (CFR Part 44).

Project Closeout

The State uses the same process for all state and federally funded hazard mitigation grant programs when monitoring the implementation of mitigation measures and closing out projects:

- Hazard Mitigation Branch staff of NCEM use periodic site visits, the monthly reports provided by the project grant recipient, and the requests for cost reimbursement to monitor progress and ensure the project is on track.
- Additional site visits are scheduled for projects requiring special assistance.
- Final inspections are conducted by mitigation staff to ensure the project is completed to specification. For example, a project to acquire homes will be inspected to ensure all structures that have been acquired are demolished to specifications.
- Post-completion inspections are conducted regularly by State mitigation staff to ensure the community has complied with the terms of the grant agreement related to the maintenance of the mitigation project. For example, such an inspection will make sure that a park developed from a site of property acquisitions remains a park. The community is also legally required by the grant agreement to bi-annually submit a statement that the property is still being maintained in accordance with open space requirements.
- Project managers conduct a site visit with the community to ensure that files contain all completed forms, reports, and documents pertaining to the grant. Project managers use a closeout checklist to guarantee that all necessary information is in the project files.
- Before projects are submitted for close out, financial reconciliation is conducted to validate all reimbursement requests before final payment is made. Requests are validated against the approved Scope of Work to ensure only allowable costs are reimbursed.
- Prior to sending a closeout request letter to FEMA, a NCEM Hazard Mitigation Branch Supervisor reviews the project closeout checklist and the financial reconciliation performed by the project manager to ensure all work has been completed and the financial portion of the project is correct, as well as ensuring the permanent project files are complete.
- A single NCEM Hazard Mitigation Branch Supervisor or delegated staff member creates all closeout letters to ensure accuracy. This staff member is responsible for following up to ensure project folders and electronic files are complete and accurate. Financial information is checked to certify that the final costs are correct.
- When the State submits letters for close out, a spreadsheet is provided with information that FEMA has requested for National Emergency Management Information System (NEMIS) data input. This spreadsheet provides property site information for every building acquired, elevated, or retrofitted in a project.
- Since North Carolina maintains status as a Managing State, NCEM is required to submit the Property Site Inventory information via NEMIS for all disasters after DR#1312 (2000 Winter Storm) and all subsequent disasters. Each time NEMIS is updated, the State is required to revise the PSI spreadsheet to include the additional

information for each structure. FEMA may request that the State update the NEMIS PSI information in a timely manner.

- A spreadsheet is also maintained to document when the State's Closeout Request Letter was submitted to FEMA, when the State received the FEMA Final Claims Letter, and when the State submitted a Concurrence Letter back to FEMA. Property site inventories for all completed projects will be used to map locations of all mitigation actions taken once the funding stream has been closed.

As part of the closeout process, NCEM Hazard Mitigation Branch Staff began drafting detailed project closeout letters which include Project Closeout Certification Statements and Property Site Inventories. These additional documents have enhanced accountability for all deliverables and financial reconciliation across all properties identified in the Scope of Work. This has produced an "end-to-end" approach, where project development, implementation, and closeout are geared to produce these final closeout deliverables along the path of the life cycle of grants management (and not just as a final step). The Hazard Mitigation Branch also developed an effective process to track all grants during the implementation and closeout phases of grants management, built around an internal tracking tool. This e-tool uses a built-in "countdown clock" to allow Branch staff to track grant deadlines against federal and state periods of performance. The Hazard Mitigation Branch also closely collaborates with FEMA Region 4 to compare their list of pending closeouts against the Region's list of closeouts, and continues this comparison as a quality control measure. Going forward, the foundation of closing the 115 projects has led to a foundation which includes a process for collecting deliverables, monitoring periods of performance, and ensuring sound fiscal reconciliation by timely reimbursement of programmatically eligible expenses.

Monitoring Mitigation Activities

Hazard Mitigation Branch staff have improved the existing system of Quarterly Reporting procedures which includes more comprehensive descriptions of projects, e.g., number of appraisals, number of elevations in progress, acquisitions, project site visits, monitoring and close-outs anticipated, and improved information regarding financial management. Hazard Mitigation Branch Project Management staff are responsible for collecting and monitoring mitigation information during the implementation of each project

6.2.2 System for Reviewing Progress on Achieving Goals

In order to track progress on achieving the goals identified in this plan, NCEM Hazard Mitigation Branch Staff will ensure that both the annual and five-year plan evaluations include a review and analysis of the plan goals, and the various actions that are intended to achieve them. This process will be substantially more rigorous and detailed during the formal plan update process. The Mitigation Strategy describes the hazard mitigation goals, and includes a detailed table that lists various strategies and actions that the State is undertaking or considering to address the goals. The system for reviewing progress on achieving goals will remain the same as it has proved successful over the last five years.

6.2.3 System for Reviewing Progress on Activities and Projects in the Mitigation Strategy

As part of the annual evaluation, NCEM will email the RMCC to determine if there are any changes to the mitigation actions listed in the mitigation strategy section. In addition, members of the RMCC will be encouraged submit new actions at this time.

As part of the five-year update to the plan, NCEM initiated a more detailed review and evaluation of all activities and projects noted in the mitigation strategy. NCEM reported its findings to the RMCC at meetings held as part of the plan update process. The results of these findings have been included in the table of mitigation goals and actions included in the Mitigation Strategy.

6.3 EVALUATION OF IMPLEMENTATION PROGRESS

Due to the previous plan's mitigation effectiveness, many of the same procedures were used in the 2023 update. Progress was reviewed and monitored using different measures, which included:

- Progress Report for Mitigation Planning Projects
- HMGP Cost Report Information
- Cost Tracking Spreadsheet

These procedures have been successful in reviewing progress and were modified and streamlined as needed for the 2023 update. Additionally, meetings were held by members of NCEM's Hazard Mitigation Branch staff to discuss progress made since the last update. Many issues were addressed, such as:

- Establishing realistic objectives and goals
- Results of completed mitigation projects
- Determining how existing state goals can complement anticipated objectives

North Carolina's strong team of federal, state, local, public and private entities have worked together to enhance the state's mitigation abilities. Through coordination, the State has effectively collected data to improve risk assessments and determine which areas need more focus. Noteworthy achievements include:

- The NC Floodplain Mapping Program, which has created, maintained, and strengthened maps for all 100 counties and has helped modify International Building Codes.
- Implementation of Integrated Hazard Risk Management and Communications Tool to address flooding, hurricane, severe winter weather, earthquake, wildfire, dam failure, drought, tornado/thunderstorm, and geological hazards.
- Vulnerability Assessment Tools which use GIS data to identify hazard-prone counties and Special Flood Hazard Areas.
- Continued working relationships between the NCEM, National Weather Service, NCDEQ, NCDOT, Forest Resources and other stakeholders.

- Swift and appropriate use of individual and public assistance to aid disaster recovery
- Creation of the NC Resilient Redevelopment Planning program to empower and rebuild communities after disasters.
- Formation of the Risk Management Tool that simplifies data to design specific and obtainable mitigation actions.

Progress will continue to be evaluated in order to enhance the plan's efficiency in the future and reflect changes throughout the state.

Appendix A. State Mitigation Plan Review Tool

Will include final State Mitigation Plan Review Tool after FEMA approval.

APPENDIX: STATE MITIGATION PLAN REVIEW TOOL

This section is organized as follows:

B.1 Plan Review Tool Summary
B.2 Standard State Mitigation Plan Regulation Checklist
B.3 Enhanced State Mitigation Plan Regulation Checklist
B.4 Strengths and Opportunities for Improvement

FEMA uses the State Mitigation Plan Review Tool ("**Plan Review Tool**") to document how the state mitigation plan meets the regulation. If plan requirements are not met, FEMA informs the state of the changes it needs to make in each of the Required Revisions sections.

The **"Strengths and Opportunities for Improvement"** summary offers FEMA an opportunity to provide more comprehensive feedback to the state.

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The FEMA Plan Approver must reference the *State Mitigation Plan Review Guide* when completing the *Plan Review Tool*. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.'

The **"Required Revisions"** summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate number, where applicable. Requirements for each Element and sub-element are described in detail in the *State Mitigation Plan Review Guide*.

FEMA will provide a narrative summary of the review findings that includes a discussion of "**Strengths and Opportunities for Improvement"** as a means to offer more comprehensive feedback to the state to acknowledge where the plan exceeds minimum requirements as well as provide suggestions for improvements. FEMA will describe the strengths that are demonstrated and highlight examples of best practices.

FEMA may provide suggestions for improvement as part of the *Plan Review Tool* or in a separate document. FEMA's suggestions for improvement are not required to be made for plan approval.

Required revisions from the Regulation Checklist are not documented in the "**Strengths and Opportunities for Improvement"** section.

B.1 Plan Review Tool Summary

State: North Carolina	**Title and Date of Plan:** North Carolina Enhanced Hazard Mitigation Plan	**Date of Submission:** 10/31/2022
State Point of Contact (Name / Title): Steve McGugan North Carolina State Hazard Mitigation Officer	**Address:** 4238 MSC Raleigh, NC 27699-4238	
Agency: North Carolina Emergency Management		
Phone Number: 919-873-5843	**E-Mail:** steve.mcgugan@ncdps.gov	

Date Received in FEMA Region:	
FEMA Reviewer (Planning – Name / Title):	**Date:**
FEMA Reviewer (HMA – Name / Title):	**Date:**
FEMA Reviewer (Name / Title):	**Date:**
FEMA Reviewer (Name / Title):	**Date:**
FEMA Approver (Name / Title):	**Date:**
Plan Status (Not Approved, Approvable Pending Adoption, Approved):	**Date:**

SUMMARY	YES	NO
STANDARD STATE MITIGATION PLAN		
Does the plan meet the standard state mitigation plan requirements?		
REPETITIVE LOSS STRATEGY		
Does the plan include a Repetitive Loss Strategy? [see S6 / RL1; S8 / RL2; S9 / RL3; S10 / RL4; S13 / RL5; and S15 / RL6]		
ENHANCED STATE MITIGATION PLAN		
Does the plan meet the enhanced state mitigation plan requirements?		

B.2 Standard State Mitigation Plan Regulation Checklist

REGULATION CHECKLIST – STANDARD PLAN *M=Met; NM=Not Met	Location in Plan	M / NM*
STANDARD (S) STATE MITIGATION PLAN		
Planning Process		
S1. Does the plan describe the planning process used to develop the plan? [44 CFR §§201.4(b) and (c)(1)]	Section 2, pages 2-4 - 2-12	
S2. Does the plan describe how the state coordinated with other agencies and stakeholders? [44 CFR §§201.4(b) and (c)(1)]	Section 2, pages 2-5 through 2-12	
Required Revisions:		
Hazard Identification and Risk Assessment		
S3. Does the risk assessment include an overview of the type and location of all natural hazards that can affect the state? [44 CFR §201.4(c)(2)(i)]	Section 3, page 3-5 through 3-151	
S4. Does the risk assessment provide an overview of the probabilities of future hazard events? [44 CFR §201.4(c)(2)(i)]	Section 3, page 3-5 through 3-151 (each hazard includes a probability of future occurrence)	
S5. Does the risk assessment address the vulnerability of state assets located in hazard areas and estimate the potential dollar losses to these assets? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]	Section 3.5.5 pages 3-210 through 3-286	

S6. Does the risk assessment include an overview and analysis of the vulnerability of jurisdictions to the identified hazards and the potential losses to vulnerable structures? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]	Section 3.5.5 pages 3-210 through 3-286 and 3.5.8 on pages 3-340 and 3-341	
S7. Was the risk assessment revised to reflect changes in development? [44 CFR §201.4(d)]	Section 3.5.2, pages 3-200 through 3-204	
Required Revisions:		
Mitigation Strategy and Priorities		
S8. Does the mitigation strategy include goals to reduce / avoid long-term vulnerabilities from the identified hazards? [44 CFR §201.4(c)(3)(i)]	Section 5.2.2, page 5-4	
S9. Does the plan prioritize mitigation actions to reduce vulnerabilities identified in the risk assessment? [44 CFR §§201.4(c)(3)(iii) and (iv)]	Section 5, pages 5-7 through 5-11. Actions listed from page 5-13 through 5-46.	

S10. Does the plan identify current and potential sources of funding to implement mitigation actions and activities? [44 CFR §201.4(c)(3)(iv)]	Section 5.4.2.3, page 5-8 through 5-10. Actions listed from page 5-13 through 5-46 also list potential funding source	
S11. Was the plan updated to reflect changes in development, progress in statewide mitigation efforts, and changes in priorities? [44 CFR §201.4(d)]	**Changes in development:** Section 3.5.2, pages 3-200 through 3-204 **Progress in statewide mitigation efforts:** Each action includes discussion of current progress and anticipated future progress Changes in priorities: page 5-3, 5-7 through 5-8.	

Required Revisions:		
State Mitigation Capabilities		
S12. Does the plan discuss the evaluation of the state's hazard management policies, programs, capabilities, and funding sources to mitigate the hazards identified in the risk assessment? [44 CFR §201.4(c)(3)(ii)]	Section 4	
Required Revisions:		

REGULATION CHECKLIST – STANDARD PLAN *M=Met; NM=Not Met	Location in Plan	M / NM*
Local Coordination and Mitigation Capabilities		
S13. Does the plan generally describe and analyze the effectiveness of local and tribal, as applicable, mitigation policies, programs, and capabilities? [44 CFR §201.4(c)(3)(ii)]	Section 4.5.2, page 4-63	
S14. Does the plan describe the process to support the development of approvable local and tribal, as applicable, mitigation plans? [44 CFR §§201.3(c)(5) and 201.4(c)(4)(i)]	Section 4.6, pages 4-70 through 4-74	
S15. Does the plan describe the criteria for prioritizing funding? [44 CFR §201.4(c)(4)(iii)]	Section 4.4.3, pages 4-52 through 4-58	
S16. Does the plan describe the process and timeframe to review, coordinate and link local and tribal, as applicable, mitigation plans with the state mitigation plan? [44 CFR §§201.3(c)(6), 201.4(c)(2)(ii), 201.4(c)(3)(iii), and 201.4(c)(4)(ii)]	Section 4.6 and Section 2	
Required Revisions:		
Plan Review, Evaluation, and Implementation		
S17. Is there a description of the method and schedule for keeping the plan current? [44 CFR §§201.4(c)(5)(i) and 201.4(d)]	Section 6	
S18. Does the plan describe the systems for monitoring implementation and reviewing progress? [44 CFR §§201.4(c)(5)(ii) and 201.4(c)(5)(iii)]	Section 6	
Required Revisions:		
Adoption and Assurances		
S19. Did the state provide documentation that the plan has been formally adopted? [44 CFR §201.4(c)(6)]	Pending APA status from FEMA	
S20. Did the state provide assurances? [44 CFR §201.4(c)(7)]	Section 1.2.5 on page 1-10	
Required Revisions:		
Repetitive Loss (RL) Strategy		
RL1. Did Element S6 (risk assessment) address RL and SRL properties? [44 CFR §§201.4(c)(2)(ii), 201.4(c)(2)(iii), and 201.4(c)(3)(v)]	Section 3.5.8.1 beginning on page 3-343	

RL2. Did Element S8 (mitigation goals) address RL and SRL properties? [44 CFR §§201.4(c)(3)(i) and 201.4(c)(3)(v)]	Section 5.2.2.1 on page 5-4	
RL3. Did Element S9 (mitigation actions) address RL and SRL properties? [44 CFR §§201.4(c)(3)(iii) and 201.4(c)(3)(v)]	Action NC-2 in the Mitigation Action Plan, page 5-14	
RL4. Did Element S10 (funding sources) address RL and SRL properties? [44 CFR §§201.4(c)(3)(iv) and 201.4(c)(3)(v)]	Section 4.4.3.1 on page 4-55	
RL5. Did Element S13 (local and tribal, as applicable, capabilities) address RL and SRL properties? [44 CFR §§201.4(c)(3)(ii) and 201.4(c)(3)(v)]	Section 4.5.2 beginning on page 4-63 and specifically in the table introduced on 4-65 and starting on 4-66.	
RL6. Did Element S15 (prioritizing funding) address RL and SRL properties? [44 CFR §§201.4(c)(4)(iii) and 201.4(c)(3)(v)]	Section 5.4.2.4 starting on page 5-10	
Required Revisions:		

HIGH HAZARD POTENTIAL DAMS

Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1. Did Element S2 (planning process) describe how the state dam safety agency, other agencies, and stakeholders participated in the planning process and contributed expertise, data, studies, information, etc. relative to high hazard potential dams?		
HHPD1-a. Does the plan describe how the state dam safety agency, other agencies, and stakeholders were involved in the planning process?	Page 2-5 – the Dam Safety Office participated in a Key State Stakeholder interview.	
HHPD1-b. Does the plan describe the types of data contributed?	Dam Inventory data w/ hazard categorization for map on p3-91, Appendix D includes the entire High Hazard Dam inventory and a link to all dams in the State is provided on page 3-89.	
HHPD2. Did Element S6 (risk assessment) address all dam risk for high hazard potential dams in the risk assessment?		
HHPD2-a. Does the plan provide a list of high hazard potential dams that have been identified by the state with their names, National Inventory of Dams identification numbers, locations by jurisdiction, and other relevant information, as well as maps?	Map on p3-91, Appendix D	
HHPD2-b. Does the plan summarize statewide vulnerabilities to/from high hazard potential dams from hazards and the potential consequences associated with dam incidents?	Section 3, page 3-262 and 3-263	
HHPD2-c. Does the plan document limitations and describe the approach to address deficiencies?	Section 3, page 3-262 and 3-263	

Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD3. Did Element S9 (mitigation goals) include mitigation goals to reduce long-term vulnerabilities from high hazard potential dams?		
HHPD3-a. Does the plan address a reduction in vulnerabilities to/from high hazard potential dams from hazards and the potential consequences associated with dam incidents as part of their own goals or with other long-term strategies?	P 5-3	hoose an item.
HHPD3-b. Does the plan link the proposed actions to reduce long-term vulnerabilities consistent with the goals?	Each action in Section 5 lists the applicable Goal and states how the action reduces risk.	hoose an item.

Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD4. Did Element S10 (mitigation actions) prioritize mitigation actions and activities to reduce vulnerabilities from high hazard potential dams?		

HHPD4-a. Does the plan include actions to reduce vulnerabilities to/from high hazard potential dams?	P5-13 – Action NC-1 – "Develop a robust network of tools and systems throughout the state to help local and state officials better prepare for and respond to flooding events." Specifically includes continuation of dam overtopping studies. P5-14 – Action NC-2 to carry out projects under a variety of assistance programs, including HHPD. Related project types include (but not limited to): Projects that include dam safety training for state personnel, increase in the number of dam inspections, increase in the submittal and testing of dam Emergency Action Plans, more timely review and issuance of permits, improved coordination with state emergency preparedness officials, identification of	hoose an item.

	dams to be repaired or removed, conducting dam safety awareness workshops and creation of dam safety videos and other outreach materials. -Projects to provide technical, planning, design and construction assistance for rehabilitation of eligible high hazard potential dams. - [The acquisition and conservation easements could apply to dam safety also.] P5-18 – Action NC-4 to evaluate and upgrade technologies. Specifically includes ongoing effort to "keep up to date on using other technologies like "Dam Watch" that have been developed outside of the state. NCDEQ-DEMLR's Dam Safety Program has supplemented this effort by performing overtopping studies on 525 dams and NCEM	

	is in the process of installing 130 dam impoundment water level gauges that are being tied into the "Dam Watch" tool efforts to develop an early warning system for emergency agencies which will also help to focus and prioritize emergency response. Other efforts include the development of a uniform web-based inspection process that ties into a newly developed semi-quantitative risk analysis process for dams to develop relative dam risk among NC's dams P5-27, Action NC-11 to “advocating for additional funding for important mitigation-related programming”. Specifically includes HHPD and state Dam Safety Emergency Fund. P5-29, Action NC-12 to Calculate dam failure flood	

Requirements	Location in Plan (section and/or page number)	Met / Not Met
	inundation areas for all high hazard dams.	
HHPD4-b. Does the plan describe the process to evaluate and prioritize actions related to high hazard potential dams that are cost-effective, environmentally sound and technically feasible?	p4-53, pdf p446 describes general guidelines for prioritizing projects.	
HHPD4-c. Does the plan describe how each action to reduce risks related to high hazard potential dams contributes to the goals and describe how strategies are linked to the state mitigation strategy?	Each action lists the applicable Goal and states how the action reduces risk.	

Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD5. Did Element S11 (funding sources) identify current and potential sources of funding to implement mitigation actions and activities for high hazard potential dams?		

HHPD5-a. Does the plan include various funding sources to mitigate vulnerabilities to and from high hazard potential dams from hazards and the potential consequences associated with dam incidents, as well as funding sources to rehabilitate or remove high hazard potential dams?	P5-27, – The NC Dam Safety Program has recently become the lead agency for the FEMA High Hazard Potential Dam (HHPD) mitigation grant which is available to eligible high hazard dams that are in Poor or Unsatisfactory condition owned by local or state government agencies or by non-profit organizations. This grant is ongoing and it is anticipated that additional funding will be provided for several more years. The NC General Assembly has also provided a temporary Dam Safety Emergency Fund to be used by the program within NCDEQ to address emergency response and mitigation of dams to cover costs to the state for draining of dam impoundments and/or breach of dams under the Dam Safety Law. Currently, this fund will	hoose an item.

Requirements	Location in Plan (section and/or page number)	Met / Not Met
	revert unspent funds to the NCEM General Fund in late 2023. Work is needed to establish this fund permanently within DEQ.	
HHPD6. Did Element S13 (local coordination) generally describe and analyze the effectiveness of local mitigation policies, programs, and capabilities that address high hazard potential dams?		
HHPD6-a. Does the plan provide a summary of the local policies, programs, and capabilities to implement mitigation actions and reduce vulnerabilities from high hazard potential dams from hazards and the potential consequences associated with dam incidents?	p 4-69	hoose an item.
HHPD6-b. Does the plan describe challenges to implementing local mitigation policies, programs and capabilities to reduce vulnerabilities to and from high hazard potential dams and the approach to overcome these challenges?	p 4-69	hoose an item.
HHPD6-c. Does the plan describe opportunities for implementing mitigation actions to reduce risks to and from high hazard potential dams through local capabilities?	p 4-69	hoose an item.
HHPD7. Did Element S15 (prioritizing funding) describe the criteria for prioritizing funding for high hazard potential dams?		
HHPD7-a. Does the plan describe the method for funding actions to reduce vulnerabilities to and from high hazard potential dams if these actions were prioritized differently than mitigation actions for other hazards?	p 4-58	hoose an item.
HHPD7-b. Does the plan document limitations and describe the approach to addressing deficiencies?	p 4-58	hoose an item.
HHPD Required Revisions:		

B.3 Enhanced State Mitigation Plan Regulation Checklist

REGULATION CHECKLIST – ENHANCED PLAN *M=Met; NM=Not Met	Location in Plan	M / NM*
ENHANCED (E) STATE MITIGATION PLAN		
Meet Standard State Mitigation Plan Elements		
E1. Does the Enhanced plan include all elements of the standard state mitigation plan? [44 CFR §201.5(b)]		
Required Revisions:		
Integrated Planning		
E2. Does the plan demonstrate integration to the extent practicable with other state and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §201.5(b)(1)]	Section 4	
Required Revisions:		
State Mitigation Capabilities		
E3. Does the state demonstrate commitment to a comprehensive mitigation program? [44 CFR §201.5(b)(4)]		
E4. Does the enhanced plan document capability to implement mitigation actions? [44 CFR §§201.5(b)(2)(i), 201.5(b)(2)(ii), and 201.5(b)(2)(iv)]	Section 5	
E5. Is the state effectively using existing mitigation programs to achieve mitigation goals? [44 CFR §201.5(b)(3)]		
Required Revisions:		
HMA Grants Management Performance		
E6. With regard to HMA, is the state maintaining the capability to meet application timeframes and submitting complete project applications? [44 CFR §201.5(b)(2)(iii)(A)]		
E7. With regard to HMA, is the state maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [44 CFR §201.5(b)(2)(iii)(B)]		
E8. With regard to HMA, is the state maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [44 CFR §201.5(b)(2)(iii)(C)]		
E9. With regard to HMA, is the state maintaining the capability to complete HMA projects within established performance periods, including financial reconciliation? [44 CFR §201.5(b)(2)(iii)(D)]		
Required Revisions:		

B.4 Strengths and Opportunities for Improvement

STRENGTHS AND OPPORTUNITIES FOR IMPROVEMENT
INSTRUCTIONS: The purpose of the "**Strengths and Opportunities for Improvement**" section is for FEMA to provide more comprehensive feedback on the state mitigation plan to help the state advance mitigation planning. The intended audience is the state staff responsible for the mitigation plan update. FEMA will address the following topics: 1. Plan strengths, including specific sections in the plan that are above and beyond the minimum requirements; and 2. Suggestions for future improvements. FEMA will provide feedback and include examples of best practices, when possible, as part of the *Plan Review Tool,* or, if necessary, as a separate document. The state mitigation plan elements are included below in italics for reference but should be deleted as the narrative summary is completed. FEMA is not required to provide feedback for each element. Required revisions from the **Regulation Checklist** are not documented in the **Strengths and Opportunities for Improvement** section. Results from the **Strengths and Opportunities for Improvement** section are not required for Plan Approval, but may inform discussions during the Program Consultation.
Describe the mitigation plan strengths, including areas that may exceed minimum requirements. - *Planning process* - *Hazard identification and risk assessment* - *Mitigation strategy* - *State mitigation capabilities* - *Local and tribal, as applicable, coordination and mitigation capabilities* - *Plan review, evaluation, and implementation* - *Adoption and assurances* - *Repetitive loss strategy, if applicable* - *Integrated planning process, if applicable* - *Commitment to a comprehensive mitigation program, if applicable* - *HMA grants management performance, if applicable*
Describe areas for future improvements to the mitigation plan. - *Planning process* - *Hazard identification and risk assessment* - *Mitigation strategy* - *State mitigation capabilities* - *Local and tribal, as applicable, coordination and mitigation capabilities* - *Plan review, evaluation, and implementation* - *Adoption and assurances* - *Repetitive loss strategy, if applicable* - *Integrated planning process, if applicable* - *Commitment to a comprehensive mitigation program, if applicable* - *HMA grants management performance, if applicable*

Appendix B. Plan Maintenance Records

Version	Date	Summary of Changes

Appendix C. Public and Stakeholder Comments

Comments Received on 322 Update Draft

NCEM solicited public comments concerning the update of the NC Enhanced State Hazard Mitigation Plan from May until November of 2021 and again on the Draft update document from September 21, 2022 through October 14 of 2022.

Five Public Comments were received from the first request May-November 2021 and are summarized here:

1. Build the mid-Currituck bridge; Private Citizen 8/30/21
2. Reflect Climate Change Science in the plan; Private Citizen 8/31/21
3. Ensure protection of coastlines and natural habitats; prohibit use of 4WD vehicles on beaches; Private Citizen 10/18/21
4. The NC Office of Resilience and Recovery suggested six optional additions to the plan update: Develop downscale climate science scenarios and models for use in the Hazard Mitigation Plan and other state applications; develop web portal to make climate data from HMP accessible for use in other hazard mitigation planning activities at local/regional level; provide training on integrating future conditions/climate change into mitigation funding applications; provide training to local governments on climate-informed mitigation tools and techniques; develop an interactive website to make State Hazard Mitigation Plan more accessible to the public; propose methodology or IT design to track mitigation proposals and implementation statewide showing non-private information to illustrate funding, program, agency, contact information and other information on a platform that support geospatial visualization NCORR 10/4/21
5. Incorporate "System Dependence Hazards" into the plan; remove references to Technologic Hazards. North Carolina Conservation Network 10/30/21

Outcome:

1. Deemed not relevant to the Hazard Mitigation Plan requirements in 44 CFR
2. Pursuant to Governor Roy Cooper's Executive Order 80 (October 29, 2018) the State of NC developed a multi-agency approach to development of a NC Climate Change Risk Assessment and Resilience Plan (June 2020) and as a result of the findings of this plan and ahead of a specific FEMA requirement to address the impacts of Climate Change in the State Hazard Mitigation Plan, NCEM incorporated findings from climate science reports and research into the Risk Assessment portion of the plan. Beginning in April of 2023, FEMA Policy Guidance will require inclusion of climate science assessments in the Risk Assessment section of all new or updated Hazard Mitigation Plans. North Carolina has voluntarily added this information to the plan to help FEMA further asses how the new policy will be implemented and scored in the review of future plans and updates. Link to Climate Change Risk Assessment and Resilience Plan: https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy-plans-and-progress/nc-climate-risk-assessment-and-resilience-plan
3. FEMA funding policy now places priority on mitigation actions and activities involving Nature-Based Solutions to Risk. As mitigation project proposals move from local to state government (NCEM) and then up to FEMA for review and approval, the NC Enhanced State Hazard Mitigation

Plan includes goals and measures identifying and promoting Nature Based Solutions to hazard risks where feasible, appropriate and cost-effective. Futher attention will be given to identification and promotion of Nature-Based Solutions in future updates of both the NC Enhanced State Hazard Mitigation Plan and the suite of Regional Hazard Mitigation Plans. Matters of Beach Access fall outside of the responsibilities and mission of NCEM's Hazard Mitigation Section

4. The proposals presented by NCORR are generally beyond the scope and budget of the State Hazard Mitigation Plan which is based on certain specific requirements set forth in Section 201 of the 44 Code of Federal Regulation. All are sound recommendations and worthy of pursuit given the limitation of funding, authority, and expertise of NCEM. Development of said downscale modeling and scenarios is a useful activity and certainly worthy of exploration as FEMA-State/multi-discipline endeavor and would be helpful in meeting future planning requirements. NCEM is currently developing a visualization tool to map and display completed mitigation projects at a parcel level statewide. This tool will have multiple applications including surveillance of completed project sites and identification of mitigation opportunities in close proximity to mitigated parcels. Further development of this action item is included in the Recommendations section of the plan introduction.

5. "System Dependence Hazards" expresses a relationship between various hazards and public exposures that would result in loss of goods/services. Federal requirements for HMPs suggest that NATURAL hazards should be thoroughly addressed. While system dependent hazards are not the same as natural hazards, sometimes a natural hazard impact might be a proximate cause leading to a system dependent hazard (ie: loss of power due to ice storm results in loss of communication systems or access to food, fuel and other services) FEMA mitigation funding sources are now prioritizing proposals that identify "whole community and community lifelines" impacts, thus the plan will suggest a range of goals and measures designed to reduce community wide impacts and harden or secure essential services and systems from the impact of natural hazards. Technological Hazards are identified in the ESHMP, not because of Federal policy or guidance, but because natural hazards can impact technological spheres in adverse ways leading to cascading impacts. Technologic Hazards are also included in the ESHMP risk assessment in order to provide a standard risk assessment for all State planning activities that rely on a hazard risk assessment (EOPs, Response Plans, etc) and to insure that North Carolina's Enhanced Hazard Mitigation Plan meets all the requirements of participation in the Emergency Management Accreditation Program.

The second request for comment produced six comments:

1. 14 points concerning Historic Resources Preservation issues including addressing records/artifacts protection; suggestions for specific mitigation measures to protect buildings/resources from wildfire hazard; development of resilience strategies for other assets/agencies; and mitigation of loss of intangibles including community identity. State Historic Preservation Office 10/12/22
2. 3 items concerning relevant funding programs available to local governments via the US Army Corp of Engineers USACE 10/14/22
3. 6 suggestions: plan should take a "whole of government approach;" final plan should raise the standards for local hazard mitigation plans and actions by mandating policy and regulation changes; integrate "nature based solutions" into project proposals; an exhaustive list of greenhouse gas mitigation measures; explicate acronyms; broader analysis and consideration of special/underserved populations. North Carolina Conservation Network 10/14/22
4. Member of the NCEM Risk Management Coordinating Council 10/17/22
5. State Geologist, NCDEQ 10/17/22

Outcome:

1. The goals and measures identified in a State Hazard Mitigation Plan are broad and general; details concerning specific actions for specific facilities or sites should be addressed in regional, local or agency-specific plans. Several of the suggested actions belong more properly to Response and Recovery plans that may be specific to communities, locations, or other state agencies. Specific reference was made to wildfire mitigation measures that are covered in the wildfire risk assessment and in the general goals and measures expressed in the plan.
2. The USACE programs have been noted in the Capabilities section of the EHMP
3. The plan draws on expertise from a range of subject matter experts and sister agencies in keeping with FEMA guidance; further, the plan includes assessments from the sister agencies concerning capabilities and capacity in keeping with FEMA's Whole Community approach to planning and project identification. Future updates of the plan will incorporate guidance from FEMA concerning examination of equity and inclusion in both planning and project activities when that guidance becomes effective---April of 2023. As FEMA programs prioritize "nature based solutions" we are working toward specific definitions and guidance including work on establishing the cost effectiveness and feasibility of certain proposals and encouraging inclusion of natural solutions in local planning activities. Greenhouse gas reduction/sequestration is beyond the scope of the natural hazards mitigation plan, however, through participation in the 2020 NC Climate Change Risk Assessment and Resilience Plan, NCEM is helping steer state government policy and actions designed to reduce emissions; additionally, the Update includes a set of Recommendations for the Council of State that include broad-stroke policies and actions that will help reduce CO_2 emissions. Common acronyms are used liberally, and are always explicated at first appearance in the plan.

Appendix D. High Hazard Potential Dams in North Carolina

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
HARNE-036	NC00007		Blanchard Lake Dam #1	IMPOUNDING	High	Harnett	35.325	-79.06028	Barbeque Swamp	Cape Fear	Harnett
HARNE-037	NC00008		Blanchard Lake Dam #2	IMPOUNDING	High	Harnett	35.32333	-79.06028	Barbeque Swamp	Cape Fear	Harnett
HARNE-038	NC00009		Blanchard Lake Dam #3	IMPOUNDING	High	Harnett	35.32306	-79.05889	Barbeque Swamp	Cape Fear	Harnett
HARNE-040	NC00011		Buffalo Lake Dam	IMPOUNDING	High	Harnett	35.289	-79.046	Little Bridge Branch	Cape Fear	Manchester
HARNE-041	NC00012		Lake Carolina	IMPOUNDING	High	Harnett	35.2812	-79.0330	Reedy Swamp	Cape Fear	Manchester
LEE-003	NC00016		San-Lee Park Dam	IMPOUNDING	High	Lee	35.4825	-79.1269	Little Lick Creek	Cape Fear	N/A
LEE-011	NC00024		Holiday Lake Dam Lower	DRAINED	High	Lee	35.50021	-79.21409	Patterson Creek	Cape Fear	
CUMBE-012	NC00028		Lake Rim Dam	IMPOUNDING	High	Cumberland	35.03083	-79.04194	Bones Creek	Cape Fear	Hope Mills
CUMBE-020	NC00036		Gates Four Dam	IMPOUNDING	High	Cumberland	34.993	-79.007	Little Rockfish Creek	Cape Fear	Pine Knoll
MOORE-041	NC00038		Simpson Lake Dam	IMPOUNDING	High	Moore	35.191	-79.143	Little River-Tr	Cape Fear	Pope Air Force Base
SCOTL-006	NC00059		Little Muddy Lake Dam	IMPOUNDING	High	Scotland	35.029998	-79.460998	Big Muddy Creek	Lumber	Wagram
MOORE-046	NC00060		Pine Lake Shooting Pres. Dam	IMPOUNDING	High	Moore	35.2714	-79.4948	Little River	Cape Fear	Whispering Pines
MOORE-135	NC00061		Lake Pinehurst Dam	IMPOUNDING	High	Moore	35.165	-79.493	Horse Creek	Lumber	
MOORE-143	NC00062		Pinewild Lake Dam	IMPOUNDING	High	Moore	35.206	-79.494	Joe's Fork Creek-Tr	Cape Fear	
MOORE-051	NC00066		Eighteenth Fairway Dam	IMPOUNDING	High	Moore	35.18611	-79.42361	Aberdeen Creek	Lumber	Aberdeen
MOORE-052	NC00067		Watson Lake Dam #1	IMPOUNDING	High	Moore	35.1657	-79.4346	Aberdeen Creek	Lumber	Aberdeen
MOORE-054	NC00069		Aberdeen Town Lake Dam	IMPOUNDING	High	Moore	35.1351	-79.4299	Aberdeen Creek	Lumber	Aberdeen
MOORE-057	NC00072		Southern Pines Waterworks Dam	IMPOUNDING	High	Moore	35.215	-79.401	Mill Creek	Cape Fear	Lakeview
MOORE-058	NC00073	258	Thagards Lake Dam	IMPOUNDING	High	Moore	35.26468	-79.36082	Little River	Cape Fear	Lakeview
MOORE-061	NC00076		Spring Valley Lake Dam	IMPOUNDING	High	Moore	35.2594	-79.3835	Little River-Tr	Cape Fear	Whispering Pines
MOORE-062	NC00077	375	Pine Lake Dam	IMPOUNDING	High	Moore	35.257	-79.369	Little River-Tr	Cape Fear	Whispering Pines
MOORE-064	NC00079		Warrior Lake Dam	IMPOUNDING	High	Moore	35.225	-79.382	Mill Creek	Cape Fear	Lakeview
MOORE-069	NC00084		Thurlow Lake Dam	IMPOUNDING	High	Moore	35.278	-79.285	Crane Ck-Os	Cape Fear	Vass
MOORE-071	NC00086		Crystal Lake Dam	IMPOUNDING	High	Moore	35.24	-79.306	Mill Creek	Cape Fear	Lakeview
BURKE-003	NC00092		South Mountain State Park Dam	IMPOUNDING	High	Burke	35.64	-81.753	Clear Creek	Catawba	Morganton
IREDE-001	NC00095		Third Creek Watershed #18	IMPOUNDING	High	Iredell	35.73333	-80.90361	Third Creek-Trib.	Yadkin-PeeDee	Statesville
RUTHE-006	NC00096		Murray Hilton Lake Dam	IMPOUNDING	High	Rutherford	35.5044	-81.7966	South Creek	Broad	South Creek
RUTHE-001	NC00097	21	Sunnyside Lake Dam	IMPOUNDING	High	Rutherford	35.313	-81.927	Long Branch-Tr	Broad	Harris
RUTHE-005	NC00098		Isothermal College Dam	IMPOUNDING	High	Rutherford	35.33889	-81.91	Bracketts Creek	Broad	Forest City
RUTHE-013	NC00099		Bald Mountain Lake Dam	IMPOUNDING	High	Rutherford	35.4647	-82.1880	Buffalo Creek	Broad	Lake Lure
RUTHE-003	NC00100		Lake Lure Dam	IMPOUNDING	High	Rutherford	35.426	-82.184	Rocky Broad River	Broad	Uree
IREDE-004	NC00108		Third Creek Dam #20	IMPOUNDING	High	Iredell	35.728	-80.883	Duck Creek	Yadkin-PeeDee	Cleveland
CLEVE-003	NC00111		Kings Mountain City Lake Dam #2	IMPOUNDING	High	Cleveland	35.194	-81.354	Kings Creek-Tr	Broad	Kings Cr Sc
CLEVE-013	NC00112		Kings Mountain Lake Dam #1	IMPOUNDING	High	Cleveland	35.2012	-81.3495	Kings Creek	Broad	Kings Creek Sc
CLEVE-017	NC00114		Lake Montonia Dam	IMPOUNDING	High	Cleveland	35.202	-81.329	Kings Creek-Tr	Broad	Kings Creek Sc
IREDE-005	NC00124		Third Creek Dam #21	IMPOUNDING	High	Iredell	35.709	-80.87	I-L Creek-Trib	Yadkin-PeeDee	Cleveland
CLEVE-007	NC00127	4	Albemarle Dam	IMPOUNDING	High	Cleveland	35.2119	-81.3555	Kings Creek - Trib.	Broad	Kings Creek Sc
RUTHE-011	NC00138		Brooks Lake Dam	IMPOUNDING	High	Rutherford	35.443	-82.005	Mountain Creek	Broad	Rutherfordton
IREDE-012	NC00147		Third Creek Dam #9	IMPOUNDING	High	Iredell	35.83583	-81.03	Third Creek-Tr	Yadkin-PeeDee	Statesville
WATAU-008	NC00152		Trout Lake	IMPOUNDING	High	Watauga	36.16927	-81.51642	Laurel Fork Creek	Yadkin-PeeDee	Darby
IREDE-018	NC00153		Skyview Lake Dam Upper	IMPOUNDING	High	Iredell	35.94333	-80.73194	Hunting Creek-Tr	Yadkin-PeeDee	Cooleemee
MACON-013	NC00158		Vitale Orchard Dam	IMPOUNDING	High	Macon	35.1228	-83.4245	N Fork Skeenah Creek-Tr	Little Tennessee	Addington Mill
MACON-006	NC00159		Mirror Lake Dam	IMPOUNDING	High	Macon	35.06333	-83.21444	Cullasaja River	Little Tennessee	Highlands
MACON-003	NC00160		Sequoyah Dam	IMPOUNDING	High	Macon	35.0675	-83.2249	Cullasaja River	Little Tennessee	Franklin
MACON-033	NC00161		Cliffside Lake Dam	IMPOUNDING	High	Macon	35.079	-83.236	Skitty Creek	Little Tennessee	Franklin
MACON-012	NC00162		White/Myatt Dam	IMPOUNDING	High	Macon	35.176	-83.334	Scott Branch	Little Tennessee	Franklin
WAKE-017	NC00163		Johnson Pond Dam	IMPOUNDING	High	Wake	35.54028	-78.75278	Black Creek-Tr	Cape Fear	Lillington
POLK-005	NC00164		Mahler's Pond Dam	IMPOUNDING	High	Polk	35.20738	-82.19025	UT to Wolfe Creek	Broad	Fingerville, SC
TRANS-024	NC00167		Toxaway Dam Lower	IMPOUNDING	High	Transylvania	35.12448	-82.93287	Toxaway River	Savannah	Seneca Sc

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
TRANS-023	NC00168		Thunder Lake	IMPOUNDING	High	Transylvania	35.132	-82.662	Clear Creek	French Broad	Cedar Mountain
TRANS-001	NC00169		Arrowhead Lake	IMPOUNDING	High	Transylvania	35.137	-82.651	Clear Creek	French Broad	Cedar Mountain
MACON-014	NC00171		Osage Lake Dam	IMPOUNDING	High	Macon	35.00662	-83.29169	Watkins Creek	Little Tennessee	Watkins Mill
MCDOW-003	NC00172		Muddy Creek Dam #8 (Nebo)	IMPOUNDING	High	McDowell	35.69630	-81.91684	Thompson Creek	Catawba	Morganton
DAVID-021	NC00177		Lexington Storage Reservoir Dam	IMPOUNDING	High	Davidson	35.858	-80.215	Leonard Creek	Yadkin-PeeDee	Lexington
DAVID-022	NC00178		Lake Tom-A-Lex Dam	IMPOUNDING	High	Davidson	35.871	-80.193	Abbotts Creek	Yadkin-PeeDee	Lexington
DAVID-006	NC00179		Merry Hills Lake Dam	IMPOUNDING	High	Davidson	35.95801	-80.06158	Payne Creek-Tr	Yadkin-PeeDee	Lexington
ROWAN-001	NC00184	22	Alpine Lake Dam	IMPOUNDING	High	Rowan	35.59583	-80.48778	Alpine Branch	Yadkin-PeeDee	Salisbury
HAYWO-003	NC00185		Lake Logan Dam	IMPOUNDING	High	Haywood	35.42118	-82.92496	West Fork Pigeon River	French Broad	Canton
HAYWO-001	NC00187		Lake Junaluska Dam	IMPOUNDING	High	Haywood	35.5274	-82.9633	Richland Creek	French Broad	Lake Junaluska
TRANS-012	NC00189		High Rock Lake Dam	IMPOUNDING	High	Transylvania	35.166	-82.681	Steel Creek	French Broad	Cedar Mountain
TRANS-002	NC00190		Betty Kay Lake Dam	IMPOUNDING	High	Transylvania	35.13495	-82.68513	Morgan Creek	French Broad	Cedar Mountain
TRANS-026	NC00191		Hemlock Lake Dam	IMPOUNDING	High	Transylvania	35.144	-82.69	Morgan Creek	French Broad	Sherwood Forest
TRANS-020	NC00192		Straus Lake Dam	IMPOUNDING	High	Transylvania	35.2564	-82.7230	Allison Creek	French Broad	Pisgah Forest
TRANS-007	NC00193		Deer Lake Dam	IMPOUNDING	High	Transylvania	35.2509	-82.7289	Lambo Creek	French Broad	Brevard
TRANS-008	NC00194		Lake Tiaroga Dam	IMPOUNDING	High	Transylvania	35.14279	-82.73511	Batson Creek	French Broad	Dunns Rock
TRANS-013	NC00195		Laurel Lake Dam	IMPOUNDING	High	Transylvania	35.30889	-82.67056	Sutton Creek	French Broad	Boylston
TRANS-006	NC00197		Atagahi Lake Dam	IMPOUNDING	High	Transylvania	35.15475	-82.71870	Carson Creek	French Broad	Conestee Falls Develop
TRANS-010	NC00198		Lake Wanteska Dam	IMPOUNDING	High	Transylvania	35.14798	-82.76758	Lower Creek	French Broad	Powellton
TRANS-009	NC00199		Ticoa Lake Dam	IMPOUNDING	High	Transylvania	35.15806	-82.73389	Batson Creek	French Broad	Dunns Rock
TRANS-016	NC00202		Young Dam	IMPOUNDING	High	Transylvania	35.13054	-82.75936	Upper Creek	French Broad	Brevard
CLEVE-018	NC00204	98	Moss Lake Dam	IMPOUNDING	High	Cleveland	35.276	-81.457	Buffalo Creek	Broad	Earl Station
POLK-009	NC00208		Turner Shoals Dam	IMPOUNDING	High	Polk	35.33545	-82.18734	Green River	Broad	Gaston Shoals
POLK-008	NC00209		Derbyshire Dam	IMPOUNDING	High	Polk	35.24105	-82.09887	Hughes Creek	Broad	Collinsville
WILKE-029	NC00215		KOA Campground Dam	IMPOUNDING	High	Wilkes	36.2753	-81.3460	South Fork Reddies River-Tr	Yadkin-PeeDee	Wilbar
MECKL-003	NC00218		Quail Acres Dam	IMPOUNDING	High	Mecklenburg	35.06917	-80.78944	Four Mile Creek-Tr	Catawba	Matthews
HENDE-014	NC00226		Lake Hosea Dam	IMPOUNDING	High	Henderson	35.21529	-82.37651	Shop Creek-Tr	Broad	Melrose
ALEXA-001	NC00229		Lower Little River Dam #1	IMPOUNDING	High	Alexander	35.893	-81.236	Lower Little River-Tr	Catawba	Taylorsville
HENDE-027	NC00233		Briar Lake Dam	IMPOUNDING	High	Henderson	35.31583	-82.50304	Shaw Creek-Tr	French Broad	Horse Shoe
HENDE-018	NC00235		Rhett Mill Dam	IMPOUNDING	High	Henderson	35.2853	-82.4396	King Creek	French Broad	Hendersonville
HENDE-020	NC00236		Wolf Lake Dam	IMPOUNDING	High	Henderson	35.26612	-82.49661	Little Mud Creek	French Broad	Hendersonville
HENDE-012	NC00238		Crooked Creek Lake Dam	IMPOUNDING	High	Henderson	35.28247	-82.47030	Mud Creek	French Broad	Hendersonville
HENDE-002	NC00239		Osceola Lake Dam	IMPOUNDING	High	Henderson	35.29763	-82.47308	Shepherd Creek	French Broad	Hendersonville
ASHE-009	NC00240		Ashe Lake Dam	IMPOUNDING	High	Ashe	36.344	-81.444	South Beaver Creek-Tr	New	Index
RUTHE-002	NC00241		Camp Occoneechee Dam	IMPOUNDING	High	Rutherford	35.40897	-82.20022	Cane Creek	Broad	Lake Lure
ALLEG-006	NC00242	355	Roaring Gap Club Lake Dam	IMPOUNDING	High	Alleghany	36.4041	-80.9838	Laurel Branch	New	Roaring Gap
ALLEG-010	NC00246		Mountain Lake Dam	IMPOUNDING	High	Alleghany	36.543	-80.98	Crab Creek	New	Ennice
CLEVE-009	NC00248		C.E. Harry Lake Dam	IMPOUNDING	High	Cleveland	35.173	-81.463	Buffalo Creek	Broad	Earl Station
WATAU-007	NC00249		Bright Penny Dam	IMPOUNDING	High	Watauga	36.17385	-81.52104	Laurel Fork Creek	Yadkin-PeeDee	Darby
WATAU-004	NC00252		Town Of Boone Water Supply Dam	IMPOUNDING	High	Watauga	36.17639	-81.68611	North Prong Flannery Fork	New	Boone
WATAU-010	NC00256		Devils Lake Dam	IMPOUNDING	High	Watauga	36.15990	-81.79022	Watauga River-Tr	Watauga	Foscoe
YADKI-014	NC00258		Deep Creek W/S #10 (PI-566)	IMPOUNDING	High	Yadkin	36.1907	-80.7352	North Deep Creek	Yadkin-PeeDee	High Rock
DAVIE-012	NC00259		Dutchmans Creek W/S Dam #8	IMPOUNDING	High	Davie	36	-80.535	Cedar Creek	Yadkin-PeeDee	High Rock
YADKI-019	NC00262		Deep Creek W/S #19a (PI-566)	IMPOUNDING	High	Yadkin	36.15742	-80.72690	Cranberry Creek	Yadkin-PeeDee	High Rock
YADKI-033	NC00263		Deep Creek W/S #21 (PI-566)	IMPOUNDING	High	Yadkin	36.092	-80.719	South Deep Creek-Tr	Yadkin-PeeDee	High Rock
YADKI-034	NC00264		Deep Creek W/S #22a (PI-566)	IMPOUNDING	High	Yadkin	36.0882	-80.7271	South Deep Creek-Tr	Yadkin-PeeDee	High Rock
YADKI-035	NC00266		Deep Creek W/S #30a (PI-566)	IMPOUNDING	High	Yadkin	36.11778	-80.67306	South Deep Creek-Tr	Yadkin-PeeDee	High Rock
JACKS-001	NC00268		Cashiers Lake Dam	IMPOUNDING	High	Jackson	35.1048	-83.1010	Chattooga River-Tr	Savannah	Grimeshaws
JACKS-002	NC00269		Hampton Lake Dam	IMPOUNDING	High	Jackson	35.0939	-83.0814	Fowler Creek	Savannah	Ford Ga

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
JACKS-007	NC00271		Trout Lake Dam	IMPOUNDING	High	Jackson	35.20247	-83.11639	Raven Fork	Little Tennessee	Tuckaseegee
SURRY-027	NC00274		Low Gap Wildlife Club Dam	IMPOUNDING	High	Surry	36.477	-80.892	Christian Creek	Yadkin-PeeDee	Elkin
SURRY-031	NC00276		Reynolds Lake Dam	IMPOUNDING	High	Surry	36.443	-80.929	Mill Creek	Yadkin-PeeDee	Rockford
SURRY-013	NC00277		Green Hill Lake Dam	IMPOUNDING	High	Surry	36.552	-80.632	Lovills Creek-Tr	Yadkin-PeeDee	Mount Airy
AVERY-013	NC00278		Linville Land Harbor Dam	IMPOUNDING	High	Avery	36.03704	-81.89197	Linville River	Catawba	Pineola
AVERY-006	NC00279		Grandfather Mtn Dam	IMPOUNDING	High	Avery	36.09674	-81.85396	Linville River	Catawba	Linville
AVERY-020	NC00281		Wildcat Lake Dam	IMPOUNDING	High	Avery	36.14892	-81.88194	Wildcat Creek	Watauga	Banner Elk
MITCH-008	NC00282		Swiss Pine Lake Dam	IMPOUNDING	High	Mitchell	35.89447	-82.07652	Graveyard Creek	French Broad	Spruce Pine
BUNCO-049	NC00285	37	Straus Pond Dam	IMPOUNDING	High	Buncombe	35.56306	-82.36	Rocky Fork Creek	French Broad	Fairview
BUNCO-021	NC00286		Echo Lake Dam	IMPOUNDING	High	Buncombe	35.5456	-82.3363	Cane Creek	French Broad	Fairview
BUNCO-025	NC00287	41	Flat Top Mountain Lake Dam	IMPOUNDING	High	Buncombe	35.569	-82.378	Flat Branch	French Broad	Fairview
BUNCO-046	NC00288		North Fork Reservoir Dam	IMPOUNDING	High	Buncombe	35.6615	-82.3448	North Fork Swannanoa River	French Broad	Swannanoa
BUNCO-006	NC00289		Bee Tree Lake Dam	IMPOUNDING	High	Buncombe	35.6412	-82.4010	Bee Tree Creek	French Broad	Swannanoa
BUNCO-036	NC00290		Lake Kenilworth Dam	IMPOUNDING	High	Buncombe	35.578	-82.531	Ross Creek	French Broad	Asheville
BUNCO-005	NC00291		Beaver Lake Dam	IMPOUNDING	High	Buncombe	35.6360	-82.5690	Beaver Dam Creek	French Broad	Woodfin
BUNCO-024	NC00293		Biltmore Lake Dam	IMPOUNDING	High	Buncombe	35.538	-82.658	Bill Moore Creek	French Broad	Enka
IREDE-024	NC00294		Third Creek Dam #12C	IMPOUNDING	High	Iredell	35.7490	-80.92917	Back Creek	Yadkin-PeeDee	Statesville
TRANS-031	NC00296		Sequoyah Woods Lake Dam	IMPOUNDING	High	Transylvania	35.1562	-82.6947	Steel Creek	French Broad	Cedar Mountain
ALEXA-002	NC00297		Third Creek Water Shed Dam #7a	IMPOUNDING	High	Alexander	35.8702	-81.068	Third Creek	Yadkin-PeeDee	Stony Point
FORSY-029	NC00301		Lasater Mill Pond Dam	IMPOUNDING	High	Forsyth	36.026	-80.42	Blanket Creek	Yadkin-PeeDee	Clemmons
FORSY-067	NC00304	380	Winston Lake Dam	IMPOUNDING	High	Forsyth	36.113	-80.201	Frazier Creek	Yadkin-PeeDee	Winston-Salem
FORSY-159	NC00305	33	Mallard Lake Dam Lower	IMPOUNDING	High	Forsyth	36.18439	-80.32682	Muddy Creek-Tr	Yadkin-PeeDee	Bethania
FORSY-160	NC00306	2	Mallard Lake Dam Upper West	IMPOUNDING	High	Forsyth	36.18790	-80.32554	Muddy Creek-Tr	Yadkin-PeeDee	Bethania
POLK-001	NC00309		Melrose Mountain Dam #2	IMPOUNDING	High	Polk	35.20841	-82.29455	UT to Big Falls Creek (Trout)	Broad	Valhalla
FORSY-146	NC00310		Hanes Lake Dam	IMPOUNDING	High	Forsyth	36.146	-80.361	Bill Branch	Yadkin-PeeDee	Pfafftown
HENDE-001	NC00311		Tuxedo Dam Lake Summit	IMPOUNDING	High	Henderson	35.23356	-82.39931	Green River	Broad	Melrose
FORSY-091	NC00315		Kernersville Water Supply Dam	IMPOUNDING	High	Forsyth	36.15448	-80.10058	Belews Creek	Roanoke	Grimes Crossroads
MCDOW-012	NC00316		Lake Tahoma	IMPOUNDING	High	McDowell	35.72309	-82.08002	Buck Creek	Catawba	Pleasant Gardens
BUNCO-058	NC00320		MSD Treatment Plant Dam	IMPOUNDING	High	Buncombe	35.64556	-82.59639	French Broad River-Tr	French Broad	Alexander
ROWAN-005	NC00322		Rowan County Wildlife Lake Dam	IMPOUNDING	High	Rowan	35.6917	-80.5357	Graft Branch	Yadkin-PeeDee	Salisbury
ROWAN-006	NC00323		Landis Water Reservoir Dam	IMPOUNDING	High	Rowan	35.585	-80.634	Grants Creek	Yadkin-PeeDee	Salisbury
ROWAN-007	NC00324		Lake Kannapolis Dam	IMPOUNDING	High	Rowan	35.5112	-80.6471	Irish Buffalo Creek	Yadkin-PeeDee	Kannapolis
FORSY-112	NC00326		Myers Lake Dam	DRAINED	High	Forsyth	36.05278	-80.27194	Salem Creek	Yadkin-PeeDee	Winston-Salem
FORSY-066	NC00327		Salem Lake Dam	IMPOUNDING	High	Forsyth	36.0959	-80.1915	Salem Creek	Yadkin-PeeDee	Winston-Salem
MECKL-011	NC00328		Cornwell Dam	IMPOUNDING	High	Mecklenburg	35.14444	-80.67083	Stevens Creek	Yadkin-PeeDee	Fairview
TRANS-003	NC00340		Cascade Lake Dam	IMPOUNDING	High	Transylvania	35.21893	-82.63946	Little River	French Broad	Little River
STOKE-016	NC00342	48	Hanging Rock State Park Dam	IMPOUNDING	High	Stokes	36.392	-80.269	Cascade Creek-Tr	Roanoke	Moores Springs
STOKE-051	NC00343		Town Fork Creek W/S Dam #13	IMPOUNDING	High	Stokes	36.29639	-80.21028	Watts Creek	Roanoke	Walnut Cove
STOKE-052	NC00346		Town Fork Creek W/S Dam #14A	IMPOUNDING	High	Stokes	36.312	-80.192	Voss Creek	Roanoke	Walnut Cove
STOKE-009	NC00347		Little Yadkin River W/S Dam #6	IMPOUNDING	High	Stokes	36.281	-80.387	Crooked Run Creek	Yadkin-PeeDee	Donnoha
STOKE-012	NC00349		Town Fork Creek W/S Dam #10	IMPOUNDING	High	Stokes	36.313	-80.279	Town Fork Creek	Roanoke	Germanton
STOKE-013	NC00350		Town Fork Creek W/S Dam #16	IMPOUNDING	High	Stokes	36.325	-80.263	Neatmans Creek	Roanoke	Walnut Cove
HENDE-009	NC00351		Blue Star Dam Lower	IMPOUNDING	High	Henderson	35.24705	-82.53727	Mud Creek	French Broad	Hendersonville
HENDE-011	NC00353		Orchard Lake Dam	IMPOUNDING	High	Henderson	35.1999	-82.3540	Pacolet River-Tr	Broad	Melrose
YADKI-012	NC00355		Deep Creek W/S #15b (PI-566)	IMPOUNDING	High	Yadkin	36.20889	-80.68333	North Deep Creek-Tr	Yadkin-PeeDee	High Rock
MCDOW-009	NC00358		Camp Grier Dam	IMPOUNDING	High	McDowell	35.63994	-82.19482	Mill Creek	Catawba	Old Fort
CATAW-003	NC00361		Maiden Water Plant Lake Dam	DRAINED	High	Catawba	35.58444	-81.19194	Maiden Creek	Catawba	Maiden
CATAW-006	NC00364		Flowers Lake Dam	IMPOUNDING	High	Catawba	35.8	-81.15889	Elk Shoal Creek-Tr	Catawba	Catawba
CATAW-009	NC00367		Newton City Lake Dam	IMPOUNDING	High	Catawba	35.65556	-81.25028	Clark Creek-Tr	Catawba	Newton

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
DAVIE-040	NC00370		Dutchman Creek W/S Dam #15A	IMPOUNDING	High	Davie	35.8864	-80.4926	Ellsworth Creek	Yadkin-PeeDee	High Rock
BURKE-005	NC00373	3	Henry River Dam	IMPOUNDING	High	Burke	35.69393	-81.42684	Henry Fork	Catawba	Henry River
WAKE-080	NC00376		Lakes Apartment Dam	IMPOUNDING	High	Wake	35.8657	-78.6292	Big Branch	Neuse	Raleigh
SURRY-032	NC00377		Stewarts Creek W/S Dam #1A	IMPOUNDING	High	Surry	36.55	-80.755	Stewarts Creek	Yadkin-PeeDee	Mount Airy
ALEXA-003	NC00379		Lower Little River Dam #2 (Oliver Teagues)	IMPOUNDING	High	Alexander	35.891	-81.237	Lower Little River-Tr	Catawba	Millersville
YADKI-036	NC00384		Deep Creek W/S #23 (Pl-566)	IMPOUNDING	High	Yadkin	36.07556	-80.695	Fisher Creek	Yadkin-PeeDee	High Rock
FRANK-001	NC00386		Franklinton Reservoir #2	IMPOUNDING	High	Franklin	36.1062	-78.4730	Taylor'S Creek	Tar-Pamlico	Franklinton
FORSY-048	NC00389		Conrad Lake Dam	DRAINED	High	Forsyth	36.121	-80.442	Mill Creek-Tr	Yadkin-PeeDee	West Bend
BUNCO-065	NC00395		Lake Tomahawk Dam	IMPOUNDING	High	Buncombe	35.61735	-82.32897	Tomahawk Branch	French Broad	Black Mountain
MCDOW-011	NC00406		Phillips Lake Dam	IMPOUNDING	High	McDowell	35.72452	-82.05320	Toms Creek	Catawba	Garden Creek
WATAU-012	NC00414		Old Blowing Rock Water Supply	IMPOUNDING	High	Watauga	36.144	-81.672	Flat Top Branch	New	Boone
DAVIE-034	NC00415	9	Hoffner Lake Dam	IMPOUNDING	High	Davie	35.817	-80.509	Reedy Creek	Yadkin-PeeDee	High Rock
MECKL-022	NC00417		Danga Lake Dam	IMPOUNDING	High	Mecklenburg	35.2137	-80.9720	Little Paw Creek	Catawba	Red River Sc
FORSY-073	NC00420	5	Joyner Lake Dam	IMPOUNDING	High	Forsyth	36.125	-80.11083	Kerners Mill Creek-Tr	Yadkin-PeeDee	Guthrie
FORSY-132	NC00421		Town Fork Creek Watershed Dam #2	IMPOUNDING	High	Forsyth	36.23611	-80.14806	Lick Creek	Roanoke	Walnut Cove
FORSY-133	NC00422		Town Fork Creek Watershed Dam #1-B	IMPOUNDING	High	Forsyth	36.24	-80.12583	Lick Creek	Roanoke	Walnut Cove
FORSY-130	NC00423		Town Fork Creek Watershed Dam #5	IMPOUNDING	High	Forsyth	36.21	-80.181	Old Field Creek	Roanoke	Walnut Cove
FORSY-131	NC00424		Town Fork Creek Watershed Dam #6	IMPOUNDING	High	Forsyth	36.21111	-80.18944	Mill Creek	Roanoke	Walnut Cove
FORSY-049	NC00430		Shallowford Lakes Dam #1	IMPOUNDING	High	Forsyth	36.115	-80.421	Mill Creek-Tr	Yadkin-PeeDee	West Bend
RANDO-056	NC00435		Dodson Lake Dam	IMPOUNDING	High	Randolph	35.87543	-79.63039	Sandy Creek-Tr	Cape Fear	Ramseur
RANDO-053	NC00436		Bouldin Dam	IMPOUNDING	High	Randolph	35.90028	-79.96806	Muddy Creek-Tr	Cape Fear	Archdale
RANDO-054	NC00437		King Lake Dam	IMPOUNDING	High	Randolph	35.906	-79.923	Muddy Creek-Tr	Cape Fear	Randleman
RANDO-003	NC00439		Colonial Ctr. Club Dam Lower	IMPOUNDING	High	Randolph	35.882	-80.032	Uwharrie River-Tr	Yadkin-PeeDee	Trinity
RANDO-040	NC00447		Richardson Lake Dam	IMPOUNDING	High	Randolph	35.7707	-79.8030	Hasketts Creek-Tr	Cape Fear	Worthville
RANDO-042	NC00449		Randleman City Lake Dam	IMPOUNDING	High	Randolph	35.8157	-79.7765	Polecat Creek	Cape Fear	Worthville
RANDO-025	NC00451		John Bunch Lake Dam	IMPOUNDING	High	Randolph	35.722	-79.861	Cedar Fork Creek-Tr	Yadkin-PeeDee	Farmer
RANDO-024	NC00452		Mccrary Lake Dam	IMPOUNDING	High	Randolph	35.716	-79.857	Cedar Fork Creek-Tr	Yadkin-PeeDee	Farmer
RANDO-027	NC00453		Lucas Lake Dam	IMPOUNDING	High	Randolph	35.736	-79.878	Back Creek	Yadkin-PeeDee	Farmer
RANDO-029	NC00454		Asheboro Country Club Lake Dam	IMPOUNDING	High	Randolph	35.723	-79.923	Caraway Creek-Tr	Yadkin-PeeDee	Farmer
RANDO-037	NC00486		Beard Lake Dam	IMPOUNDING	High	Randolph	35.831	-79.936	Caraway Creek-Tr	Yadkin-PeeDee	Flint Hill
ANSON-017	NC00502		Wadesboro Lake Dam	IMPOUNDING	High	Anson	34.92367	-80.08033	North Fork Jones Creek	Yadkin-PeeDee	Wadesboro
ANSON-019	NC00504		Little Lake Dam	IMPOUNDING	High	Anson	34.915	-80.13	North Fork Jones Creek	Yadkin-PeeDee	Wadesboro
ANSON-023	NC00508		White Store Lake Dam	IMPOUNDING	High	Anson	34.88	-80.228	Bell Ck-Tr	Yadkin-PeeDee	Lowrys
UNION-002	NC00511		Aero Plantation Lake Dam 1	IMPOUNDING	High	Union	34.99417	-80.745	West Mundy'S Run Creek	Catawba	Van Wyck Sc
UNION-003	NC00512		Aero Plantation Lake Dam 2	IMPOUNDING	High	Union	34.9899	-80.7413	West Mundy's Run Creek	Catawba	Van Wyck
UNION-008	NC00518		Mundorf Lake Dam	IMPOUNDING	High	Union	35.0333	-80.7587	Six Mile Creek-Trib.	Catawba	Van Wyck Sc
CABAR-001	NC00519		Lake Concord Dam	IMPOUNDING	High	Cabarrus	35.47805	-80.58494	Cold Water Creek-Tr	Yadkin-PeeDee	Kanannapolis
CABAR-002	NC00520		Lake Fisher Dam	IMPOUNDING	High	Cabarrus	35.486	-80.578	Cold Water Creek	Yadkin-PeeDee	Concord
CABAR-005	NC00523		Lake Lynn Dam	IMPOUNDING	High	Cabarrus	35.39806	-80.53056	Cold Water Creek-Tr	Yadkin-PeeDee	Concord
CABAR-006	NC00524		Buffalo Ranch Lake Dam	IMPOUNDING	High	Cabarrus	35.385	-80.524	Cold Water Creek-Tr	Yadkin-PeeDee	Faggerts
CABAR-008	NC00526		Oak Cliff Lake Dam	IMPOUNDING	High	Cabarrus	35.3704	-80.4520	Dutch Buffalo Creek-Os	Yadkin-PeeDee	Georgeville
UNION-009	NC00529		Emerald Lake Golf Course Dam	IMPOUNDING	High	Union	35.14139	-80.61111	Paddle Branch	Yadkin-PeeDee	Cheraw Sc
UNION-011	NC00531		Baker Quarry Lake Dam	IMPOUNDING	High	Union	35.042	-80.611	Crooked Creek-Os	Yadkin-PeeDee	Cheraw Sc
UNION-012	NC00532		Twitty Dam	IMPOUNDING	High	Union	35.037	-80.477	Stewarts Creek	Yadkin-PeeDee	Olive Branch Nc
UNION-015	NC00535		Lake Monroe Dam	IMPOUNDING	High	Union	34.94111	-80.51833	Richardson Creek	Yadkin-PeeDee	Monroe
UNION-016	NC00536		Lake Lee Dam	IMPOUNDING	High	Union	34.966	-80.511	Richardson Creek	Yadkin-PeeDee	Monroe
UNION-017	NC00537		Brewer Lake Dam	IMPOUNDING	High	Union	35.036	-80.433	Richardson Creek-Os	Yadkin-PeeDee	Cheraw Sc
STANL-001	NC00543		Carolina Stalite Dam	IMPOUNDING	High	Stanly	35.22222	-80.24583	Long Branch	Yadkin-PeeDee	Aquadale

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
STANL-004	NC00546		Long Lake Dam	IMPOUNDING	High	Stanly	35.352	-80.226	Long Creek	Yadkin-PeeDee	Albemarle
ROCKI-021	NC00551		Lake Hunt Dam	IMPOUNDING	High	Rockingham	36.32537	-79.72612	Troublesome Creek-Tr	Cape Fear	Foushee
ROCKI-007	NC00555		Young Lake Dam	IMPOUNDING	High	Rockingham	36.461	-79.863	Buffalo Creek-Tr	Roanoke	Eden
ROCKI-032	NC00564		Southern C's Farm Lake Dam	IMPOUNDING	High	Rockingham	36.27833	-79.86722	Troublesome Creek-Tr	Cape Fear	Wittys Crossroads
ROCKI-017	NC00565		Lake Hazel Dam	IMPOUNDING	High	Rockingham	36.393	-79.709	Carroll Creek	Roanoke	Reidsville
ROCKI-010	NC00570		John Smith Lake Dam	IMPOUNDING	High	Rockingham	36.485	-79.795	Matrimony Cr.-Tr	Roanoke	Eden
ROCKI-004	NC00572		Grogan Estate Lake Dam	IMPOUNDING	High	Rockingham	36.409	-79.991	Big Beaver Island Creek-Tr	Roanoke	Madison
GUILF-083	NC00583		Benjamin Dam	IMPOUNDING	High	Guilford	36.084	-79.855	North Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-042	NC00585		Hillside Lake Dam	IMPOUNDING	High	Guilford	36.1316	-79.9241	Brush Creek-Tr	Cape Fear	Greensboro
GUILF-090	NC00592		Fairfield Lake Dam	IMPOUNDING	High	Guilford	36.031	-79.899	Bull Run Creek-Tr	Cape Fear	Jamestown
GUILF-088	NC00593		Friendly Lake Dam	IMPOUNDING	High	Guilford	36.114	-79.889	Horsepen Creek-Tr	Cape Fear	Greensboro
GUILF-084	NC00594		Lake Hamilton Dam	IMPOUNDING	High	Guilford	36.086	-79.864	Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-062	NC00598		Brooks Lake Dam	IMPOUNDING	High	Guilford	36.2331	-79.7191	Benaja Creek-Tr	Cape Fear	Benaja
GUILF-085	NC00599		Buffalo Lake Dam	IMPOUNDING	High	Guilford	36.113	-79.783	North Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-065	NC00600		Lake Herman Dam	IMPOUNDING	High	Guilford	36.172	-79.726	Reedy Fork - Tr	Cape Fear	Ossipee
GUILF-108	NC00602		Teague Lake Dam	IMPOUNDING	High	Guilford	35.92	-79.667	Little Alamance Creek-Tr	Cape Fear	Alamance
GUILF-102	NC00604		Wood Lake Dam	IMPOUNDING	High	Guilford	35.9697	-79.7942	Polecat Creek-Tr	Cape Fear	Worthville
GUILF-089	NC00609		Koger Properties Dam	IMPOUNDING	High	Guilford	36.0516	-79.8866	South Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-093	NC00611		Uwharrie Lake Dam	IMPOUNDING	High	Guilford	36.0404	-79.9294	Long Branch-Tr	Cape Fear	Jamestown
GUILF-049	NC00612		Hillsdale Lake Dam	IMPOUNDING	High	Guilford	36.184	-79.876	Tr- Lake Brandt	Cape Fear	Summerfield
CHATH-005	NC00618		Siler City Water Supply Dam	IMPOUNDING	High	Chatham	35.765	-79.46	Rocky River-Tr	Cape Fear	Siler City
CHATH-006	NC00619		Charles L. Turner Reservoir Dam	IMPOUNDING	High	Chatham	35.763	-79.456	Rocky River	Cape Fear	Siler City
RICHM-010	NC00634		Richmond Community College Dam	IMPOUNDING	High	Richmond	34.9075	-79.7111	Falling Creek-Os	Yadkin-PeeDee	Rockingham
RICHM-011	NC00635		Hamlet City Lake Lower Dam	IMPOUNDING	High	Richmond	34.8830	-79.6923	Marks Creek	Yadkin-PeeDee	Hamlet
RICHM-013	NC00637		Hamlet City Lake Upper Dam	IMPOUNDING	High	Richmond	34.8992	-79.6704	Marks Creek	Yadkin-PeeDee	Hamlet
RICHM-019	NC00644		Wall Lake Dam	IMPOUNDING	High	Richmond	34.8705	-79.8272	Speed Creek	Yadkin-PeeDee	Cheraw Sc
RICHM-021	NC00646		Rankin Lake Dam	IMPOUNDING	High	Richmond	35.1	-79.778	Little Mountain Creek-Os	Yadkin-PeeDee	Cheraw Sc
RICHM-026	NC00651		McKinney Lake Dam	IMPOUNDING	High	Richmond	35.008	-79.627	Hitchcock Creek	Yadkin-PeeDee	Ledbetter
RICHM-028	NC00653		Ledbetter Lake Dam	IMPOUNDING	High	Richmond	34.9847	-79.7146	Hitchcock Creek	Yadkin-PeeDee	Ledbetter
RICHM-030	NC00655		Hinson Lake Dam	IMPOUNDING	High	Richmond	34.9385	-79.7502	Falling Creek	Yadkin-PeeDee	Rockingham
PERSO-002	NC00656	60	Lake Hyco Dam	IMPOUNDING	High	Person	36.5082	-79.0421	Hyco River	Roanoke	Mcgehees Mill
PERSO-004	NC00658		Roxboro Municipal Lake Dam	IMPOUNDING	High	Person	36.435	-79.017	Storys Creek	Roanoke	Chub Lake
PERSO-013	NC00666		Roxboro Afterbay Dam	IMPOUNDING	High	Person	36.5223	-78.9972	Hyco River	Roanoke	Denniston
GUILF-074	NC00669		Lynwood Lake Dam	IMPOUNDING	High	Guilford	36.004	-79.731	Little Alamance Creek-Tr	Cape Fear	Troxlers Mill
GUILF-070	NC00671		Buckhorn Lake Dam	IMPOUNDING	High	Guilford	36.216	-79.596	Reedy Fork Creek-Tr	Cape Fear	Ossipee
GUILF-104	NC00676		Forest Oaks Lake Dam	IMPOUNDING	High	Guilford	35.9969	-79.714	Beaver Creek	Cape Fear	Alamance
GUILF-009	NC00677		Heron's Nest Dam	IMPOUNDING	High	Guilford	36.1733	-80.0144	Haw River-Tr	Cape Fear	Oak Ridge
GUILF-060	NC00678		Cedar Hollow Dam	IMPOUNDING	High	Guilford	36.22677	-79.81480	Mears Fork Creek-Tr	Cape Fear	Altamahaw
GUILF-052	NC00679		Lake Jeanette Dam	IMPOUNDING	High	Guilford	36.159	-79.798	Richland Creek	Cape Fear	Ossipee
GUILF-087	NC00680		Jefferson Standard Country Club Dam	IMPOUNDING	High	Guilford	36.1138	-79.8737	Horsepen Creek-Tr	Cape Fear	Greensboro
GUILF-081	NC00682		Rounda Dam	IMPOUNDING	High	Guilford	36.022	-79.786	South Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-025	NC00684		Hobbs Lake Dam	IMPOUNDING	High	Guilford	36.211	-79.9440	Haw River-TR	Cape Fear	Altamahaw
GUILF-096	NC00686		City Lake Dam	IMPOUNDING	High	Guilford	35.9952	-79.9448	Deep River	Cape Fear	Jamestown
GUILF-063	NC00687		Lake Townsend Dam	IMPOUNDING	High	Guilford	36.18963	-79.73170	Reedy Fork	Cape Fear	Ossipee
GUILF-092	NC00689		Dogwood Lake Dam	IMPOUNDING	High	Guilford	36.0003	-79.8952	Reddicks Creek-Tr	Cape Fear	Randleman
GUILF-077	NC00692		Aydelette Lake Dam	IMPOUNDING	High	Guilford	36.038	-79.699	Little Alamance Creek-Tr	Cape Fear	Troxlers Mill
GUILF-091	NC00695		Adams Lake Dam	IMPOUNDING	High	Guilford	36.023	-79.907	Bull Run Creek-Tr	Cape Fear	Jamestown
GUILF-050	NC00698		Lake Higgins Dam	IMPOUNDING	High	Guilford	36.1686	-79.8799	Brush Creek	Cape Fear	Ossipee
GUILF-051	NC00700		Lake Brandt Dam	IMPOUNDING	High	Guilford	36.1709	-79.8373	Reedy Fork	Cape Fear	Ossipee

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
GUILF-095	NC00704		Oak Hollow Lake Dam	IMPOUNDING	High	Guilford	36.0128	-79.9851	West Fork Deep River	Cape Fear	High Point
RANDO-023	NC00708		Farlow Lake Dam	IMPOUNDING	High	Randolph	35.643	-79.802	North Prong Richland Creek	Cape Fear	Highfalls
MOORE-074	NC00711	123	Boy Scouts Of America Dam Upper	IMPOUNDING	High	Moore	35.33636	-79.55949	Suck Creek	Cape Fear	Carbonton
MOORE-081	NC00718		Boy Scouts Of America Dam Lower (Nello Teer Lake)	IMPOUNDING	High	Moore	35.33207	-79.54572	Suck Creek	Cape Fear	Carbonton
RANDO-052	NC00723		Overman Lake Dam	IMPOUNDING	High	Randolph	35.827	-79.551	Rocky River-Tr	Cape Fear	Siler City
RANDO-022	NC00726		Shaw-Hudson Lake Dam	IMPOUNDING	High	Randolph	35.651	-79.757	Richland Creek-Tr	Cape Fear	Highfalls
ALAMA-002	NC00739		Lake Cammack Dam	IMPOUNDING	High	Alamance	36.1774	-79.4113	Stony Creek	Cape Fear	Carolina
ALAMA-012	NC00742		Timber Ridge Lake Dam	IMPOUNDING	High	Alamance	35.91	-79.517	Poppaw Creek	Cape Fear	Saxapahaw
ALAMA-004	NC00748	108	Forest Lake Dam	IMPOUNDING	High	Alamance	36.108	-79.281	Mill Creek-Tr	Cape Fear	Haw River
ALAMA-014	NC00762	375	Old Stony Creek Dam	IMPOUNDING	High	Alamance	36.1281	-79.4061	Stony Creek	Cape Fear	Hopedale
MOORE-092	NC00764		Harris Lake Dam #1	IMPOUNDING	High	Moore	35.308	-79.695	Mill Creek-Os	Cape Fear	Robbins
ORANG-002	NC00770		Hogan Farms Dam	IMPOUNDING	High	Orange	35.949	-79.1	Bolin Creek	Cape Fear	Chapel Hill
ORANG-003	NC00771		Lake Michael Dam	IMPOUNDING	High	Orange	36.108	-79.25	Back Creek-Tr	Cape Fear	Haw River
ORANG-005	NC00773		Lake Orange Dam	IMPOUNDING	High	Orange	36.146	-79.149	East Fork Eno River	Neuse	Hillsborough
ORANG-008	NC00776		Blackburn Lake Dam	IMPOUNDING	High	Orange	36.03972	-79.13028	Eno River-Tr	Neuse	Hillsborough
ORANG-011	NC00779		Cane Creek Resevoir Dam	IMPOUNDING	High	Orange	35.95028	-79.24111	Cane Creek	Cape Fear	
ORANG-013	NC00781		Eastwood Lake Dam	IMPOUNDING	High	Orange	35.946	-79.031	Booker Creek	Cape Fear	Chapel Hill
ORANG-014	NC00782		University Lake Dam	IMPOUNDING	High	Orange	35.897	-79.092	Morgan Creek	Cape Fear	Carrboro
SURRY-010	NC00788		Shopshire Dam	IMPOUNDING	High	Surry	36.421	-80.617	Ararat River-Tr	Yadkin-PeeDee	Ararat/ White Plains
WAKE-002	NC00794		Hedingham Dam #1	IMPOUNDING	High	Wake	35.811	-78.547	Neuse River-Tr	Neuse	Raleigh
WAKE-003	NC00795		Gresham Lake Dam	IMPOUNDING	High	Wake	35.8796	-78.5738	Perry Creek	Neuse	Milburnie (at Dam US-1 and I-5
WAKE-010	NC00802		Robertson Lake Dam	IMPOUNDING	High	Wake	35.825	-78.457	Marks Creek-Tr	Neuse	Smithfield
EDGEC-005	NC00818		Wiggins Lake Dam	IMPOUNDING	High	Edgecombe	35.897	-77.68	Cokey Swamp-Tr	Tar-Pamlico	Wiggins Crossroads
EDGEC-006	NC00819		Nobles Millpond Dam	IMPOUNDING	High	Edgecombe	35.884	-77.666	Cokey Creek-Tr	Tar-Pamlico	Wiggins Crossroads
FRANK-003	NC00821		Lake Royale Dam	IMPOUNDING	High	Franklin	35.9503	-78.1878	Cypress Creek	Tar-Pamlico	Spring Hope
WAKE-165	NC00845		Johnson Pond Dam	IMPOUNDING	High	Wake	35.814	-78.284	Moccasin Creek-Tr	Neuse	NC-39
WAKE-022	NC00850		Crossgate Lake Dam #1	IMPOUNDING	High	Wake	35.912	-78.637	Honeycut Creek	Neuse	Raleigh
WAKE-024	NC00851		Shaw Lake Dam	IMPOUNDING	High	Wake	35.893	-78.659	Honeycutt Creek-	Neuse	Raleigh
WAKE-026	NC00853		Partin Lake Dam	IMPOUNDING	High	Wake	35.5701	-78.7361	Black Creek	Neuse	Mount Pleasant
WAKE-030	NC00857		Camp Adventure Lake Dam	IMPOUNDING	High	Wake	35.9831	-78.6874	Upper Barton Creek-Tr	Neuse	Falls
WAKE-031	NC00858		Dunnaway Lake Dam	IMPOUNDING	High	Wake	35.879	-78.733	Turkey Creek	Neuse	Raleigh
WAKE-032	NC00859		Brown Lake Dam (AKA St. Andrews Plantation WAKE-268)	IMPOUNDING	High	Wake	35.914	-78.514	Toms Creek	Neuse	Milburnie
WAKE-034	NC00861		Lake Benson Dam	IMPOUNDING	High	Wake	35.66203	-78.61149	Swift Creek	Neuse	Smithfield (Benson Rd near Dam
WAKE-035	NC00862		Lake Johnson Dam	IMPOUNDING	High	Wake	35.76170	-78.70506	Walnut Creek	Neuse	Raleigh (Lake Dam Rd at Dam)
WAKE-036	NC00863		Lake Raleigh Dam	IMPOUNDING	High	Wake	35.7652	-78.6769	Walnut Creek	Neuse	Raleigh (Main Camp. Dr @ Dam)
WAKE-037	NC00864		Lake Wheeler Dam	IMPOUNDING	High	Wake	35.69429	-78.69406	Swift Creek	Neuse	Smithfield (See Comments)
WAKE-038	NC00865		Mason Lake Dam	IMPOUNDING	High	Wake	36.008	-78.533	Horse Creek-Os	Neuse	Milburnie
WAKE-039	NC00866		Mitchell Lake Dam	IMPOUNDING	High	Wake	35.927	-78.377	Little River-Tr	Neuse	Bagley
WAKE-046	NC00873		Holding Lake Dam	IMPOUNDING	High	Wake	35.95657	-78.50896	Smith Creek-Tr	Neuse	Milburnie (S. Franklin St @ Da
WAKE-049	NC00876		Panther Lake Dam	IMPOUNDING	High	Wake	35.5658	-78.6925	Black Creek	Neuse	Smithfield
WAKE-050	NC00877		Preston Crossings Dam	IMPOUNDING	High	Wake	35.7985	-78.8449	Turkey Creek-Tr	Neuse	Cary
WAKE-053	NC00880		Sunset Lake Dam	IMPOUNDING	High	Wake	35.652	-78.788	Middle Creek	Neuse	Holly Springs (Sunset Lake Rd)
WAKE-058	NC00885		Baker Lake Dam	IMPOUNDING	High	Wake	35.8867	-78.6651	Mine Creek-Tr	Neuse	Raleigh
WILSO-007	NC00894		Lake Wilson	IMPOUNDING	High	Wilson	35.7889	-77.9206	Toisnot Swamp	Neuse	Wilson (LakeWIlsonRd@Dam)
PITT-002	NC00898	328	Lake Glenwood Dam	IMPOUNDING	High	Pitt	35.576	-77.314	Hardee Creek-Tr	Tar-Pamlico	Yankee Hall
NASH-011	NC00913		Tar River Reservoir Dam	IMPOUNDING	High	Nash	35.899	-77.885	Tar River	Tar-Pamlico	Rocky Mount
WAKE-060	NC00926		Fred G Bond Dam	IMPOUNDING	High	Wake	35.7814	-78.8281	Crabtree Creek	Neuse	Morrisville (SE CaryPkwy .48 m
WAKE-062	NC00928		Rowland Lake Dam	IMPOUNDING	High	Wake	35.56611	-78.72528	Black Creek-Tr	Neuse	Mount Pleasant

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
WAKE-067	NC00933		Lake Pine Dam	IMPOUNDING	High	Wake	35.74724	-78.81657	Williams Creek	Neuse	Cary
WAKE-068	NC00934	178	Bass Lake Dam	IMPOUNDING	High	Wake	35.642	-78.803	Basal Creek	Neuse	Holly Springs (BassLakeRd@dam)
WAYNE-001	NC00936		Spring Lake Dam	IMPOUNDING	High	Wayne	35.312	-77.865	Walnut Creek-Tr	Neuse	Seven Springs
WAYNE-002	NC00937		Tom Harrison Memorial Dam	IMPOUNDING	High	Wayne	35.3036	-77.8651	Walnut Creek	Neuse	Seven Springs
WAYNE-003	NC00938		Wayne County Wildlife Pond Dam	IMPOUNDING	High	Wayne	35.457	-77.849	Beaver Dam	Neuse	Snow Hill (Wildlife Dr @ dam)
WAYNE-006	NC00941		Sleepy Creek Upper Lake Dam	IMPOUNDING	High	Wayne	35.256	-77.964	Sleepy Creek	Neuse	Seven Springs
WAYNE-007	NC00942		Williams Millpond Dam	IMPOUNDING	High	Wayne	35.187	-77.984	Lewis Branch	Cape Fear	Hallsville
WAYNE-009	NC00944		HF Lee Cooling Lake Dam	IMPOUNDING	High	Wayne	35.381	-78.085	Neuse Riv Off Stream	Neuse	Goldsboro
GREEN-001	NC00945		Grays Millpond Dam	IMPOUNDING	High	Greene	35.35244	-77.66151	Wheat Swamp Creek	Neuse	Grifton
LENOI-003	NC00948		Tull Millpond Dam	IMPOUNDING	High	Lenoir	35.155	-77.734	Southwest Creek	Neuse	Deep Run
GREEN-002	NC00951		Turnage Millpond Dam	IMPOUNDING	High	Greene	35.414	-77.73	Tyson Marsh	Neuse	Snow Hill
JOHNS-004	NC00959		Earp Lake Dam	IMPOUNDING	High	Johnston	35.668	-78.449	Neuse River-Tr	Neuse	Clayton
JOHNS-010	NC00965		Keen Lake Dam #1	IMPOUNDING	High	Johnston	35.47832	-78.48085	Black Creek-Tr	Neuse	Four Oaks
JOHNS-016	NC00972		Brown Lake Dam	IMPOUNDING	High	Johnston	35.594	-78.237	Buffalo Creek	Neuse	Bagley
GREEN-005	NC00981		Whitley Lake Dam	IMPOUNDING	High	Greene	35.4048	-77.8040	Bear Creek	Neuse	Lagrange
WAYNE-010	NC00982		Rudy Hill Dam	IMPOUNDING	High	Wayne	35.3867	-77.8620	Peters Branch	Neuse	Lagrange (Parkstown Rd .42 mi)
WAYNE-013	NC00985		Bass Lake Dam	IMPOUNDING	High	Wayne	35.411	-77.881	West Bear Creek	Neuse	Lagrange
WAKE-085	NC00987		Brooks Pond Dam	IMPOUNDING	High	Wake	35.567	-78.726	Black Creek-Tr	Neuse	Buck Rowland Road
WAKE-075	NC00994		Turfgrass Lake Dam #3	IMPOUNDING	High	Wake	35.7836	-78.5489	Crabtree Creek-Tr	Neuse	Smithfield
WAKE-176	NC00995		Wake Forest Water Supply Dam	IMPOUNDING	High	Wake	35.97083	-78.48944	Smith Creek	Neuse	Milburnie (WaitAve(NC-98)(.12)
WAKE-172	NC00998		Moss Lake Dam	IMPOUNDING	High	Wake	35.793	-78.32	Little River-Tr	Neuse	Hares Crossroads
GRANV-003	NC01002		Lake Devin	IMPOUNDING	High	Granville	36.2998	-78.6214	Hachers Run	Tar-Pamlico	
GRANV-004	NC01003		Lake Rogers Dam	IMPOUNDING	High	Granville	36.1295	-78.7050	Ledge Creek	Neuse	West Lake Road
GRANV-008	NC01008		Lake Butner	IMPOUNDING	High	Granville	36.1671	-78.7725	Knap Of Reeds Creek	Neuse	Range Road
DURHA-001	NC01021		Crystal Lake Dam	IMPOUNDING	High	Durham	36.05506	-78.93695	Eno River-Tr	Neuse	Durham (Hillandale Rd)
DURHA-005	NC01023		Newcomb Lake Dam	IMPOUNDING	High	Durham	36.076	-78.97	Seven Mile Creek	Neuse	Durham (Umstead Rd.)
DURHA-008	NC01027		Lake Michie Dam	IMPOUNDING	High	Durham	36.1508	-78.8299	Flat River	Neuse	Redwood
DURHA-015	NC01032		Bailey Lake Dam	IMPOUNDING	High	Durham	35.9956	-78.7866	Little Lick Creek-Tr	Neuse	Falls
DURHA-021	NC01037		Lake Elton Dam	IMPOUNDING	High	Durham	35.926	-78.898	Northeast Creek-Tr	Cape Fear	Parkwood
DURHA-022	NC01038		Parkwood Lake Dam	IMPOUNDING	High	Durham	35.88364	-78.91213	Northeast Creek	Cape Fear	Parkwood
DURHA-023	NC01039		Lakehurst S/D Dam	IMPOUNDING	High	Durham	35.89132	-78.92821	Northeast Creek-Tr	Cape Fear	Farrington
DURHA-027	NC01043		Eden Lake Dam	IMPOUNDING	High	Durham	36.1198	-78.9090	Little River-Tr	Neuse	Orange Factory (Mason Rd is 0
DURHA-031	NC01046		Bay Meadows Lake Dam	IMPOUNDING	High	Durham	35.872	-78.994	Morgan Creek-Tr	Cape Fear	Farrington
DURHA-032	NC01047		Thompson Lake Dam	IMPOUNDING	High	Durham	35.90583	-78.98833	Little Creek-Tr	Cape Fear	Farrington
DURHA-034	NC01049		Cole Lake Dam	IMPOUNDING	High	Durham	36.043	-78.966	Eno River-Tr	Neuse	Huckleberry Springs (Fleming D
DURHA-035	NC01050		Willowhaven Lake Dam #2	IMPOUNDING	High	Durham	36.0720	-78.9644	Seven Mile Creek	Neuse	Durham (Continental Rd. at Dam
DURHA-036	NC01051		Lake Vista Dam	IMPOUNDING	High	Durham	36.0816	-78.9570	Eno River-Tr	Neuse	Durham
FRANK-009	NC01064		Moore Lake Dam	IMPOUNDING	High	Franklin	35.979	-78.422	Little River	Neuse	Lowell Mill
FRANK-011	NC01066		Jackson Lake Dam	IMPOUNDING	High	Franklin	36.065	-78.209	Cypress Creek	Tar-Pamlico	Stanhope
FRANK-020	NC01070		Bunn Lake Dam	IMPOUNDING	High	Franklin	35.8515	-78.2705	Moccasin Creek	Neuse	Zebulon
FRANK-017	NC01074		Lands Lake Dam	IMPOUNDING	High	Franklin	35.9572	-78.2900	Crooked Creek-Tr	Tar-Pamlico	Bunn
ROBES-003	NC01077		Cultural Center Lake Dam	IMPOUNDING	High	Robeson	34.697	-79.26	Gum Swamp	Lumber	Lumberton
ROBES-004	NC01078		Weatherspoon Cooling Lake Dam	IMPOUNDING	High	Robeson	34.5847	-78.9714	Lumber River	Lumber	Lumberton
SCOTL-008	NC01080		Richmond Millpond Dam	IMPOUNDING	High	Scotland	34.821	-79.53	Gum Swamp Creek	Lumber	Laurel Hill
SCOTL-011	NC01085		Pine Lake Dam	IMPOUNDING	High	Scotland	34.974	-79.575	Gum Swamp Creek	Lumber	Laurel Hill
SCOTL-018	NC01092		Fair Lake Dam	IMPOUNDING	High	Scotland	34.742	-79.517	Gum Swamp Creek	Lumber	Dillon Sc
HARNE-045	NC01096	288	Hannas Lake Dam	IMPOUNDING	High	Harnett	35.3160	-78.5978	East Mingo Creek	Cape Fear	Dunn
HARNE-046	NC01097		McLamb Lake Dam	IMPOUNDING	High	Harnett	35.3	-78.586	East Mingo Creek	Cape Fear	Falcon
JONES-001	NC01105		Brock Millpond Dam	IMPOUNDING	High	Jones	35.06	-77.356	Crooked Run	Neuse	Trenton

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
CARTE-001	NC01106		Walker Millpond Dam	IMPOUNDING	High	Carteret	34.7876	-76.8012	Black Creek	White Oak	Morehead City
HARNE-057	NC01117		Cambro Lake Dam	IMPOUNDING	High	Harnett	35.294	-78.904	North Prong Anderson Creek	Cape Fear	Linden
CUMBE-029	NC01121		Hope Mills Dam #1	IMPOUNDING	High	Cumberland	34.97283	-78.94521	Little Rockfish Creek	Cape Fear	Hope Mills
CUMBE-038	NC01130		Glenville Lake Dam	IMPOUNDING	High	Cumberland	35.06913	-78.89680	Little Cross Creek	Cape Fear	Fayetteville
CUMBE-039	NC01131		Kornbow Lake Dam	IMPOUNDING	High	Cumberland	35.10173	-78.92884	Little Cross Creek	Cape Fear	Fayettevillle
CUMBE-040	NC01132		Mintz Lake Dam	IMPOUNDING	High	Cumberland	35.089	-78.924	Little Cross Creek	Cape Fear	Fayetteville
CUMBE-041	NC01133		Forrest Lake Dam	IMPOUNDING	High	Cumberland	35.04444	-78.90556	Branson Creek	Cape Fear	Fayetteville
CUMBE-051	NC01143		Beaver Creek Dam	IMPOUNDING	High	Cumberland	35.06	-78.98194	Beaver Creek	Cape Fear	Hope Mills
CUMBE-054	NC01146		Bonnie Doone Lake Dam	IMPOUNDING	High	Cumberland	35.10964	-78.94382	Little Cross Creek	Cape Fear	Fayetteville
CUMBE-061	NC01154		College Lake Dam	DRAINED	High	Cumberland	35.141	-78.892	Cape Fear River-Os	Cape Fear	Fayetteville
CUMBE-062	NC01169		Lewis Lake Dam	DRAINED	High	Cumberland	35.21889	-78.89056	Lower Little River-Os	Cape Fear	Linden
SAMPS-018	NC01181		Williams Lake Dam Upper	DRAINED	High	Sampson	34.9612	-78.4790	Little Coharie Creek-Tr	Cape Fear	Clear Run
COLUM-004	NC01195		Holtrachem Stormwater Waste Lagoon	IMPOUNDING	High	Columbus	34.35333	-78.20778	Cape Fear River	Cape Fear	Riegelwood
COLUM-005	NC01196		Lake Tabor Dam	IMPOUNDING	High	Columbus	34.15833	-78.85833	Grissett Swamp	Lumber	
JACKS-037	NC01198		Fairfield Lake Dam	IMPOUNDING	High	Jackson	35.12	-83.038	Trays Island Creek	Savannah	Sapphire
GASTO-003	NC01204		Shorts Lake Dam	IMPOUNDING	High	Gaston	35.21	-81.291	South Crowders Creek Trib	Catawba	Red River Sc
GASTO-004	NC01205		Arrowood Lake Dam	IMPOUNDING	High	Gaston	35.29694	-81.30001	Long Creek-Trib.	Catawba	Gastonia
GASTO-010	NC01211		Robinwood Lake Dam	IMPOUNDING	High	Gaston	35.2348	-81.1576	Anthony Creek	Catawba	Gastonia
MECKL-023	NC01217		Arrowood Quarry Dam	IMPOUNDING	High	Mecklenburg	35.0958	-80.9200	Mccullough Branch	Catawba	Pineville
POLK-002	NC01221		Melrose Mountain Dam #1	IMPOUNDING	High	Polk	35.20576	-82.29404	UT to Big Falls Creek (Trout)	Broad	Valhalla
CHERO-016	NC01222		Tanglewood Forest Dam Lower	IMPOUNDING	High	Cherokee	35.114	-84.024	Brittian Creek	Hiwassee	Murphy
JACKS-023	NC01225		Frady Cove Estates	IMPOUNDING	High	Jackson	35.3210	-83.2367	Blake Branch	Little Tennessee	Dillsboro
HENDE-003	NC01226		Feeney Dam	IMPOUNDING	High	Henderson	35.46256	-82.41043	Hoopers Creek	French Broad	Hoopers Creek
ALLEG-007	NC01227		High Meadows Lake Dam	IMPOUNDING	High	Alleghany	36.407	-80.997	Laurel Branch-Tr	New	Cherry Lane
WATAU-013	NC01228		Appalachian Ski Mountain Lake	IMPOUNDING	High	Watauga	36.17556	-81.66306	Payne Branch	New	Boone
CUMBE-007	NC01229		Clark Pond Dam	IMPOUNDING	High	Cumberland	35.085	-78.926	Cross Creek-Os	Cape Fear	Fayetteville
HAYWO-002	NC01230		Camp Daniel Boone Lake Dam	IMPOUNDING	High	Haywood	35.392	-82.897	Little East Fork Pigeon River	French Broad	Retreat
WAKE-175	NC01231		Northshore Lake Dam	IMPOUNDING	High	Wake	35.8369	-78.5878	Marsh Creek-Tr	Neuse	Raleigh
ALLEG-004	NC01237		Temple Lake Dam	IMPOUNDING	High	Alleghany	36.4467	-81.0965	Pine Swamp Creek-Tr	New	Sparta
BUNCO-052	NC01238		Camp Ridgecrest Lake Dam	IMPOUNDING	High	Buncombe	35.61743	-82.27599	Swannanoa River-Tr	French Broad	Black Mountain
CALDW-017	NC01239		Girl Scout Pond Dam	IMPOUNDING	High	Caldwell	35.9550	-81.3952	Ginger Creek-Tr	Catawba	Draco
AVERY-010	NC01243		Tynecastle	IMPOUNDING	High	Avery	36.12097	-81.83496	Watauga River	Watauga	Foscoe
AVERY-007	NC01245		Grandfather Mountain Club Lake Dam	IMPOUNDING	High	Avery	36.07253	-81.84506	Grandmother Creek	Catawba	Linville
BUNCO-007	NC01247		Black Mountain Reservoir Dam	IMPOUNDING	High	Buncombe	35.61078	-82.28731	Swannanoa River-Trib	French Broad	Black Mtn
BUNCO-048	NC01248	119	Lake Evens Dam	IMPOUNDING	High	Buncombe	35.5367	-82.3297	Upper Flat Creek-Tr	Broad	Bat Cave
BUNCO-033	NC01249		Freedom Lake	IMPOUNDING	High	Buncombe	35.59417	-82.63917	Hominy Creek-Tr	French Broad	Asheville
BUNCO-063	NC01250		Thrash Dam	IMPOUNDING	High	Buncombe	35.58	-82.689	Little Pole Creek	French Broad	Candler
BUNCO-067	NC01253		Woodfin Reservoir Dam	IMPOUNDING	High	Buncombe	35.7002	-82.4356	Sugar Camp Fork	French Broad	Beech Community
BUNCO-017	NC01254		Lake Craig Dam	Dry Detention	High	Buncombe	35.58184	-82.49328	Swannanoa River	French Broad	Asheville
CHERO-009	NC01256	10	Pied Piper Dam Lower	IMPOUNDING	High	Cherokee	35.02889	-84.19806	Persimmon Creek-Tr	Hiwassee	Hiawassee Village
CHERO-010	NC01257	13	Pied Piper Dam Upper	IMPOUNDING	High	Cherokee	35.03001	-84.19614	Persimmon Creek-Trib	Hiwassee	Hiawassee Village
CHERO-006	NC01259		Hideaway Mountain Lake Dam	IMPOUNDING	High	Cherokee	35.03534	-84.23514	Persimmon Creek-Tr	Hiwassee	Hothouse
CHERO-002	NC01260		Skomp Dam	IMPOUNDING	High	Cherokee	35.01302	-84.08935	Gold Branch	Hiwassee	Hiawassee Dam
CHERO-017	NC01263		Upper Tanglewood Dam	IMPOUNDING	High	Cherokee	35.11861	-84.02528	Valley River-Tr	Hiwassee	Murphy
GRAHA-004	NC01269	3	Phillips Dam	IMPOUNDING	High	Graham	35.31250	-83.79874	Tulula Creek-Trib	Little Tennessee	Robbinsville
HAYWO-004	NC01270		Waynesville Water Supply Dam	IMPOUNDING	High	Haywood	35.42522	-83.00931	Allen Creek	French Broad	Hazelwood
HAYWO-008	NC01271		Broyhill Baptist Children's Home Pond Dam	IMPOUNDING	High	Haywood	35.51537	-82.93561	Pigeon River-Tr	French Broad	Waynesville
ROWAN-024	NC01272	211	Lake Corriher Dam	IMPOUNDING	High	Rowan	35.565	-80.60861	Flat Rock Branch	Yadkin-PeeDee	China Grove

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
HENDE-008	NC01277		Blue Star Dam Upper	IMPOUNDING	High	Henderson	35.24327	-82.54486	Mud Creek	French Broad	Hendersonville
WAYNE-014	NC01278		Robin Lake Estates Dam A	IMPOUNDING	High	Wayne	35.28856	-78.00906	Carraway Creek-Tr	Neuse	Seven Springs
HENDE-013	NC01279		Forge Mountain Grist Mill Dam	IMPOUNDING	High	Henderson	35.3473	-82.6210	Turkey Creek-Tr	French Broad	Mills River
HENDE-022	NC01280		Sky Lake Estate Dam	IMPOUNDING	High	Henderson	35.32155	-82.51979	Shaw Creek-Tr	French Broad	Horse Shoe
WAYNE-015	NC01282		Sleepy Creek Lake Lower Dam	IMPOUNDING	High	Wayne	35.252	-77.959	Sleepy Creek	Neuse	Seven Springs
WAKE-089	NC01283		NCSU Centennial Campus Farm Pond Dam	IMPOUNDING	High	Wake	35.765	-78.672	Swift Creek-Tr	Neuse	Raleigh
HENDE-039	NC01284		Lake Sheila Dam	IMPOUNDING	High	Henderson	35.19170	-82.37239	Pacolet River-Tr	Broad	Melrose
HENDE-045	NC01285		Ball Lake Dam	IMPOUNDING	High	Henderson	35.3106	-82.3688	Trib to Hungry River	Broad	Mount Valley
BURKE-009	NC01288		Morganton Watershed Dam	IMPOUNDING	High	Burke	35.62278	-81.70444	Henry River	Catawba	Morganton
CALDW-010	NC01293		Clement Dam	DRAINED	High	Caldwell	35.91693	-81.46840	Cedar Creek	Catawba	Oak Hill
CALDW-024	NC01295		Old Mill Lake Dam	IMPOUNDING	High	Caldwell	35.80055	-81.41104	Gunpowder Creek	Catawba	Granite Falls
JACKS-003	NC01298		Hogback Dam	IMPOUNDING	High	Jackson	35.11659	-83.01391	Little Hogback Creek	Savannah	Sapphire
TRANS-058	NC01301		Intermont Dam	IMPOUNDING	High	Transylvania	35.10605	-83.00160	Burlingame Creek	Savannah	Lake Jocassee
JACKS-024	NC01302		Hodge Dam	IMPOUNDING	High	Jackson	35.3579	-83.1683	Locust Creek-Tr	Little Tennessee	Sylva
JACKS-032	NC01306		Laurel Lake Dam	IMPOUNDING	High	Jackson	35.11967	-83.08092	Horsepasture River-Tr	Savannah	Sapphire
JACKS-034	NC01307		McGuire Lake Dam	IMPOUNDING	High	Jackson	35.3426	-83.1467	Wayehutta Creek-Tr	Little Tennessee	Cullowhee
HENDE-034	NC01309		Echo Lake Dam	IMPOUNDING	High	Henderson	35.31453	-82.50306	Shaw Creek-Tr	French Broad	Horse Shoe
CATAW-022	NC01312		Lethcoe Dam	IMPOUNDING	High	Catawba	35.7239	-81.2208	Lyle Creek-Tr	Catawba	
CATAW-044	NC01319		Leatherman Lake Dam	IMPOUNDING	High	Catawba	35.5875	-81.36139	Pott Creek-Tr	Catawba	Lincolnton
CATAW-052	NC01321		Jones Lake Dam	IMPOUNDING	High	Catawba	35.58167	-81.07972	South Fork Creek-Tr	Catawba	Keisters Store
CATAW-054	NC01322		Marshall Active Ash Basin Dam	IMPOUNDING	High	Catawba	35.6060	-80.9602	Lake Norman	Catawba	Mount Holly
IREDE-035	NC01332		Wilson Godfrey Dam	IMPOUNDING	High	Iredell	35.96944	-80.95056	Tuckers Creek-Tr	Yadkin-PeeDee	
TRANS-015	NC01339		Line Runner Ridge Dam	IMPOUNDING	High	Transylvania	35.11558	-82.78968	Gerren Creek-Tr	French Broad	Rosman
IREDE-124	NC01340		Woods Drive Dam	IMPOUNDING	High	Iredell	35.80225	-80.88369	Fourth Creek-Tr	Yadkin-PeeDee	Statesville
ALEXA-011	NC01341		Moretz Lake Dam	IMPOUNDING	High	Alexander	35.846	-81.279	Middle Little River	Catawba	Falls
ALEXA-024	NC01342		Rink Lake Dam	IMPOUNDING	High	Alexander	35.83023	-81.26666	Little River	Catawba	Falls
MCDOW-007	NC01343		Muddy Creek Dam - Boy Scouts of America	IMPOUNDING	High	McDowell	35.59594	-81.86777	Muddy Creek	Catawba	Dysartsville
MADIS-004	NC01345		Mars Hill Water Supply Dam	IMPOUNDING	High	Madison	35.94214	-82.49465	Big Laurel Creek	French Broad	Faust
MADIS-005	NC01346		Chestnut Hill Dam	IMPOUNDING	High	Madison	35.80258	-82.63360	Long Branch	French Broad	Marshall
MITCH-007	NC01348		Spruce Pine Water Supply Dam #1	IMPOUNDING	High	Mitchell	35.95607	-82.06283	Beaver Creek	French Broad	Spruce Pine
SWAIN-003	NC01353		Bryson City Water Supply Dam	IMPOUNDING	High	Swain	35.46483	-83.46701	Lands Creek	Little Tennessee	Bryson City
MACON-024	NC01365		Watauga Vista Dam	IMPOUNDING	High	Macon	35.24892	-83.31114	Watauga Creek	Little Tennessee	Watauga
MACON-025	NC01366		Wildwood Mountain Dam	IMPOUNDING	High	Macon	35.091	-83.164	Big Creek	Little Tennessee	Highlands
TRANS-032	NC01370		Blue Ridge Hills	IMPOUNDING	High	Transylvania	35.15442	-82.90258	North Fork Flat Creek	French Broad	Rosman
TRANS-034	NC01373		Aerated Stabilization Basin	IMPOUNDING	High	Transylvania	35.25444	-82.69167	Stream Waste Lagoon-Os	French Broad	Penrose
TRANS-051	NC01374		Marchman Lake Dam	IMPOUNDING	High	Transylvania	35.17366	-82.70206	E Fork French Broad-Tr	French Broad	Dunns Rock
TRANS-043	NC01378		Arrowhead Lake Dam	IMPOUNDING	High	Transylvania	35.135	-82.686	Morgan Creek	French Broad	Sherwood Forest
WILSO-010	NC01379		Buckhorn Lake	IMPOUNDING	High	Wilson	35.691	-78.12	Contentnea Creek-Tr	Neuse	
MACON-031	NC01388		Lake Charles Dam	IMPOUNDING	High	Macon	35.0787	-83.3581	Tessentee Creek-Tr	Little Tennessee	Franklin
TRANS-039	NC01393		Eagle'S Nest	IMPOUNDING	High	Transylvania	35.12917	-82.66056	Clear Creek	French Broad	Cedar Mountain
DAVID-015	NC01395		Glossons Lake Dam #2	IMPOUNDING	High	Davidson	35.78748	-80.32080	North Potts Creek-Tr	Yadkin-PeeDee	Linwood
FORSY-025	NC01396		Haynes Estate Lake Dam #2	IMPOUNDING	High	Forsyth	36.009	-80.388	Johnson Creek-Tr	Yadkin-PeeDee	Clemmons
SURRY-003	NC01397		Klondike Farm Dam	IMPOUNDING	High	Surry	36.29555	-80.86566	Grassy Creek	Yadkin-PeeDee	Elkin
ASHE-011	NC01405		Fleetwood Falls Lake Dam	IMPOUNDING	High	Ashe	36.29944	-81.54472	South Fork New River-Tr	New	
LEE-012	NC01410		Holiday Lake Dam Upper	IMPOUNDING	High	Lee	35.495	-79.218	Patterson Creek	Cape Fear	Cumnock
DAVID-007	NC01420		Davis Lake Dam #1	IMPOUNDING	High	Davidson	35.9599	-80.0684	Payne Creek-Tr	Yadkin-PeeDee	Lexington
DAVIE-011	NC01424		Dutchmans Creek W/S Dam #6 (Pl-566)	IMPOUNDING	High	Davie	35.99	-80.597	Greasy Creek	Yadkin-PeeDee	High Rock
DAVIE-006	NC01425		Dutchmans Creek W/S Dam #5	IMPOUNDING	High	Davie	36.01334	-80.63175	Howard Branch	Yadkin-PeeDee	High Rock

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
DAVIE-007	NC01426		Dutchmans Creek W/S Dam #2	IMPOUNDING	High	Davie	36.0425	-80.65528	Steelman Creek	Yadkin-PeeDee	High Rock
ANSON-026	NC01439		Bonsal Tailings Dam	IMPOUNDING	High	Anson	34.94528	-79.9375	Island Creek-Tr	Yadkin-PeeDee	Morven, Nc
CALDW-016	NC01442		Fox Lake Dam	IMPOUNDING	High	Caldwell	35.88722	-81.67167	Celia Creek-Tr	Catawba	Gamewell
WAKE-127	NC01449		Crabtree Creek W/S #1 (PL-566)	IMPOUNDING	High	Wake	35.85941	-78.82525	Stirrup Iron Creek	Neuse	Raleigh
WAKE-223	NC01450		Crabtree Crk. W/S Structure #2	IMPOUNDING	High	Wake	35.817	-78.855	Crabtree Creek-Tr	Neuse	Davis Drive
WAKE-102	NC01451		Blackhawk Dam	IMPOUNDING	High	Wake	35.81274	-78.79031	Crabtree Creek-Tr	Neuse	Cary
WAKE-129	NC01452		Shelley Lake	IMPOUNDING	High	Wake	35.8564	-78.6609	Lead Mine Creek	Neuse	Raleigh (W.MillbrookRd.@Dam)
WAKE-130	NC01453		Crabtree Creek W/S Dam #18	IMPOUNDING	High	Wake	35.8	-78.829	Coles Creek	Neuse	Morrisville
WAKE-131	NC01454		Lake Lynn	IMPOUNDING	High	Wake	35.87261	-78.69704	Hare Snipe Creek	Neuse	Raleigh (Lynn Rd near dam)
WAKE-094	NC01456		Bentwinds Upper Dam	IMPOUNDING	High	Wake	35.6246	-78.7651	Terrible Creek-Tr	Neuse	Seven Springs
WAKE-161	NC01457		Camp Durant Lake Dam #2	IMPOUNDING	High	Wake	35.8921	-78.5774	Perry Creek-Tr	Neuse	Milburnie
WAKE-171	NC01461		Coachman Trail Lake Dam Lower	IMPOUNDING	High	Wake	35.943	-78.63	Cedar Creek	Neuse	Falls (CoachmanWay@Dam)
WILKE-021	NC01474		Miller Dam	IMPOUNDING	High	Wilkes	36.1843	-80.9088	East Swan Creek-Tr	Yadkin-PeeDee	Jonesville
YADKI-024	NC01482		Deep Creek W/S #6b (Pl-566)	IMPOUNDING	High	Yadkin	36.149	-80.762	South Deep Creek-Tr	Yadkin-PeeDee	High Rock
SURRY-015	NC01490		Doggett Reservoir	IMPOUNDING	High	Surry	36.49667	-80.65278	Stewarts Creek-Tr	Yadkin-PeeDee	White Plains
STOKE-014	NC01498		Little Yadkin River W/S Dam #12	IMPOUNDING	High	Stokes	36.362	-80.358	E Prong Little Yadkin Rvr-Tr	Yadkin-PeeDee	Pinnacle
STOKE-042	NC01508		Lilly Lake Dam	IMPOUNDING	High	Stokes	36.263	-80.413	Crooked Run Creek-Tr	Yadkin-PeeDee	Donnoha
JOHNS-034	NC01512		Gates Pond	IMPOUNDING	High	Johnston	35.4538	-78.4023	Holts Lake-Os to Falling Creek	Neuse	US-301
WATAU-016	NC01524		Asu/Norris Branch Dam	IMPOUNDING	High	Watauga	36.23849	-81.66990	Norris Branch	New	Boone
FORSY-024	NC01531		Haynes Estate Lake Dam #1	IMPOUNDING	High	Forsyth	36.004	-80.393	Johnson Creek-Tr	Yadkin-PeeDee	Clemmons
FORSY-149	NC01532		Fowler Lake Dam #2	IMPOUNDING	High	Forsyth	36.16028	-80.35611	Muddy Creek-Tr	Yadkin-PeeDee	Pfafftown
FORSY-150	NC01533		Fowler Lake Dam #1	IMPOUNDING	High	Forsyth	36.1581	-80.3574	Muddy Creek-Tr	Yadkin-PeeDee	Pfafftown
FORSY-158	NC01535		K & W Lake Dam	IMPOUNDING	High	Forsyth	36.17389	-80.33111	Muddy Creek-Tr	Yadkin-PeeDee	Winston-Salem
ORANG-027	NC01537		Lake Ellen Dam	IMPOUNDING	High	Orange	35.946	-79.053	Booker Creek	Cape Fear	Chapel Hill
FORSY-157	NC01539		Creeson Lake Dam	IMPOUNDING	High	Forsyth	36.16158	-80.25143	Leak Fork Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-122	NC01543		Beauchamp Lake Dam	IMPOUNDING	High	Forsyth	36.098	-80.374	Tomahawk Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-040	NC01544		Parker Lake Dam #2	IMPOUNDING	High	Forsyth	36.0790	-80.4100	Ellison Creek-Tr	Yadkin-PeeDee	Winston-Salem
ROWAN-047	NC01549		Buck Main Ash Basin Dam	IMPOUNDING	High	Rowan	35.7110	-80.3633	Yadkin River	Yadkin-PeeDee	High Rock
GRANV-019	NC01555		Nye Lake Dam #1	IMPOUNDING	High	Granville	36.201	-78.749	Knap Reeps Creek	Neuse	Falls
HARNE-060	NC01558	343	White Lake Dam	IMPOUNDING	High	Harnett	35.41	-78.832	Cape Fear River-Os	Cape Fear	Lillington
MOORE-112	NC01562		Seven Lakes Dam #2	IMPOUNDING	High	Moore	35.284	-79.558	Big Juniper Creek	Cape Fear	Lillington
MOORE-113	NC01563		Seven Lakes Dam #3	IMPOUNDING	High	Moore	35.2775	-79.55667	Big Juniper Creek-Tr	Cape Fear	Lillington
MOORE-114	NC01564		Seven Lakes Dam #4	IMPOUNDING	High	Moore	35.27861	-79.56806	Big Juniper Creek	Cape Fear	Lillington
MOORE-115	NC01565		Seven Lakes Dam #5	IMPOUNDING	High	Moore	35.27556	-79.56167	Big Juniper Creek	Cape Fear	Lillington
TRANS-061	NC01568		Siniard Lake Dam Lower	IMPOUNDING	High	Transylvania	35.256	-82.741	Long Branch	French Broad	Brevard
WATAU-019	NC01569		Rosasco Lake Dam Upper	IMPOUNDING	High	Watauga	36.22049	-81.77603	Bairds Cr.-Tr	Watauga	Elizabethton Tn
SURRY-002	NC01571		Cedar Brook Lake Dam	DRAINED	High	Surry	36.306	-80.854	Camp Creek	Yadkin-PeeDee	Elkin Valley
MOORE-111	NC01573		Seven Lakes Dam #1	IMPOUNDING	High	Moore	35.2786	-79.5743	Big Juniper Creek	Cape Fear	Lillington
FORSY-147	NC01579		Gambill Lake Dam Middle	IMPOUNDING	High	Forsyth	36.156	-80.366	Bill Branch-Tr	Yadkin-PeeDee	Pfafftown
ROCKI-027	NC01599		Troublesome Creek Dam	IMPOUNDING	High	Rockingham	36.2827	-79.6614	Troublesome Creek	Cape Fear	Altamahaw
ROCKI-020	NC01604		Eden Presettling Impoundment Dam	IMPOUNDING	High	Rockingham	36.478	-79.744	Dan River-Tr	Roanoke	Eden
MACON-017	NC01614		Burningtown Lake Dam	IMPOUNDING	High	Macon	35.2418	-83.4854	Daves Creek	Little Tennessee	Stiles
IREDE-031	NC01617		Mathis Lake Dam	IMPOUNDING	High	Iredell	36.0425	-80.97833	Brushy Creek	Yadkin-PeeDee	Statesville
IREDE-090	NC01622		Brookdale Lake Dam	IMPOUNDING	High	Iredell	35.8015	-80.8757	Fourth Creek-Tr	Yadkin-PeeDee	Statesville
WAKE-212	NC01627		Longview Lake Dam Lower	IMPOUNDING	High	Wake	35.7858	-78.5942	Crabtree Creek-Tr	Neuse	Raleigh
STANL-031	NC01631		Reservoir Lake Dam	IMPOUNDING	High	Stanly	35.39917	-80.19833	None	Yadkin-PeeDee	Albemarle
WAKE-132	NC01633		Springdale Estates Lower Dam	IMPOUNDING	High	Wake	35.8959	-78.7114	Hare Snipe Creek	Neuse	Raleigh
GUILF-045	NC01644		Ski Lake Dam	IMPOUNDING	High	Guilford	36.154	-79.89	Brush Creek-Tr	Cape Fear	Ossipee
FORSY-035	NC01647	8	Lake Falmouth Dam	IMPOUNDING	High	Forsyth	36.07034	-80.43362	Ellison Creek-Tr	Yadkin-PeeDee	High Rock

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
WAKE-189	NC01656		Myrick Lake Dam	IMPOUNDING	High	Wake	35.783	-78.485	Poplar Creek	Neuse	Knightdale
FORSY-144	NC01658		Young Lake Dam #2	IMPOUNDING	High	Forsyth	36.147	-80.324	Mill Creek-Tr	Yadkin-PeeDee	Winston-Salem
CABAR-026	NC01663		Furr Lake Dam #1	IMPOUNDING	High	Cabarrus	35.338	-80.464	Dutch Buffalo Creek-Tr	Yadkin-PeeDee	Mt. Pleasant
WAKE-199	NC01664		Stonebridge Lake Dam	IMPOUNDING	High	Wake	35.918	-78.67	Barton Creek-Tr	Neuse	Falls
WAKE-214	NC01665		Springdale Estates Upper Dam	IMPOUNDING	High	Wake	35.897	-78.718	Haresnipe Creek-Tr	Neuse	Raleigh
DURHA-105	NC01666		Discovery Lake Dam	IMPOUNDING	High	Durham	35.88564	-78.87611	Burdens Creek-Tr	Cape Fear	Haywood
GASTO-016	NC01668		Allen Inactive Ash Basin Dam	DRAINED	High	Gaston	35.1842	-81.0063	Catawba River-Os	Catawba	Red River
GASTO-061	NC01669		Allen Active Ash Basin Dam	IMPOUNDING	High	Gaston	35.1741	-81.0076	Catawba River-Os	Catawba	Red River
GASTO-023	NC01674		Paradise Point Dam	IMPOUNDING	High	Gaston	35.185	-81.05	South Fork River-Tr	Catawba	Red River
GASTO-029	NC01676		Gaston Country Club Lake Dam	IMPOUNDING	High	Gaston	35.208	-81.147	Catawba Creek-Tr	Catawba	Gastonia
GASTO-048	NC01681		Sparrow Springs Lake Dam	IMPOUNDING	High	Gaston	35.188	-81.291	South Crowders Creek Trib	Catawba	Red River
MECKL-027	NC01691	129	Forest Lake Dam	IMPOUNDING	High	Mecklenburg	35.205	-80.719	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-028	NC01692		Delta Lake Dam	IMPOUNDING	High	Mecklenburg	35.249	-80.731	Reedy Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-047	NC01696		Sharon Lake Upper Dam	IMPOUNDING	High	Mecklenburg	35.123	-80.875	Little Sugar Creek-Tr	Catawba	Charlotte
IREDE-021	NC01698		Martin Dam	IMPOUNDING	High	Iredell	35.86194	-80.85417	Fifth Creek-Tr	Yadkin-PeeDee	Cool Springs
BUNCO-043	NC01707		Morgan Pond Dam	IMPOUNDING	High	Buncombe	35.521	-82.391	Ashworth Creek-Tr	French Broad	Fairview
GUILF-139	NC01709		Pilot Life Dam	IMPOUNDING	High	Guilford	36.021	-79.887	Reddicks Creek-Tr	Cape Fear	Randleman
WAKE-215	NC01711		North Ridge Lake Dam Upper	IMPOUNDING	High	Wake	35.883	-78.613	Perry Creek	Neuse	Raleigh
WAKE-216	NC01712		North Ridge Lake Dam Lower	IMPOUNDING	High	Wake	35.877	-78.602	Perry Creek	Neuse	Raleigh
GUILF-153	NC01715		Owens Dam	IMPOUNDING	High	Guilford	35.983	-79.961	Deep River-Tr	Cape Fear	High Point
SWAIN-010	NC01716		Cheoah Valley Dam	IMPOUNDING	High	Swain	35.46171	-83.92381	Alken Branch	Little Tennessee	Chilhowee
WAKE-222	NC01719		Fuller Lake Dam	IMPOUNDING	High	Wake	35.89001	-78.65211	Lead Mine Creek-Tr	Neuse	Sawmill Road
WAKE-219	NC01720		Crabtree Creek W/S Structure #11a	IMPOUNDING	High	Wake	35.829	-78.726	Richland Creek	Neuse	Raleigh-EbenezerChRd (.78 mi)
ALAMA-032	NC01734		McEwen Estate Dam	IMPOUNDING	High	Alamance	36.07283	-79.53376	Back Creek	Cape Fear	Alamance
ALAMA-035	NC01737		Tate Dam	IMPOUNDING	High	Alamance	36.0969	-79.4657	Little Alamance Creek-Tr	Cape Fear	Burlington
ALEXA-009	NC01791		Cy Purser Pond Dam	IMPOUNDING	High	Alexander	35.93444	-81.2675	Beaver Branch-Tr	Catawba	Liledoun
ALEXA-034	NC01808		McCurdy Dam	IMPOUNDING	High	Alexander	35.98865	-81.10636	Big Branch-Tr	Yadkin-PeeDee	Cooleemee
ALEXA-035	NC01809		Bowman Dam	IMPOUNDING	High	Alexander	35.83306	-81.26	Middle Little River-Tr	Catawba	
ANSON-043	NC01838		Bv Hedrick Tailings Dike #3	IMPOUNDING	High	Anson	34.93972	-79.92917	Island Creek-Tr	Yadkin-PeeDee	Lilesville
ASHE-003	NC01841		Gimlin Dam	IMPOUNDING	High	Ashe	36.28652	-81.37552	Obids Creek	New	Obids
ASHE-005	NC01842		Long Hope Club Dam	IMPOUNDING	High	Ashe	36.405	-81.623	Long Hope Creek	New	Creston
ASHE-006	NC01843		Flat Rock Pond Dam	IMPOUNDING	High	Ashe	36.455	-81.418	Headwaters Dog Creek	New	Index
ASHE-007	NC01844		Indian Lake Dam	IMPOUNDING	High	Ashe	36.33972	-81.52667	old Fields Creek-Tr	New	
AVERY-009	NC01852		Brushy Creek Dam #8	IMPOUNDING	High	Avery	35.93918	-81.99555	Off Stream of North Toe River	French Broad	Spruce Pine
AVERY-011	NC01853		Johnson Dam	IMPOUNDING	High	Avery	36.0754	-81.9774	Ashely Creek	French Broad	Spear
AVERY-015	NC01856		Weber Pond Dam	IMPOUNDING	High	Avery	36.06472	-81.89246	Linville River-Tr	Catawba	Linville
AVERY-019	NC01859		Sugar Mtn Dam	IMPOUNDING	High	Avery	36.13032	-81.85480	Flattop Creek	Watauga	Banner Elk
AVERY-021	NC01860		Linville Ridge Dam	IMPOUNDING	High	Avery	36.10270	-81.86753	West Fork Linville River	Catawba	Linville
AVERY-027	NC01866		Triangle Dam	DRAINED	High	Avery	36.14906	-81.93694	Curtis Creek	Watauga	Heaton
AVERY-031	NC01870		Weatherman Dam	IMPOUNDING	High	Avery	35.9585	-82.0055	North Toe River-Trib	French Broad	Spruce Pine
BEAUF-006	NC01876		PCS Phosphate R1 & R2 Blend Dike	IMPOUNDING	High	Beaufort	35.3632	-76.7948	Pamlico	Tar-Pamlico	Pamlico
BUNCO-011	NC01887		Busbee Reservoir Dam	IMPOUNDING	High	Buncombe	35.5434	-82.5088	Tributary to Sweeten Creek	French Broad	Biltmore
BUNCO-012	NC01888		Capps Pond Dam	IMPOUNDING	High	Buncombe	35.44682	-82.50149	Pinner Creek-Trib	French Broad	Fletcher
BUNCO-018	NC01893		Crowfields Dam	IMPOUNDING	High	Buncombe	35.50443	-82.52975	Dingle Creek-Trib	French Broad	Asheville
BUNCO-032	NC01904		Holcombe Dam	IMPOUNDING	High	Buncombe	35.7525	-82.5500	Flat Creek-Tr	French Broad	Marshall
BUNCO-034	NC01905		Jewell Acres Dam	IMPOUNDING	High	Buncombe	35.635	-82.479	Bull Branch-Tr	French Broad	Riceville
BUNCO-035	NC01906	17	Lake Charles Dam	IMPOUNDING	High	Buncombe	35.47834	-82.25362	Grassy Creek	Broad	Bat Cave
BUNCO-037	NC01907		Caldwell Pond Dam	IMPOUNDING	High	Buncombe	35.5513	-82.6911	Unnamed trib to Pole Creek	French Broad	Candler
BUNCO-039	NC01909		Camp Merrimac Dam	IMPOUNDING	High	Buncombe	35.63556	-82.31806	Swannanoa River-Tr	French Broad	Black Mtn

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
BUNCO-041	NC01911		Moore's Dam	IMPOUNDING	High	Buncombe	35.54047	-82.41252	Cane Creek-Tr	French Broad	Fairview
BUNCO-054	NC01918		Ross Creek Dam	Dry Detention	High	Buncombe	35.596	-82.531	Ross Creek	French Broad	Asheville
BUNCO-057	NC01921		Smith Dam	DRAINED	High	Buncombe	35.61226	-82.66120	Dix Creek	French Broad	Juno
BUNCO-061	NC01923		Lake Susan Dam	IMPOUNDING	High	Buncombe	35.64694	-82.29877	Flat Creek	French Broad	Black Mountain
BUNCO-068	NC01927		Woodland Hills Dam	IMPOUNDING	High	Buncombe	35.67972	-82.58917	Reems Creek-Tr	French Broad	Alexander
BUNCO-072	NC01930		Schmidt Pond Dam	IMPOUNDING	High	Buncombe	35.45986	-82.57884	Avery Cr-Tr	French Broad	Asheville
BUNCO-078	NC01936		Roddy Dam	IMPOUNDING	High	Buncombe	35.6984	-82.5901	Reems Creek-Tr	French Broad	Alexander
BURKE-011	NC01940		Maple Lane Fish Pond Dam	IMPOUNDING	High	Burke	35.72394	-81.46270	UT to Drowning Creek (WS-IV)	Catawba	Hickory
BURKE-012	NC01941		Barus Dam	DRAINED	High	Burke	35.72111	-81.56667	Double Branch	Catawba	Valdese
BURKE-026	NC01952		Coffey Pond Dam	DRAINED	High	Burke	35.67489	-81.73183	Bailey Branch-Tr	Catawba	
CABAR-012	NC01962		Propst Pond Dam	IMPOUNDING	High	Cabarrus	35.41083	-80.73667	Rocky River-Os	Yadkin-PeeDee	Harrisburg
CABAR-032	NC01976		Elmoe Pond Dam	IMPOUNDING	High	Cabarrus	35.4172	-80.6606	Coddle Creek-Os	Yadkin-PeeDee	Roberta Mill
CABAR-033	NC01977		Cabarrus Country Club Lake Dam	IMPOUNDING	High	Cabarrus	35.3969	-80.6252	Wolf Meadow Branch	Yadkin-PeeDee	Roberta Mill
CABAR-050	NC01993		Black Run Creek Dam	IMPOUNDING	High	Cabarrus	35.44083	-80.4375	Black Run Creek	Yadkin-PeeDee	Mt Pleasant
CALDW-007	NC02000		Benfield Dam	IMPOUNDING	High	Caldwell	35.88629	-81.49092	Angley Creek-Os	Catawba	
CALDW-019	NC02009		Green Mtn Camp Dam Lower	IMPOUNDING	High	Caldwell	35.965	-81.516	Fork Creek-Tr	Catawba	
CASWE-010	NC02018		Yanceyville Water Supply Dam	IMPOUNDING	High	Caswell	36.392	-79.35	Country Line Creek-Tr	Roanoke	
CASWE-012	NC02020		Lunsford Dam	IMPOUNDING	High	Caswell	36.34306	-79.50972	Hostler Br-Tr	Roanoke	
CATAW-012	NC02022		Catawba Springs Golf Dam Lower	IMPOUNDING	High	Catawba	35.79528	-81.24833	Lake Hickory-Tr	Catawba	Taylorsville Beach
CHATH-027	NC02066		Red Bud Dam	IMPOUNDING	High	Chatham	35.7547	-79.1186	Haw River-Tr	Cape Fear	N/A
CHATH-029	NC02067		Wendy Hill Dam	IMPOUNDING	High	Chatham	35.79822	-78.95457	Lick Branch	Cape Fear	N/A
CHATH-060	NC02094		Governors Club Dam #3	IMPOUNDING	High	Chatham	35.8363	-79.0311	Cub Creek-Tr	Cape Fear	
CHATH-061	NC02095		Governors Club Dam #4	IMPOUNDING	High	Chatham	35.84	-79.04556	Cub Creek-Tr	Cape Fear	
CHATH-062	NC02096		Governors Club Dam #1	IMPOUNDING	High	Chatham	35.8475	-79.03667	Cub Creek-Tr	Cape Fear	
CHERO-018	NC02104		Andrews Water Supply Dam	IMPOUNDING	High	Cherokee	35.218	-83.843	Dan Holland Creek	Hiwassee	Andrews
CLEVE-015	NC02113		Maples Fishing Pond Dam	IMPOUNDING	High	Cleveland	35.224	-81.398	Beason Creek-Tr	Broad	Earl Station
CUMBE-021	NC02130		The Lakes Dam	IMPOUNDING	High	Cumberland	35.074	-78.98	Beaver Creek-Os	Cape Fear	Pine Knoll
CUMBE-024	NC02136		Tallywood Dam	IMPOUNDING	High	Cumberland	35.051	-78.931	Branson Creek Trib.	Cape Fear	Fayetteville
CUMBE-066	NC02140		Edens Lake	IMPOUNDING	High	Cumberland	35.076	-78.984	Beaver Creek-Os	Cape Fear	Fayetteville
CUMBE-067	NC02141		Aaran Lakes West Dam	IMPOUNDING	High	Cumberland	35.00993	-78.98761	Beaver Creek-Os	Cape Fear	Hopemills
CUMBE-073	NC02147		Harris Dam	IMPOUNDING	High	Cumberland	35.076	-78.977	Beaver Creek-Os	Cape Fear	Fayetteville
CUMBE-074	NC02148		Summertime Dam	IMPOUNDING	High	Cumberland	35.06667	-78.93667	Hybarts Branch-Tr	Cape Fear	Fayetteville
CUMBE-075	NC02149		Evans Dam	IMPOUNDING	High	Cumberland	35.068	-78.933	Hybarts Branch	Cape Fear	Fayetteville
CUMBE-076	NC02150		North Lake Dam	IMPOUNDING	High	Cumberland	35.1210	-78.8730	Cape Fear River-Tr	Cape Fear	Fayetteville
CUMBE-077	NC02151	162	Mirror Lake Dam	IMPOUNDING	High	Cumberland	35.05444	-78.92222	Hybart'S Branch	Cape Fear	Fayetteville
CUMBE-080	NC02154		Lake Clair Dam	IMPOUNDING	High	Cumberland	35.0370	-78.9132	Blounts Creek-Tr	Cape Fear	Fayetteville
CUMBE-081	NC02155		Pritchard Dam	IMPOUNDING	High	Cumberland	35.085	-78.94	Little Cross Creek-Tr	Cape Fear	Fayetteville
CUMBE-082	NC02156		Civitan Lake Dam	IMPOUNDING	High	Cumberland	35.0969	-78.8826	Cross Creek-Tr	Cape Fear	Fayetteville
CUMBE-087	NC02161		Charles Smith Dam	IMPOUNDING	High	Cumberland	35.121	-78.875	Cape Fear River-Tr	Cape Fear	Fayetteville
DAVID-042	NC02190		Johnson Dam	IMPOUNDING	High	Davidson	35.96863	-80.06650	Rich Fork Creek-Tr	Yadkin-PeeDee	Lexington
DAVIE-054	NC02250		Lake Myers Family Campground Dam	IMPOUNDING	High	Davie	35.922	-80.656	Beaver Creek-Tr	Yadkin-PeeDee	Cooleemee
DAVIE-057	NC02253		Dutchman Creek W/S Dam #17	IMPOUNDING	High	Davie	36.01944	-80.65389	Dutchman Creek	Yadkin-PeeDee	High Rock?
DUPLI-020	NC02262		Scott Pond Dam	IMPOUNDING	High	Duplin	35.0794	-77.90778	Goshen Swamp	Cape Fear	
DURHA-044	NC02270		Dairy Pond Dam	IMPOUNDING	High	Durham	36.04254	-78.94679	Eno River-Tr	Neuse	Durham
DURHA-104	NC02317		Stone Throw Apartments Pond Dam	IMPOUNDING	High	Durham	35.892	-78.883	Burdens Creek-Tr	Cape Fear	
DURHA-114	NC02323		Grove Park Dam	IMPOUNDING	High	Durham	35.9758	-78.8129	unnamed trib. to Little Lick C	Neuse	
DURHA-118	NC02324		Oxford Commons Dam	IMPOUNDING	High	Durham	36.0418	-78.8925	Eno River-Tr	Neuse	William Penn Plaza Rd
FORSY-004	NC02352		Shelton Lake Dam	IMPOUNDING	High	Forsyth	36.136	-80.381	Muddy Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-026	NC02368		Lea Lake Dam	IMPOUNDING	High	Forsyth	36.02	-80.396	Johnson Creek-Tr	Yadkin-PeeDee	Clemmons

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
FORSY-028	NC02370		Reynolds Lake Dam #1	IMPOUNDING	High	Forsyth	36.0321	-80.3919	Johnson Creek-Tr	Yadkin-PeeDee	Clemmons
FORSY-050	NC02383		Shallowford Lakes Dam #2	IMPOUNDING	High	Forsyth	36.112	-80.417	Mill Creek-Tr	Yadkin-PeeDee	West Bend
FORSY-077	NC02402		Hauser Lake Dam	IMPOUNDING	High	Forsyth	36.102	-80.109	Smith Creek-Tr	Yadkin-PeeDee	Guthrie
FORSY-105	NC02424		Sabrina Lake Dam	DRAINED	High	Forsyth	36.012	-80.287	South Fork Muddy Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-111	NC02428		Janita Lake Dam Upper	IMPOUNDING	High	Forsyth	36.035	-80.28972	Salem Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-117	NC02433		Haynes Lake Dam	IMPOUNDING	High	Forsyth	36.10933	-80.33166	Muddy Creek-Tr	Yadkin-PeeDee	High Rock
FORSY-118	NC02434		Whitaker Lake Dam	IMPOUNDING	High	Forsyth	36.115	-80.304	Silas Creek-Tr	Yadkin-PeeDee	Winston-Salem
FORSY-120	NC02436	94	Brookberry Farm Lake Dam West	IMPOUNDING	High	Forsyth	36.109	-80.373	Tomahawk Creek	Yadkin-PeeDee	Winston-Salem
FORSY-165	NC02457	265	Woodview Lake Dam-Lower	IMPOUNDING	High	Forsyth	36.191	-80.347	Mill Creek #3-Tr	Yadkin-PeeDee	Bethania
FORSY-177	NC02466	33	Wall Lake Dam	IMPOUNDING	High	Forsyth	36.241	-80.305	Beaver Dam Creek	Yadkin-PeeDee	Rural Hall
FORSY-181	NC02468		Gambill Pond Dam Lower	IMPOUNDING	High	Forsyth	36.15306	-80.36472	Bill Branch-Tr	Yadkin-PeeDee	Pfafftown
FORSY-183	NC02469	2	Mallard Lake Dam Upper	IMPOUNDING	High	Forsyth	36.188	-80.322	Muddy Ck-Tr	Yadkin-PeeDee	
FRANK-109	NC02571		Lowery Dam	IMPOUNDING	High	Franklin	36.0267	-78.5334	Horse Creek-Tr	Neuse	Holden Road
FRANK-131	NC02589		Lambert Dam	IMPOUNDING	High	Franklin	35.9017	-78.2317	Press Prong Creek-Tr	Neuse	Daddysville
FRANK-137	NC02595		Cone Pond Dam	IMPOUNDING	High	Franklin	35.9068	-78.2628	Norris Creek-Tr	Tar-Pamlico	Spring Hope
GASTO-036	NC02610		Leigh Lake Dam	IMPOUNDING	High	Gaston	35.21171	-81.1549	Catawba Creek-Tr	Catawba	Gastonia
GASTO-046	NC02617		Johnny Long Pond Dam	IMPOUNDING	High	Gaston	35.22765	-81.25201	Crowders Creek -Trib	Catawba	
GASTO-062	NC02626		Cox Dam	IMPOUNDING	High	Gaston	35.369	-81.018	Dutchmans Creek-Tr	Catawba	Lucia
GASTO-063	NC02627		Pharr Yarns Dam	IMPOUNDING	High	Gaston	35.30506	-81.10778	South Fork Catawba River-Tr	Catawba	Spencer Mountain
GASTO-066	NC02629		Ben Webber Lake Dam	IMPOUNDING	High	Gaston	35.30116	-81.32527	Long Creek-Tr	Catawba	Bessemer City
GASTO-068	NC02631		Warren Dam	IMPOUNDING	High	Gaston	35.34242	-81.08517	South Stanly Creek - Trib.	Catawba	
GASTO-071	NC02634		Bessemer City Water Treat. Res. Dam	IMPOUNDING	High	Gaston	35.28887	-81.29705	Long Creek-Tr	Catawba	
GASTO-074	NC02637		Lake Sparta	IMPOUNDING	High	Gaston	35.23537	-81.26506	Crowders Creek-Tr	Catawba	
GASTO-078	NC02641		Lithco Mine Tailings Dam F	IMPOUNDING	High	Gaston	35.3383	-81.2984	Long Creek	Catawba	Bessemer City
GRAHA-003	NC02645		Tobacco Branch Dam	IMPOUNDING	High	Graham	35.38671	-83.63561	Tobacco Branch	Little Tennessee	Bryson City
GRAHA-008	NC02648		Robert Mosely Dam	IMPOUNDING	High	Graham	35.35222	-83.84174	Cheoah River-Trib	Little Tennessee	Tapoco
GRAHA-009	NC02649		Mission Ready Dam	IMPOUNDING	High	Graham	35.25535	-83.88242	Flat Branch	Little Tennessee	
GRANV-036	NC02670		Noblin Dam	IMPOUNDING	High	Granville	36.295	-78.59	Fishing Creek-Tr	Tar-Pamlico	Oxford
GUILF-008	NC02752		Barker-Frazier Excv Inc Dam	IMPOUNDING	High	Guilford	36.16884	-80.01320	Haw River-Tr	Cape Fear	Summerfield
GUILF-010	NC02753		Odom Dam	IMPOUNDING	High	Guilford	36.169	-80.01	Haw River-Tr	Cape Fear	Summerfield
GUILF-015	NC02755		Smith Dam	IMPOUNDING	High	Guilford	36.038	-80.007	West Fork Deep River-Tr	Cape Fear	High Point
GUILF-016	NC02756		Hutton Dam	IMPOUNDING	High	Guilford	36.027	-80.032	Hiatt Branch-Tr to Oak Hollow	Cape Fear	High Point
GUILF-017	NC02757	13	Church Of God Of Prophecy Dam	IMPOUNDING	High	Guilford	36.021	-80.008	Hiatt Branch-Tr	Cape Fear	High Point
GUILF-033	NC02767		Ridgewood Farm Dam	IMPOUNDING	High	Guilford	36.149	-79.997	Beaver Creek-Tr	Cape Fear	Ossippee
GUILF-115	NC02779		Sparger Lake Dam	IMPOUNDING	High	Guilford	36.1257	-79.8240	Richland Creek-Tr	Cape Fear	Greensboro
GUILF-131	NC02788		Lower Colonial Dam	IMPOUNDING	High	Guilford	36.0668	-79.9389	East Fork Deep River-Tr	Cape Fear	Greensboro
GUILF-147	NC02801		Piedmont Centre Dam	IMPOUNDING	High	Guilford	36.05639	-79.9425	East Fork Deep River-Tr	Cape Fear	High Point
GUILF-148	NC02802		Jamesford Meadows Dam	IMPOUNDING	High	Guilford	36.03306	-79.93444	Long Branch-Tr	Cape Fear	Jamestown
GUILF-149	NC02803		Deep River Pointe-Lower Dam	IMPOUNDING	High	Guilford	36.03611	-79.96694	East Fork Deep River-Tr	Cape Fear	High Point
GUILF-154	NC02807		Welborn Dam	IMPOUNDING	High	Guilford	35.919	-79.93	Muddy Creek-Tr	Cape Fear	Randleman
GUILF-166	NC02819		Roth Dam	IMPOUNDING	High	Guilford	35.976	-79.843	Hickory Creek-Tr	Cape Fear	Randleman
GUILF-168	NC02821		Gibson Dam	IMPOUNDING	High	Guilford	35.973	-79.785	Polecat Creek-Tr	Cape Fear	Randleman
GUILF-178	NC02831		Guilford Technical Institute Dam	IMPOUNDING	High	Guilford	35.9989	-79.8991	Bull Run Creek-Tr	Cape Fear	Jamestown
GUILF-180	NC02833		Lakeview Farm Dam	IMPOUNDING	High	Guilford	36.0090	-79.8634	Hickory Creek-Tr	Cape Fear	Greensboro
GUILF-183	NC02836		Pine Lake Dam	IMPOUNDING	High	Guilford	36.02417	-79.84278	South Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-186	NC02838		Northline Corporation Dam	IMPOUNDING	High	Guilford	36.0892	-79.8355	North Buffalo Creek-Tr	Cape Fear	Greensboro
GUILF-187	NC02839		Price Dam	IMPOUNDING	High	Guilford	36.1145	-79.8623	Horsepen Creek-Tr	Cape Fear	Greensboro
GUILF-188	NC02840		Lake Windemere Dam	IMPOUNDING	High	Guilford	36.126	-79.85	Horsepen Creek-Tr	Cape Fear	Greensboro
GUILF-190	NC02842		Mallard Lake Dam	IMPOUNDING	High	Guilford	36.139	-79.829	Richland Creek-Tr	Cape Fear	

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
GUILF-191	NC02843		Cathedral of His Glory Dam	IMPOUNDING	High	Guilford	36.136	-79.827	Richland Creek-Tr	Cape Fear	
GUILF-206	NC02858		Green Dam	IMPOUNDING	High	Guilford	36.2093	-79.6960	Reedy Fork Creek-Tr	Cape Fear	
GUILF-209	NC02861		Lakota Farm Dam	IMPOUNDING	High	Guilford	36.1446	-79.6617	North Buffalo Creek-Tr	Cape Fear	Mcleansville
GUILF-231	NC02882		Lynco Dam	IMPOUNDING	High	Guilford	36.005	-79.729	Little Alamance Creek-Tr	Cape Fear	Troxlers Mill
GUILF-232	NC02883		Foster Sikes Dam	IMPOUNDING	High	Guilford	35.965	-79.714	Big Alamance Creek-Tr	Cape Fear	Alamance
GUILF-236	NC02887		Hagan Stone Park Dam	IMPOUNDING	High	Guilford	35.95	-79.733	Big Alamance Creek-Tr	Cape Fear	
GUILF-251	NC02902		John Painter Dam	IMPOUNDING	High	Guilford	36.092	-79.62	Rock Creek-Tr	Cape Fear	
GUILF-276	NC02927		Knight Dam	IMPOUNDING	High	Guilford	36.20278	-79.82722	Long Branch-Tr	Cape Fear	Greensboro
GUILF-280	NC02931		Old Deep River Golf Course Dam	IMPOUNDING	High	Guilford	36.07889	-79.96611	East Fork Deep River-Tr	Cape Fear	Greensboro
HARNE-006	NC02949		Olde Farm Lake Dam	DRAINED	High	Harnett	35.292	-78.99	Anderson Creek	Cape Fear	
HARNE-008	NC02951		Watkins Pond Dam	IMPOUNDING	High	Harnett	35.486	-78.67	Black River-Os	Cape Fear	Coats
HARNE-030	NC02973		Harnett Metals Dam	DRAINED	High	Harnett	35.221	-78.945	Jumping Creek-Tr	Cape Fear	Spring Lake
HARNE-042	NC02974	15	Blanchard Dam #4	IMPOUNDING	High	Harnett	35.32262	-79.04242	Barbecue Creek-Tr	Cape Fear	Erwin
HARNE-064	NC02978		Silver Lake Dam	IMPOUNDING	High	Harnett	35.28167	-79.05	Oak Branch	Cape Fear	
HARNE-065	NC02979		Crystal Lake Dam	IMPOUNDING	High	Harnett	35.28639	-79.04806	Little Bridge Creek	Cape Fear	Spring Lake
HARNE-074	NC02988		Carolina Lakes Dam #1	IMPOUNDING	High	Harnett	35.2812	-79.0330	Reedys Creek-Tr	Cape Fear	
HARNE-075	NC02989		Carolina Lakes Dam #2	IMPOUNDING	High	Harnett	35.2795	-79.0262	Reedys Creek-Tr	Cape Fear	
HARNE-078	NC02992		Honeycutt Dam Lower	IMPOUNDING	High	Harnett	35.514	-78.749	Black River-Os	Cape Fear	Angier
HAYWO-011	NC02998		Hardin Dam	IMPOUNDING	High	Haywood	35.44238	-82.83031	Burnett Creek-Tr	French Broad	Bethel
HAYWO-012	NC02999		Cataloochee Ski Slope Dam	IMPOUNDING	High	Haywood	35.5622	-83.0931	Hemphill Creek-Tr	French Broad	Maggie Valley
HAYWO-013	NC03000		Boland Pond Dam	IMPOUNDING	High	Haywood	35.534	-83.107	Fie Branch-Tr	French Broad	Maggie Valley
HAYWO-014	NC03001		Cataloochee Ranch Dam	IMPOUNDING	High	Haywood	35.54722	-83.09111	Evans Creek-Tr	French Broad	Maggie Valley
HAYWO-015	NC03002		Lake Jane Dam	IMPOUNDING	High	Haywood	35.49097	-82.86004	Coffee Branch-Trib	French Broad	Canton
HENDE-007	NC03005		Blue Ridge Communtiy College Dam	IMPOUNDING	High	Henderson	35.30623	-82.42491	Bat Fork Creek	French Broad	Hendersonville
HENDE-032	NC03011		Jordan Mill Pond Dam	IMPOUNDING	High	Henderson	35.27211	-82.43561	Mud Creek-Tr	French Broad	Flat Rock
HENDE-035	NC03013		Meditation Lake Dam	IMPOUNDING	High	Henderson	35.33079	-82.42942	Mud Creek-Tr	French Broad	Hendersonville
HENDE-040	NC03016		Camp Pinewood Lake Dam	IMPOUNDING	High	Henderson	35.33327	-82.43812	Devils Cradle Creek-Tr	French Broad	Hendersonville
HENDE-042	NC03018		Rainbow Spring Lake Dam	IMPOUNDING	High	Henderson	35.31575	-82.48830	Mud Creek-Tr	French Broad	Hendersonville
HENDE-048	NC03022		Sizemore Dam	DRAINED	High	Henderson	35.40198	-82.50640	Mud Creek-Tr	French Broad	Naples
HENDE-051	NC03025		Camp Judaea Dam	IMPOUNDING	High	Henderson	35.37602	-82.38456	Little Clear Creek-Tr	French Broad	Balfour
HENDE-056	NC03029		Spring Farm Pond Dam	DRAINED	High	Henderson	35.20069	-82.36368	Pacolet River-Tr	Broad	Melrose
HENDE-058	NC03031		Hendersonville Country Club Dam	IMPOUNDING	High	Henderson	35.30270	-82.48538	Mud Creek-Tr	French Broad	Hendersonville
HENDE-065	NC03037		Frady Dam	IMPOUNDING	High	Henderson	35.44013	-82.52181	Kimsey Creek-Tr	French Broad	Long Shoals
HENDE-074	NC03046		Pettit Pond Dam	IMPOUNDING	High	Henderson	35.23070	-82.37193	Camp Creek-Tr	Broad	Mount Valley
HENDE-088	NC03059		Bowman Bluff Dam	IMPOUNDING	High	Henderson	35.30644	-82.56428	French Broad River-Tr	French Broad	Etowah
HENDE-092	NC03063		Hidden Valley Campground Dam	DRAINED	High	Henderson	35.29315	-82.57566	French Broad River-Tr	French Broad	Etowah
HENDE-093	NC03064		Shealy Lake Dam Upper	DRAINED	High	Henderson	35.29981	-82.49424	UT to Finley Creek	French Broad	Valley Hill
HENDE-094	NC03065		Wolf Weinhold Dam	IMPOUNDING	High	Henderson	35.22718	-82.52485	Hampy Creek	Broad	Tuxedo
HENDE-105	NC03076		Freeman Dam	IMPOUNDING	High	Henderson	35.23630	-82.45786	Vernon Creek	Broad	Tuxedo
HERTF-004	NC03079		Chowan University Dam	IMPOUNDING	High	Hertford	36.433	-77.098	College Branch	Chowan	Murfreesboro
HERTF-005	NC03080		Holly Hill Road Dam	IMPOUNDING	High	Hertford	36.434	-77.101	College Branch	Chowan	Murfreesboro
HERTF-006	NC03081		Revelles Pond Dam Upper	IMPOUNDING	High	Hertford	36.434	-77.105	College Branch	Chowan	Murfreesboro
HOKE-016	NC03090		Wood Lake Dam	IMPOUNDING	High	Hoke	34.99619	-79.14605	Black Branch-Tr	Cape Fear	Hope Mills
IREDE-036	NC03107	4	New Hope Fishing Lake East	IMPOUNDING	High	Iredell	35.97722	-80.94222	Tuckers Creek-Tr	Yadkin-PeeDee	Love Valley
IREDE-037	NC03108	2	New Hope Fishing Lake West	IMPOUNDING	High	Iredell	35.97722	-80.94361	Tuckers Creek-Tr	Yadkin-PeeDee	Love Valley
IREDE-044	NC03114		Statesville Country Club Dam #2	IMPOUNDING	High	Iredell	35.7896	-80.8155	Fourth Creek-Tr	Yadkin-PeeDee	Statesville
IREDE-078	NC03146		Morrison Plantation Dam #1	IMPOUNDING	High	Iredell	35.5944	-80.8816	McCrary Creek-Trib.	Catawba	
IREDE-132	NC03163		Earth Movers Dam Lower	IMPOUNDING	High	Iredell	35.71139	-81.04417	Catawba River-Trib.	Catawba	
IREDE-133	NC03164		Earth Movers Dam Upper	IMPOUNDING	High	Iredell	35.716	-81.046	Catawba River-Trib.	Catawba	

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
JACKS-028	NC03178		Sapphire Valley Golf Course Dam	IMPOUNDING	High	Jackson	35.11696	-83.03196	Mud Creek	Savannah	Sapphire
JACKS-033	NC03180		Wolf Lake Dam	IMPOUNDING	High	Jackson	35.156	-83.068	Flatwood Branch	Savannah	Fairfield Development
JACKS-036	NC03182		Lancewood Dam	IMPOUNDING	High	Jackson	35.11926	-83.09737	Horsepasture River-Tr	Savannah	Fairfield Development
JACKS-050	NC03193		Hanks Dam	IMPOUNDING	High	Jackson	35.088	-83.088	Fowler Creek	Savannah	Bull Pen
JOHNS-031	NC03204		Berry Downs Dam	IMPOUNDING	High	Johnston	35.46194	-78.39778	Holt Lake-Os	Neuse	Smithfield
LEE-016	NC03259		Sanford Raw Water Reservoir	IMPOUNDING	High	Lee	35.53361	-79.0475	Bush Creek-Os	Cape Fear	N/A
LEE-022	NC03264		San-Lee Park Upper Dam	IMPOUNDING	High	Lee	35.48176	-79.12472	Little Lick Creek	Cape Fear	N/A
LEE-029	NC03271		Cedar Lake Dam	IMPOUNDING	High	Lee	35.592	-79.154	Deep River-Tr	Cape Fear	
LEE-036	NC03276		Hall Pond Dam	IMPOUNDING	High	Lee	35.442	-79.171	Gasters Creek-Tr	Cape Fear	Sanford
LINCO-009	NC03287		Gladden Pond Dam	IMPOUNDING	High	Lincoln	35.5465	-81.1908	Lackard Creek-Tr	Catawba	
LINCO-015	NC03293		National Fruit Products Dam	IMPOUNDING	High	Lincoln	35.54416	-81.38269	Howard Creek-Tr	Catawba	
LINCO-020	NC03297		Leatherman Pond Dam	IMPOUNDING	High	Lincoln	35.5477	-81.3905	Howards Creek - Trib	Catawba	Vale
LINCO-044	NC03316		Horseshoe Pond Dam	IMPOUNDING	High	Lincoln	35.51289	-81.23066	Carpenter Creek-Tr	Catawba	
MACON-010	NC03329		R.S. Jones Jr Upper Dam	IMPOUNDING	High	Macon	35.178	-83.42	Wallace Branch-Tr	Little Tennessee	Cozads Mill
MACON-011	NC03330		R.S. Jones Jr Lower Dam	IMPOUNDING	High	Macon	35.177	-83.421	Wallace Branch-Tr	Little Tennessee	Cozads Mill
MACON-028	NC03334		Palmisano Dam	IMPOUNDING	High	Macon	35.11051	-83.41880	S Fork Skeenah Creek-Tr	Little Tennessee	Prentiss
MACON-029	NC03335	2	W. S. Jones Lake	IMPOUNDING	High	Macon	35.2174	-83.2548	North Prong Elijay Creek	Little Tennessee	Franklin
MACON-032	NC03337		Houston Dam	IMPOUNDING	High	Macon	35.09872	-83.20428	Houston Branch	Little Tennessee	Highlands
MACON-037	NC03339		Club Lake Dam	IMPOUNDING	High	Macon	35.0507	-83.2197	Monger Creek	Little Tennessee	Highlands
MACON-039	NC03341		Brush Creek Upper Dam	IMPOUNDING	High	Macon	35.102	-83.239	Brush Creek	Little Tennessee	Cullasaja
MACON-040	NC03342		Brush Creek Lower Dam	IMPOUNDING	High	Macon	35.101	-83.242	Brush Creek	Little Tennessee	Cullasaja
MACON-043	NC03345		Tritonia Dam	IMPOUNDING	High	Macon	35.2001	-83.4495	Iotla Creek-Tr	Little Tennessee	Iotla
MACON-044	NC03346		Trimont Mtn. Dam	IMPOUNDING	High	Macon	35.18249	-83.40998	Crawford Branch	Little Tennessee	Franklin
MACON-048	NC03350		Browns Lake Dam	IMPOUNDING	High	Macon	35.02738	-83.30640	Middle Creek	Little Tennessee	Scaly Mountain
MACON-051	NC03353		Cobb Lake Dam	IMPOUNDING	High	Macon	35.28365	-83.40200	Matlock Creek	Little Tennessee	Snow Hill
MACON-056	NC03358		Rocky Knob Dam	IMPOUNDING	High	Macon	35.00843	-83.30039	Watkins Creek-Tr	Little Tennessee	Scaly Mountain
MADIS-006	NC03364		Fakhoury Dam	IMPOUNDING	High	Madison	35.80368	-82.54774	Little Creek	French Broad	Forks Of Ivy
MCDOW-010	NC03380		Lady Marion Dam	IMPOUNDING	High	McDowell	35.69412	-82.02559	Buck Creek	Catawba	Marion
MCDOW-020	NC03386		Muddy Creek Dam #3 (Lemon Tree)	IMPOUNDING	High	McDowell	35.63217	-81.99246	Hicks Branch	Catawba	Morganton
MCDOW-026	NC03392		Marion Manufacturing Dam	IMPOUNDING	High	McDowell	35.68557	-81.97816	Trib to Young's Fork (Copernin	Catawba	Marion
MECKL-014	NC03399		Griffith Dam #1	IMPOUNDING	High	Mecklenburg	35.32432	-80.81583	Mallard Creek-Tr	Yadkin-PeeDee	Derita
MECKL-025	NC03400		Billingsley Dam	IMPOUNDING	High	Mecklenburg	35.1940	-80.8085	Brier Creek-Os	Catawba	Charlotte
MECKL-030	NC03402		Moody Pond Dam	IMPOUNDING	High	Mecklenburg	35.15347	-80.94144	Coffey Creek-Tr	Catawba	
MECKL-032	NC03403		Linda Lake Dam	IMPOUNDING	High	Mecklenburg	35.24472	-80.72889	Reedy Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-041	NC03410		Oakwood Lane Dam	IMPOUNDING	High	Mecklenburg	35.2425	-80.73139	Reedy Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-045	NC03414		Ardrey Park Dam	IMPOUNDING	High	Mecklenburg	35.0379	-80.8583	Clems Branch Trib	Catawba	
MECKL-046	NC03415		Lock Lane Dam	IMPOUNDING	High	Mecklenburg	35.1340	-80.8160	Mcmullen Creek-Tr	Catawba	Charlotte
MECKL-052	NC03419		Lake Plaza Dam	IMPOUNDING	High	Mecklenburg	35.253	-80.772	Briar Creek-Tr	Catawba	Charlotte
MECKL-054	NC03421		Pellynwood Lake Dam	IMPOUNDING	High	Mecklenburg	35.1340	-80.7917	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-056	NC03423		Giverney Dam	IMPOUNDING	High	Mecklenburg	35.13694	-80.81417	Mcmullen Creek-Tr	Catawba	Charlotte
MECKL-058	NC03425		Methodist Home Dam	IMPOUNDING	High	Mecklenburg	35.23167	-80.76611	Briar Creek - Trib.	Catawba	Charlotte
MECKL-064	NC03431		Reddmans Pier Dam	IMPOUNDING	High	Mecklenburg	35.203	-80.752	Campbell Creek - Trib.	Catawba	Charlotte
MECKL-065	NC03432		Lakeside Drive Dam	IMPOUNDING	High	Mecklenburg	35.23806	-80.72556	Reedy Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-067	NC03434		O'Dillon Lake Dam	IMPOUNDING	High	Mecklenburg	35.2879	-80.8449	Stewart Crk-Os	Catawba	
MECKL-076	NC03443		Quail Hollow West Dam	IMPOUNDING	High	Mecklenburg	35.11833	-80.86139	Little Sugar Ck.-Tr	Catawba	Charlotte
MECKL-077	NC03444		Sharon Lake Lower Dam	IMPOUNDING	High	Mecklenburg	35.1205	-80.8726	Little Sugar Crk-Os	Catawba	Charlotte
MECKL-078	NC03445		Village Lake Dam	IMPOUNDING	High	Mecklenburg	35.15944	-80.74778	Mcalpine Crk-Os	Catawba	Charlotte
MECKL-080	NC03447		Lake Providence Dam	IMPOUNDING	High	Mecklenburg	35.069	-80.783	Fourmile Creek-Tr	Catawba	
MECKL-081	NC03448	109	Hideaway Bay Dam	IMPOUNDING	High	Mecklenburg	35.2185	-80.7425	Mcalpine Creek-Tr	Catawba	Charlotte

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
MECKL-082	NC03449		Ivey's Pond Dam	IMPOUNDING	High	Mecklenburg	35.07333	-80.78694	Rocky Branch-Tr	Catawba	Charlotte
MECKL-086	NC03453		University Place Dam	IMPOUNDING	High	Mecklenburg	35.3134	-80.7495	Mallard Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-088	NC03455		Withrow Dam	IMPOUNDING	High	Mecklenburg	35.34056	-80.70972	Mallard Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-092	NC03459		Baucom Lake Dam	IMPOUNDING	High	Mecklenburg	35.2846	-80.7205	Back Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-093	NC03460		Davis Lake Subdivision Dam	IMPOUNDING	High	Mecklenburg	35.34389	-80.81139	Clarks Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-095	NC03462		Clearwater Lake Dam At Runaway Bay	IMPOUNDING	High	Mecklenburg	35.15778	-80.7425	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-098	NC03465		Harris Pond Dam	IMPOUNDING	High	Mecklenburg	35.3307	-80.7826	Clarks Creek-Tr	Yadkin-PeeDee	
MECKL-100	NC03467		Hidden Landing Dam	IMPOUNDING	High	Mecklenburg	35.22	-80.74472	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-101	NC03468		Raintree Dam #O	IMPOUNDING	High	Mecklenburg	35.0946	-80.7794	Fourmile Creek-Tr	Catawba	Charlotte
MECKL-102	NC03469		Raintree Dam #2	IMPOUNDING	High	Mecklenburg	35.08833	-80.78083	Fourmile Creek-Tr	Catawba	Charlotte
MECKL-103	NC03470		Raintree Dam #4	IMPOUNDING	High	Mecklenburg	35.08083	-80.7825	Fourmile Creek-Tr	Catawba	Charlotte
MECKL-104	NC03471		Raintree Dam #7	IMPOUNDING	High	Mecklenburg	35.07167	-80.7982	Fourmile Creek-Tr	Catawba	Charlotte
MECKL-107	NC03474		Radbourne Subdivision Dam	IMPOUNDING	High	Mecklenburg	35.3346	-80.7873	Clarks Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-112	NC03479		Maplecroft Dam	IMPOUNDING	High	Mecklenburg	35.46222	-80.80333	South Prong West Branch-Tr	Yadkin-PeeDee	
MECKL-116	NC03483	40	Woodrow Allen Dam	IMPOUNDING	High	Mecklenburg	35.20944	-80.64472	Clear Creek-Tr	Yadkin-PeeDee	Mint Hill
MECKL-117	NC03484		Windrow Dam	IMPOUNDING	High	Mecklenburg	35.13278	-80.67861	Crooked Creek-Tr	Yadkin-PeeDee	Matthews
MECKL-119	NC03486		Beverly Crest Dam	IMPOUNDING	High	Mecklenburg	35.11	-80.77444	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-121	NC03488		Winterbrooke Dam	IMPOUNDING	High	Mecklenburg	35.095	-80.732	Fourmile Creek-Tr	Catawba	Matthews
MOORE-007	NC03520		Pinehurst National Dam #4	IMPOUNDING	High	Moore	35.196	-79.444	Aberdeen Creek-Os	Lumber	Aberdeen
MOORE-008	NC03521		Longleaf Golf Course Dam	IMPOUNDING	High	Moore	35.2110	-79.4186	Mill Creek	Cape Fear	
MOORE-010	NC03523		Pinecrest High School Dam	IMPOUNDING	High	Moore	35.18306	-79.43417	Aberdeen Creek-Tr	Lumber	Aberdeen
MOORE-013	NC03526		Swan Lake Dam	IMPOUNDING	High	Moore	35.1903	-79.382	Aberdeen Creek	Cape Fear	Southern Pines
MOORE-020	NC03533		Firestone Pond Dam	IMPOUNDING	High	Moore	35.16722	-79.34778	James Creek-Tr	Cape Fear	
MOORE-026	NC03538		Hight Pond Dam	DRAINED	High	Moore	35.113	-79.426	Aberdeen Ck-Tr	Lumber	
MOORE-027	NC03539		Cardinal Club Pond Dam	IMPOUNDING	High	Moore	35.0982	-79.4781	Aberdeen Creek-Tr	Lumber	
MOORE-101	NC03555		Blue Farm	IMPOUNDING	High	Moore	35.2428	-79.4002	Nick'S Creek-Os	Cape Fear	Whispering Pines
MOORE-109	NC03563		Mckeithan Lake Dam	IMPOUNDING	High	Moore	35.099	-79.561	Drowning Ck-Tr	Lumber	Pinebluff
MOORE-121	NC03570		Watson Lake Dam #2	IMPOUNDING	High	Moore	35.1541	-79.4363	Aberdeen Creek	Lumber	Aberdeen
MOORE-131	NC03580		Pinehurst Gc #6, Dam #2	IMPOUNDING	High	Moore	35.21452	-79.44222	Nick'S Creek-Tr	Cape Fear	
MOORE-132	NC03581		Queens Court Dam	IMPOUNDING	High	Moore	35.1760	-79.4960	Horse Creek-Tr	Lumber	
MOORE-133	NC03582		Lake Pinehurst Pond Dam #2	IMPOUNDING	High	Moore	35.176	-79.494	Horse Ck-Tr	Lumber	
MOORE-137	NC03586		Pinehurst Gc#6 Dam#3	IMPOUNDING	High	Moore	35.212	-79.446	Nick'S Creek-Tr	Cape Fear	Whispering Pines
MOORE-140	NC03589		Pinebrook-Pinehurst Unit 14	IMPOUNDING	High	Moore	35.22646	-79.44447	Juniper Creek Trib	Cape Fear	Whispering Pines
MOORE-145	NC03594		Cardinal Lake Dam	IMPOUNDING	High	Moore	35.2354	-79.3710	Unnamed tributary to Mill Cree	Cape Fear	
MOORE-150	NC03599		Pinehurst National-Dam #1	IMPOUNDING	High	Moore	35.18861	-79.44361	Aberdeen Creek-Tr	Lumber	Aberdeen
MOORE-152	NC03601		Pinehurst National Dam 3a	IMPOUNDING	High	Moore	35.19361	-79.44333	Aberdeen Creek-Tr	Lumber	Aberdeen
MOORE-153	NC03602		John Garner Pond Dam	IMPOUNDING	High	Moore	35.21167	-79.61972	Jackson Creek-Tr	Lumber	Jackson Springs
NORTH-019	NC03642		Champion Lagoon Dam	IMPOUNDING	High	Northampton	36.47056	-77.635	Roanoke River-Os	Roanoke	N/A
ORANG-043	NC03663		Flint Ridge Dam	IMPOUNDING	High	Orange	36.054	-79.105	Eno River-Tr	Neuse	Hillsborough
ORANG-045	NC03666		Hines Pond Dam	IMPOUNDING	High	Orange	36.08	-79.075	Eno River-Tr	Neuse	
ORANG-048	NC03669		Meadowlands	IMPOUNDING	High	Orange	36.061	-79.079	Eno River-Tr	Neuse	Hillsborough
ORANG-052	NC03671		Colony Lake	IMPOUNDING	High	Orange	35.93722	-79.00806	Little Creek-Tr	Cape Fear	
PERSO-027	NC03689		South Hyco Lake Dam	IMPOUNDING	High	Person	36.3477	-79.1483	South Hyco Creek	Roanoke	
PITT-009	NC03696		Greenville Utilities Commision Dam	IMPOUNDING	High	Pitt	35.6377	-77.3986	Tar-Os	Tar-Pamlico	Greenville
POLK-033	NC03719		Old Tryon Water Suppy Dam	IMPOUNDING	High	Polk	35.21372	-82.30179	Big Fall Creek (tr)	Broad	
RANDO-010	NC03721		King Dam	IMPOUNDING	High	Randolph	35.59583	-79.80889	Reed Creek-Tr	Yadkin-PeeDee	Asbury
RANDO-021	NC03722		Ramseur Water Supply Dam	IMPOUNDING	High	Randolph	35.74361	-79.67722	Sandy Creek	Cape Fear	Franklinville
RANDO-060	NC03725		Ingold Dam	IMPOUNDING	High	Randolph	35.75444	-79.88	Back Creek-Tr	Yadkin-PeeDee	Asheboro
RANDO-061	NC03726		Woodman Dam	IMPOUNDING	High	Randolph	35.782	-79.785	Deep River-Tr	Cape Fear	Cenral Falls

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
RANDO-110	NC03770		Upper Toms Creek Nursery Dam	IMPOUNDING	High	Randolph	35.64889	-79.985	Toms Ck-Tr	Yadkin-PeeDee	Farmer
RANDO-111	NC03771		Middle Toms Creek Nursery Dam	IMPOUNDING	High	Randolph	35.648	-79.985	Toms Ck-Tr	Yadkin-PeeDee	Farmer
RANDO-112	NC03772		Lower Toms Creek Nursery Dam	IMPOUNDING	High	Randolph	35.64639	-79.98694	Toms Creek-Tr	Yadkin-PeeDee	Farmer
RANDO-118	NC03778		Pinewood Country Club Dam	IMPOUNDING	High	Randolph	35.62	-79.817	North Prong Richland Ck	Cape Fear	
RANDO-125	NC03785		Fox Dam	IMPOUNDING	High	Randolph	35.712	-79.889	Back Ck-Tr	Yadkin-PeeDee	Farmer
RANDO-185	NC03845		Robert L. Reece Lake Dam	IMPOUNDING	High	Randolph	35.681	-79.97	Uwharrie River	Yadkin-PeeDee	Farmer
ROCKI-064	NC03901		Jack Neal Dam	IMPOUNDING	High	Rockingham	36.2932	-79.9454	Hogans Creek-Tr	Roanoke	Eden
ROCKI-162	NC03998		Ed Wilkins Dam	IMPOUNDING	High	Rockingham	36.32611	-79.69389	Troublesome Crk.-Tr	Cape Fear	
ROCKI-195	NC04031		Newman-Bowman Dam	IMPOUNDING	High	Rockingham	36.326	-79.673	Troublesome Creek-Tr	Cape Fear	
ROWAN-025	NC04069	41	Landis Lake Dam	IMPOUNDING	High	Rowan	35.5638	-80.6020	Grants Creek-Os	Yadkin-PeeDee	China Grove
ROWAN-028	NC04072		Salisbury City Park Dam	DRAINED	High	Rowan	35.6815	-80.4635	Grant Ck-Os	Yadkin-PeeDee	Salisbury
ROWAN-055	NC04082		Howard Hensley Dam	IMPOUNDING	High	Rowan	35.57944	-80.67417	Kerr Creek-Tr	Yadkin-PeeDee	
RUTHE-025	NC04093		Pine Knoll Fish Pond Dam	IMPOUNDING	High	Rutherford	35.276	-81.938	Jarretts Creek	Broad	Cliffside
RUTHE-027	NC04095		John W. Bennett Dam	IMPOUNDING	High	Rutherford	35.35778	-81.89417	Kathy Creek	Broad	Bostic
RUTHE-029	NC04096		2nd Broad River Watershed Dam #22	IMPOUNDING	High	Rutherford	35.50972	-81.95694	Hox Creek	Broad	Logan
RUTHE-030	NC04097		Nelson Park Dam	IMPOUNDING	High	Rutherford	35.331	-81.821	2nd Broad River-Tr	Broad	Caroleen
RUTHE-032	NC04099		Second Broad River Watershed #16	IMPOUNDING	High	Rutherford	35.4933	-81.8508	Mountain Creek	Broad	Bostic
RUTHE-037	NC04104		Second Broad River W.S. Structure #23	IMPOUNDING	High	Rutherford	35.5213	-81.9837	Stoney Creek	Broad	Bostic
RUTHE-040	NC04107		Second Broad Watershed #14	IMPOUNDING	High	Rutherford	35.509	-81.858	Fork Creek	Broad	Bostic
RUTHE-049	NC04116		Second Broad W.S. Structure #13	IMPOUNDING	High	Rutherford	35.4771	-82.0074	Mill Creek	Broad	Bostic
RUTHE-050	NC04117		Shumont Estates Dam	IMPOUNDING	High	Rutherford	35.44974	-82.18122	trib to Bill's Creek	Broad	Bills Creek
SAMPS-007	NC04125		Edwards Pond Dam	IMPOUNDING	High	Sampson	35.003	-78.355	Coharie Creek-Os	Cape Fear	
SAMPS-010	NC04128		Boykin Lake Dam	IMPOUNDING	High	Sampson	34.961	-78.36	Great Coharie Creek	Cape Fear	Clinton
SAMPS-011	NC04129	44	Stafford Pond Dam	IMPOUNDING	High	Sampson	34.829	-78.326	Gaddy Branch	Cape Fear	Ingold
STANL-010	NC04144		Snyder Pond Dam	IMPOUNDING	High	Stanly	35.488	-80.217	Rices Creek-Os	Yadkin-PeeDee	Badin
STANL-015	NC04149		Hinson Pond Dam	IMPOUNDING	High	Stanly	35.25944	-80.34722	Stony Run-Os	Yadkin-PeeDee	
STANL-037	NC04164		Lowder Pond Dam	IMPOUNDING	High	Stanly	35.3948	-80.2249	Town Creek-Os	Yadkin-PeeDee	Albemarle
STANL-040	NC04167		Brooks Dam	IMPOUNDING	High	Stanly	35.4239	-80.2935	Long Creek-Tr	Yadkin-PeeDee	Albemarle
STANL-047	NC04174		George Sells Dam	IMPOUNDING	High	Stanly	35.46278	-80.30222	Long Creek-Tr	Yadkin-PeeDee	Albemarle
STOKE-015	NC04185		Slate Dam/Little Yadkin W/S#17	IMPOUNDING	High	Stokes	36.367	-80.342	E Prong Little Yadkin Rvr-Tr	Yadkin-PeeDee	Pinnacle
STOKE-060	NC04213		Little Yadkin River W/S Dam #4	IMPOUNDING	High	Stokes	36.341	-80.422	West Prong Little Yadkin River	Yadkin-PeeDee	Donnaha
STOKE-084	NC04237		Tedder Dam-Lower	IMPOUNDING	High	Stokes	36.306	-80.307	Timmons Creek-Tr	Roanoke	Germanton
STOKE-089	NC04242		Lakeview Acres Dam	IMPOUNDING	High	Stokes	36.26389	-80.32	Muddy Creek-Tr	Yadkin-PeeDee	Rural Hall
STOKE-092	NC04245		Day Dam	IMPOUNDING	High	Stokes	36.27583	-80.35611	Crooked Run	Yadkin-PeeDee	King
SURRY-001	NC04250		Willowbrook Carp Lake Dam	IMPOUNDING	High	Surry	36.257	-80.802	Yadkin River-Tr	Yadkin-PeeDee	
SURRY-024	NC04262		Town Of Pilot Mountain Dam	IMPOUNDING	High	Surry	36.39889	-80.48722	Toms Creek-Tr	Yadkin-PeeDee	Pilot Mountain
SURRY-038	NC04268		Jordon Dam	IMPOUNDING	High	Surry	36.52722	-80.59417	Ararat River-Tr	Yadkin-PeeDee	Mount Airy
SURRY-046	NC04276		Carpenter Dam	IMPOUNDING	High	Surry	36.47944	-80.69917	Cooks Creek-Tr	Yadkin-PeeDee	Dobson
SURRY-047	NC04277		Blue Dam	IMPOUNDING	High	Surry	36.417	-80.659	Fisher River-Tr	Yadkin-PeeDee	Rockford
SURRY-061	NC04291		W. Reynolds Dam	IMPOUNDING	High	Surry	36.442	-80.932	Long Creek	Yadkin-PeeDee	Devotion
SURRY-063	NC04293		Alberty Dam	IMPOUNDING	High	Surry	36.32167	-80.71833	Bear Creek-Tr	Yadkin-PeeDee	Rockford
SURRY-068	NC04298		Elkin Reservoir Dam	IMPOUNDING	High	Surry	36.262	-80.867	Elkin Creek-Tr	Yadkin-PeeDee	Elkin
SWAIN-002	NC04326		Schmehl Dam	IMPOUNDING	High	Swain	35.43935	-83.36773	Tuckaseegee River	Little Tennessee	Ela
SWAIN-007	NC04330	7	Widenhouse Dam	IMPOUNDING	High	Swain	35.44593	-83.40660	Galbraith Creek-Trib	Little Tennessee	Bryson City
SWAIN-011	NC04333		Whitney Dam	IMPOUNDING	High	Swain	35.38678	-83.36806	Connelly Creek	Little Tennessee	Bryson City
TRANS-027	NC04337		Indian Lake Lower Dam	IMPOUNDING	High	Transylvania	35.16099	-82.93326	Indian Creek	Savannah	Lake Toxaway
TRANS-035	NC04338		Brevard Music Camp Lower Dam	IMPOUNDING	High	Transylvania	35.2410	-82.7490	Brushy Creek	French Broad	Brevard
TRANS-036	NC04339		Brevard Music Camp Lake Upper Dam	IMPOUNDING	High	Transylvania	35.2408	-82.7529	Brushy Creek	French Broad	Brevard
TRANS-050	NC04345	2	Pisgah Forest Farm Dam	IMPOUNDING	High	Transylvania	35.22233	-82.64993	Little River-Trib	French Broad	Penrose

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
TRANS-060	NC04349		Lake Megan Dam	IMPOUNDING	High	Transylvania	35.17361	-82.71556	Dunns Creek	French Broad	Dunns Rock
TRANS-062	NC04350		Siniard Upper Pond Dam	DRAINED	High	Transylvania	35.259	-82.743	Long Branch	French Broad	Brevard
TRANS-064	NC04352		Emerald Lake Dam	IMPOUNDING	High	Transylvania	35.1525	-82.6175	Duncan Creek	French Broad	Penrose
TRANS-065	NC04353		Rainbow Pond Dam	IMPOUNDING	High	Transylvania	35.13277	-82.77109	Fork French Broad River	French Broad	East Fork
TRANS-067	NC04355		Gaither Pond Dam	IMPOUNDING	High	Transylvania	35.31694	-82.67028	Osborne Branch	French Broad	Mills River
TRANS-068	NC04356		Lewis Dam	IMPOUNDING	High	Transylvania	35.31528	-82.66889	Osborne Branch	French Broad	Mills River
TRANS-070	NC04358		Bass Lake Dam	IMPOUNDING	High	Transylvania	35.2899	-82.6248	French Broad River-Tr	French Broad	Horseshoe
TRANS-073	NC04361		Turkey Pen Farm Dam	IMPOUNDING	High	Transylvania	35.32778	-82.65667	Dog Creek	French Broad	Mills River
TRANS-074	NC04362		Sapphire Lakes G & T Dam #1	IMPOUNDING	High	Transylvania	35.10942	-82.98133	Horsepasture River-Tr	Savannah	Seneca, S.C.
TRANS-078	NC04366		Eagle Lake Dam	IMPOUNDING	High	Transylvania	35.19028	-82.7	Phillips Creek	French Broad	Brevard
UNION-027	NC04372		Griffin Pond Dam	IMPOUNDING	High	Union	35.12889	-80.64417	Stevens Creek-Tr	Yadkin-PeeDee	
UNION-036	NC04380		Providence Glen Dam	IMPOUNDING	High	Union	34.9804	-80.7669	West Fork Creek-Tr	Catawba	
UNION-048	NC04391		Hilton Pond Dam	IMPOUNDING	High	Union	35.0379	-80.6524	Twelvemile Creek-Tr	Catawba	Waxhaw
UNION-059	NC04402		Lake Providence Dam	IMPOUNDING	High	Union	35.01528	-80.71194	Twelvemile Creek-Tr	Catawba	
UNION-064	NC04407		Antioch Church Road Dam	IMPOUNDING	High	Union	35.0207	-80.7106	Twelvemile Creek-Tr	Catawba	
VANCE-028	NC04430		Rose's Warehouse Dam	IMPOUNDING	High	Vance	36.2839	-78.4006	Martin Creek-Os	Tar-Pamlico	
VANCE-034	NC04436		Buffalo Millpond	IMPOUNDING	High	Vance	36.229	-78.422	Buffalo Creek	Tar-Pamlico	
WAKE-023	NC04437		Crossgate Dam #2	IMPOUNDING	High	Wake	35.91267	-78.6364	Honeycutt Creek	Neuse	Raleigh
WAKE-025	NC04438		Jack Rigsbee Dam	IMPOUNDING	High	Wake	35.79111	-78.855	Turkey Creek-Tr	Neuse	Cary
WAKE-093	NC04439		Lewis Dam	IMPOUNDING	High	Wake	36.00722	-78.54083	Horse Creek-Tr	Neuse	Wake Forest
WAKE-097	NC04441		Ballentine Farms Pond Dam	IMPOUNDING	High	Wake	35.61139	-78.7775	Terrible Creek-Tr	Neuse	
WAKE-098	NC04442		Riggsbee Dam	IMPOUNDING	High	Wake	35.79583	-78.85194	Turkey Creek-Tr	Neuse	Apex
WAKE-100	NC04444		Rtp South Dam	IMPOUNDING	High	Wake	35.8521	-78.8734	Kitt Creek	Cape Fear	Apex
WAKE-101	NC04445		Barbee Dam	IMPOUNDING	High	Wake	35.8017	-78.8425	Turkey Creek-Tr	Neuse	Council Gap Ct. (homes before)
WAKE-103	NC04446		Crooked Creek	IMPOUNDING	High	Wake	35.6294	-78.7412	Terrible Creek-Tr	Neuse	Bushy Meadow Drive
WAKE-107	NC04450		Pendleton Lake	IMPOUNDING	High	Wake	35.9477	-78.6282	Upper Barton Creek-Tr	Neuse	Swan Mill Crossing Rd
WAKE-114	NC04456		Crabtree Dam 20-A	IMPOUNDING	High	Wake	35.8673	-78.8085	Brier Creek	Neuse	John Brantley Blvd
WAKE-118	NC04460		Em Johnson Alum Sludge Lagoon Dam	IMPOUNDING	High	Wake	35.9158	-78.6035	Honeycutt Creek-Os	Neuse	Raleigh (FallsOfNeuseRd @ dam)
WAKE-120	NC04462		Alyson Pond	IMPOUNDING	High	Wake	35.894	-78.594	Perry Creek-Tr	Neuse	Yucca Trail Dr.
WAKE-125	NC04466		Heathrow Dam	IMPOUNDING	High	Wake	35.901	-78.597	Perry Creek-Tr	Neuse	Cub Trail Road
WAKE-146	NC04481		Robertson Pond Dam	IMPOUNDING	High	Wake	35.828	-78.449	Marks Creek-Tr	Neuse	Smithfield
WAKE-147	NC04482		Cedar Hills Lake Dam	IMPOUNDING	High	Wake	35.853	-78.625	Big Creek	Neuse	E. Millbrook Rd
WAKE-156	NC04490		Eastgate Park Dam	IMPOUNDING	High	Wake	35.84023	-78.62404	Big Branch-Tr	Neuse	Raleigh
WAKE-180	NC04504		Bullard And Patterson Dam	IMPOUNDING	High	Wake	35.75556	-78.54917	Walnut Creek-Tr	Neuse	Walnut Crk Trail Rd
WAKE-195	NC04516	138	White Oak Lake Dam	IMPOUNDING	High	Wake	35.77535	-78.71388	Simmons Branch	Neuse	US-1 (Cliff Benson Beltline
WAKE-198	NC04519		Camp Pond Dam	IMPOUNDING	High	Wake	35.83167	-78.72422	Richland Creek-Tr	Neuse	Raleigh
WAKE-200	NC04520		Wooten Pond Dam	IMPOUNDING	High	Wake	35.877	-78.66	Lead Mine Creek-Tr	Neuse	Raleigh
WAKE-210	NC04527		Ammons Lake Dam Upper	IMPOUNDING	High	Wake	35.8817	-78.6701	Mine Creek-Tr	Neuse	Raleigh
WAKE-211	NC04528		Ammons Lake Dam Lower	IMPOUNDING	High	Wake	35.87832	-78.66422	NW Trib of Mine Creek	Neuse	Raleigh
WAKE-213	NC04529		Longview Lake Upper Dam	IMPOUNDING	High	Wake	35.7846	-78.5980	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-218	NC04531		Coachman Trail Lake Dam Upper	IMPOUNDING	High	Wake	35.94194	-78.63417	Cedar Creek	Neuse	Coachman's Way Rd
WAKE-220	NC04532		Byrd Dam	DRAINED	High	Wake	35.71056	-78.71306	Lake Wheeler-Os	Neuse	Baird Drive
WAKE-221	NC04533		North Blvd Comm Center Dam	IMPOUNDING	High	Wake	35.844	-78.585	Marsh Creek-Tr	Neuse	Waterbury Road
WAKE-224	NC04535		Hart-Curtis Pond	IMPOUNDING	High	Wake	35.835	-78.65	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-225	NC04536		Crabtree Creek Dam 5-A	IMPOUNDING	High	Wake	35.86833	-78.82472	Stirup Iron Creek	Neuse	Raleigh (I-40 @ Dam)
WAKE-226	NC04537		Williams-Johnson Pond Dam	IMPOUNDING	High	Wake	35.834	-78.654	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-227	NC04538		The Lakes Lower Dam	IMPOUNDING	High	Wake	35.8641	-78.6288	Big Branch	Neuse	Shanda Drive
WAKE-228	NC04539		State Fair H & L Dam	IMPOUNDING	High	Wake	35.798	-78.717	Richland Creek-Tr	Neuse	Raleigh
WAKE-232	NC04543		Goodnight Dam	IMPOUNDING	High	Wake	35.81944	-78.75694	Reedy Creek	Neuse	Research Drive

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
WAKE-234	NC04545		Summer Lake Dam	IMPOUNDING	High	Wake	35.863	-78.7	Haresnipe Creek-Tr	Neuse	West Millbrook Rd
WAKE-235	NC04546		Meredith College Dam	IMPOUNDING	High	Wake	35.7971	-78.6851	S.W. Beaverdam Creek	Neuse	Faircloth Street
WAKE-236	NC04547		Underwood Dam	IMPOUNDING	High	Wake	35.73889	-78.62083	Walnut Creek-Tr	Neuse	Seabrook Road
WAKE-238	NC04549		Martin Marietta #1 Dam	IMPOUNDING	High	Wake	35.89734	-78.75111	Sycamore Creek-Tr	Neuse	Raleigh
WAKE-243	NC04554		Darden Dam	IMPOUNDING	High	Wake	35.9248	-78.7295	Upper Barton Creek-Tr	Neuse	
WAKE-252	NC04563		Bailey Dam	IMPOUNDING	High	Wake	35.9421	-78.6684	Barton Creek-Tr	Neuse	Six Forks Road
WAKE-264	NC04575		Marshall Pond #1	IMPOUNDING	High	Wake	35.84592	-78.51026	Smith Creek-Tr	Neuse	
WAKE-265	NC04576		Marshall Pond #2	IMPOUNDING	High	Wake	35.9400	-78.5072	Sandford Creek-Tr	Neuse	Forestville Road
WAKE-268	NC04579		St. Andrews Plantation Dam	IMPOUNDING	High	Wake	35.9140	-78.5140	Smith Creek-Tr	Neuse	Coach Lantern Ave
WAKE-304	NC04614		Peacock Dam	IMPOUNDING	High	Wake	35.697	-78.609	Lake Benson-Os	Neuse	Kentucky Drive
WAKE-308	NC04615		NCSU Unit No. 4 Dam	IMPOUNDING	High	Wake	35.7908	-78.7004	Walnut Creek-Tr	Neuse	Ligon Stdreet
WAKE-314	NC04616		Coronado Lake Dam	IMPOUNDING	High	Wake	35.7822	-78.7736	Walnut Creek-Tr	Neuse	Cary
WAKE-317	NC04619		Gallop Dam	IMPOUNDING	High	Wake	35.804	-78.799	Crabtree Creek-Tr	Neuse	
WAKE-318	NC04620		Laurel Hills Dam	IMPOUNDING	High	Wake	35.8372	-78.7020	Crabtree Creek-Tr	Neuse	Laurel Hills Road
WAKE-319	NC04621		Howell Dam	IMPOUNDING	High	Wake	35.763	-78.873	White Oak Creek-Tr	Cape Fear	
WAKE-324	NC04624		Regency Park Dam	IMPOUNDING	High	Wake	35.7274	-78.7927	Swift Creek-Tr	Neuse	Ederlee Drive
WAKE-327	NC04626		Massengill Dam	IMPOUNDING	High	Wake	35.6693	-78.6656	Swift Creek-Tr	Neuse	Walerville Street
WAKE-333	NC04632		Landmark Apts. Dam	IMPOUNDING	High	Wake	35.8191	-78.6982	House Creek-Tr	Neuse	Raleigh
WATAU-014	NC04651		Snow Lake	IMPOUNDING	High	Avery	36.19063	-81.87475	King Creek	Watauga	Beech Mountain
WATAU-018	NC04653		Rosasco Dam Lower	IMPOUNDING	High	Watauga	36.22058	-81.77793	Baird Cr.-Tr	Watauga	Elizabethton
WATAU-021	NC04655	75	Blowing Rock Cntry Club Dam	IMPOUNDING	High	Watauga	36.12611	-81.66667	Middle Fork Creek	New	Blowing Rock
WATAU-022	NC04656	426	New River Lake Dam	IMPOUNDING	High	Watauga	36.12923	-81.66971	Middle Fork Creek	New	Blowing Rock
WATAU-024	NC04658		Sweetgrass Dam	IMPOUNDING	High	Watauga	36.1277	-81.7405	Boone Fork	Watauga	Schull's Mill
WATAU-027	NC04661		Beech Mountain Water Supply Dam	IMPOUNDING	High	Watauga	36.21948	-81.9072	Buckeye Creek	Watauga	Kellersville
WAYNE-022	NC04668		HF Lee Active Ash Basin Dam	IMPOUNDING	High	Wayne	35.3791	-78.0698	Neuse	Neuse	Goldsboro
WILKE-005	NC04672		Oliver Dam	IMPOUNDING	High	Wilkes	36.0885	-81.1601	Cub Creek-Tr	Yadkin-PeeDee	North Wilkesboro
WILKE-028	NC04687		Al Beshears Dam	IMPOUNDING	High	Wilkes	36.2549	-81.3439	South Fork Reddies River-Tr	Yadkin-PeeDee	Wilbar
YANCE-004	NC04749	2	Clouse Lake Dam	IMPOUNDING	High	Yancey	35.92432	-82.24899	Shoal Creek tributary	French Broad	Windom
YANCE-007	NC04752		Ayers Pond Dam	IMPOUNDING	High	Yancey	35.92090	-82.27115	Crabtree Creek-Tr	French Broad	Windom
YANCE-010	NC04755		Moonshine Mountain Rd Dam	IMPOUNDING	High	Yancey	35.95261	-82.28394	Mine Fork	French Broad	Day Brook
YANCE-011	NC04756		Phoenix Pond Dam	IMPOUNDING	High	Yancey	35.97920	-82.29337	Jacks Creek	French Broad	Day Brook
GUILF-184	NC04757		Pringle Dam	IMPOUNDING	High	Guilford	36.036	-79.768	South Buffalo Creek-Tr	Cape Fear	Greensboro
BUNCO-082	NC04767		Kyle Boone Dam	IMPOUNDING	High	Buncombe	35.68056	-82.48139	Ox Creek-Os	French Broad	Beech
CASWE-014	NC04769		Country Line W/S #1(Farmer Lk) (Pl-566)	IMPOUNDING	High	Caswell	36.38495	-79.36121	Country Line Creek	Roanoke	Milton
CASWE-031	NC04786		Jones Dam	IMPOUNDING	High	Caswell	36.45833	-79.28972	S. Fork Rattlesnake Creek-Tr	Roanoke	Blanch
CUMBE-088	NC04797	12	Devonwood Lower Dam	DRAINED	High	Cumberland	35.075	-78.995	Persimmon Ck-Tr	Cape Fear	Fayetteville
FORSY-197	NC04803		Town And Country Lake Dam	IMPOUNDING	High	Forsyth	36.14306	-80.30917	Mill Creek-Tr	Yadkin-PeeDee	
FORSY-202	NC04808		Century Park Lake Dam	IMPOUNDING	High	Forsyth	36.106	-80.091	Smith Creek	Yadkin-PeeDee	
MECKL-125	NC04814		Piper Glen Dam B	IMPOUNDING	High	Mecklenburg	35.079	-80.813	Four Mile Creek-Tr	Catawba	Charlotte
MECKL-127	NC04816		Franklin Treatment Plant 250 Mg Raw Water Reservoir	IMPOUNDING	High	Mecklenburg	35.282	-80.888	Stewart Creek-Tr	Catawba	Charlotte
MECKL-129	NC04818		Fernhill Pond Dam	IMPOUNDING	High	Mecklenburg	35.1498	-80.8880	Kings Branch-Tr	Catawba	Charlotte
MECKL-130	NC04819		Col. Francis J. Beatty Park Dam	IMPOUNDING	High	Mecklenburg	35.06361	-80.74444	Six Mile Creek	Catawba	Charlotte
MECKL-132	NC04821		Cobblestone Dam	IMPOUNDING	High	Mecklenburg	35.04129	-80.83250	Mcalpine-Os	Catawba	Charlotte
MECKL-136	NC04825		Cottonwood Dam	IMPOUNDING	High	Mecklenburg	35.0982	-80.8075	Mcalpine Creek-Tr	Catawba	Charlotte
MOORE-157	NC04833		J.L. Frith Pond Dam #2	IMPOUNDING	High	Moore	35.3101	-79.5724	Mcclendon'S Creek-Tr	Cape Fear	Robbins
SAMPS-037	NC04843		Melva Brook Pond Lower Dam	IMPOUNDING	High	Sampson	34.9574	-78.26904	Rowan Branch-Tr	Cape Fear	Clinton
STOKE-102	NC04854		Little Yadkin River W/S Dam #18	IMPOUNDING	High	Stokes	36.37028	-80.33861	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
STOKE-104	NC04856		Little Yadkin River W/S Dam #25	IMPOUNDING	High	Stokes	36.34139	-80.34194	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
STOKE-105	NC04857		Little Yadkin River W/S Dam #26	IMPOUNDING	High	Stokes	36.33889	-80.34167	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
UNION-072	NC04865		Price Dam	IMPOUNDING	High	Union	35.008	-80.676	Price Mill Creek-Tr	Catawba	
ALAMA-085	NC04873		Back Creek Reservoir	IMPOUNDING	High	Alamance	36.10027	-79.33030	East Back Creek	Cape Fear	Haw River
MCDOW-032	NC04876		2nd Broad River W.S. Structure #11-15 (Brevard Ross)	IMPOUNDING	High	McDowell	35.55897	-81.98077	Scrub Grass Branch (Sw Fk)	Broad	Union Mills
MCDOW-033	NC04877		2nd Broad River W.S. Structure #11-16(Brevard)	IMPOUNDING	High	McDowell	35.55889	-81.98080	Scrub Grass Branch (Nw Fk)	Broad	Union Mills
MECKL-143	NC04881		Arnold Palmer Dam	IMPOUNDING	High	Mecklenburg	35.19722	-80.80417	Briar Creek-Tr	Catawba	Charlotte
GUILF-287	NC04892		Brookway Dam	IMPOUNDING	High	Guilford	36.10611	-79.89194	Horsepen Creek-Tr	Cape Fear	Greensboro
CABAR-054	NC04901		Lake Don T. Howell Dam	IMPOUNDING	High	Cabarrus	35.43972	-80.69722	Coddle Creek	Yadkin-PeeDee	Concord
WAKE-310	NC04910		Delta Lake	IMPOUNDING	High	Wake	35.856	-78.709	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-342	NC04917		Garner Ww Lagoon #1	IMPOUNDING	High	Wake	35.63702	-78.58479	Swift Creek-Tr	Neuse	I-40 (James E. Harrison Freewa
WAKE-343	NC04918		Garner Ww Lagoon #2	IMPOUNDING	High	Wake	35.63976	-78.58281	Swift Creek-Tr	Neuse	I-40 (James E. Harrison Freewa
WAKE-353	NC04927		Hedingham #2	IMPOUNDING	High	Wake	35.80694	-78.55333	Neuse River-Tr	Neuse	Wild Dunes Drive
RANDO-190	NC04933		Holly Ridge Golf Links Dam No. 1	IMPOUNDING	High	Randolph	35.85944	-79.89833	Muddy Creek-Tr	Cape Fear	Randleman
CASWE-061	NC04939		J.J. Pointer Dam	IMPOUNDING	High	Caswell	36.494	-79.175	Trib to Country Line Ck	Roanoke	Milton
WAKE-207	NC04946		Jones Pond Dam	IMPOUNDING	High	Wake	35.57111	-78.79667	Kenneth Branch-Tr	Cape Fear	
WAKE-345	NC04949		Kildaire Farms Dam	IMPOUNDING	High	Wake	35.7597	-78.7981	Swift Creek-Tr	Neuse	Cary
WAKE-356	NC04952		Lake Crabtree	IMPOUNDING	High	Wake	35.8374	-78.7835	Crabtree Creek	Neuse	Raleigh (OldReedyCrRd.is.15 mi
ALAMA-087	NC04954		Lake Mackintosh Dam	IMPOUNDING	High	Alamance	36.04039	-79.50353	Great Alamance Creek	Cape Fear	Alamance
DUPLI-024	NC04959		Limestone Creek Watershed Dam No. 1	IMPOUNDING	High	Duplin	34.9825	-77.79694	Cabin Creek	Cape Fear	Hallsville, Nc
WAKE-348	NC04961		Lochmere Dam	IMPOUNDING	High	Wake	35.7266	-78.7648	Lynn'S Branch	Neuse	Lochmere Drive
WAKE-337	NC04964		Manchester Dam	IMPOUNDING	High	Wake	35.923	-78.624	Honeycutt Creek-Tr	Neuse	Enderbury Drive
CABAR-059	NC04967		Melvin Harwood Dam	DRAINED	High	Cabarrus	35.463	-80.423	Black Run Creek-Tr	Yadkin-PeeDee	Mount Pleasant
WAKE-339	NC04979		Remington Park Dam	IMPOUNDING	High	Wake	35.865	-78.554	Perry Creek-Tr	Neuse	I-540 (Northern Wake Expresswa
CABAR-060	NC04980		Lake Daffodil Dam	IMPOUNDING	High	Cabarrus	35.34611	-80.55389	Irish Buffalo Creek-Tr	Yadkin-PeeDee	Locust
MADIS-012	NC04983		Ross Dam	IMPOUNDING	High	Madison	35.75111	-82.64806		French Broad	Marshall
TRANS-083	NC04984		Salter Dam	IMPOUNDING	High	Transylvania	35.28639	-82.67139		French Broad	Pisgah Forest
JOHNS-032	NC04986		James Wright Pond Dam	IMPOUNDING	High	Johnston	35.54278	-78.56667	Middle Creek-Tr; Beaver Dam Br	Neuse	Sanders Road
SURRY-097	NC04990		Scott-Harris Dam	IMPOUNDING	High	Surry	36.33778	-80.65639	Little Beaver Creek-Tr	Yadkin-PeeDee	Dobson
ORANG-042	NC04994		Spring Valley Dam	IMPOUNDING	High	Orange	35.92972	-79.08111	Bolin Creek-Tr	Cape Fear	
ORANG-050	NC04999		Strayhorn Dam #2	IMPOUNDING	High	Orange	36.04	-79.058	Stony Creek-Tr	Neuse	Old State Hwy. 10
WAKE-366	NC05026		Art Museum Dam	IMPOUNDING	High	Wake	35.80883	-78.7	House Creek-Tr	Neuse	Nancy Ann Drive
LEE-017	NC05027		Ashmore Lake Dam	IMPOUNDING	High	Lee	35.49306	-79.22361		Cape Fear	
WAKE-370	NC05036		Betts Pond Dam	IMPOUNDING	High	Wake	35.5696	-78.8453		Cape Fear	
MOORE-163	NC05037		Bibey Pond Dam #1	IMPOUNDING	High	Moore	35.262	-79.364	Little River-Tr	Cape Fear	Whispering Pines
MOORE-164	NC05038		Bibey Pond Dam #2	IMPOUNDING	High	Moore	35.261	-79.364	Little River-Tr	Cape Fear	Whispering Pines
DURHA-045	NC05046		Boles Lake Dam	IMPOUNDING	High	Durham	36.04354	-78.93708	Eno River-Tr	Neuse	Durham
WAKE-347	NC05053	106	Carolina Country Club Dam	IMPOUNDING	High	Wake	35.82250	-78.65362	Beaver Dam and Crabtree Creeks	Neuse	Scotland Street
MECKL-144	NC05059		Clarks Creek Subdivision Dam	IMPOUNDING	High	Mecklenburg	35.43028	-80.81778	North Prong Clarks Creek	Yadkin-PeeDee	Huntersville
WAKE-351	NC05068		Crossgate Dam #3	IMPOUNDING	High	Wake	35.9140	-78.6370	Honeycutt Creek-Tr	Neuse	White Chapel Way
GUILF-289	NC05073		Davis Lake Dam	IMPOUNDING	High	Guilford	36.0456	-79.9542	Trib. East Fork Deep River	Cape Fear	Jamestown
ANSON-051	NC05076		E & D Sheppard Dam	DRAINED	High	Anson	34.9467	-79.8801	Pee Dee River - Tr	Yadkin-PeeDee	Lilesville
WAKE-362	NC05077		E.M. Johnson Plant A Dam	IMPOUNDING	High	Wake	35.9118	-78.5973	Honeycutt Cr. Tr.	Neuse	Raleigh (FallsofNeuseRd@Dam)
WAKE-358	NC05078		E.M. Johnson Water Plant B	IMPOUNDING	High	Wake	35.9111	-78.59639	Neuse River	Neuse	Raleigh (Raven Ridge Road)
ROWAN-038	NC05081		Ellis Crossroads Raw Water Reservoir Dam #1	IMPOUNDING	High	Rowan	35.7252	-80.4688	Grants Creek-OS	Yadkin-PeeDee	Salisbury
ROWAN-039	NC05082		Ellis Crossroads Raw Water Reservoir Dam #2	IMPOUNDING	High	Rowan	35.72639	-80.46806	Deals Creek-OS	Yadkin-PeeDee	
CABAR-063	NC05089		Faggart Dam	IMPOUNDING	High	Cabarrus	35.34778	-80.53028	Cold Water Creek-Tr	Yadkin-PeeDee	Locust
WAKE-357	NC05102		Haddon Hall Dam	IMPOUNDING	High	Wake	35.74083	-78.86444	Beaver Creek	Cape Fear	

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
BLADE-017	NC05104		Happy Valley Pond Dam	IMPOUNDING	High	Bladen	34.60472	-78.64944	Baldwin Branch	Cape Fear	Elizabethtown
DURHA-117	NC05112		Hock Dam	IMPOUNDING	High	Durham	36.04497	-78.89628	Eno River-Tr	Neuse	William Penn Plaza Rd
WAKE-360	NC05133		Lake Plaza Dam	IMPOUNDING	High	Wake	35.86356	-78.62333	Big Branch-Tr	Neuse	Raleigh
BUNCO-083	NC05140		Laurel Lake Dam	IMPOUNDING	High	Buncombe	35.597	-82.335	Swannanoa River-Tr	French Broad	Black Mtn
WAKE-309	NC05142		Leadmine Lake Dam	IMPOUNDING	High	Wake	35.86806	-78.67528	Lead Mine Creek	Neuse	Raleigh
DURHA-046	NC05143		Little River Dam	IMPOUNDING	High	Durham	36.1135	-78.8685	Little River	Neuse	Falls
WAKE-344	NC05145		Loch Highlands Dam	IMPOUNDING	High	Wake	35.7221	-78.7792		Neuse	Loch Highlands Drive
WAKE-334	NC05146		Lochmere Lake Dam #2	IMPOUNDING	High	Wake	35.72889	-78.77556	Long Branch	Neuse	Lochmere Drive
RANDO-193	NC05150		Lower Zoo Dam	IMPOUNDING	High	Randolph	35.6175	-79.75306	Panther Creek-Tr	Cape Fear	N/A
HOKE-024	NC05151		Lupo Lake Dam	IMPOUNDING	High	Hoke	34.9925	-79.1403	Black Branch	Cape Fear	Hope Mills
WAKE-170	NC05154		Mallard Pond Dam	IMPOUNDING	High	Wake	35.77806	-78.73333	Walnut Creek-Tr	Neuse	Buck Jones Rd.
MOORE-181	NC05160		Mcneil Lake Dam	IMPOUNDING	High	Moore	35.22257	-79.27673	Little River-Trib	Cape Fear	Spring Lake
DURHA-115	NC05165		N. Durham Quarry East Dam	IMPOUNDING	High	Durham	36.2159	-78.9482	Buffalo Ck, N. Fork Little Riv	Neuse	Bunny Rd at Lick Creek
DURHA-116	NC05166		N. Durham Quarry West Dam	IMPOUNDING	High	Durham	36.2136	-78.9509	Buffalo Ck, N. Fork Little Riv	Neuse	Cothran Rd
LEE-014	NC05168		New Johnson Pond Dam	IMPOUNDING	High	Lee	35.49194	-79.21861		Cape Fear	
WAKE-312	NC05174		Olde Raleigh Dam #1	IMPOUNDING	High	Wake	35.83028	-78.70889	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-313	NC05175		Olde Raleigh Dam #2	IMPOUNDING	High	Wake	35.83028	-78.70833	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-311	NC05176		Olde Raleigh Dam #3	IMPOUNDING	High	Wake	35.83278	-78.70972	Crabtree Creek-Tr	Neuse	Raleigh
WAKE-116	NC05177		Panther Creek Dam	IMPOUNDING	High	Wake	35.8175	-78.91333	Panther Creek	Cape Fear	
WAKE-117	NC05180		Perimeter Park West Dam	IMPOUNDING	High	Wake	35.85417	-78.82722	Stirrup Iron, Crabtree, Reedy	Neuse	Marcom Dr
GUILF-288	NC05182		Piedmont Lake Dam	IMPOUNDING	High	Guilford	36.0526	-79.9485	Trib. East Fork Deep River	Cape Fear	Jamestown
MOORE-178	NC05183		Pinesage Lake Dam	IMPOUNDING	High	Moore	35.22083	-79.50778	Nick'S Creek-Tr	Cape Fear	Pinehurst
WAKE-349	NC05193		Rtp W-1	IMPOUNDING	High	Wake	35.86205	-78.87600	Kit Creek	Cape Fear	
HOKE-025	NC05199		Scull Lake Dam	IMPOUNDING	High	Hoke	35.03667	-79.14361	Puppy Creek-Os	Cape Fear	Hope Mills
JACKS-056	NC05201		Silver Springs Dam	IMPOUNDING	High	Jackson	35.0858	-83.0571	Silver Run Cr-Tr	Savannah	
ALAMA-090	NC05203		Somerton Lake Dam	IMPOUNDING	High	Alamance	36.0812	-79.5018	Gum Creek-Tr	Cape Fear	Burlington
WAKE-321	NC05210		Sutton Dam	IMPOUNDING	High	Wake	35.6625	-78.5981	Mahles Creek-Tr	Neuse	
HOKE-027	NC05213		Thomas Lake Dam #2	IMPOUNDING	High	Hoke	34.98472	-79.275	Toney Creek-Os	Lumber	Raeford
DURHA-014	NC05216		Twin Lake Dam #2	IMPOUNDING	High	Durham	35.99528	-78.8375	Little Lick Creek-Tr	Neuse	Lakecrest and Lakeside Drives
WAKE-369	NC05218		Underwood Pond Dam	IMPOUNDING	High	Wake	35.57321	-78.83745		Cape Fear	
UNION-076	NC05230		Walden Pond Dam #3	IMPOUNDING	High	Union	34.9808	-80.7886	Tarkhill Branch-Os	Catawba	Marvin
ROWAN-037	NC05231		Waller Dam	IMPOUNDING	High	Rowan	35.73139	-80.61111	Second Creek-Tr	Yadkin-PeeDee	
WAKE-305	NC05235		Weston #1	IMPOUNDING	High	Wake	35.69889	-78.61556	Swift Creek-Tr	Neuse	Aversboro Road
WAKE-306	NC05236		Weston #2	IMPOUNDING	High	Wake	35.69815	-78.61673	Swift Creek-Tr	Neuse	Aversboro and Lakeside Rd (int
ALEXA-036	NC05245		Icard Dam	IMPOUNDING	High	Alexander	35.81627	-81.33984	Upper Little River	Catawba	
BRUNS-007	NC05247		Shallotte Wastewater Lagoon No. 1	IMPOUNDING	High	Brunswick	33.99722	-78.37778	Shallotte River	Lumber	Shallotte
BRUNS-009	NC05248		Shallotte Wastewater Lagoon No. 2	IMPOUNDING	High	Brunswick	33.99444	-78.37778	Shallotte River	Lumber	Shallotte
CABAR-019	NC05249		Christy Nursery Dam	IMPOUNDING	High	Cabarrus	35.41111	-80.65444	Coddle Creek-Tr	Yadkin-PeeDee	Concord
CATAW-069	NC05260		Martin Marietta Maiden Quarry Dam	IMPOUNDING	High	Catawba	35.58722	-81.24444	Clarks Creek-Tr	Catawba	Maiden
CHATH-066	NC05261		Governors Club Dam #5	IMPOUNDING	High	Chatham	35.84583	-79.05889	Cub Creek-Tr	Cape Fear	
CHATH-067	NC05262		Governors Club Dam #6	IMPOUNDING	High	Chatham	35.84333	-79.0625	Cub Creek-Tr	Cape Fear	
CHATH-068	NC05263		Governors Club Dam #7	IMPOUNDING	High	Chatham	35.84111	-79.06194	Cub Creek-Tr	Cape Fear	
FORSY-206	NC05283		Brookdale Lake Dam	IMPOUNDING	High	Forsyth	36.0030	-80.3949	Johnson Creek -Tr	Yadkin-PeeDee	Clemmons
HARNE-083	NC05293		Sherman Lakes Lower	IMPOUNDING	High	Harnett	35.546811	-78.816919	UT to Kenneth Creek	Cape Fear	
HARNE-084	NC05294		Sherman Lakes Upper	IMPOUNDING	High	Harnett	35.547294	-78.819061	Neal Creek Trib	Cape Fear	
HARNE-085	NC05295		Atkins Dam	IMPOUNDING	High	Harnett	35.544914	-78.816877	Neals Creek Trib	Cape Fear	
HARNE-086	NC05296		Harnett Co Raw Water Reservoir	IMPOUNDING	High	Harnett	35.40639	-78.81722	Cape Fear	Cape Fear	Lillington
LENOI-011	NC05310		J.C. Howard Dam	IMPOUNDING	High	Lenoir	35.10028	-77.68194	Tr To Trent River	Neuse	Davis Mill Rd
LENOI-014	NC05313		Hillcrest Lake Dam	IMPOUNDING	High	Lenoir	35.27656	-77.63458	Unnamed Trib into Neuse River	Neuse	Lakeview Tr. at Hillcrest Rd.

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
MECKL-145	NC05315		Ballantrae At Piper Glen	IMPOUNDING	High	Mecklenburg	35.08111	-80.82083	Fourmile Creek-Tr	Catawba	Charlotte
MECKL-147	NC05317		Jordan Dam	IMPOUNDING	High	Mecklenburg	35.29194	-80.93444	Gum Branch-Tr	Catawba	Charlotte
MECKL-156	NC05326		University Place On The Green Dam	IMPOUNDING	High	Mecklenburg	35.3162	-80.7441	Mallard Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-158	NC05328	2	Beaty Dam	IMPOUNDING	High	Mecklenburg	35.5081	-80.8456	Davidson Creek-Tr	Catawba	Davidson
MECKL-159	NC05329		Peter's Lake Dam At The Villas	IMPOUNDING	High	Mecklenburg	35.03556	-80.78139	Sixmile Creek-Tr	Catawba	Charlotte
MECKL-162	NC05332		Carson Pond Dam	IMPOUNDING	High	Mecklenburg	35.09472	-80.80833	Mcalpine Creek-Tr	Catawba	Charlotte
MECKL-163	NC05333		Franklin Treatment Plant Raw Water Reservoir	IMPOUNDING	High	Mecklenburg	35.2825	-80.89306	Stewart Creek-Tr	Catawba	Charlotte
MECKL-167	NC05337		Lakeview Dam At Faires Farm	IMPOUNDING	High	Mecklenburg	35.29760	-80.72135	Back Creek-Tr	Yadkin-PeeDee	Charlotte
MECKL-174	NC05344		Irwin Creek Flood Protection Dike	IMPOUNDING	High	Mecklenburg	35.19694	-80.90583	Irwin Creek-Os	Catawba	Charlotte
MECKL-178	NC05348		Pierson Pond Dam	IMPOUNDING	High	Mecklenburg	35.20194	-80.77028	Brier Creek-Tr	Catawba	Charlotte
MECKL-179	NC05349		Lakepointe Corporate Center Dam	IMPOUNDING	High	Mecklenburg	35.2006	-80.9181	King'S Branch-Tr	Catawba	Charlotte
MECKL-181	NC05351		Page's Pond Dam	IMPOUNDING	High	Mecklenburg	35.45889	-80.80833	South Prong-Tr	Yadkin-PeeDee	Davidson
MOORE-182	NC05353		Lake Auman Dam	IMPOUNDING	High	Moore	35.23833	-79.60306	Jackson	Lumber	Jackson Springs
MOORE-184	NC05355		Mclendon Creek Dam	IMPOUNDING	High	Moore	35.28314	-79.59274	Mclendon Creek	Cape Fear	West End
MOORE-187	NC05358		Whispering Woods Golf Course Dam	IMPOUNDING	High	Moore	35.23525	-79.36654	Trib-Mill Creek	Cape Fear	
ONSLO-004	NC05365		Jacksonville Waste Water Lagoon	IMPOUNDING	High	Onslow	34.7725	-77.5526	Southwest Creek	White Oak	Jacksonville
PAMLI-002	NC05367		Pamlico Regional Wastewater Dike	IMPOUNDING	High	Pamlico	35.14583	-76.74611	Bay River	Neuse	Bayboro
PITT-011	NC05368		Brook Valley Country Club Dam	IMPOUNDING	High	Pitt	35.58839	-77.32928	Meeting House Branch	Tar-Pamlico	Greenville
POLK-038	NC05371		White Oak Mtn. Dam #1	IMPOUNDING	High	Polk	35.27357	-82.21592	Horse Creek	Broad	Columbus
POLK-039	NC05372		White Oak Mtn. Dam #2	IMPOUNDING	High	Polk	35.27472	-82.21682	Horse Creek	Broad	Columbus
POLK-040	NC05373		White Oak Mtn. Dam #4	IMPOUNDING	High	Polk	35.27713	-82.21870	Horse Creek	Broad	Columbus
RICHM-052	NC05379		Millstone 4-H Camp Dam	IMPOUNDING	High	Richmond	35.05528	-79.68917	Millstone Lake	Yadkin-PeeDee	
ROCKI-227	NC05385		Greensboro National Golf Course Dam #1	IMPOUNDING	High	Rockingham	36.2629	-79.8260	Haw River - Tr	Cape Fear	
ROCKI-228	NC05386		Greensboro National Golf Course Dam #2	IMPOUNDING	High	Rockingham	36.2611	-79.8208	Haw River - Tr	Cape Fear	
ROWAN-062	NC05391		Stricklin Dam	IMPOUNDING	High	Rowan	35.6235	-80.6654	Kerr Creek - Tr	Yadkin-PeeDee	Millbridge
STOKE-099	NC05398		Little Yadkin River W/S Dam #9	IMPOUNDING	High	Stokes	36.34583	-80.36139	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
STOKE-100	NC05399		Little Yadkin River W/S Dam #13a	IMPOUNDING	High	Stokes	36.35611	-80.34778	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
STOKE-101	NC05400		Little Yadkin River W/S Dam #14/16	IMPOUNDING	High	Stokes	36.36583	-80.34333	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
STOKE-103	NC05401		Little Yadkin River W/S Dam #20	IMPOUNDING	High	Stokes	36.37278	-80.3275	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
STOKE-107	NC05402		Little Yadkin River W/S Dam # 29	IMPOUNDING	High	Stokes	36.33	-80.3525	E Prong Little Yadkin River-Tr	Yadkin-PeeDee	
TRANS-084	NC05406		Forest Lake Dam	IMPOUNDING	High	Transylvania	35.20095	-82.78691	Wilson Mill Creek	French Broad	Rosman
UNION-079	NC05410		Olde Sycamore Wwtp Lagoon Dam	IMPOUNDING	High	Union	35.1595	-80.6038	Duck Creek-Tr	Yadkin-PeeDee	
UNION-080	NC05411		Baker Quarry Fresh Water Pond Dam	IMPOUNDING	High	Union	35.0306	-80.6033	Stewarts Creek-Tr	Yadkin-PeeDee	
RUTHE-057	NC05440		Second Broad W.S.Structure #2	IMPOUNDING	High	Rutherford	35.4977	-81.9966	Cathey's Creek	Broad	Rutherfordton
STOKE-111	NC05441		Town Fork Creek W/S Dam #7	IMPOUNDING	High	Stokes	36.2616	-80.2125	Red Bank Creek	Roanoke	Walnut Cove
BUNCO-084	NC05442		Kyfields Condominiums Dam	IMPOUNDING	High	Buncombe	35.6928	-82.5722	Reems Creek-Tr	French Broad	Weaverville
HENDE-108	NC05445		Macedonia Lake Dam	IMPOUNDING	High	Henderson	35.25325	-82.37096	Camp Creek-Tr	Broad	Mount Valley
JACKS-058	NC05446		Breedlove Dam	IMPOUNDING	High	Jackson	35.1516	-83.0718	Logan Creek-Tr	Savannah	Cashiers
MITCH-018	NC05453		Red Hill Quartz Plant Dam	IMPOUNDING	High	Mitchell	36.01292	-82.26192	North Toe River-Trib	French Broad	Huntdale
CABAR-074	NC05471		Wilkinson Dam	IMPOUNDING	High	Cabarrus	35.4042	-80.6569	Coddle-Creek-Tr	Yadkin-PeeDee	Roberta Mill
ROWAN-063	NC05476		Salisbury Community Park Dam	IMPOUNDING	High	Rowan	35.6971	-80.5485	Grants Creek-Tr	Yadkin-PeeDee	Salisbury
ONSLO-006	NC05478		North Topsail Water & Sewer Lagoon	IMPOUNDING	High	Onslow	34.5375	-77.43194	Mill Creek	White Oak	North Topsail Beach
DAVID-086	NC05502		Freeman Lake Dam	DRAINED	High	Davidson	35.8655	-80.0868	Hamby Creek-Tr	Yadkin-PeeDee	Thomasville
DAVID-087	NC05503		Tucker Dam	IMPOUNDING	High	Davidson	35.85142	-80.05398	Little Uwharrie-Tr	Yadkin-PeeDee	Trinity
DAVID-088	NC05504	69	Cedar Lodge Dam Lower	IMPOUNDING	High	Davidson	35.84141	-80.08434	Hamby Creek-Tr	Yadkin-PeeDee	Thomasville
DAVID-089	NC05505		Cedar Lodge Dam Upper	IMPOUNDING	High	Davidson	35.83847	-80.08327	Hamby Creek-Tr	Yadkin-PeeDee	Thomasville
DAVID-097	NC05513	16	Sapona Country Club Dam	IMPOUNDING	High	Davidson	35.8118	-80.3135	Beaver Dam Creek	Yadkin-PeeDee	Lexington
DAVID-100	NC05516		Jerry Clinard Lake Dam	IMPOUNDING	High	Davidson	35.9002	-80.1342	Hunts Fork-Tr	Yadkin-PeeDee	Thomasville

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
GUILF-301	NC05527		Jefferson Square Det. Pond Dam	IMPOUNDING	High	Guilford	36.1200	-79.8781	Trib. Horsepen Creek	Cape Fear	
WILKE-050	NC05534		Big Warrior Creek Dam	IMPOUNDING	High	Wilkes	36.0433	-81.2857	Big Warrior Creek	Yadkin-PeeDee	Boomer
ALAMA-092	NC05541		Hudgins Dam	DRAINED	High	Alamance	36.0711	-79.4467	Little Alamance Creek-Tr	Cape Fear	
ASHE-013	NC05542		Headwaters Dam	IMPOUNDING	High	Ashe	36.3707	-81.6252		New	
FORSY-209	NC05549		Beaver Brook Drive Dam	IMPOUNDING	High	Forsyth	36.0238	-80.3902	Johnson Creek-Tr	Yadkin-PeeDee	Clemmons
FORSY-210	NC05550	179	Arboretum Townhouse Dam	IMPOUNDING	High	Forsyth	36.1264	-80.0577	Deep Creek-Tr	Cape Fear	Kernersville
GUILF-303	NC05554		Innkeeper Detention Pond	IMPOUNDING	High	Guilford	36.07629	-79.95948	East Fork Deep River-Tr	Cape Fear	Greensboro
GUILF-306	NC05557		Donald Cox Dam	IMPOUNDING	High	Guilford	35.94	-79.6828	Trib To Big Alamance Creek	Cape Fear	Greensboro
HENDE-109	NC05558		Little Lake Dam	IMPOUNDING	High	Henderson	35.2498	-82.3564	Camp Creek-Tr	Broad	
IREDE-145	NC05560		Curtis Pond Dam	IMPOUNDING	High	Iredell	35.5354	-80.7879	Dye Creek-Trib.	Yadkin-PeeDee	Mooresville
IREDE-147	NC05562		Statesville Raw Water Reservoir Dam	IMPOUNDING	High	Iredell	35.8410	-80.8842	Fourth Creek - tributary	Yadkin-PeeDee	Statesville
MACON-060	NC05565		Fisher Pond Dam	IMPOUNDING	High	Macon	35.0060	-83.3025	Watkins Creek	Little Tennessee	Scaly Mountain
MECKL-182	NC05566		Symphony Park Dam	IMPOUNDING	High	Mecklenburg	35.156	-80.8353	Brier Creek-Tr	Catawba	Charlotte
RANDO-198	NC05568		Bullins Lake Dam	IMPOUNDING	High	Randolph	35.7309	-79.7943	Penwood Branch Trib	Cape Fear	Asheboro
RANDO-200	NC05570		Randleman Dam	IMPOUNDING	High	Randolph	35.8344	-79.8131	Deep River	Cape Fear	Randleman
RUTHE-062	NC05574		Laurel Lake Dam	IMPOUNDING	High	Rutherford	35.45582	-82.14639	Bills Creek-Tr	Broad	Lake Lure
SAMPS-050	NC05576		B. Vann Dam	DRAINED	High	Sampson	35.1909	-78.3753	Sevenmile Swamp- Trib	Cape Fear	
CALDW-031	NC05586		Broyhill Walking Park Dam	IMPOUNDING	High	Caldwell	35.9032	-81.5252	Trib to Lower Creek	Catawba	Lenoir
CLEVE-042	NC05588		Poplar Circle Dam	IMPOUNDING	High	Cleveland	35.2590	-81.5695	First Broad River - TR	Broad	
IREDE-148	NC05591		Lowe's CSC Dam	IMPOUNDING	High	Iredell	35.53924	-80.85502	Catawba River - Tr	Catawba	
HAYWO-017	NC05592		Barrett Pond Dam	DRAINED	High	Haywood	35.47220	-83.05126	Hayatt Creek Trib	French Broad	
STANL-055	NC05596		Spring Lake Garden Dam	IMPOUNDING	High	Stanly	35.3928	-80.2231	Town Creek - Trib.	Yadkin-PeeDee	
IREDE-149	NC05601		Morrison Plantation Dam #2	IMPOUNDING	High	Iredell	35.5902	-80.8891	McCrary Creek - Trib.	Catawba	
IREDE-150	NC05602		Morrison Plantation Dam #3	IMPOUNDING	High	Iredell	35.5858	-80.8830	McCrary Creek - Trib.	Catawba	
HENDE-111	NC05605		Carriage Park Dam	IMPOUNDING	High	Henderson	35.3462	-82.5142	Marston	French Broad	
RUTHE-063	NC05615	243	Willow Lake Estates	IMPOUNDING	High	Rutherford	35.34759	-82.01027	no stream flow into lake	Broad	
MECKL-183	NC05616		Winery Lane Dam	IMPOUNDING	High	Mecklenburg	35.2014	-80.7199	McAlpine Creek - tributary	Catawba	Charlotte
MADIS-014	NC05618		Stackhouse Dam Upper	IMPOUNDING	High	Madison	35.87583	-82.75598	King Creek	French Broad	Hot Springs
WAKE-373	NC05622		Breckenridge Recreation Center Dam	IMPOUNDING	High	Wake	35.83989	-78.86276	Kitt Creek TR	Cape Fear	Cary
WAKE-374	NC05623		Breckenridge Tract 9 & 10 Dam	IMPOUNDING	High	Wake	35.84129	-78.87309	Kitt Creek TR	Cape Fear	Cary
WAKE-375	NC05626		Eagle Ridge Golf Course Dam	IMPOUNDING	High	Wake	35.6703	-78.6700	Swift Creek - TR	Neuse	Smithfield
HENDE-112	NC05628		General Electric Lighting Systems Dam	IMPOUNDING	High	Henderson	35.27190	-82.40963	Off Stream of Bat Fork Creek	French Broad	Hendersonville
DURHA-120	NC05629		Ridgefield Subdv. SWDP Dam 14	IMPOUNDING	High	Durham	36.0052	-78.8109	Chunky Pipe Creek TR	Neuse	Durham
YANCE-012	NC05632		DEYTON DAM	IMPOUNDING	High	Yancey	35.92360	-82.27182	UNNAMMED TRIB. TO CRABTREE CRK	French Broad	BURNSVILLE
CLEVE-044	NC05636		Hughes Lake Dam	IMPOUNDING	High	Cleveland	35.1819	-81.3653	Kings Creek - Trib.	Broad	
MOORE-191	NC05637		Fairwoods Dam #4	IMPOUNDING	High	Moore	35.18573	-79.45446		Lumber	
HAYWO-018	NC05638	105	Lipham Dam	IMPOUNDING	High	Haywood	35.52491	-82.83001	TRIB. TO PIGEON RIVER	French Broad	CANTON
UNION-090	NC05639		Waybridge at Weddington	IMPOUNDING	High	Union	35.0330	-80.7283	Twelvemile Creek - Trib.	Catawba	
BEAUF-010	NC05642		PCS Phosphate R7 Blend Dike	IMPOUNDING	High	Beaufort	35.3133	-76.8163	NA	Tar-Pamlico	NA
WAKE-376	NC05644		Lake Amberly Dam	IMPOUNDING	High	Wake	35.8286	-78.9149	Morris Branch	Neuse	
FORSY-211	NC05650		Northwest Water Treatment Plant Dam #1	IMPOUNDING	High	Forsyth	36.1486	-80.4161	offstream	Yadkin-PeeDee	
FORSY-212	NC05651		Northwest Water Treatment Plant Dam #2	IMPOUNDING	High	Forsyth	36.1477	-80.4148	offstream	Yadkin-PeeDee	
POLK-042	NC05652		Robin Smith Dam	IMPOUNDING	High	Polk	35.21197	-82.28083	UT to Little Fall Creek (TR)	Broad	
DURHA-121	NC05653		The Streets at Southpoint Mall Dam	IMPOUNDING	High	Durham	35.90152	-78.94565	tributary to New Hope Creek	Cape Fear	
WAKE-379	NC05658		Huggins Glen Dam	IMPOUNDING	High	Wake	35.7809	-78.8155	unnamed trib. to Crabtree Cree	Neuse	Castalia Drive
CLEVE-045	NC05664		Lake Hollifield Dam	IMPOUNDING	High	Cleveland	35.2471	-81.6736	Sandy Run Branch - Trib.	Broad	
LINCO-068	NC05666		Glen Oaks Golf Course Dam B	IMPOUNDING	High	Lincoln	35.55628	-81.21864	Hog Branch - Trib.	Catawba	
HOKE-030	NC05670		Price Pond Dam	IMPOUNDING	High	Hoke	35.1029	-79.3783		Lumber	Aberdeen
STANL-056	NC05671		Deese Road Dam	IMPOUNDING	High	Stanly	35.4715	-80.2506	Curl Tail Creek - Trib.	Yadkin-PeeDee	

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
GUILF-312	NC05672		AMP Detention Dam	IMPOUNDING	High	Guilford	36.0800	-79.9750	Un Trib to East Fork Deep Rive	Cape Fear	High Point
LINCO-069	NC05673		Kaylor Pond Dam	IMPOUNDING	High	Lincoln	35.5324	-81.2121	Lackard Creek - Trib.	Catawba	
MECKL-185	NC05678		Berewick Farm Pond Dam #2	IMPOUNDING	High	Mecklenburg	35.1639	-80.9868	Beaverdam Creek - Trib.	Catawba	
GATES-001	NC05680		Merchants Millpond Dam	IMPOUNDING	High	Gates	36.4323	-76.6994	Benntees Creek	Chowan	
WAKE-380	NC05683	52	Windcrest	IMPOUNDING	High	Wake	35.6633	-78.8277	Middle Creek Tributary	Neuse	Amacord Way
WAKE-381	NC05685		Hasentree Golf Communtiy Dam	IMPOUNDING	High	Wake	35.9915	-78.5930	Water Fork	Neuse	Hasentree Club Drive
WAKE-382	NC05686		Neuse River Waste Water Treatment Plant Equalization Basin	IMPOUNDING	High	Wake	35.72223	-78.48989	Neuse River	Neuse	Mai Plantation Road
AVERY-032	NC05687		Grandfather Small Pond	IMPOUNDING	High	Avery	36.10350	-81.85163	unknown	Catawba	banner elk
MACON-061	NC05691		Rogers Dam	IMPOUNDING	High	Macon	35.18926	-83.40777		Little Tennessee	
GUILF-316	NC05694		Bridford Apartments Dam	IMPOUNDING	High	Guilford	36.0422	-79.9046	Trib to Bull Run	Cape Fear	Greensboro
WAKE-383	NC05695		Searstone	IMPOUNDING	High	Wake	35.7891	-78.8419	Turkey Creek trib	Neuse	Cary
COLUM-008	NC05701		South Bay Dike	IMPOUNDING	High	Columbus	34.3466	-78.2040	Cape Fear River	Cape Fear	NA
WAKE-384	NC05707		Powell Tract Dam	IMPOUNDING	High	Wake	35.6970	-78.7800	Camp Branch-OS	Neuse	Millens Bay Court
UNION-100	NC05711		Stonebridge Golf Course Dam	IMPOUNDING	High	Union	34.9400	-80.6230	Beaverdam Creek - Trib.	Yadkin-PeeDee	
BUNCO-088	NC05712		Lake Julian Dam	IMPOUNDING	High	Buncombe	35.4765	-82.5470	Trib to French Broad River	French Broad	Asheville
CLEVE-047	NC05714		Cliffside Retention Basin Dam	IMPOUNDING	High	Cleveland	35.2186	-81.7561	Broad River - OS	Broad	
ORANG-054	NC05715		Randy Fox Dam	IMPOUNDING	High	Orange	36.11427	-79.05732	Little Creek-Tr	Neuse	Hillsborough
ALAMA-093	NC05718		Mill Creek Subdivision Dam	IMPOUNDING	High	Alamance	36.1319	-79.2599	Tr. Mill Creek	Cape Fear	Mebane
HENDE-114	NC05720		Highland Lake SWDP Dam	IMPOUNDING	High	Henderson	35.28394	-82.43071	Trib to King's Creek	French Broad	Flat rock
ASHE-014	NC05727	4	Charles Harris Dam	IMPOUNDING	High	Ashe	36.3882	-81.2471	tributary of Meadow Fork	New	Laurel Springs
GASTO-092	NC05731		Messick Mobile Home Park Dam	IMPOUNDING	High	Gaston	35.2078	-81.1318	Catawba Creek - Tributary	Catawba	Gastonia
TRANS-085	NC05739		Graber Dam	IMPOUNDING	High	Transylvania	35.1490	-82.9096	North Flat Creek	French Broad	
BUNCO-091	NC05748		North Buncombe Quarry SB No. 7	IMPOUNDING	High	Buncombe	35.6858	-82.6166	French Broad River	French Broad	Weaverville
CALDW-034	NC05750		Coffey Dam	DRAINED	High	Caldwell	35.98723	-81.67254	House Branch	Catawba	Collettsville
WAKE-388	NC05753		Carolina Pines Dam	IMPOUNDING	High	Wake	35.7509	-78.6595	Trib. - Walnut Creek	Neuse	Raleigh
ORANG-055	NC05776		Occoneechee Upper Dam	IMPOUNDING	High	Orange	36.0600	-79.1147	Eno River trib	Neuse	Virginia Cates Rd.
ORANG-056	NC05777		Occoneechee Lower Dam	IMPOUNDING	High	Orange	36.0599	-79.1136	Eno River trib	Neuse	Virginia Cates Rd.
WAKE-391	NC05779		Haddon Hall Upper Dam	IMPOUNDING	High	Wake	35.7385	-78.8574		Cape Fear	
CATAW-073	NC05784		Mirror Lake Dam	IMPOUNDING	High	Catawba	35.6293	-81.0913	North Fork Mountain Creek - Tr	Catawba	
FORSY-215	NC05790		Dell Phase 1 SWDP Dam	IMPOUNDING	High	Forsyth	36.0632	-80.1273		Yadkin-PeeDee	
ORANG-017	NC05793		Hillsborough Water Supply Dam	IMPOUNDING	High	Orange	36.1486	-79.1714	West Fork Eno River	Neuse	Hillsborough (N. Elland Cedar)
WAKE-393	NC05795		RTP W-5 Dam	IMPOUNDING	High	Wake	35.85373	-78.88680	Kit Creek	Cape Fear	Jordan Reservoir
BUNCO-094	NC05798		Porter Dam	IMPOUNDING	High	Buncombe	35.74667	-82.62873	White Branch	French Broad	
WAKE-394	NC05802		Burnside Drive Dam	IMPOUNDING	High	Wake	35.6519	-78.7366	Middle Creek	Neuse	Burnside Drive
ROWAN-066	NC05810		Happy Lake Dam	DRAINED	High	Rowan	35.5602	-80.4964	Crane Creek	Yadkin-PeeDee	
SWAIN-014	NC05817		Lott Dam	IMPOUNDING	High	Swain	35.30584	-83.60356	Big Creek	Little Tennessee	Wesser
DURHA-123	NC05819		Patterson Place Dam	IMPOUNDING	High	Durham	35.9478	-78.9864	UT to New Hope Creek	Cape Fear	
SWAIN-016	NC05820		Frischholz Dam	IMPOUNDING	High	Swain	35.41055	-83.53017	Grassy Branch (B)	Little Tennessee	Almond
STOKE-113	NC05822		Little Yadkin W/S Dam # 8A	IMPOUNDING	High	Stokes	36.3530	-80.3675	East Prong Little Yadkin River	Yadkin-PeeDee	King
SWAIN-017	NC05828		Crimmins Dam	IMPOUNDING	High	Swain	35.43021	-83.54767	Grassy Branch (2-66)	Little Tennessee	Grassy Branch
CHATH-071	NC05829		Legacy Pond #2	IMPOUNDING	High	Chatham	35.7605	-79.0575	UT to Parker's Creek	Cape Fear	
MECKL-198	NC05830		Carolina Golf and Country Club Irrigation Dam	IMPOUNDING	High	Mecklenburg	35.2145	-80.8969	Irwin Creek - Trib.	Catawba	
WAYNE-030	NC05834		Mt. Olive Waste Water Treatment Plant #2	IMPOUNDING	High	Wayne	35.1957	-78.0427	offstream	Cape Fear	
WAKE-395	NC05843		Timberlake Dam	IMPOUNDING	High	Wake	35.7909	-78.3535	Little River	Neuse	Cedarmere Drive
HAYWO-024	NC05844		Harvey Dam	IMPOUNDING	High	Haywood	35.43264	-82.91017		French Broad	
JOHNS-096	NC05850		Son Lan Lee Shipwash Dam	IMPOUNDING	High	Johnston	35.6236	-78.5306	White Oak Cr. Swift Cr.	Neuse	St. Jiles Dr
CHATH-073	NC05853		Briar Chapel Reclamation Facility - 5 Day Upset Storage Pond	Dry Detention	High	Chatham	35.8233	-79.1196	None; off stream	Cape Fear	Bynum

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
FORSY-216	NC05854	53	Hillcrest Towne Center Pond B Dam	IMPOUNDING	High	Forsyth	36.0553	-80.3240	unnamed trib. to Little Creek	Yadkin-PeeDee	Winston-Salem
FORSY-217	NC05855	20	Hillcrest Towne Center Pond E Dam	IMPOUNDING	High	Forsyth	36.0557	-80.3274	unnamed trib. to Little Creek	Yadkin-PeeDee	Winston-Salem
WAKE-397	NC05860		Stonemont Pond Dam	IMPOUNDING	High	Wake	35.6230	-78.8701		Cape Fear	
HAYWO-025	NC05865		Smoky Mountain Sanctuary POA Dam	IMPOUNDING	High	Haywood	35.45779	-82.97688	Farmers Branch	French Broad	Waynesville
YADKI-065	NC05866		Deep Creek Watershed 5D Dam	IMPOUNDING	High	Yadkin	36.1262	-80.7303		Yadkin-PeeDee	
WAKE-398	NC05870		Seymour Farms Pond Dam	IMPOUNDING	High	Wake	35.7117	-78.8589	UT to Little Branch	Cape Fear	Apex
CLEVE-049	NC05874		Cliffside Active Ash Basin Downstream Dam	IMPOUNDING	High	Cleveland	35.2172	-81.7478	Suck Creek -- offstream	Broad	
CLEVE-050	NC05875		Cliffside Active Ash Basin Upstream Dam	IMPOUNDING	High	Cleveland	35.2142	-81.7555	o/s -- Broad River	Broad	
CABAR-084	NC05876		Christenbury Corners SWM Pond Dam	IMPOUNDING	High	Cabarrus	35.3792	-80.7282	Clarke Creek	Yadkin-PeeDee	Concord
WAKE-399	NC05877		Rosewood Subdivision Dam	IMPOUNDING	High	Wake	35.9653	-78.7051	UT to Barton Creek	Neuse	MacTavish Way
MECKL-207	NC05881		Hunter Acres Pond Dam	IMPOUNDING	High	Mecklenburg	35.3065	-80.8117	trib to Mallard Creek	Yadkin-PeeDee	
BEAUF-011	NC05885		PCS Phosphate #1a Cooling Pond Dike	IMPOUNDING	High	Beaufort	35.3708	-76.7874	Offstream	Tar-Pamlico	
DAVID-112	NC05887		Yachtmans Point Dam	IMPOUNDING	High	Davidson	35.6389	-80.2750	Trib to High Rock Lake	Yadkin-PeeDee	
HENDE-118	NC05890		Valmont Dam	IMPOUNDING	High	Henderson	35.3277	-82.4822	Tributary to Brittain Creek	French Broad	Hendersonville
WAKE-400	NC05894		Tryon Road Dam	IMPOUNDING	High	Wake	35.7465	-78.7503	Speight Br.; Swift Cr.;	Neuse	Tryon Rd (NC-1009)
RUTHE-070	NC05914		Cliffside Inactive Ash Basin #5 Main Dam	DRAINED	High	Rutherford	35.2156	-81.7687		Broad	
MITCH-020	NC05916		Hawkins Sediment Basin 4	IMPOUNDING	High	Mitchell	35.93605	-82.08485	offstream	French Broad	Spruce Pine
YADKI-066	NC05920		Yadkinville WTP Reservoir Dam	IMPOUNDING	High	Yadkin	36.1008	-80.6503	Off Stream	Yadkin-PeeDee	Yadkinville
STOKE-116	NC05937		Belews Creek Active Ash Basin Dam	IMPOUNDING	High	Stokes	36.2965	-80.0751	Tributary to Dan River	Roanoke	Mayodan
STOKE-117	NC05938		Belews Creek Saddle Dike #1 Dam	IMPOUNDING	High	Stokes	36.3143	-80.0402	Tributary to Dan River	Roanoke	Mayodan
STOKE-118	NC05939		Belews Creek Saddle Dike #2 Dam	IMPOUNDING	High	Stokes	36.3176	-80.0359	Tributary to Dan River	Roanoke	Mayodan
STOKE-119	NC05940		Belews Creek Saddle Dike #3 Dam	IMPOUNDING	High	Stokes	36.3196	-80.0336	Tributary to Dan River	Roanoke	Mayodan
ROCKI-235	NC05941		Belews Creek Saddle Dike #4 Dam	IMPOUNDING	High	Rockingham	36.3215	-80.0315	Tributary to Dan River	Roanoke	Mayodan
ROCKI-236	NC05942		Belews Lake Dam	IMPOUNDING	High	Rockingham	36.3200	-80.0244	Tributary to Dan River	Roanoke	Mayodan
ROCKI-237	NC05945		Dan River Active Primary Ash Basin Dam	DRAINED	High	Rockingham	36.4883	-79.7148	Dan River	Roanoke	Eden
ROCKI-238	NC05946		Dan River Active Secondary Ash Basin Dam	IMPOUNDING	High	Rockingham	36.4919	-79.7114	Dan River	Roanoke	Eden
ROBES-009	NC05948	25	Weatherspoon 1979 Ash Basin Dam	IMPOUNDING	High	Robeson	34.5913	-78.9693	Lumber	Lumber	Boardman
JOHNS-097	NC05958		Miry Branch Dam	IMPOUNDING	High	Johnston	35.5936	-78.5819		Neuse	
RUTHE-072	NC05959		Cliffside Inactive Ash Basin #5 Saddle Dam	DRAINED	High	Rutherford	35.2157	-81.7657		Broad	
MECKL-211	NC05961		Hechenbleikner Dam	IMPOUNDING	High	Mecklenburg	35.30381	-80.73205		Yadkin-PeeDee	
CRAVE-004	NC05962		Carolina Commons Dam	DRAINED	High	Craven	35.0220	-77.0141	Brice Creek	Neuse	James City
ROWAN-068	NC05966		Buck Ash Basin #1 Dam	IMPOUNDING	High	Rowan	35.7064	-80.3742	Yadkin River	Yadkin-PeeDee	High Rock
ROWAN-069	NC05967		Buck Basin #1 to Basin #2 Dam	IMPOUNDING	High	Rowan	35.7031	-80.3672	Yadkin River	Yadkin-PeeDee	High Rock
ROWAN-070	NC05968		Buck Basin #2 to Basin #3 Dam	IMPOUNDING	High	Rowan	35.7076	-80.3643	Yadkin River	Yadkin-PeeDee	High Rock
ROWAN-071	NC05969		Buck Ash Basin Divider Dam	IMPOUNDING	High	Rowan	35.7098	-80.3641	Yadkin River	Yadkin-PeeDee	High Rock
BUNCO-097	NC05971		Asheville 1964 Ash Basin Dam	IMPOUNDING	High	Buncombe	35.4674	-82.5479	French Broad River	French Broad	
PERSO-033	NC05973		Roxboro East Ash Basin Dam	IMPOUNDING	High	Person	36.4806	-79.0670		Roanoke	
HENDE-123	NC05974		Tuxedo Saddle Dam	IMPOUNDING	High	Henderson	35.2325	-82.3989	Green River	Broad	Melrose
DUPLI-032	NC05975		NC Hwy 11/903 Dam	IMPOUNDING	High	Duplin	35.0060	-77.9107		Cape Fear	
DUPLI-034	NC05977		Bennetts Bridge Rd. Dam	IMPOUNDING	High	Duplin	35.0773	-77.9099		Cape Fear	
BRUNS-011	NC05978		Boiling Springs Lake Upper Dam	IMPOUNDING	High	Brunswick	34.0239	-78.0658	Allen Creek	Cape Fear	Boiling Springs Lake
WAYNE-031	NC05980		HF Lee Inactive Ash Basin #1 Dam	IMPOUNDING	High	Wayne	35.3813	-78.1102	Neuse	Neuse	
WAYNE-032	NC05981		HF Lee Inactive Ash Basin #2 Dam	IMPOUNDING	High	Wayne	35.3828	-78.1041	neuse	Neuse	
WAYNE-033	NC05982		HF Lee Inactive Ash Basin #3 Dam	IMPOUNDING	High	Wayne	35.3758	-78.1069	Neuse	Neuse	Goldsboro
MECKL-213	NC05988		McDonald Dam	IMPOUNDING	High	Mecklenburg	35.2926	-80.8131	tributary to Irwin Creek	Catawba	Charlotte
CUMBE-108	NC05990		Strickland Bridge Dam	IMPOUNDING	High	Cumberland	35.0087	-79.0214	Rockfish Creek	Cape Fear	Hope Mills
MECKL-214	NC05992		Samonds Dam	IMPOUNDING	High	Mecklenburg	35.2935	-80.8118	Unnamed tributary to Irwin Cre	Catawba	Charlotte

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
CHATH-075	NC05996		Cape Fear 1956 Ash Basin Dam	DRAINED	High	Chatham	35.5971	-79.0509	OS-Deep River	Cape Fear	
CHATH-076	NC05997		Cape Fear 1963 Ash Basin Dam	DRAINED	High	Chatham	35.5865	-79.0510	OS-Deep River	Cape Fear	
CHATH-077	NC05998		Cape Fear 1970 Ash Basin Dam	DRAINED	High	Chatham	35.5829	-79.0499	OS-Deep River	Cape Fear	
CHATH-078	NC05999		Cape Fear 1978 Ash Basin Dam	IMPOUNDING	High	Chatham	35.5876	-79.0455	OS-Deep River	Cape Fear	
CHATH-079	NC06000		Cape Fear 1985 Ash Basin Dam	IMPOUNDING	High	Chatham	35.5864	-79.0395	OS-Deep River	Cape Fear	
PERSO-034	NC06002		Mayo Lake Dam	IMPOUNDING	High	Person	36.5367	-78.8760	Mayo Creek	Roanoke	
PERSO-035	NC06003		Mayo Active Ash Basin Dam	IMPOUNDING	High	Person	36.5380	-78.8936	Crutchfield Branch	Roanoke	
PERSO-038	NC06006		Roxboro West Ash Basin Dam	IMPOUNDING	High	Person	36.4766	-79.0773	OS-Hyco River	Roanoke	
PERSO-039	NC06007		Roxboro West Ash Basin Rock Filter Dam	IMPOUNDING	High	Person	36.4645	-79.0707	OS-Hyco River	Roanoke	
PERSO-040	NC06008		Roxboro West FGD Settling Pond Dam	DRAINED	High	Person	36.4737	-79.0767	Sargents Creek	Roanoke	
PERSO-041	NC06009		Roxboro East FGD Settling Pond Dam	IMPOUNDING	High	Person	36.4737	-79.0751	Sargents Creek	Roanoke	
PERSO-042	NC06010		Roxboro FGD Forward Flush Pond Dam	IMPOUNDING	High	Person	36.4719	-79.0768	Sargents Creek	Roanoke	
PERSO-044	NC06016		Jimmie Bowes Transmission Line Embankment	DRAINED	High	Person	36.4950	-79.0164	Ghent Creek-TR	Roanoke	
UNION-108	NC06019		Woodhall Dam	IMPOUNDING	High	Union	34.9749	-80.8030	tributary to Cowhorn Branch	Catawba	
CABAR-087	NC06025		Sycamore Ridge Dam	IMPOUNDING	High	Cabarrus	35.4600	-80.5791	Tributary to Cold Water Creek	Yadkin-PeeDee	Concord
CLEVE-055	NC06035		Cleveland Co. Sanitary District Water Storage Reservoir Dam	IMPOUNDING	High	Cleveland	35.43453	-81.56608	UT to First Broad River	Broad	Lawndale
GASTO-106	NC06046		Poston Park Dam	IMPOUNDING	High	Gaston	35.2832	-81.1065	Houser Branch	Catawba	Lowell
ANSON-056	NC06054	6	Anson County WWTP Upper Dam (Sludge Lagoon)	IMPOUNDING	High	Anson	34.97108	-79.93131	McCoy Creek	Yadkin-PeeDee	Blewitt Falls Dam
ANSON-057	NC06055	6	Anson County WWTP Lower Dam (Sludge Lagoon)	IMPOUNDING	High	Anson	34.9729	-79.9300	McCoy Creek	Yadkin-PeeDee	Blewitt Falls Dam
CHERO-038	NC06058	105	Senecal Dam	IMPOUNDING	High	Cherokee	35.08765	-84.25823		Hiwassee	
HARNE-099	NC06059		Hamilton Lake Dam	IMPOUNDING	High	Harnett	35.5489	-78.8151	UT Kenneth Creek	Cape Fear	Chalebeate Springs
BEAUF-012	NC06062		PCS Phosphates R-5 Dike	IMPOUNDING	High	Beaufort	35.3411	-76.8310		Tar-Pamlico	
WAKE-405	NC06066		Bedford at Falls River Dam #1	IMPOUNDING	High	Wake	35.9300	-78.5679		Neuse	
WAYNE-035	NC06067		Ruth Bryan Dam	IMPOUNDING	High	Wayne	35.4051	-78.0492		Neuse	
ONSLO-008	NC06070		Jacksonville LTS-South Storage Lagoon	IMPOUNDING	High	Onslow	34.7625	-77.5417		White Oak	
MOORE-199	NC06080		Southern Pines Raw Water Reservoir Dam	IMPOUNDING	High	Moore	35.0838	-79.5006	offstream	Lumber	
CUMBE-112	NC06087		Mildred White Crystal Lake Dam	IMPOUNDING	High	Cumberland	35.1229	-78.8885		Cape Fear	Fayetteville
WAKE-406	NC06089		Woolner Dam	IMPOUNDING	High	Wake	35.7208	-78.7921	Swift Creek-TR	Neuse	Cary
WAKE-407	NC06093		Pine Knoll Dam	IMPOUNDING	High	Wake	35.8269	-78.5900	UT to Marsh Creek	Neuse	Raleigh
CHATH-082	NC06101		Governors Village Dam #8	IMPOUNDING	High	Chatham	35.8486	-79.0242		Cape Fear	
CLEVE-057	NC06103		Fluff's Carp & Catfish Lake Dam	IMPOUNDING	High	Cleveland	35.2071	-81.4872	tributary to Buffalo Creek	Broad	
WAKE-409	NC06108		Carolina Country Club Water Harvesting Pond Dam	IMPOUNDING	High	Wake	35.8219	-78.6568	Offstream of Beaverdam Creek	Neuse	Raleigh
CALDW-036	NC06110		Holden Dam	IMPOUNDING	High	Caldwell	35.9195	-81.6462	unname trib to Mulberry	Catawba	Colletsville
JACKS-069	NC06111		Town of Sylva Water Supply Dam	IMPOUNDING	High	Jackson	35.4087	-83.1992	Dills Branch	Little Tennessee	Sylva
DURHA-128	NC06117		Forest at Duke Dam	IMPOUNDING	High	Durham	35.9725	-78.9518		Cape Fear	
FORSY-222	NC06118		Kaymoore Dam	IMPOUNDING	High	Forsyth	36.0126	-80.2776	Trib to Muddy Creek	Yadkin-PeeDee	
UNION-109	NC06120		Ladera Dam	IMPOUNDING	High	Union	34.9883	-80.8064	Tributary to Six-Mile Creek	Catawba	Marvin
HAYWO-029	NC06123		Fishers Lake Dam	IMPOUNDING	High	Haywood	35.5106	-82.8167	Unnamed Tributary to Garden Cr	French Broad	Canton
LINCO-122	NC06125		City of Cherryville Water Supply Reservoir	IMPOUNDING	High	Lincoln	35.4177	-81.3708	Offstream	Catawba	
JOHNS-099	NC06127		Terry Parker Pond Dam	IMPOUNDING	High	Johnston	35.4872	-78.4686	Sassorixa Swamp-TR	Neuse	Lassiter Pond Road
MONTG-043	NC06129		River Road Dam	IMPOUNDING	High	Montgomery	35.3607	-80.0404	Big Island Creek	Yadkin-PeeDee	Troy
DUPLI-035	NC06130		Bennetts Bridge Upper South	IMPOUNDING	High	Duplin	35.0764	-77.9085		Cape Fear	
DUPLI-036	NC06131		Bennetts Bridge Upper North	IMPOUNDING	High	Duplin	35.0772	-77.9072		Cape Fear	
UNION-110	NC06133		Willowcroft Dam	IMPOUNDING	High	Union	35.0655	-80.7195	West Fork Twelve Mile Creek	Catawba	
GREEN-184	NC06134		Audie Murphy Irrigation Pond	IMPOUNDING	High	Greene	35.5352	-77.8205	Unnamed tributary to Appletree	Neuse	Lindell
DURHA-129	NC06139		Williams Terminal Reservoir Dam	IMPOUNDING	High	Durham	36.0200	-78.9373	Ellerbe Creek	Neuse	Durham

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
UNION-112	NC06140		McGee Dam	IMPOUNDING	High	Union	35.0177	-80.7532	Mundy's Run	Catawba	Weddington
CUMBE-114	NC06141		Wooded Lake Dam	DRAINED	High	Cumberland	35.1441	-78.8816		Cape Fear	
CUMBE-115	NC06143		Autry Pond Dam	IMPOUNDING	High	Cumberland	34.9991	-79.0203	Little Rockfish Creek	Cape Fear	Fayetteville
MECKL-221	NC06144		Walden Two Dam	IMPOUNDING	High	Mecklenburg	35.2153	-80.6607	Trib to McKee Creek	Yadkin-PeeDee	
ROWAN-074	NC06145		Chicken Springs Dam	IMPOUNDING	High	Rowan	35.6885	-80.4464		Yadkin-PeeDee	Spencer
DURHA-130	NC06146		Duke Water Harvesting Pond Dam	IMPOUNDING	High	Durham	36.0031	-78.9501	Sandy Creek	Cape Fear	Durham
WAKE-413	NC06147		Duke Energy Garner NTA Yard Expansion SWMF #4	IMPOUNDING	High	Wake	35.7252	-78.6274		Neuse	
WAKE-414	NC06148		Highland Creek SWF # 1	IMPOUNDING	High	Wake	35.8931	-78.5189		Neuse	
WAKE-415	NC06149		Highland Creek SWF # 2	IMPOUNDING	High	Wake	35.8926	-78.5176		Neuse	
WAKE-416	NC06150		Highland Creek SWF # 10	IMPOUNDING	High	Wake	35.8938	-78.5220		Neuse	
BEAUF-021	NC06154		PCS Phosphate R-9 Dike	IMPOUNDING	High	Beaufort	35.3367	-76.8076		Tar-Pamlico	
UNION-113	NC06157		Providence Downs South Pond Dam	IMPOUNDING	High	Union	34.9819	-80.8145	Cowhorn Branch	Catawba	Marvin
HENDE-124	NC06159		Lake Pointe Dam	IMPOUNDING	High	Henderson	35.3416	-82.4507		French Broad	
WAKE-418	NC06160		McCullers Pond Dam	IMPOUNDING	High	Wake	35.6571	-78.7100	Mills Branch	Neuse	
CABAR-090	NC06167		Taylor Glen Dam	IMPOUNDING	High	Cabarrus	35.3836	-80.6781	Coddle creek	Yadkin-PeeDee	
WAKE-422	NC06171		Silverton Dam	IMPOUNDING	High	Wake	35.8136	-78.8047	trib to Crabtree Creek	Neuse	Cary
MECKL-223	NC06177		Landtec Pond Dam	IMPOUNDING	High	Mecklenburg	35.1162	-80.7349	Unamed Tributary to 4-mile cre	Catawba	Matthews
IREDE-284	NC06178		FARM POND DAM	DRAINED	High	Iredell	35.5486	-80.7785	Rocky River	Yadkin-PeeDee	Mooresville
YADKI-344	NC06187		Highland Orchard Dam	IMPOUNDING	High	Yadkin	36.1809	-80.8356	Unnamed Trib to Arnolds Branch	Yadkin-PeeDee	Jonesville
YADKI-345	NC06188		Highland Orchard Dam	IMPOUNDING	High	Yadkin	36.1740	-80.8340		Yadkin-PeeDee	
JOHNS-101	NC06191		Regal Pond Dam	IMPOUNDING	High	Johnston	35.5069	-78.6066	Hooks Branch	Neuse	Hardee's Crossroads
JOHNS-102	NC06196		Hamilton Pond Dam	IMPOUNDING	High	Johnston	35.4913	-78.5446	Pole Branch	Neuse	Benson
WAKE-430	NC06197		North Ridge Country Club Hole #13 Dam	IMPOUNDING	High	Wake	35.8773	-78.6071		Neuse	
GASTO-324	NC06200		Allen Retention Basin Dam	IMPOUNDING	High	Gaston	35.1870	-81.0170	Catawba	Catawba	
CATAW-075	NC06201		Marshall Holding Basin Dam	IMPOUNDING	High	Catawba	35.6015	-80.9785		Catawba	
CATAW-076	NC06202		Marshall Retention Basin Dam	IMPOUNDING	High	Catawba	35.5999	-80.9762		Catawba	
STOKE-120	NC06203		Belews Creek Holding Basin Dam	IMPOUNDING	High	Stokes	36.2847	-80.0663		Roanoke	
STOKE-121	NC06204		Belews Creek Retention Basin Dam	IMPOUNDING	High	Stokes	36.2847	-80.0663		Roanoke	
PERSO-047	NC06205		Roxboro Holding Basin Dam	IMPOUNDING	High	Person	36.4840	-79.0740		Roanoke	
PERSO-048	NC06206		Roxboro Retention Basin Dam	IMPOUNDING	High	Person	36.4840	-79.0740		Roanoke	
PERSO-049	NC06207		Mayo FGD Settling Basin Dam	IMPOUNDING	High	Person	36.5390	-78.8830		Roanoke	
PERSO-050	NC06208		Mayo Retention Basin Dam	IMPOUNDING	High	Person	36.5280	-78.9020		Roanoke	
VANCE-040	NC06210		Medlin Pond Dam	IMPOUNDING	High	Vance	36.3130	-78.3600		Tar-Pamlico	
WAKE-432	NC06214		Courtyards at Kildaire SCM A	IMPOUNDING	High	Wake	35.6904	-78.7880	NA	Neuse	Apex
WAKE-433	NC06215		Courtyards at Kildaire SCM B	IMPOUNDING	High	Wake	35.6921	-78.7894	Neuse River	Neuse	Cary
WAKE-434	NC06216		Trilogy Dam	IMPOUNDING	High	Wake	35.6689	-78.7086		Neuse	
MECKL-226	NC06222		1516 Glenn Valley Dam	IMPOUNDING	High	Mecklenburg	35.1031	-80.7593	Undetermined	Catawba	Matthews
STANL-384	NC06252		Huneycutt Pig Farm Dam	IMPOUNDING	High	Stanly	35.3495	-80.3027	Trib. to Ramsey Ck	Yadkin-PeeDee	Albemarle
CABAR-466	NC06255		Beechwood Place Dam	IMPOUNDING	High	Cabarrus	35.3870	-80.5960	Undetermined	Yadkin-PeeDee	Concord
GUILF-324	NC06268		Aaron Sink Farm Pond Dam	IMPOUNDING	High	Guilford	35.9612	-79.8771	Unnamed tributary to Hickory C	Cape Fear	Greensboro
CABAR-469	NC06281		Horton (BMP) Dam	IMPOUNDING	High	Cabarrus	35.3689	-80.6175	Wolf Meadow Branch	Yadkin-PeeDee	Concord
CHATH-085	NC06282		Horton's Pond Dam	IMPOUNDING	High	Chatham	35.7602	-78.9836	MIll Branch and Jordan Lake	Cape Fear	Bells
DUPLI-037	NC06291		Warsaw Bio Gas Lined Process Holding Pond	IMPOUNDING	High	Duplin	35.0049	-78.1200	Unnamed Tributary to Turkey Cr	Cape Fear	Warsaw
MACON-067	NC06305		Coweeta Lake Dam	IMPOUNDING	High	Macon	35.0747	-83.3947	Coweeta River	Little Tennessee	Otto
WAKE-446	NC06324		Allen Trust Dam	IMPOUNDING	High	Wake	35.8295	-78.5772	Undeterminable	Neuse	Starmount Hills
BRUNS-012	NC06405		Upper (Allen Creek) Dam	IMPOUNDING	High	Brunswick	34.0216	-78.0693	Allen Creek	Cape Fear	Boiling Springs
DURHA-138	NC06420		Lake Swannanoa Dam	IMPOUNDING	High	Durham	36.0293	-78.9562	Ellerbe Creek	Neuse	Durham
FORSY-238	NC06425		Mitch Allen Dam (proposed)	IMPOUNDING	High	Forsyth	36.2400	-80.4308	Near Yadkin River	Yadkin-PeeDee	Tobaccoville

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
BUNCO-504	NC06429		Asheville North Stormwater Pond Dam	IMPOUNDING	High	Buncombe	35.4690	-82.5491		French Broad	Asheville
BUNCO-505	NC06430		Asheville South Stormwater Pond Dam	IMPOUNDING	High	Buncombe	35.4664	-82.5479		French Broad	Asheville
MECKL-239	NC06433		Beam Road Dam	IMPOUNDING	High	Mecklenburg	35.1847	-80.9277	Sugar Creek	Catawba	Charlotte
WAKE-460	NC06435		Ransdell - Wake Chapel Dam	IMPOUNDING	High	Wake	35.5971	-78.8031		Cape Fear	
FRANK-334	NC06437		Fox Lake Dam	IMPOUNDING	High	Franklin	36.0754	-78.3052	UT to Wolfpen Branch	Tar-Pamlico	Louisburg
IREDE-289	NC06438		Rick Howell Lake Dam	IMPOUNDING	High	Iredell	35.7067	-80.8260	Trib to Greasy Creek	Yadkin-PeeDee	Statesville
WAKE-461	NC06442		Guilford Mills Dam	IMPOUNDING	High	Wake	35.6132	-78.8023	Neuse River Basin	Neuse	Fuquay-Varina
DURHA-139	NC06443		Chamberlynne Subdivision Dam #3	IMPOUNDING	High	Durham	35.9314	-78.9325	Third Fork Creek	Cape Fear	Durham
DURHA-140	NC06444		Chamberlynne Dam #4	IMPOUNDING	High	Durham	35.9325	-78.9333	Third Fork Creek	Cape Fear	Durham
CABAR-007	NC06451		Frank Liske Park Dam	IMPOUNDING	High	Cabarrus	35.3647	-80.6207	Wolf Meadow Branch - Tr	Yadkin-PeeDee	Roberta Mill
ROBES-011	NC06452		Lumberton City Flood Gate	IMPOUNDING	High	Robeson	34.6275	-79.0399	Lumber	Lumber	Lumberton
TRANS-092	NC06465		Waterford Place POA Dam	IMPOUNDING	High	Transylvania	35.2392	-82.7522	UT to Hunts Breach Stream	French Broad	Brevard
JOHNS-105	NC06468		Ronald Barbour Dam	IMPOUNDING	High	Johnston	35.4814	-78.5264		Neuse	
FORSY-240	NC06471		Tanglewood Forest HOA Dam	IMPOUNDING	High	Forsyth	36.0107	-80.3919	Tributary to Johnson's Creek	Yadkin-PeeDee	Clemmons
UNION-124	NC06473		Yadkin River Water Supply Project Dam	IMPOUNDING	High	Union	35.0646	-80.4429	UT to Richardson Creek	Yadkin-PeeDee	Unionville
MECKL-240	NC06477		Reformed Theological Seminary Dam	IMPOUNDING	High	Mecklenburg	35.1370	-80.8039	Tributary to McAlpine Creek	Catawba	Charlotte
CABAR-477	NC06479		Hunton Forest Dam	IMPOUNDING	High	Cabarrus	35.4235	-80.6452		Yadkin-PeeDee	
BEAUF-404	NC06482		R-11 Dike, Nutrien-Aurora Division	IMPOUNDING	High	Beaufort	35.3686	-76.7603		Tar-Pamlico	
GASTO-333	NC06486		Kenneth Raymond Stowe II Dam	IMPOUNDING	High	Gaston	35.1992	-81.0859	UT to the Catawba Creek	Catawba	Gastonia
WAKE-465	NC06487		Rogers Farm Pond Dam	IMPOUNDING	High	Wake	35.8928	-78.4485	UT to Harris Creek	Neuse	Rolesville
GUILF-335	NC06489		WDB-B Dam	IMPOUNDING	High	Guilford	35.9984	-79.7980	UT to S. Buffalo Creek	Cape Fear	Reidsville
IREDE-293	NC06490		Larkin Golf Course North Dam	IMPOUNDING	High	Iredell	35.7437	-80.8660	Trib to Third Creek	Yadkin-PeeDee	Cleveland
IREDE-294	NC06491		Larkin Golf Course South Dam	IMPOUNDING	High	Iredell	35.7434	-80.8656	Trib to Third Creek	Yadkin-PeeDee	Cleveland
MECKL-241	NC06497		Coffey Creek Dam	IMPOUNDING	High	Mecklenburg	35.1915	-80.9416	Coffey Creek	Catawba	Charlotte
STANL-387	NC06499		Charlotte Pipe BMP #1	IMPOUNDING	High	Stanly	35.2158	-80.3468	UT to Coldwater Creek	Yadkin-PeeDee	Oakboro
STANL-388	NC06500		Charlotte Pipe BMP #2	IMPOUNDING	High	Stanly	35.2128	-80.3460	UT to Coldwater Creek	Yadkin-PeeDee	Oakbrook
STANL-389	NC06501		Charlotte Pipe BMP #3	IMPOUNDING	High	Stanly	35.2126	-80.3432	UT to Coldwater Creek	Yadkin-PeeDee	Oakboro
UNION-125	NC06502		City of Monroe WWTP Equalization Pond	IMPOUNDING	High	Union	34.9948	-80.4941	Richardson Creek	Yadkin-PeeDee	Monroe
CABAR-478	NC06503		Heritage Moss Creek BMP Dam	IMPOUNDING	High	Cabarrus	35.4386	-80.7384	UT to Rocky River	Yadkin-PeeDee	Concord
ORANG-068	NC06504		Wilkins Dam	IMPOUNDING	High	Orange	36.1154	-79.1130		Neuse	
ORANG-069	NC06505		Haithcock Heirs Dam	IMPOUNDING	High	Orange	36.1197	-79.1146		Neuse	
CABAR-479	NC06507		Cannon Run #1	IMPOUNDING	High	Cabarrus	35.4368	-80.7333	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-480	NC06508		Cannon Run #2	IMPOUNDING	High	Cabarrus	35.4350	-80.7336	UT to the Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-481	NC06509		Cannon Run #3	IMPOUNDING	High	Cabarrus	35.4346	-80.7319	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-482	NC06510		Cannon Run #4	IMPOUNDING	High	Cabarrus	35.4349	-80.7301	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-483	NC06511		Cannon Run #5	IMPOUNDING	High	Cabarrus	35.4350	-80.7285	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-484	NC06512		Cannon Run #6	IMPOUNDING	High	Cabarrus	35.4331	-80.7328	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-485	NC06513		Cannon Run #7	IMPOUNDING	High	Cabarrus	35.4342	-80.7298	UT to Rocky River	Yadkin-PeeDee	Harrisburg
CABAR-486	NC06514		Cannon Run #8	IMPOUNDING	High	Cabarrus	35.4344	-80.7285	UT to Rocky River	Yadkin-PeeDee	Harrisburg
GUILF-336	NC06515		Brighterwood Crossing Dam	IMPOUNDING	High	Guilford	36.0684	-79.5918	Cape Fear and Rocky Creek	Cape Fear	Whitsett
GUILF-524	NC06516		Konica Drive Dam	IMPOUNDING	High	Guilford	36.0575	-79.5772	Lake MacIntoch and Little Alam	Cape Fear	Whitsett
ALAMA-103	NC06518		Villas on The 5th Dam	IMPOUNDING	High	Alamance	36.0699	-79.2868	Little Haw Creek	Cape Fear	Mebane
MOORE-207	NC06519		Rockery Pond Dam	IMPOUNDING	High	Moore	35.2687	-79.3673	Little River	Cape Fear	Lake View
ROWAN-080	NC06521		Yadkin High Rock	IMPOUNDING	High	Rowan	35.6006	-80.2345	Yadkin River	Yadkin-PeeDee	High Rock
BUNCO-511	NC06522		Craggy Dam	IMPOUNDING	High	Buncombe	35.6416	-82.5997	French Broad River	French Broad	Woodfin
BURKE-042	NC06523		Paddy Creek Chute Spillway	IMPOUNDING	High	Burke	35.7388	-81.8443	Catawba River	Catawba	Glen Alpine
JACKS-071	NC06526		E. Fork (Tannasee Creek) Dam Gated Spillway 2 Fuse Plugs	IMPOUNDING	High	Jackson	35.2132	-83.0013	Tuckasegee River	Little Tennessee	Tuckasegee
MACON-070	NC06528		White Oak Creek Dam	IMPOUNDING	High	Macon	35.2288	-83.6319	White Oak Creek	Little Tennessee	Aquone

State ID	NID ID	Estimated Population at Risk (PAR)	Dam Name	DAM_STATUS	Dam Hazard Potential	COUNTY	LATITUDE	LONGITUDE	RIVER_STREAM	RIVER_BASIN	Nearest Town
NORTH-023	NC06530		Gaston North Saddle Dam	IMPOUNDING	High	Northampton	36.5079	-77.8111	Roanoke	Roanoke	Henrico
GASTO-334	NC06531		Spencer Mountain Dam	IMPOUNDING	High	Gaston	35.3092	-81.1116	South Fork Catawba River	Catawba	Spencer Mountain
GASTO-335	NC06532		Spencer Mountain Canal Embankment	IMPOUNDING	High	Gaston	35.3097	-81.1055	South Fork Catawba River	Catawba	Spencer Mountain
MADIS-017	NC06533		Capitola Dam	IMPOUNDING	High	Madison	35.7948	-82.6803	French Broad River	French Broad	Marshall
DURHA-141	NC06534		Summit Church Dam	IMPOUNDING	High	Durham	36.0582	-78.9484	UT to Crystal Lake	Neuse	Cabe's Mill
CABAR-487	NC06536		Piper Landing Wet Pond #2	IMPOUNDING	High	Cabarrus	35.4063	-80.6192	UT to Irish Buffalo Little Cre	Yadkin-PeeDee	Concord