THE UNIVERSITY OF NORTH CAROLINA SYSTEM



# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

East Carolina University
Elizabeth City State University
Fayetteville State University
North Carolina Central University
North Carolina School of Science and Mathematics
North Carolina State University
University of North Carolina at Chapel Hill
University of North Carolina at Pembroke
University of North Carolina at Wilmington

wsp

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# 1. Introduction

Section 1 provides a general introduction to hazard mitigation and an introduction to the UNC Eastern Campuses Regional Hazard Mitigation Plan. This section contains the following subsections:

- 1.1 Background
- 1.2 Purpose and Authority
- 1.3 Scope
- 1.4 References
- 1.5 Plan Organization

## 1.1 Background

Each year in the United States, natural and human-caused hazards take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses incurred by insurance companies and non-governmental organizations are not reimbursed by tax dollars. Many natural hazards are predictable, and much of the damage caused by hazard events can be reduced or even eliminated.

Hazards are a natural part of the environment that will inevitably continue to occur, but there is much we can do to minimize their impacts and prevent them from resulting in disasters. Every community faces different hazards, has different resources to draw upon in combating problems, and has different interests that influence the solutions to those problems. Because there are many ways to deal with hazards and many agencies that can help, there is no one solution for managing or mitigating their effects. Planning is one of the best ways to develop a customized program that will mitigate the impacts of hazards while accounting for the unique character of a community.

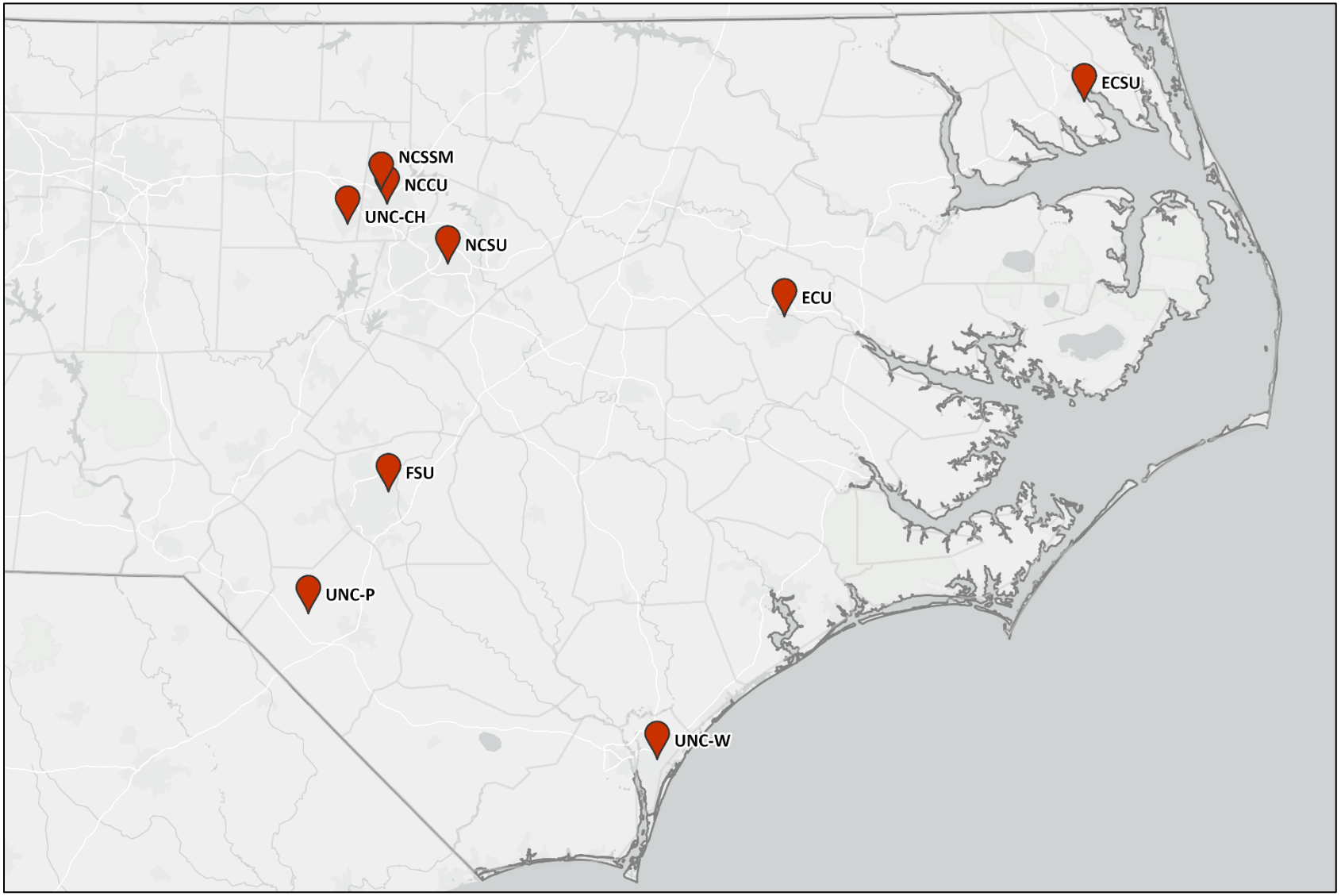
A well-prepared hazard mitigation plan will ensure that all possible activities are reviewed and implemented so that the problem is addressed by the most appropriate and efficient solutions. It can also ensure that activities are coordinated with other goals and activities, preventing conflicts and reducing the costs of implementing each individual activity. North Carolina's public institutions have a significant investment in terms of buildings, facilities, infrastructure, historical and cultural landmarks, library and art collections, laboratories and other essential assets, many of which are vulnerable to the impacts of natural hazards. This plan provides a framework for the UNC System Eastern Campuses to work together toward mitigation.

The UNC System Eastern Campuses comprises the following nine institutions:

- East Carolina University (ECU)
- Elizabeth City State University (ECSU)
- Fayetteville State University (FSU)
- North Carolina Central University (NCCU)
- North Carolina School of Science and Math (NCSSM)
- North Carolina State University (NCSU)
- University of North Carolina Chapel Hill (UNC-CH)
- University of North Carolina Pembroke (UNC-P)
- University of North Carolina Wilmington (UNC-W)

Figure 1.1 below provides an overview of the general location of each campus.

**Figure 1.1 – UNC Eastern Campus Locations**



## 1.2 Purpose and Authority

In an effort to reduce the nation's mounting natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) to invoke new and revitalized approaches to mitigation planning. Section 322 of DMA 2000 emphasizes the need for state and local government entities to closely coordinate on mitigation planning activities and makes the development of a hazard mitigation plan a specific eligibility requirement for any local jurisdiction applying for federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP), the Building Resilient Infrastructure and Communities (BRIC) program, and the Flood Mitigation Assistance (FMA) Program, all of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Jurisdictions with an adopted and federally approved hazard mitigation plan thereby become pre-positioned to receive available mitigation funds before and after the next disaster strikes.

This plan has been prepared in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000, (DMA 2000) Public Law 106-390 of October 30, 2000, as implemented at CFR 201.6 and 201.7 dated October 2007. Additionally, development of this plan followed the guidance outlined in the FEMA 2003 publication “Building a Disaster-Resistant University.”

This plan was developed in a joint and cooperative manner by members of a Hazard Mitigation Planning Committee (HMPC) which included representatives of various departments from each participating campus as well as other outside stakeholders. This plan was prepared in coordination with FEMA Region 4 and the North Carolina Division of Emergency Management (NCEM) to ensure that it meets all applicable federal and state planning requirements. A Local Mitigation Plan Review Tool, found in Appendix A, provides a summary of FEMA’s current minimum standards of acceptability and notes the location within this plan where each planning requirement is met. This plan will ensure all nine institutions participating in the UNC Eastern Campuses plan are eligible for federal disaster assistance including the FEMA HMGP program.

This plan will be adopted by each participating campus in accordance with standard local procedures. Copies of adoption resolutions are provided in Section 6 Plan Adoption.

## 1.3 Scope

This document comprises a Hazard Mitigation Plan for the University of North Carolina (UNC) System Eastern Campuses region, which covers the main campuses of ECU, ECSU, FSU, NCCU, NCSSM, NCSU, UNC-CH, UNC-P, and UNC-W. It should be noted that several of the participating schools and universities have satellite campuses, some of which were evaluated on a case-by-case basis or for certain relevant hazards. It is up to each institution to determine how the findings of this plan apply to their satellite campuses.

A map of each campus included in this plan is provided below in Figure 1.2 through Figure 1.12.

The HMPC conducted a risk assessment that identified and profiled hazards that pose a risk to the planning area, assessed the planning area's vulnerability to these hazards, and examined each participating campus' capabilities to mitigate them. The hazards profiled in this plan include:

- Natural Hazards:
  - Dam Failure
  - Drought
  - Earthquake
  - Excessive Heat
  - Flooding
  - Geological: Landslide & Sinkhole
  - Hurricane & Coastal Hazards
  - Severe Winter Weather
  - Tornadoes & Thunderstorms
  - Wildfire
- Technological / Human-Caused Hazards:
  - Cyber Security
  - Hazardous Substances
  - Infectious Disease
  - Terrorism

**Figure 1.2 – ECU Campus Map**

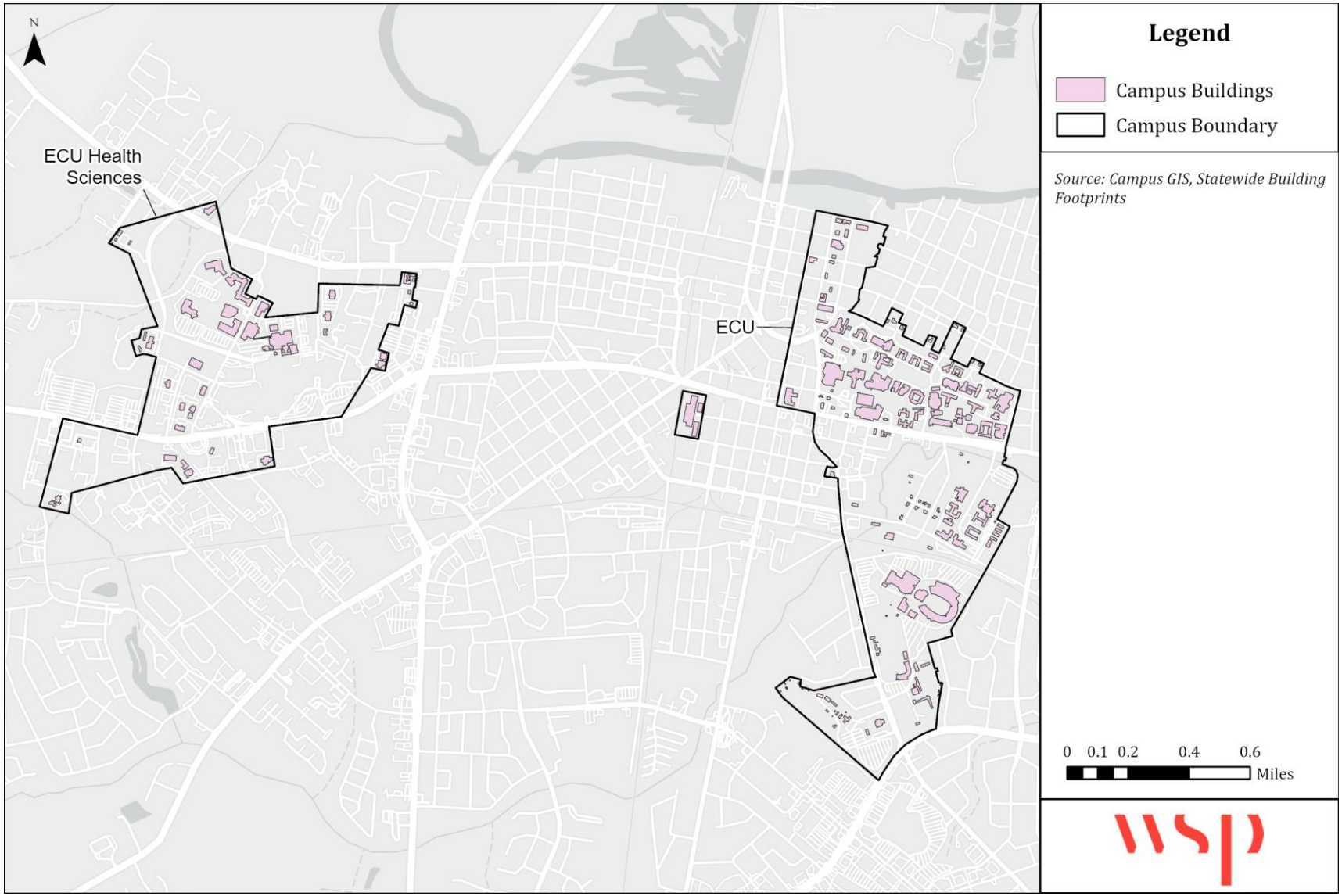


**Figure 1.3 – ECSU Campus Map**

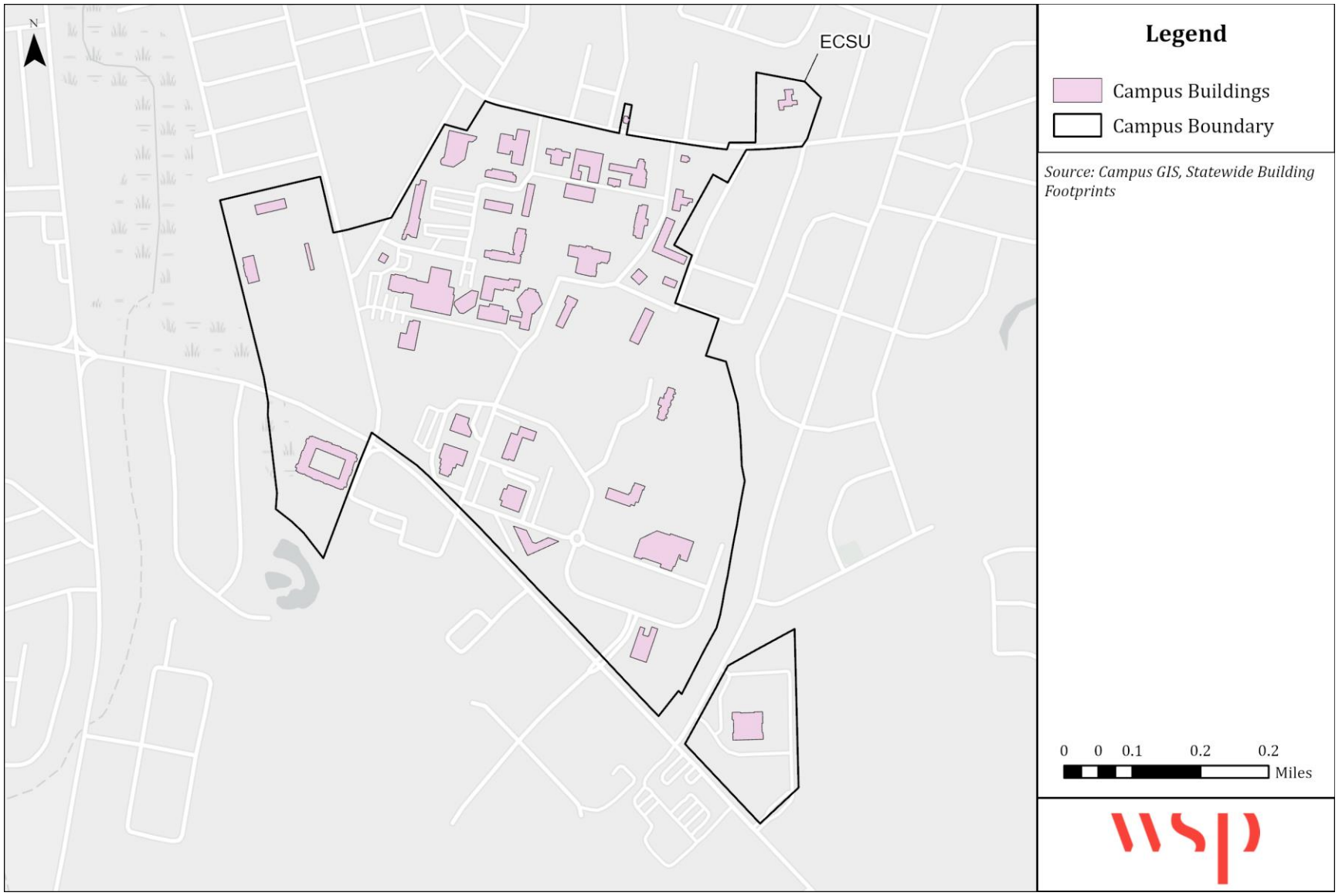


**Figure 1.4 – FSU Campus Map**



**Figure 1.5 – NCCU Campus Map**

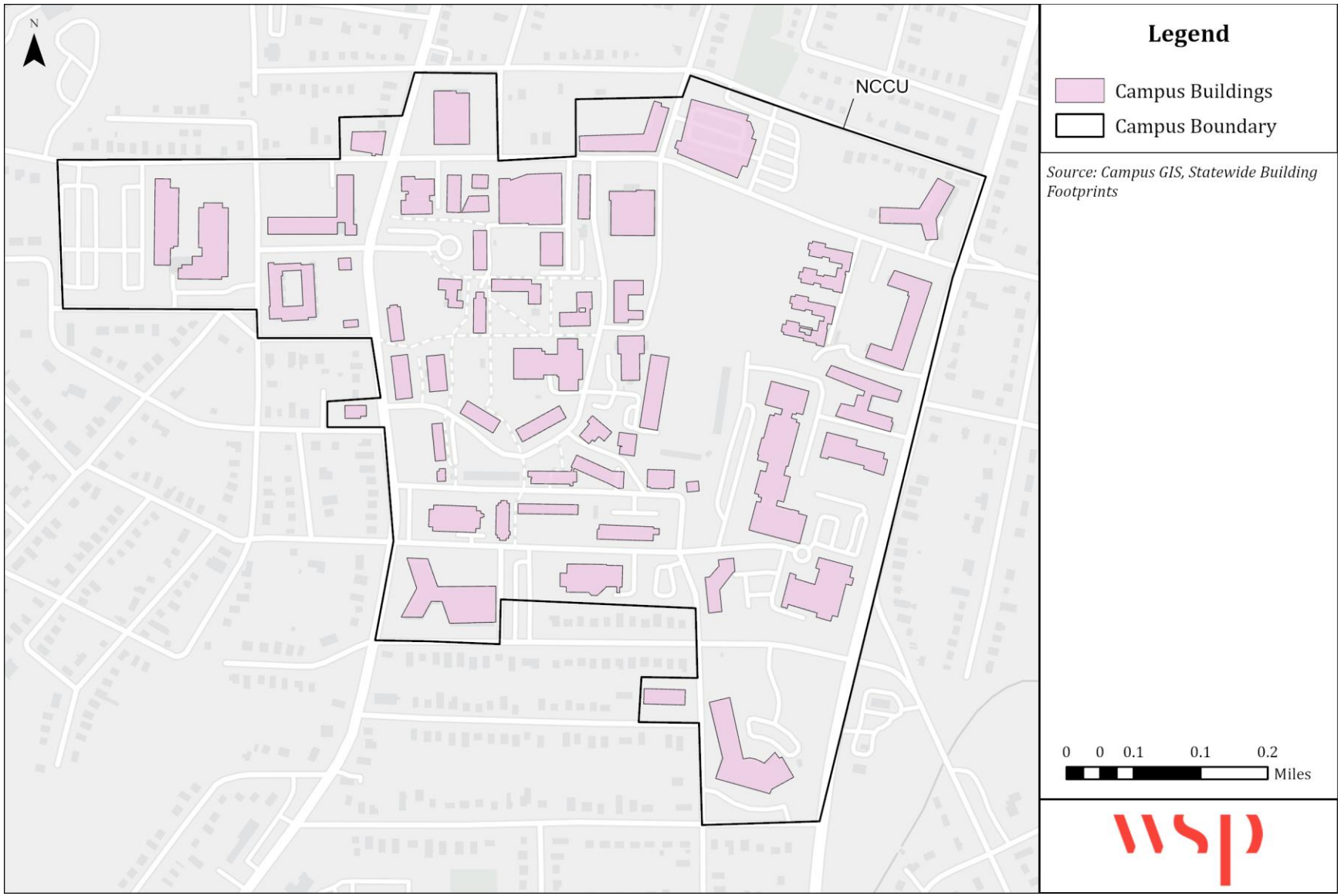


**Figure 1.6 – NCSSM Campus Map**

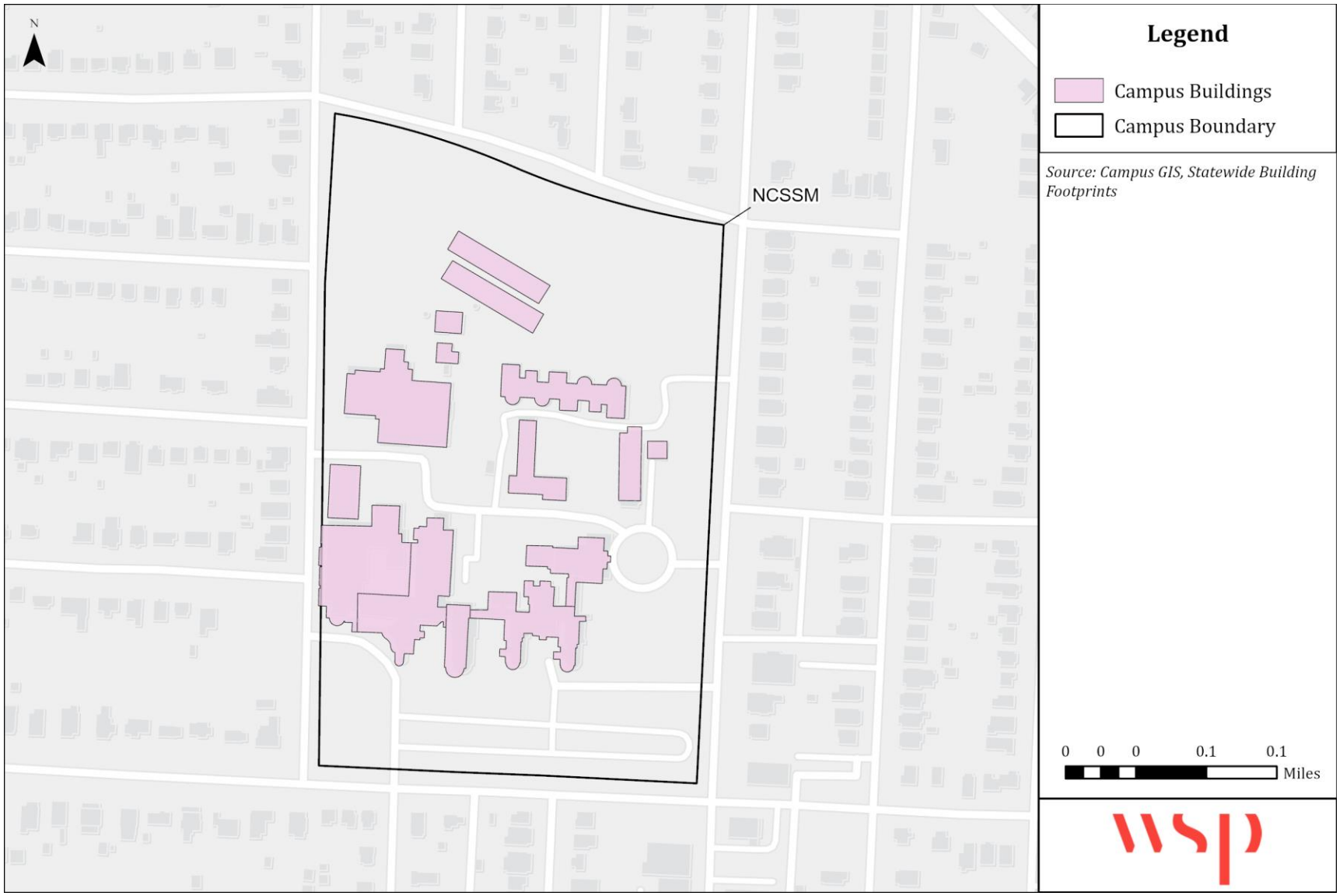


**Figure 1.7 – NCSU Campus Map**

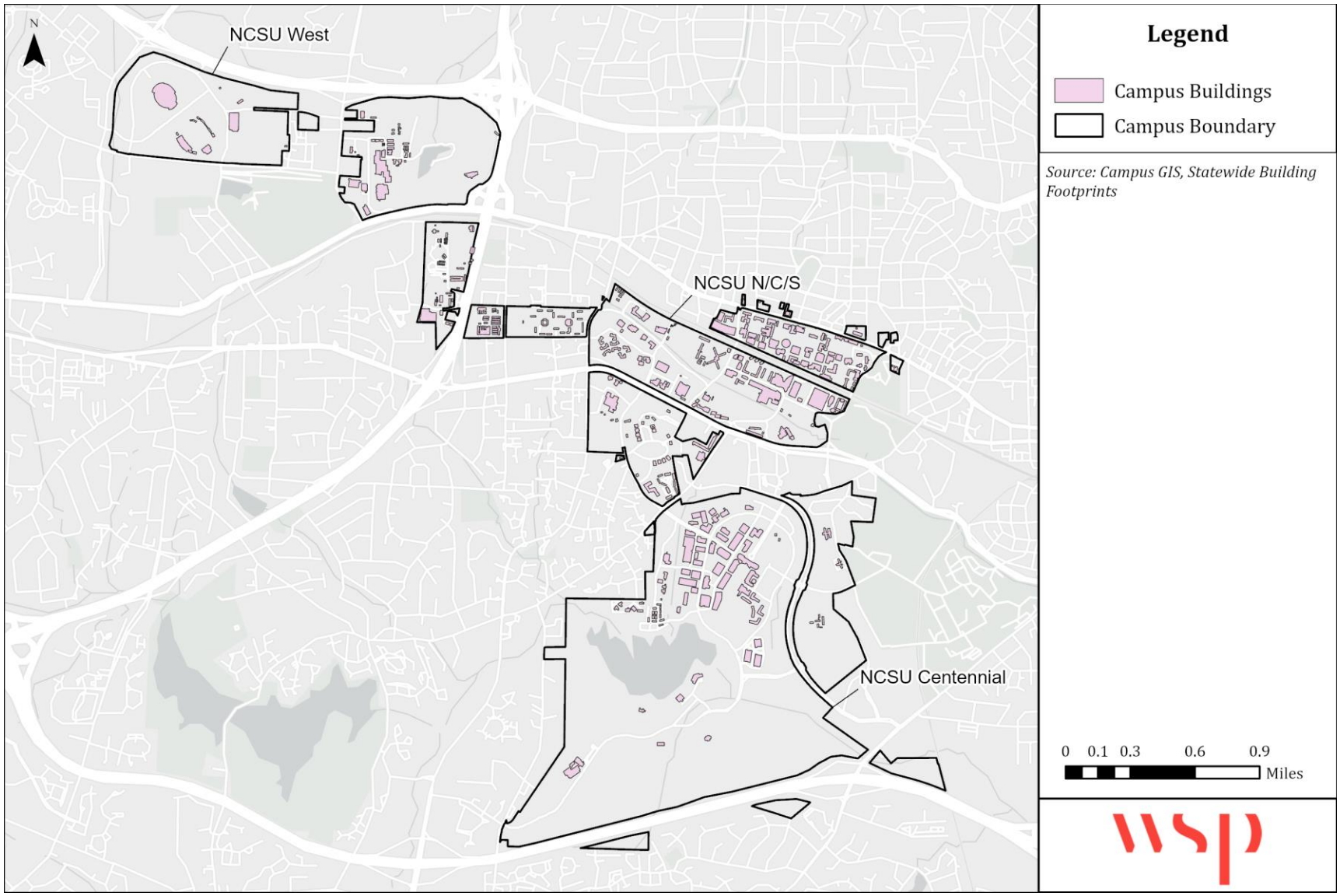


**Figure 1.8 – UNC-CH Central, South, and East Campus Map**

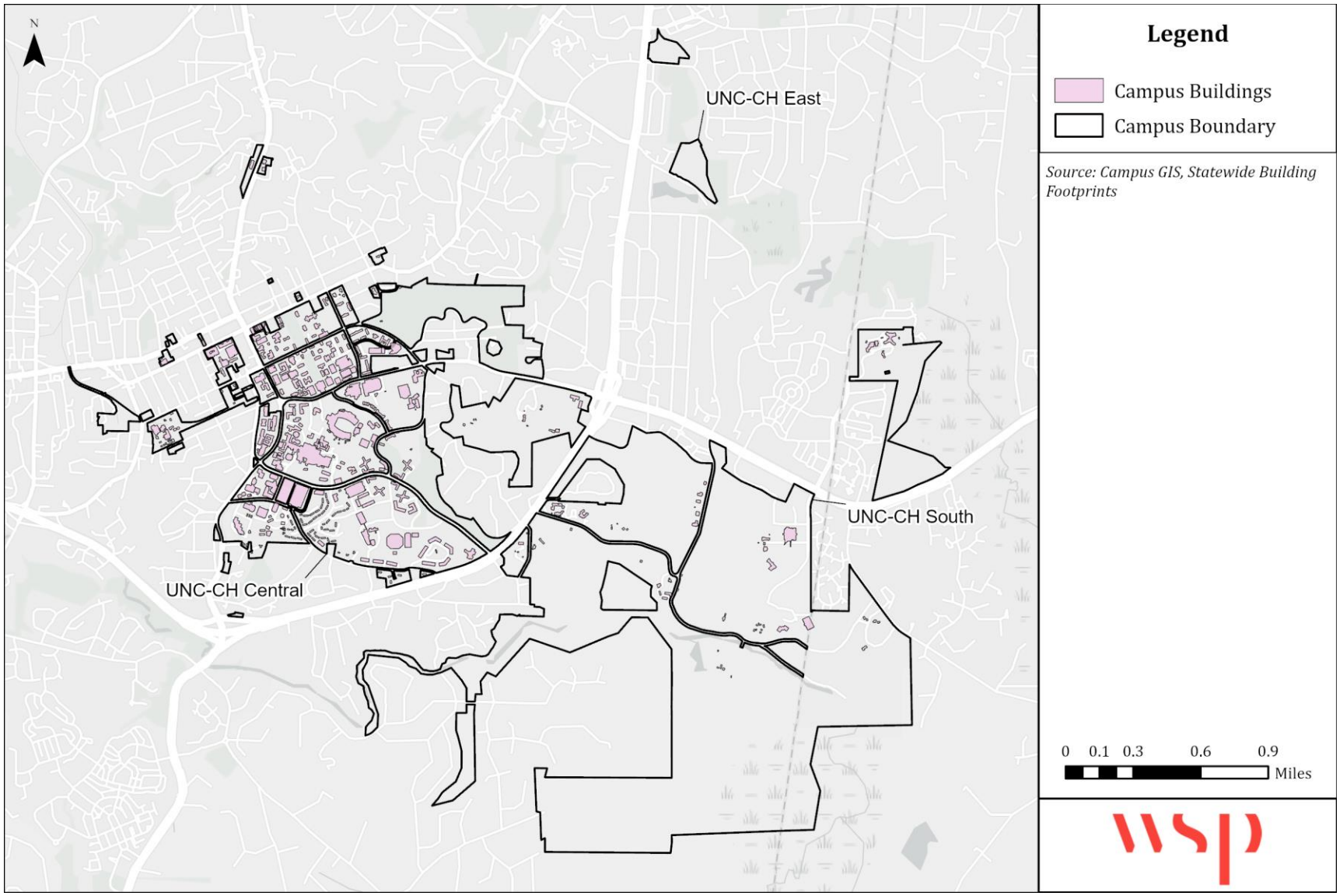


**Figure 1.9 – UNC-CH North Campus Map**

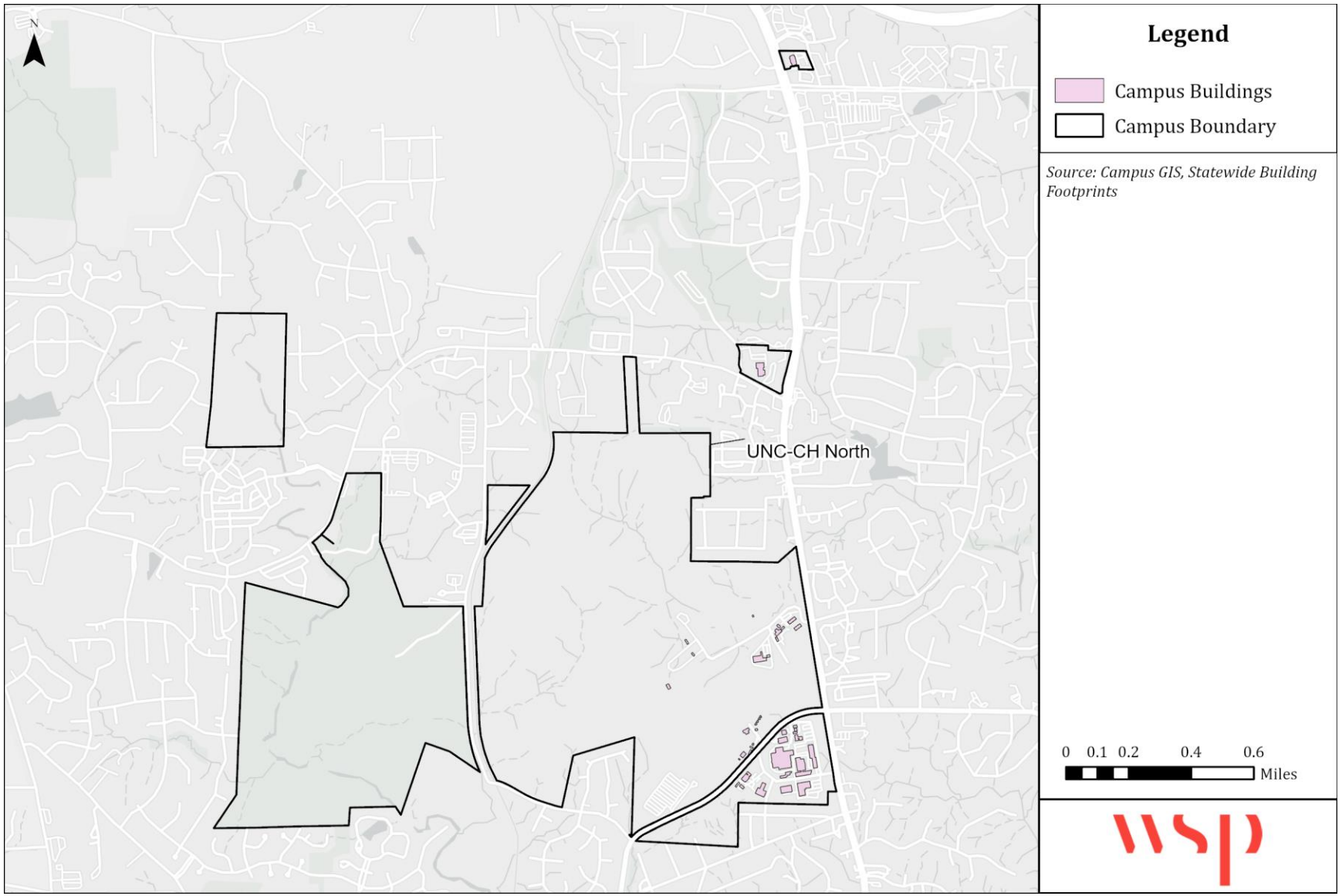


**Figure 1.10 - UNC-CH West Campus Map**

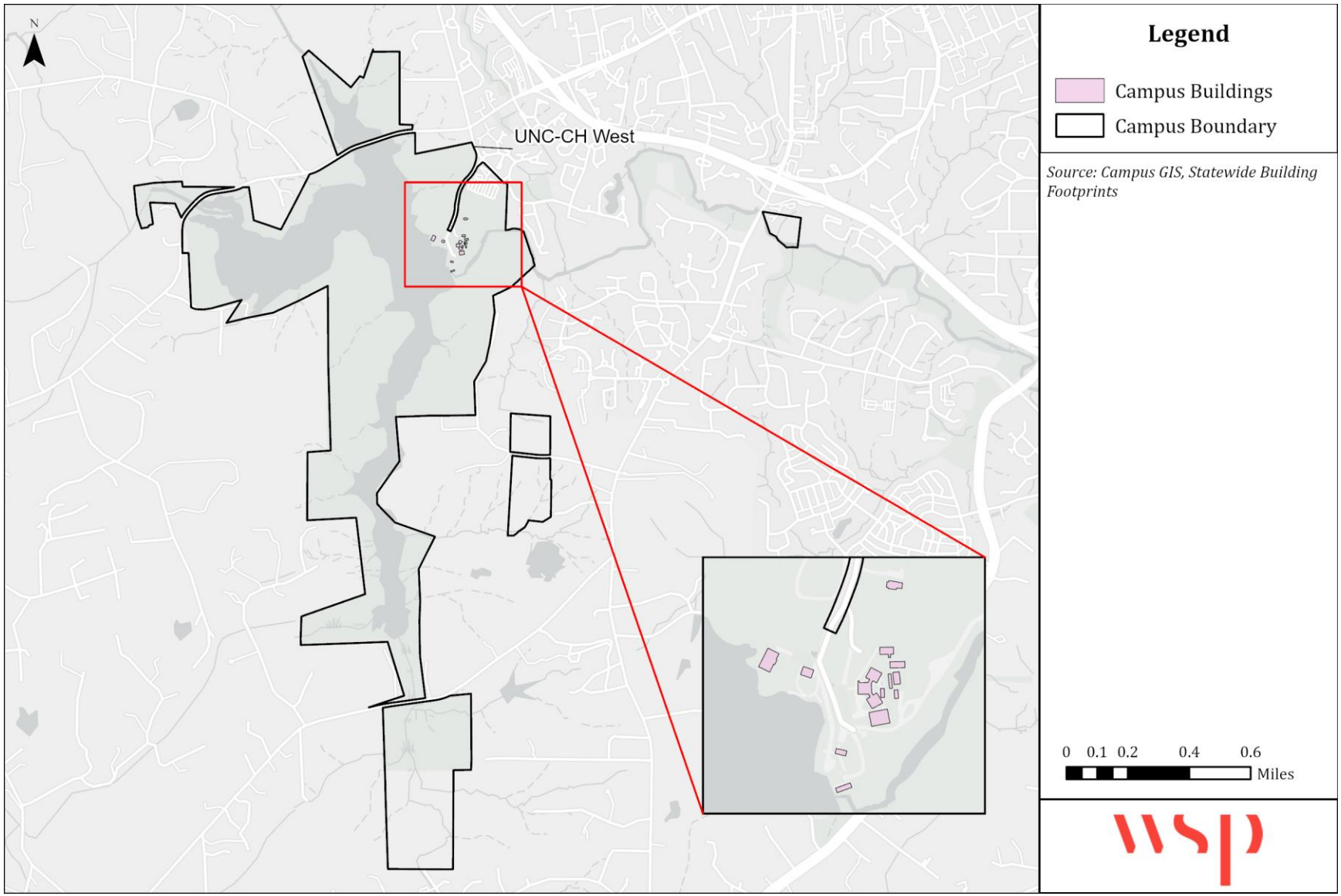


**Figure 1.11 – UNC-P Campus Map**

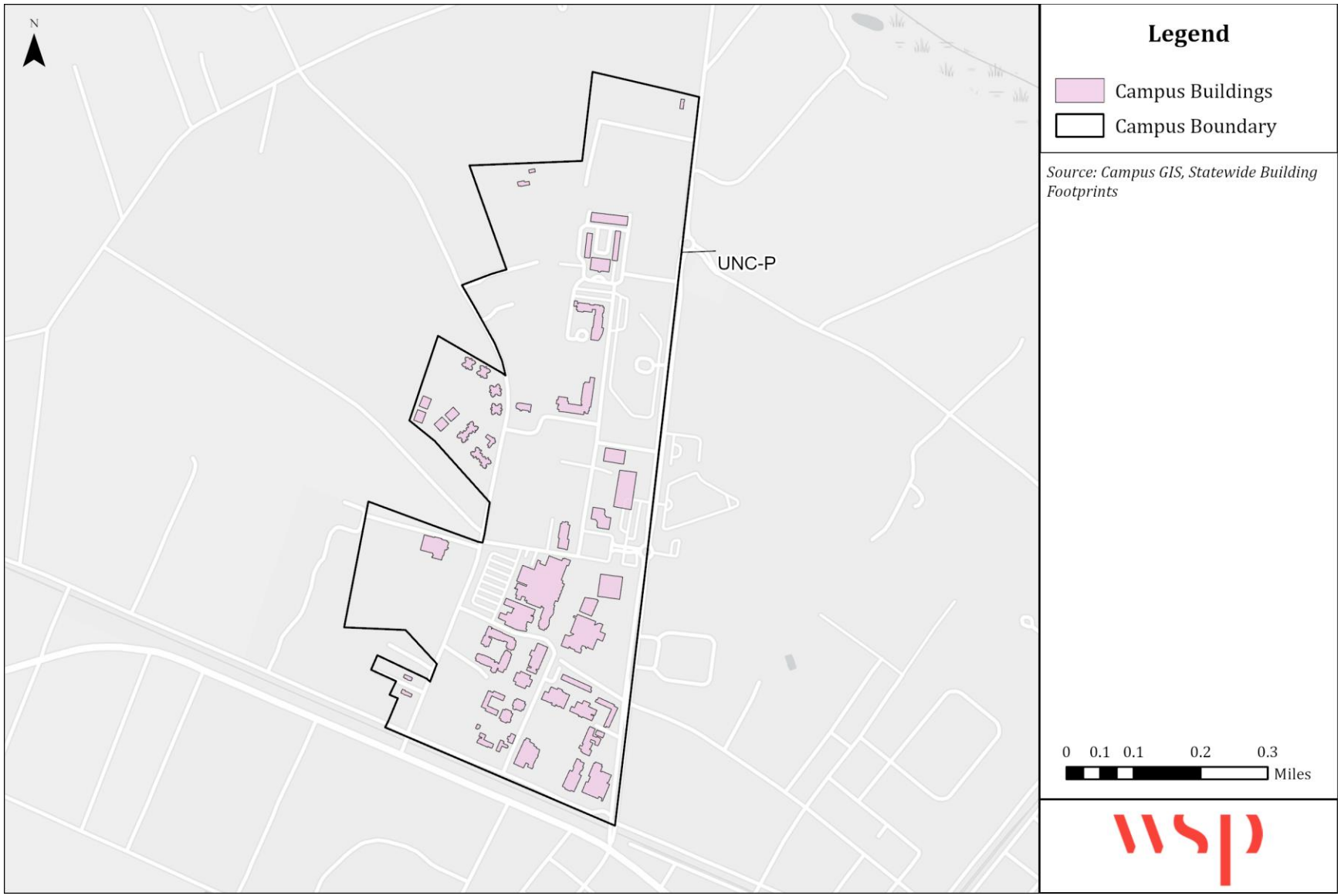
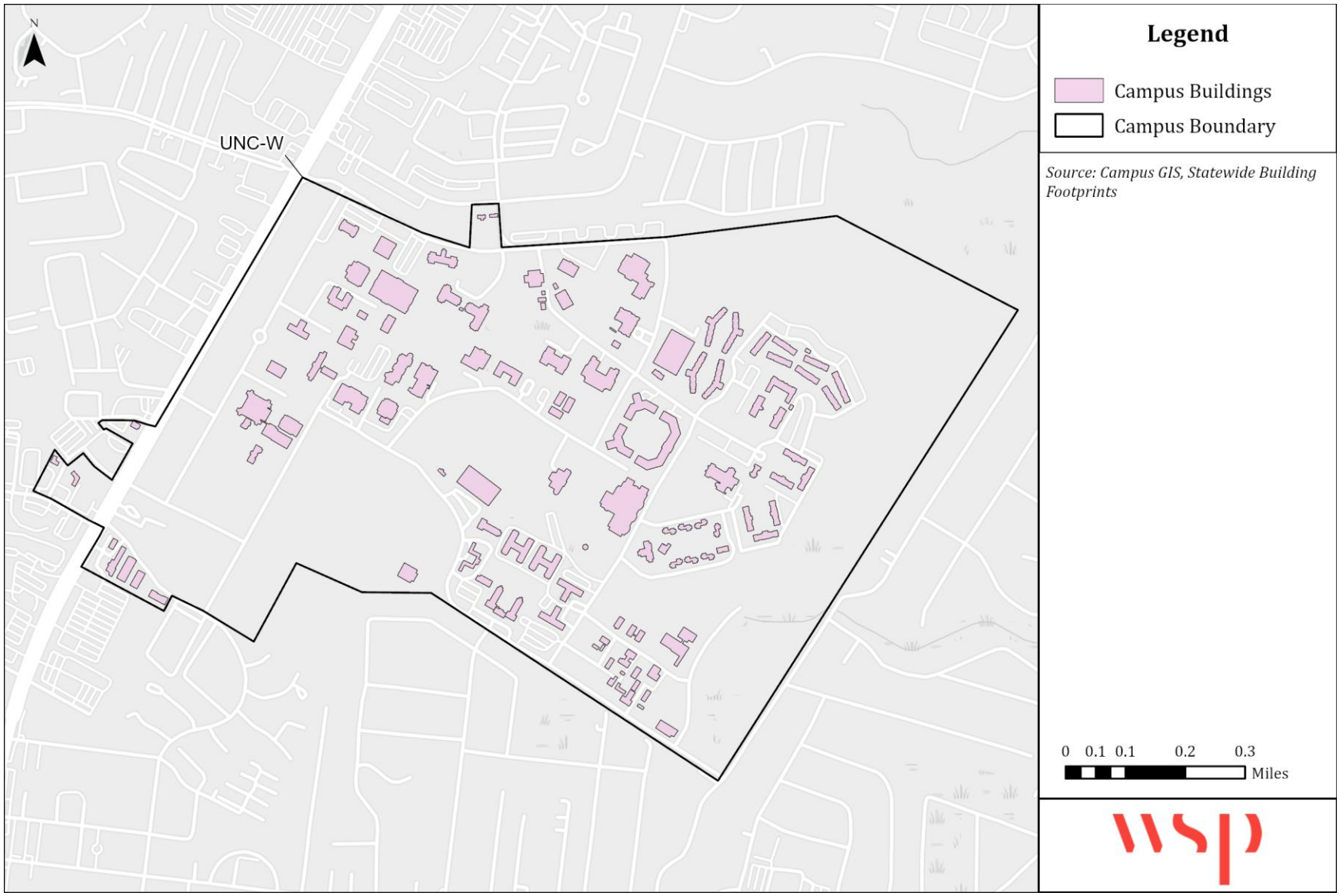


**Figure 1.12 – UNC-W Campus Map**



## 1.4 References

The following FEMA guides and reference documents were used to prepare this document:

- FEMA 386-1: Getting Started: Building Support for Mitigation Planning. September 2002.
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001.
- FEMA 386-3: Developing the Mitigation Plan. April 2003.
- FEMA 386-4: Bringing the Plan to Life. August 2003.
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007.
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005.
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003.
- FEMA 386-8: Multijurisdictional Mitigation Planning. August 2006.
- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008.
- FEMA. Local Mitigation Planning Handbook. June 2025.
- FEMA. Local Mitigation Planning Policy Guide. April 11, 2025.
- FEMA Hazard Mitigation Assistance Program and Policy Guide. January 20, 2025.
- FEMA Hazard Mitigation Assistance Unified Guidance. June 1, 2010.
- FEMA. Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013.
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.
- FEMA National Fire Incident Reporting System 5.0: Complete Reference Guide. January 2008.
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

Additional sources used in the development of this plan, including data compiled for the Hazard Risk and Vulnerability Assessments, are listed in Appendix C.

## 1.5 Plan Organization

The UNC Eastern Campuses Hazard Mitigation Plan is organized into the following sections:

- Section 1: Introduction
- Section 2: Planning Process
- Section 3: Hazard Identification & Hazard Profiles
- Section 4: Mitigation Strategy
- Section 5: Plan Implementation and Maintenance
- Section 6: Plan Adoption
- Annexes:
  - Campus Profile

  - Asset Inventory
  - Hazard Risk & Vulnerability Assessment
  - Capability Assessment
  - Mitigation Action Plan
- Appendix A: Local Plan Review Tool
- Appendix B: Planning Process Documentation
- Appendix C: References

# 2. Planning Process

**Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan. To develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:**

1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and

3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

**Requirement §201.6(c)(1): The plan shall include the following:**

1) Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

This section provides a review of the planning process followed for the development of this plan. This section consists of the following subsections:

- 2.1 Purpose
- 2.2 What's Changed in the Plan
- 2.3 Preparing the Plan
- 2.4 Hazard Mitigation Planning Committee
- 2.5 Involving the Public
- 2.6 Outreach Efforts
- 2.7 Involving the Stakeholders
- 2.8 Documentation of Plan Progress

## 2.1 Purpose & Vision

The purpose of the UNC Eastern Campuses Hazard Mitigation Plan is to identify, assess, and mitigate hazard risk to better protect the people and property within each campus from the effects of natural and human-caused hazards. This plan documents progress on previous hazard mitigation planning efforts, updates the previous planning effort to reflect current conditions and relevant hazards and vulnerabilities on each campus, increases public education and awareness about the plan and planning process, ensures grant eligibility for each campus, maintains compliance with state and federal requirements for local hazard mitigation plans, and identifies and outlines strategies the campuses will use to decrease vulnerability and increase resiliency.

## 2.2 What's Changed in the Plan

This plan is an update to the 2021 UNC Eastern Campuses Plan, which included participation from East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Central University, North Carolina School of Science and Mathematics, North Carolina State University, University of North Carolina – Chapel Hill, University of North Carolina – Pembroke, and University of North Carolina – Wilmington.

The development of this regional hazard mitigation plan involved a comprehensive review of each of the existing campus plans and an assessment of the success of each campus in evaluating, monitoring and implementing the mitigation strategy outlined in their existing plans. Only the information and data still valid from the existing plans was carried forward as applicable into this regional plan. The following requirements were addressed during the development of this plan:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to inventories; and
- Incorporate new action recommendations or changes in action prioritization.

In addition to the specific changes in hazard analyses in 4.2, the following items were also addressed in this plan:

- GIS was used, to the extent data allowed, to analyze the priority hazards as part of the vulnerability assessment.
- Assets at risk to identified hazards were identified by property type and values of properties based on current data in North Carolina Emergency Management's iRisk Database.
- An updated discussion on climate change and its projected effect on specific hazards was included in each hazard profile in the risk assessment.
- A discussion on growth and development was updated to reflect changes in campus population and facilities.
- Enhanced public outreach and stakeholder coordination efforts were conducted throughout the plan update process.

## 2.3 Preparing the Plan

The planning process for preparing the UNC Eastern Campuses Hazard Mitigation Plan was based on DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1. Planning Process;
2. Risk Assessment;
3. Mitigation Strategy; and
4. Plan Maintenance.

Into this process, the planning consultant integrated a more detailed planning process used for FEMA's Community Rating System (CRS) which breaks down the four phases into 10 planning steps. Table 2.1 shows how the 10-step CRS planning process aligns with the four phases of hazard mitigation planning pursuant to the Disaster Mitigation Act of 2000.

**Table 2.1 – Mitigation Planning and CRS 10-Step Process Reference Table**

| DMA Process | CRS Process |
|---|---|
| **Phase I – Planning Process** | |
| §201.6(c)(1) | Step 1. Organize to Prepare the Plan |
| §201.6(b)(1) | Step 2. Involve the Public |
| §201.6(b)(2) & (3) | Step 3. Coordinate |
| **Phase II – Risk Assessment** | |
| §201.6(c)(2)(i) | Step 4. Assess the Hazard |
| §201.6(c)(2)(ii) & (iii) | Step 5. Assess the Problem |
| **Phase III – Mitigation Strategy** | |
| §201.6(c)(3)(i) | Step 6. Set Goals |
| §201.6(c)(3)(ii) | Step 7. Review Possible Activities |
| §201.6(c)(3)(iii) | Step 8. Draft an Action Plan |
| **Phase IV – Plan Maintenance** | |
| §201.6(c)(5) | Step 9. Adopt the Plan |
| §201.6(c)(4) | Step 10. Implement, Evaluate and Revise the Plan |

The planning process is further detailed in Section 2.3.1 through 2.3.4 below.

## 2.3.1 Phase I – Planning Process

### Planning Step 1: Organize to Prepare the Plan

With the nine campuses' commitment to participate in the DMA planning process, campus officials worked to establish the framework and organization for development of the plan. An initial meeting was held with key community representatives to discuss the organizational aspects of the plan development process. Representatives from the campuses' Emergency Management, Safety and Security, and Environmental Health and Safety departments led each individual campus' effort to reorganize and coordinate for the plan update. Consultants from WSP assisted by leading the UNC Eastern Campuses region through the planning process and preparing the plan document.

**Planning Step 2: Involve the Public**

Public involvement in the development of the plan was sought using various methods, as detailed in Section 2.5 and Section 2.6.

**Planning Step 3: Coordinate**

The planning committees formed for development of the 2021 plan were reconvened for this plan update. Where necessary, additional members were added to the Hazard Mitigation Planning Committee (HMPC). More details on the HMPC are provided in Section 2.4. Stakeholder coordination was incorporated into the formation of the HMPC and was sought through additional outreach. These efforts are detailed in Section 2.7.

***Coordination with Other Community Planning Efforts and Hazard Mitigation Activities***

In addition to stakeholder involvement, coordination with other community planning efforts was also seen as paramount to the success of this plan. Mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. The UNC Eastern Campuses and surrounding communities use a variety of planning mechanisms, such as Strategic Plans, Campus Master Plans, Community Comprehensive Plans, subdivision regulations, building codes, and ordinances to guide growth and development. Integrating existing planning efforts, mitigation policies, and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from existing plans, studies, reports, and initiatives as well as other relevant data from neighboring communities and other jurisdictions; a detailed listing of resources referenced can be found in each campus' annex.

These and other documents were reviewed and considered, as appropriate, during the collection of data to support the planning process and plan development, including the hazard identification, vulnerability assessment, and capability assessment. Overviews of the Hazard Identification and Risk Assessment and Capability Assessment can be found in Section 3 and Section 5, respectively. Detailed data is contained in each campus' annex.

## 2.3.2 Phase II – Risk Assessment

**Planning Steps 4 and 5: Identify/Assess the Hazard and Assess the Problem**

The HMPC completed a comprehensive effort to identify, document, and profile all hazards that have, or could have, an impact on the planning area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. A draft of the risk and vulnerability assessment was made available on the plan website for the HMPC, stakeholders, and the public to review and comment. A more detailed description of the risk assessment process and results is included in Section 3 Hazard Identification and Hazard Profiles and in each campus annex under the Hazard Risk & Vulnerability Assessment section.

The HMPC also conducted a capability assessment to review and document the planning area's current capabilities to mitigate risk and vulnerability to hazards. By collecting information about

existing government programs, policies, regulations, ordinances, and emergency plans, the HMPC could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. The findings of the capability assessment are provided in each campus annex.

### 2.3.3 Phase III – Mitigation Strategy

**Planning Steps 6 and 7: Set Goals and Review Possible Activities**
WSP facilitated brainstorming and discussion sessions with the HMPC that described the purpose and process of developing a vision for the planning process and setting planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Section 4 Mitigation Strategy.

**Planning Step 8: Draft an Action Plan**
A complete first draft of the plan was prepared based on input from the HMPC regarding the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7. This draft was shared for HMPC, stakeholder, and public review and comment via the plan website. HMPC, public, and stakeholder comments were integrated into the final draft for NCEM and FEMA Region 4 to review and approve, contingent upon final adoption by the campuses.

### 2.3.4 Phase IV – Plan Maintenance

**Planning Step 9: Adopt the Plan**
To secure buy-in and officially implement the plan, the plan will be reviewed and adopted by all participating campuses. Adoption resolutions are provided in Section 6.

**Planning Step 10: Implement, Evaluate and Revise the Plan**
Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. Up to this point in the planning process, the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing appropriate mitigation actions. Section 5 Plan Implementation and Maintenance provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. Section 5 also discusses opportunities for incorporating the plan into existing planning mechanisms and how to address continued public involvement.

## 2.4 Hazard Mitigation Planning Committee

This Hazard Mitigation Plan was developed under the guidance of the HMPC. Each of the nine campuses identified members for its own campus-level committee. The campus committees worked together as a joint HMPC to represent each campus' interests while fostering a regional planning approach.

To form the planning committee, the Emergency Management leads from each campus were designated as the primary representatives and were asked to identify additional members from a variety of campus departments. Where possible, an invitation was sent to contacts from the previous planning effort, or new staff in the same position. Table 2.2 lists all HMPC members and the campus and department they represent.

**Table 2.2 – HMPC Members**

| Campus | Representative | Role; Department |
|---|---|---|
| ECU | Phil Lewis | Director, Environmental Health and Safety |
| ECU | Aspen Lawrence | Emergency Manager, Environmental Health and Safety |
| ECU | Nick Agresta | Emergency Management Specialist, Environmental Health & Safety |
| ECU | Bill Koch | Associate Vice Chancellor, Campus Safety and Auxiliary Service |
| ECU | Jason Sugg | Chief of Police, ECU Police |
| ECU | Chris Sutton | Deputy Chief, ECU Police |
| ECU | Kelly Shook | Assistant Director, Environmental Health and Safety |
| ECU | Bill Bagnell | Associate Vice Chancellor; Campus Operations |
| ECU | Ricky Hill | Director; Facilities Services (Main Campus) |
| ECU | Griff Avin | Director; Facilities Services (Health Sciences Campus) |
| ECU | Mike O'Driscoll | Associate Professor; Department of Coastal Studies |
| ECU | Merrill Flood | Director of Planning and Development; Community Engagement and Research |
| ECU | Anuradha Mukherji | Associate Professor; Geography, Planning, and Environment |
| ECU | Peter Groenendyk | Associate Vice Chancellor, Campus Living |
| ECU | Gretchen Brockmann | Director, Housing Operations |
| ECU | Randy Gentry | Director; Pitt County Emergency Management |
| ECSU | Danny Clipper | EM/EHS Coordinator, University Police |
| ECSU | Dennis Leary | Director; Facilities Management |
| ECSU | Amanda Brooks | Interim AVC Design & Construction, Campus Facilities & Planning |
| ECSU | Ernest Cuthbertson | Director of Public Safety, University Police |
| ECSU | Lee Brown | Chief of Staff, Office of the Chancellor |
| ECSU | Sabrina Williams | Director; Housing and Residence Life |
| ECSU | Kevin Wade | Associate Vice Chancellor; Student Affairs |
| ECSU | Kevin Kupietz | Emergency Management Coordinator; Aviation & Emergency Management |
| ECSU | Robert Thibeault | Director of Budgets; Business and Finance |
| ECSU | S Keith Hargrove | Chancellor |
| FSU | Abiodun Awoyemi | Director of Emergency Management; Police & Public Safety |
| FSU | Elizabeth Hunt | Assistant Vice Chancellor, Risk and Compliance |
| FSU | Alpha Clowney | Chief of Police, Associated Vice Chancellor of Public Safety; Police & Public Safety |
| FSU | Gregory Moyd | Assistant Vice Chancellor; Student Affairs |
| FSU | Gretchen Cobb | Director of Business Services, Business and Finance |
| FSU | Carl Dean | Associate VC Human Resources, Human Resources |
| FSU | Conroy Campbell | Database Administrator; Information Technology |
| FSU | Harold Miller | Director, Planning & Construction; Facilities Management |
| FSU | Benita Angel Powell | Assistant General Counsel; Legal Office |

| Campus | Representative | Role; Department |
|---|---|---|
| NCCU | Christopher Russell | Director of Environmental Health & Safety; Environmental and Occupational Health and Safety |
| NCCU | Rondall Rice | Associate Vice Chancellor for Administration, Office of the Chancellor |
| NCCU | Steven Alas | Emergency Management Coordinator; Environment and Occupational Health & Safety |
| NCCU | Joel Faison | Director of Infrastructure & Information Security; Information Technology Services |
| NCCU | Dr. Undi Hoffler | Director, Research Compliance and Technology Transfer; Division of Research & Sponsored Programs |
| NCCU | Ondin Mihalcescu | Director of Design, Planning, and Construction; Capital Projects Management |
| NCCU | Timothy Williams | Architectural Project Manager; Capital Projects Management |
| NCCU | Jerry Guerrier | Director of Facilities Services, Facilities Operations |
| NCCU | Gregory Hughes | Captain, Campus Police |
| NCCU | Tyra Slade | General Counsel, Legal Affairs |
| NCSSM | Brian Wiggs | Director of Security; Campus Safety & Security |
| NCSSM | Robert Allen | Vice Chancellor; Finance and Operations |
| NCSSM | Nathan Harmer | Director of IT Infrastructure and Operations |
| NCSU | Todd Becker | Director; Emergency Preparedness |
| NCSU | Chris Octetree | Emergency Manager; Emergency Management and Mission Continuity |
| NCSU | Ian Toms | University Fire Marshal; Fire and Life Safety |
| NCSU | Doug Morton | Associate Vice Chancellor; Facilities |
| NCSU | Allen Boyette | Senior Director, Energy Systems; Facilities |
| NCSU | Alicia Knight | Associate Vice Chancellor; Environmental Health and Public Safety |
| NCSU | Drew Nicholson | Manager, Insurance and Risk Management |
| NCSU | Greg Sparks | Associate Vice Chancellor, Communication Technologies |
| UNC-CH | Crystal Donaldson | Continuity & Resiliency Planner, Emergency Management and Planning |
| UNC-CH | Darrell Jeter | Director; Emergency Management & Planning |
| UNC-CH | Abbas Piran | Director, Facilities Technology; Facilities Services |
| UNC-CH | John Albrechtsen | Facilities Operations; Facilities Services |
| UNC-CH | Cathy Brennan | Executive Director; Environmental Health & Safety |
| UNC-CH | Joe Magura | Director, Facilities Engineering |
| UNC-CH | Beatrice Muganda | Project Manager, Energy Services |
| UNC-CH | Laurie Burroughs | Budget Manager, SCE Finance |
| UNC-CH | Brigitte Ironside | Budget Analyst, SCE Finance |
| UNC-P | Charles Chavis | Environmental Health and Safety Professional; Environmental Health and Safety |
| UNC-P | Michael Bullard | Director; Environmental Health & Safety |
| UNC-P | Dr. Kyle Smith | Dean of Students, Student Affairs |
| UNC-P | George Johnson | Chief/Director, Police and Public Safety |
| UNC-P | Dr. Christine Poteet | Assistant Vice Chancellor for Student Affairs; Student Health Services |
| UNC-P | Victor Deese | Assistant Vice Chancellor for Facilities, Facilities Management |
| UNC-P | Dr. Scott Billingsley | Asst VC for Planning and Accreditation, Academic Affairs |
| UNC-P | Andrea Jacobs | Executive Assistant, Athletics |

| Campus | Representative | Role; Department |
|---|---|---|
| UNC-P | Katina Blue | Associate Vice Chancellor for Information Resources/Chief Information Officer, Division of Information Technology |
| UNC-P | Mark Vesely | Director of Operation and Maintenance, Facilities Management |
| UNC-P | Johsua Johnson | Director, Student Health Services |
| UNC-W | Jeff Campbell | Director; Environmental Health and Safety |
| UNC-W | Jade Myers | Business Services Coordinator, Environmental Health and Safety |
| UNC-W | Stuart Borrett | Associate Provost; Research and Innovation |
| UNC-W | Parker Moran | Director of Network, It Operations & Research |
| UNC-W | Mike Cherry | Associate Athletic Director of Facilities & Event Management, Athletics |
| UNC-W | Paul Townend | Associate Vice Chancellor & Dean; Undergraduate Studies |
| UNC-W | Larry Wray | Executive Director; Campus Life |
| UNC-W | Wes Merrill | Director of Operations, College of Health & Human Services |
| UNC-W | Kevin Meaney | Executive Director, Housing and Residence Life |
| UNC-W | Laura McBrayer | Senior Associate Director; Library Information Technology & Scholarly Research |
| UNC-W | Kristy Burnette | Institutional Risk Management Coordinator; Enterprise Risk Management |
| UNC-W | Mark Morgan | Associate Vice Chancellor; Facilities |
| UNC-W | Steven Still | Emergency Management Director; New Hanover County Emergency Management |

The DMA planning regulations and guidance stress that to satisfy multi-jurisdictional participation requirements, each campus seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC;
- Detail where within the planning area the risk differs from that facing the entire area;
- Identify potential mitigation actions; and
- Formally adopt the plan.

For the UNC Eastern Campuses HMPC, “participation” meant the following:

- Providing facilities for meetings;
- Attending and participating in the HMPC meetings;
- Collecting and providing requested data (as available);
- Providing information on local capability;
- Providing an update on previously adopted mitigation actions;
- Managing administrative details;
- Making decisions on plan process and content;
- Identifying mitigation actions for the plan;
- Reviewing and providing comments on plan drafts;
- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan;
- Coordinating and participating in the public input process; and

- Coordinating the formal adoption of the plan by local governing bodies.

Detailed summaries of HMPC meetings are provided under Meetings and Workshops, including meeting dates, locations, and topics discussed. During the planning process, the HMPC members communicated through face-to-face meetings, Microsoft Teams, email, and telephone conversations. Additionally, draft documents were distributed via the plan website so that the HMPC members and the public could easily access and review them and provide comments.

The formal HMPC meetings followed the 10 CRS Planning Steps. These meetings were essential for facilitating discussion, gaining consensus, and initiating data collection efforts with local government staff, community officials, and other identified stakeholders. More importantly, the meetings and workshops prompted continuous input and feedback from relevant participants throughout the drafting stages of the Plan. The meeting dates, locations, and topics discussed are summarized in Table 2.3. More details on each meeting, including agendas, minutes, and sign-in sheets for the HMPC meetings are included in Appendix B. All HMPC meetings were open to the public. Public meetings are summarized in Table 2.4.

**Table 2.3 – Summary of HMPC Meetings**

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| **Meeting #1 - Kickoff** | | | |
| All Campuses HMPC | 1) Introduction to DMA, CRS, and FMA requirements and the planning process<br>2) Review of HMPC responsibilities and the project schedule<br>3) Preliminary hazard identification | July 22, 2025, 1 PM | Microsoft Teams |
| **Meeting #2** | | | |
| ECU | 1) Review Draft Hazard Identification & Risk Assessment | October 17, 2025, 1 PM | Microsoft Teams |
| ECSU | | November 17, 2025, 2 PM | Microsoft Teams |
| FSU | | November 24, 2025, 1 PM | Microsoft Teams |
| NCCU | | November 11, 2025, 3 PM | Microsoft Teams |
| NCSSM | | December 16, 2025, 10 AM | Microsoft Teams |
| NCSU | | October 29, 2025, 10 AM | Microsoft Teams |
| UNC-CH | | November 5, 2025, 1 PM | Microsoft Teams |
| UNC-P | | November 3, 2025, 10 AM | Microsoft Teams |
| UNC-W | | January 22, 2026, 3pm | Microsoft Teams |

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| **Meeting #3** | | | |
| ECU | 1) Update Goals and Objectives<br>2) Review Capability Assessment<br>3) Update Mitigation Action Plans<br>4) Review Mitigation Alternatives | March 4, 2026, 3pm | Microsoft Teams |
| ECSU | | February 18, 2026, 3pm | Microsoft Teams |
| FSU | | March 4, 2026, 11am | Microsoft Teams |
| NCCU | | February 25, 2026, 11am | Microsoft Teams |
| NCSSM | | March 27, 2026 10am | Microsoft Teams |
| NCSU | | February 19, 2026, 2pm | Microsoft Teams |
| UNC-CH | | March 5, 2026, 1:30pm | Microsoft Teams |
| UNC-P | | February 26, 2026, 3pm | Microsoft Teams |
| UNC-W | | February 6, 2026, 2:30pm | Microsoft Teams |
| **Meeting #4** | | | |
| All Campuses HMPC | 1) Review the Draft Hazard Mitigation Plan<br>2) Solicit comments and feedback | March 31, 2026, 3pm | Microsoft Teams |

## 2.5 Involving the Public

An important component of any mitigation planning process is public participation. Input from faculty, staff, students, and the surrounding community provides the entire planning team with a greater understanding of local concerns and increases the likelihood of successfully implementing mitigation actions by developing community “buy-in” from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of any mitigation strategy.

Public involvement in the development of the plan was sought using various methods including open public meetings, an interactive plan website, a public survey, and by making copies of draft plan documents available for public review online.

All public meetings were advertised on the plan website, which was shared on campus websites and social media. Copies of meeting announcements are provided in Appendix B. The public meetings held during the planning process are summarized in Table 2.4.

**Table 2.4 – Summary of Public Meetings**

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| Public Meeting #1 | 1) Introduction to DMA, CRS, and FMA requirements and the planning process<br>2) Review of planning process, hazards identified, public survey and website, and the project schedule. | September 29, 2025, 1 PM & September 30, 2025, 5 PM | Microsoft Teams |
| Public Meeting #2 | 1) Review Draft Hazard Mitigation Plan<br>2) Solicit comments and feedback | March 31, 2026, 5pm | Microsoft Teams |

# 2.6 Outreach Efforts

The HMPC agreed to employ a variety of public outreach methods including established public information mechanisms and resources within each campus. The table below details public outreach efforts employed during the preparation of this plan.

**Table 2.5 – Public Outreach Efforts**

| Location | Date | Event/Message |
|---|---|---|
| Plan website | Ongoing | Meeting announcements, meeting materials, and description of hazards; contact information provided to request additional information and/or provide comments |
| Campus websites | Ongoing | Link to the plan website shared to expand reach |
| Campus social media | Ongoing | Meeting announcements, survey, and website link shared |
| Campus e-newsletters & distribution lists | Ongoing | Meeting announcements, survey, and website link shared |
| Public survey | Ongoing | Survey hosted online and made available via shareable link |
| Plan website - Annex drafts | January-March 2026 | Draft Campus Annexes including risk assessment, capability assessment, and campus profile made available for review and comment online |
| Plan website - Draft Plan | March 2026 | Full draft plan made available for review and comment online |

A public outreach survey was made available in September 2025 and remained open for response through February 2026. The public survey requested public input into the Hazard Mitigation Plan planning process and the identification of mitigation activities to lessen the risk and impact of future hazard events. The survey is shown in Appendix B. The survey was announced at the first HMPC and public meetings and was made available online on the plan website. In total, 570 survey responses were received.

The following is a list of high-level summary results and analysis derived from survey responses:

- Responses were received from individuals associated with all nine campuses, with NCCU, UNC-P, FSU, and ECSU accounting for 87% of responses.

- Over a third of respondents have experienced a hazard on or around campus; most of these experiences involved flooding and hurricanes.
- Over half of respondents feel at least somewhat prepared for a hazard impacting their school or campus.
- Across all campuses, respondents consider hurricanes & tropical storms, flooding, extreme heat, tornadoes & thunderstorms, and cyber threat the highest risk hazards.
- Prevention, emergency services, and public education are the most preferred mitigation categories.
- Nearly three quarters of respondents do not know where storm shelters are located on campus.
- Text message and email are the preferred ways for disseminating hazard-related information to students, faculty, and staff.

Detailed survey results are provided in Appendix B.

## 2.7 Involving Stakeholders

In addition to representatives in campus operations at each campus, the Hazard Mitigation Planning Committee also included stakeholder participants. Stakeholders on the HMPC included ECU professors from the Department of Geography, Planning, and Environment and the Department of Coastal Studies; the ECSU Aviation & Emergency Management Coordinator; as well as local government representatives, including the Pitt County Emergency Manager and the New Hanover County Emergency Management Director. Representatives from North Carolina Emergency Management (NCEM) also attended HMPC meetings. Input from additional stakeholders, including surrounding communities, was solicited through invitations to the open public meetings and distribution of the public survey. However, if any additional stakeholders representing other agencies and organizations participated through the public survey, that information is unknown due to the anonymous nature of the survey.

## 2.8 Documentation of Plan Progress

Progress on the implementation of mitigation strategies developed in the previous plan is documented here. Table 2.6 summarizes the status of mitigation actions from the previous plan.

A list of all completed and deleted actions from the previous plan is provided in each campus annex along with the updated Mitigation Action Plans detailing carried forward and new mitigation actions.

**Table 2.6 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| ECU | 16 | 3 | 8 |
| ECSU | 15 | 2 | 10 |
| FSU | 5 | 9 | 3 |

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| NCCU | 1 | 2 | 8 |
| NCSSM | 3 | 5 | TBD |
| NCSU | 2 | 3 | 3 |
| UNC-CH | 1 | 46 | 16 |
| UNC-P | 8 | 2 | 14 |
| UNC-W | 16 | 6 | 31 |

# 3. Hazard Identification & Hazard Profiles

**Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.**

**Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.**

**Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.**

**44 CFR Subsection D §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. Plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:**
A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;

(B): An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; and

(C): Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

This section describes the hazard identification and risk assessment process for the development of the UNC Eastern Campuses Hazard Mitigation Plan (HMP). It documents how the participating schools met Step 4: Assess the Hazard, and Step 5: Assess the Problem from the 10-step planning process and provides an overview of all hazards evaluated for the plan.

## 3.1 Overview

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of the potential risk to hazards in the planning area and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events. This risk

assessment followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:




This four-step process was organized into a UNC Eastern Campuses system-wide hazard identification and a more detailed campus-level risk and vulnerability assessment. The system-wide portion of the risk assessment presented here contains the overall hazard identification and hazard profiles, and is broken into the following sub-sections:

- **Section 3.2**: **Hazard Identification** identifies the natural and human-caused hazards that threaten the UNC Eastern Campuses.
- **Section 3.3: Risk Assessment Methodology** describing the approach to evaluating hazards and the organization of this information in the plan.
- **Section 3.4**: **Hazard Profiles** describes each hazard, discusses climate change implications for the hazard, evaluates potential consequences of the hazard, and summarizes the applicable campuses and their risk conclusions.
- **Section 3.5: Conclusions on Hazard Risk** presents the results of the Priority Risk Index by defining each hazard as a Low, Moderate, or High risk hazard for each campus.

## 3.2 Hazard Identification

To identify a full range of hazards relevant to all or part of the UNC Eastern Campuses, HMPC representatives from each campus began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan and the 2021 UNC Eastern Campuses Hazard Mitigation Plan, as summarized in Table 3.1. The HMPC used these lists to identify a full range of hazards for potential inclusion in this plan update and to ensure consistency across state, regional, and campus planning efforts.

**Table 3.1 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses HMP? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Extreme Heat | Yes | Yes |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | Yes |
| Drought | Yes | Yes |
| Tornadoes/Thunderstorms | Yes | Yes |

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses HMP? |
|---|---|---|
| Geological (Landslides, Sinkholes, Coastal Erosion) | Yes | Yes |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | Yes |
| Cyber Threat | Yes | Yes |
| Vandalism/Theft | No | Yes |

The HMPC evaluated the above list of hazards using existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses HMP to determine the significance of these hazards to the planning area. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage.

## 3.3 Risk Assessment Methodology

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

1. A set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.4; and
2. A campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the summary hazard profiles located in Section 3.4, each hazard is profiled in the following format:

### Hazard Description

This section provides a description of the hazard, including discussion of its duration and speed of onset or warning time, as well as any secondary effects.

### Climate Change

Where applicable, this section discusses how climate change may or may not influence the risk posed by the hazard on the planning area in the future.

### Consequence Analysis

This section summarizes the potential negative consequences of the hazard across the seven criteria set by the Emergency Management Accreditation Program (EMAP).

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard. Where possible, problem statements are identified at a campus level.

## 3.3.1 Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the UNC Eastern Campuses planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 (probability, impact, spatial extent, warning time, and duration) for each hazard. Each degree of risk was assigned a value (1 to 4) and a weighting factor as summarized in Table 3.2.

PRI ratings are provided by category throughout each hazard profile. Ratings specific to each campus are provided at the beginning of each hazard profile and are detailed in the campus annexes. The results of the risk assessment and overall PRI scoring are provided in Section 3.5 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to prioritize all potential hazards for each campus in the UNC Eastern Campuses planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allow for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

### Table 3.2 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY**<br>**What is the likelihood of a hazard event occurring in a given year?** | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT**<br>**In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?** | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE.<br>MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | **4** | |
| **SPATIAL EXTENT**<br>**How large of an area could be impacted by a hazard event? Are impacts localized or regional?** | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME**<br>**Is there usually some lead time associated with the hazard event? Have warning measures been implemented?** | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION**<br>**How long does the hazard event usually last?** | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

# 3.4 Hazard Profiles

## 3.4.1 Dam Failure

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| | | | | | ✓ | ✓ | | |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| NCSU | Possible | Critical | Negligible | Less than 6 hrs | Less than 1 week | 2.4 |
| UNC-CH | Possible | Critical | Negligible | Less than 6 hrs | Less than 1 week | 2.4 |

### Hazard Description

A dam is a barrier constructed across a watercourse that stores, controls, or diverts water. Dams are usually constructed of earth, rock, concrete, or mine tailings. The water impounded behind a dam is referred to as the reservoir and is measured in acre-feet. One acre-foot is the volume of water that covers one acre of land to a depth of one foot. Dams can benefit farmland, provide recreation areas, generate electrical power, and help control erosion and flooding issues.

A dam failure is the collapse or breach of a dam that causes downstream flooding. Dam failures may be caused by natural events, manmade events, or a combination. Due to the lack of advance warning, failures resulting from natural events, such as earthquakes or landslides, may be particularly severe. Prolonged rainfall and subsequent flooding is the most common cause of dam failure.

Dam failures usually occur when the spillway capacity is inadequate and water overtops the dam or when internal erosion in the dam foundation occurs (also known as piping). If internal erosion or overtopping causes a full structural breach, a high-velocity, debris-laden wall of water is released and rushes downstream, damaging or destroying anything in its path. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can also result from any one or a combination of the following:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross-section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and practices;

- Negligent operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway; or
- High winds, which can cause significant wave action and result in substantial erosion.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. Dam failures are generally catastrophic if the structure is breached or significantly damaged. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major casualties and loss of life could result, as well as water quality and health issues. Potentially catastrophic effects to roads, bridges, and homes are also of major concern. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

Dam failure can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow.

Dam failures are of particular concern because the failure of a large dam has the potential to cause more death and destruction than the failure of any other manmade structure. This is because of the destructive power of the flood wave that would be released by the sudden collapse of a large dam. Dams are innately hazardous structures. Failure or poor operation can result in the release of the reservoir contents—this can include water, mine waste, or agricultural refuse–causing negative impacts upstream or downstream or at locations far from the dam. Negative impacts of primary concern are loss of human life, property damage, lifeline disruption, and environmental damage.

*Warning Time: 4 – Less than 6 hours*

*Duration: 3 – Less than 1 week*

## Climate Change

Studies have been conducted to investigate the impact of climate change scenarios on dam safety. Climate change impacts on dam failure will most likely be those related to changes in precipitation and flood probability. Climate change projections suggest that precipitation may increase and occur in more extreme events, which may increase risk of flooding, putting stress on dams and increasing likelihood of dam failure. The safety of dams for the future climate can be based on an evaluation of changes in design floods and the freeboard available to accommodate an increase in flood levels. The results from some studies indicate that the design floods with the corresponding outflow floods and flood water levels will increase in the future, and this increase will affect the safety of the dams in the future. Studies concluded that

the total hydrological failure probability of a dam will increase in the future climate and that the extent and depth of flood waters will increase by the future dam break scenario.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Localized impact expected to be severe for inundation area and moderate to light for other adversely affected areas. |
| Responders | Localized impact expected to limit damage to personnel in the inundation area at the time of the incident. |
| Continuity of Operations (including Continued Delivery of Services) | Damage to facilities/personnel in the area of the incident may require temporary relocation of some operations. Localized disruption of roads and/or utilities may postpone delivery of some services. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult. Impact may reduce deliveries. |
| Property, Facilities and Infrastructure | Localized impact to facilities and infrastructure in the inundation area of the incident. Some severe damage possible. |
| Environment | Localized impact expected to be severe for inundation area and moderate to light for other adversely affected areas. Consequences include erosion, water quality degradation, wildlife displacement or destruction, and habitat destruction. |
| Economic Condition of the Jurisdiction | Local economy and finances adversely affected, possibly for an extended period of time, depending on damage and length of investigation. |
| Public Confidence in the Jurisdiction's Governance | Localized impact expected to primarily adversely affect only the dam owner and local entities. A catastrophic failure could result in more widespread loss of public confidence. |

## Problem Statements

- While a significant dam failure has not occurred in Wake County or Orange County to date, failure in the future is still possible. There are 8 high hazard dams located within two miles of UNC-CH campus and 17 high hazard dams located within two miles of NCSU campus.

## 3.4.2 Drought

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ✓ | | ✓ |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| UNC-CH | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |
| UNC-W | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |

### Hazard Description

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture and water below the minimum necessary for sustaining plant, animal, and human life systems. Influencing factors include temperature patterns, precipitation patterns, agricultural and domestic water-supply needs, and growth. Lack of annual precipitation and poor water conservation practices can result in drought conditions.

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or wildland fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and can take years before the consequences are realized. It is often not obvious or easy to quantify when a drought begins and ends. Droughts can be a short-term event over several months or a long-term event that lasts for years or even decades.

Drought is a complex issue involving many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects and common drought types are detailed below:

- **Meteorological drought** is usually defined by a period of below average water supply.
- **Agricultural drought** occurs when there is an inadequate water supply to meet the needs of the State's crops and other agricultural operations such as livestock.
- **Hydrological drought** is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- **Socioeconomic drought** occurs when a drought impacts health, well-being, and quality of life or when a drought starts to have an adverse economic impact on a region.

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought are those related to water intensive activities such as agriculture, wildland fire protection, municipal usage, commerce, tourism, recreation,

and wildlife preservation. Drought conditions can also cause soil to compact, increasing an area's susceptibility to flooding, and reduce vegetation cover, which exposes soil to wine and erosion. A reduction to electric power generation and water quality deterioration are also potential problems.

The **U.S. Drought Monitor** provides a summary of drought conditions across the United States and Puerto Rico. Often described as a blend of art and science, the Drought Monitor map is updated weekly by combining a variety of data-based drought indices and indicators and local expert input into a single composite drought indicator.

The **Palmer Drought Severity Index** (PDSI) devised in 1965, was the first drought indicator to assess moisture status comprehensively. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief. It is more complex than the Standardized Precipitation Index (SPI) and the Drought Monitor.

The **Standardized Precipitation Index** (SPI) is a way of measuring drought that, like the PDSI, is negative for drought and positive for wet conditions. However, the SPI is a probability index that considers only precipitation, while Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff).

The North Carolina Drought Management Advisory Council, established in 1992, was given official statutory status and assigned the responsibility for issuing drought advisories in 2003. The drought advisories provide accurate and consistent information to assist local governments and other water users in taking appropriate drought response actions in specific areas of the state that are exhibiting impending or existing drought conditions.

By definition, drought develops and worsens over a period of time. It inherently has a slow speed of onset and a long duration. Additionally, due to the variety of indices for tracking drought, there is significant time to issue hazard warnings. Drought warnings can be regularly updated and allow for response to escalate depending on the severity of conditions.

*Warning Time: 1 – More than 24 hours*

*Duration: 4 – More than one week*

## Climate Change

The United States Geological Survey (USGS) reports that climate change has already altered the natural pattern of droughts across the country. Climate change has made droughts longer, more frequent, and more severe. With heavy precipitation events becoming more common while overall precipitation totals remain relatively steady, it is anticipated that the average number of dry days will rise. Temperatures are projected to continue rising so evaporation rates are expected to increase, resulting in decreased soil moisture levels. These combined factors indicate a probable increase in both intensity and duration of droughts in the Southeast.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | The public can be impacted through health effects due to economic losses, conflicts arising from water shortages, decreased incomes, limited recreational opportunities, increased occurrences of heat stroke and even fatalities. |
| Responders | Impacts to responders are unlikely. Exceptional drought conditions may impact the amount of water immediately available to respond to structure fire and wildfires. |
| Continuity of Operations (including Continued Delivery of Services) | 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. During extreme drought conditions, alternative water supplies may be needed. |
| Property, Facilities and Infrastructure | Drought has the capacity to impact water supply across residential, commercial, institutional, industrial, and government-owned areas, potentially leading to reduced levels in wells and reservoirs. As a result, utilities may find it necessary to raise rates to cope with the decreased availability of water. |
| Environment | Environmental impacts include strain on local plant and wildlife; increased probability of erosion and wildfire; and decreased water quality. |
| Economic Condition of the Jurisdiction | Farmers could encounter crop losses or heightened expenses related to livestock. Additionally, business reliant on agriculture may suffer secondary effects. The severity of drought could extend its impact to local enterprises in landscaping, recreation, and tourism, as well as public utilities. |
| Public Confidence in the Jurisdiction's Governance | In cases of prolonged drought without relief, local, or state governments frequently need to implement water restrictions, potentially affecting public confidence. |

## Problem Statements

- Orange County experienced drought periods of 100 weeks or longer three times between 2000-2025.
- Critical functions at UNC-CH rely on a chilled water system; UNC-CH has attempted to mitigate impacts to these functions during periods of drought by integrating the use of reclaimed water systems.
- New Hanover County experienced drought periods of 70 weeks or longer two times between 2000-2025.
- UNC-W receives treated water from the Cape Fear River Public Utility Authority (CFPUA). CFPUA sets water shortage and emergency management advisory stages that correspond to certain water restrictions.
- Drought can increase the probability and severity of wildfire.

## 3.4.3 Earthquake

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| ECSU | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| FSU | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| NCCU | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| NCSSM | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| NCSU | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| UNC-CH | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| UNC-P | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| UNC-W | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Hazard Description

An earthquake is a movement or shaking of the ground. Most earthquakes are caused by the release of stress accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's 10 tectonic plates. The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Earthquakes generally occur with little to no warning and last for a short period of time. However, earthquakes can often be followed by periods of aftershocks that vary in severity but can compound damage.

*Warning Time: 4 – Less than 6 hours*

*Duration: 1 – Less than 6 hours*

### Climate Change

Scientists are beginning to believe there may be a connection between climate change and earthquakes. Changing ice caps and sea-level redistribute weight over fault lines, which could potentially have an influence on earthquake occurrences. However, currently no studies quantify the relationship to a high level of detail, so recent earthquakes should not be linked with climate change.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Impact expected to be moderate to severe for people who are unprotected or unable to take shelter; moderate to light impacts are expected for those who are protected. |
| Responders | Responders may need to enter compromised structures or infrastructure. Adverse impacts are expected to be severe for unprotected personnel and moderate to light for protected personnel. |
| Continuity of Operations (including Continued Delivery of Services) | Damage to facilities/personnel in the area of peak ground shaking may require relocation of operations and lines of succession execution. Disruption of lines of communication and damage of facilities may postpone delivery of services. |
| Property, Facilities and Infrastructure | Damage to facilities and infrastructure in the area of the incident may be extensive for facilities, people, and infrastructure. Cascading impacts may result if buildings, infrastructure, or vehicles housing hazardous materials are impacted. |
| Environment | May cause extensive damage, creating denial or delays in the use of some areas. Remediation may be needed. |
| Economic Condition of the Jurisdiction | If ground shaking is severe, local economy and finances expected to be adversely affected, possibly for an extended period of time. Minor shaking may cause economic losses due to damage to local businesses or loss of inventory. |
| Public Confidence in the Jurisdiction's Governance | Ability to respond and recover may be questioned and challenged if response, and recovery are not timely and effective. |

## Problem Statements

While earthquakes are an unlikely hazard event for the UNC Eastern Campuses, loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for each campus. According to iRisk loss estimates, earthquakes could cause building damage across all campuses in the UNC System Eastern Campuses region. Loss estimates for the 500-year earthquake event are summarized below by campus:

- ECSU – The 500-year event may cause $13,083 in building damage
- ECU – The 500-year earthquake event may cause over $1.5 million in building damage across Main and Health Sciences campuses
- FSU – The 500-year earthquake event may cause $439,436 in building damage
- NCCU – The 500-year earthquake event may cause $292,097 in building damage
- NCSSM – The 500-year earthquake event may cause $162,390 in building damage
- NCSU – The 500-year earthquake event may cause over $3.5 million in building damage across all NCSU campuses
- UNC-CH – The 500-year earthquake event may cause over $2.5 million in building damage across all UNC-CH campuses
- UNC-P – The 500-year earthquake event may cause $694,255 in building damage
- UNC-W – The 500-year earthquake event may cause $488,314 in building damage

## 3.4.4 Excessive Heat

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Highly Likely | Critical | Large | More than 24 hrs | Less than 1 week | 3.3 |
| ECSU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| FSU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCCU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCSSM | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCSU | Highly Likely | Critical | Large | More than 24 hrs | Less than 1 week | 3.3 |
| UNC-CH | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| UNC-P | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| UNC-W | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Hazard Description

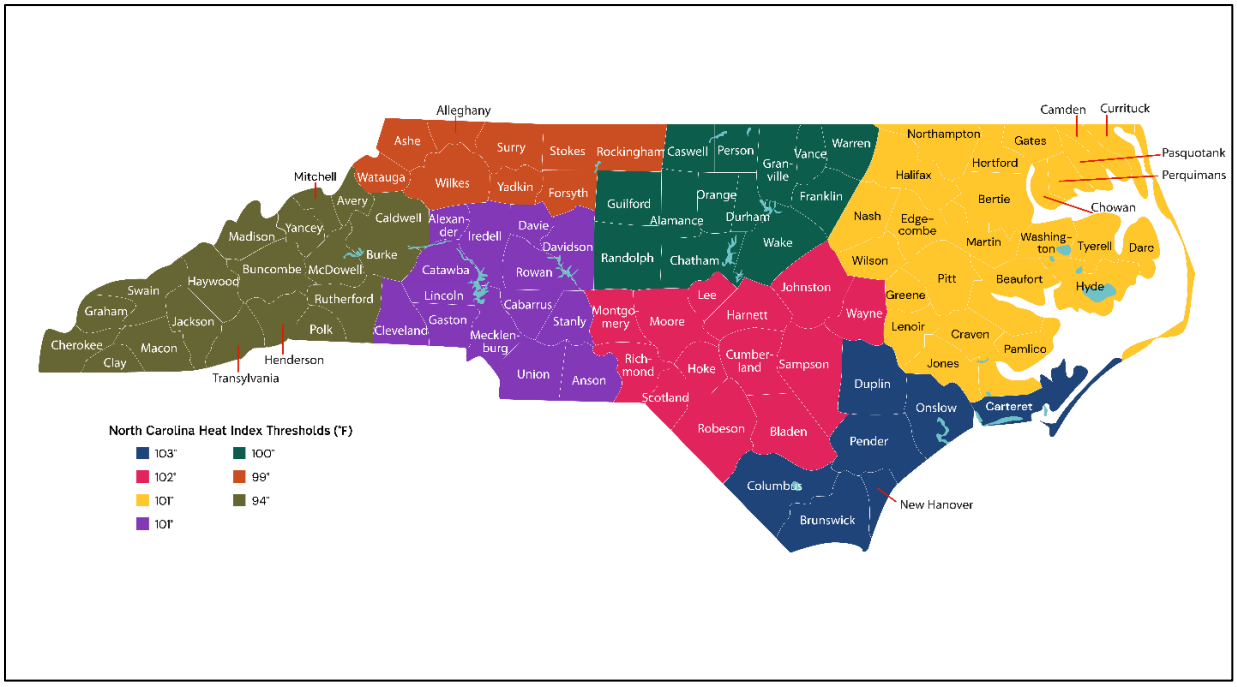
Per information provided by Ready.gov, in most of the United States extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. As temperatures rise, our bodies naturally cool down by sweating. In extreme heat, the body must work extra hard to maintain a normal temperature and sweating might not be enough to cool down. When this happens, a person's body temperature rises faster than it can cool itself. Additionally, when the humidity is high, as is common during extreme heat events in North Carolina, evaporative cooling through sweating becomes less effective. Heat-related illnesses occur when the body overheats from exposure to high temperatures and in severe cases can cause damage to the brain and other vital organs. Heat-related illnesses can also arise from moderate to vigorous physical activity in hot situations.

Extreme heat often results in the highest annual number of deaths among all weather-related disasters. On average, the number of extreme heat days has been increasing each year, putting residents at higher risk of heat-related illnesses. In 2023, more people in the United States died of heat-related illness than any year on record. Per Ready.gov, older adults, children, and people with certain illnesses and chronic conditions are at greater risk from extreme heat; and humidity increases the feeling of heat.

The National Weather Service (NWS) uses the heat index, also known as apparent temperature, to determine when to issue health alerts. The heat index is a measure of how hot it really feels when the relative humidity is considered along with the actual air temperature. In most areas of the country, the NWS generally issues alerts “when the heat index is expected to exceed 105°F -110°F for at least two consecutive days,” but they also work with local partners to determine the most appropriate conditions for a specific geography.

In North Carolina, the Department of Health and Human Services (DHHS) uses regional temperature thresholds to activate its Heat Health Alert System. The regional thresholds, shown in Figure 3.1, recognize that an area's typical climate conditions and relevant local factors, such as the proportion of the population engaged in outdoor work, can impact how heat affects the local population. DHHS sends heat alerts to county health departments and Heat Health Alert System subscribers when the daily maximum heat index is forecasted to meet or exceed the heat index threshold for their region.

**Figure 3.1 – North Carolina Heat Index Thresholds**




Source: https://climate.ncsu.edu/heat_toolkit/thresholds/

The National Weather Service also has a system in place to initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F) and the nighttime minimum Heat Index is 80°F or above for two or more consecutive days. A heat advisory is issued when temperatures reach 105 degrees, and a warning is issued at 115 degrees.

The most dangerous place to be during an extreme heat incident is in a permanent home, with little or no air conditioning. Those at greatest risk for heat-related illness include people 65 years of age and older, young children, people with chronic health problems such as heart disease, people who are obese, people who are socially isolated, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease. However, even young and healthy individuals are susceptible if they participate in

strenuous physical activities during hot weather or are not acclimated to hot weather. Table 3.3 lists typical symptoms and health impacts of exposure to extreme heat.

**Table 3.3 – Typical Health Impacts of Extreme Heat**

| Heat Index (HI) | Disorder |
|---|---|
| 80-90° F (HI) | Fatigue possible with prolonged exposure and/or physical activity |
| 90-105° F (HI) | Heatstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity |
| 105-130° F (HI) | Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity |

Source: National Weather Service Heat Index Program, www.weather.gov/os/heat/index.shtml

Impacts of extreme heat are not only focused on human health, as prolonged heat exposure can have devastating impacts on infrastructure as well. Prolonged high heat exposure increases the risk of pavement deterioration, as well as railroad warping or buckling. High heat also puts a strain on energy systems and consumption, as air conditioners are run at a higher rate and for longer; extreme heat can also reduce transmission capacity over electric systems.

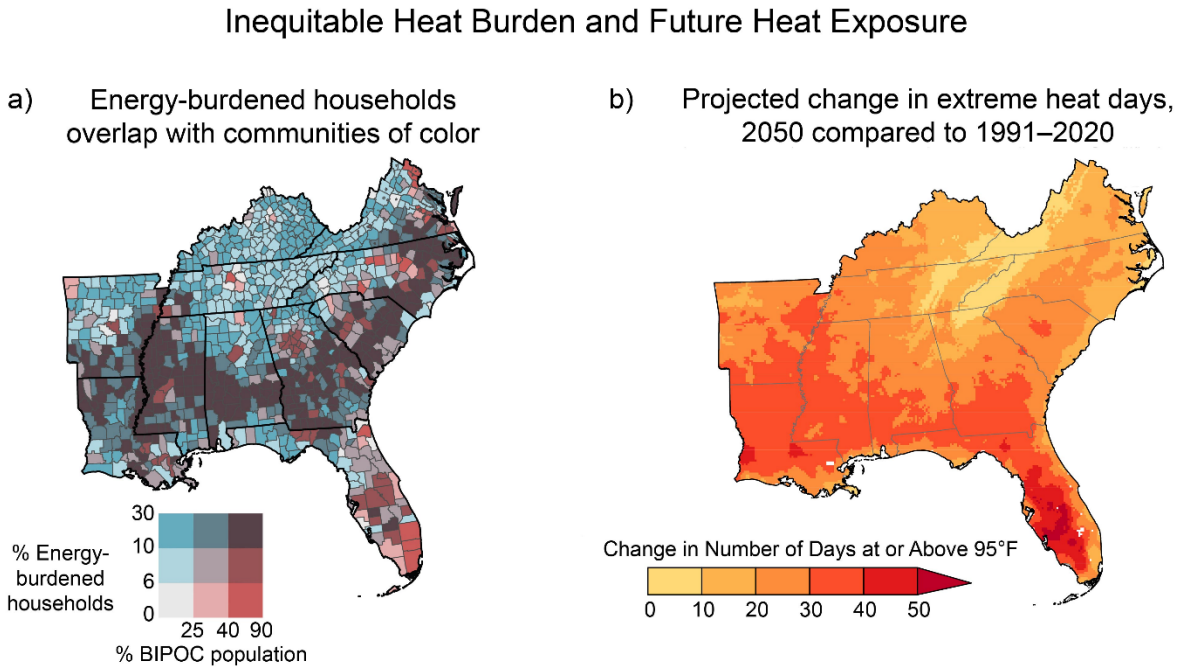
*Warning Time: 1 – More than 24 hours*

*Duration: 3 – Less than one week*

## Climate Change

Research shows that average temperatures will continue to rise in the Southeast United States and globally, directly affecting North Carolina. Per the Fifth National Climate Assessment, “The number of extreme warm days (above 95°F) is expected to continue increasing with every increment of global warming” and that “heatwaves in the Southeast are happening more frequently and are occurring during a longer heat season, with some cities also showing increasing trends in their duration and intensity.” Additional heat stresses can be attributed to the urban heat island effect which can increase the temperature of those living in urban environments compared to rural areas. Projected changes in extreme heat days are shown in Table 3.4.

**Table 3.4- Projected Change in Number of Days Over 95°F**




Source: USGCRP, 2023: Fifth National Climate Assessment

The Fifth National Climate Assessment also notes that warm nights (minimum temperatures at or above 70°F) in the southeast have increased the most compared to all other continental U.S. regions.

The State Climate Office of North Carolina's County-specific climate projections, which are based on the Fifth National Climate Assessment, are summarized in Table 3.5 and Table 3.6.

**Table 3.5 – Extreme Heat Projections, Days per Year with Maximum Temperatures over 95°F**

| Campus City | Historical | Best Case Scenario | Worst Case Scenario |
|---|---|---|---|
| ECU – Greenville | 9 | 32 | 45 |
| ECSU – Elizabeth City | 5 | 20 | 28 |
| FSU – Fayetteville | 11 | 33 | 45 |
| NCCU – Durham | 9 | 32 | 45 |
| NCSSM – Durham | 9 | 32 | 45 |
| NCSU – Raleigh | 10 | 33 | 46 |
| UNC-CH – Chapel Hill | 8 | 28 | 41 |
| UNC-P – Pembroke | 12 | 36 | 50 |
| UNC-W – Wilmington | 6 | 22 | 33 |

Source: North Carolina Resilience Exchange Climate Projections and Observations

**Table 3.6 – Extreme Heat Projections, Nights per Year with Minimum Temperature over 70°F**

| Campus City | Historical | Best Case Scenario | Worst Case Scenario |
|---|---|---|---|
| ECU – Greenville | 41 | 75 | 89 |
| ECSU – Elizabeth City | 47 | 78 | 91 |
| FSU - Fayetteville | 44 | 76 | 90 |
| NCCU – Durham | 9 | 32 | 45 |
| NCSSM – Durham | 9 | 32 | 45 |
| NCSU – Raleigh | 33 | 69 | 84 |
| UNC-CH – Chapel Hill | 17 | 47 | 64 |
| UNC-P – Pembroke | 40 | 74 | 89 |
| UNC-W – Wilmington | 64 | 95 | 107 |

Source: North Carolina Resilience Exchange Climate Projections and Observations

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Extreme heat may cause illness and/or death. |
| Responders | Consequences may be greater for responders if their work requires exertion and/or wearing heavy protective gear. |
| Continuity of Operations (including Continued Delivery of Services) | Continuity of operations is not expected to be impacted by extreme heat. Complications may arise if electricity demand results in power outages; however, this should be managed for critical operations with backup power and system redundancies. |
| Property, Facilities and Infrastructure | Minor impacts may occur, including possible damages to road surfaces and power lines. |
| Environment | Environmental impacts include strain on local plant and wildlife, including potential for illness or death. |
| Economic Condition of the Jurisdiction | Farmers may face crop losses or increased livestock costs. |
| Public Confidence in the Jurisdiction's Governance | Extreme heat is unlikely to impact public confidence. |

## Problem Statements

- All campuses are located within counties that experience greater than 21 hours (typically between 50-65) with heat index temperatures at or above 100°F and there is a 100% annual chance of heat index values meeting or exceeding 100°F in any given year.
- Outdoor workers and student athletes are among those most vulnerable to excessive heat on UNC campuses.

# 3.4.5 Flooding

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Highly Likely | Critical | Small | 6 to 12 hours | Less than 1 week | 2.8 |
| ECSU | Highly Likely | Minor | Small | 6 to 12 hours | Less than 1 week | 2.5 |
| FSU | Highly Likely | Minor | Small | 6 to 12 hours | Less than 1 week | 2.5 |
| NCCU | Highly Likely | Critical | Moderate | 6 to 12 hours | Less than 6 hours | 3.1 |
| NCSSM | Possible | Minor | Negligible | 6 to 12 hours | Less than 6 hours | 1.5 |
| NCSU | Highly Likely | Limited | Small | 6 to 12 hours | Less than 1 week | 2.8 |
| UNC-CH | Highly Likely | Limited | Moderate | 6 to 12 hours | Less than 1 week | 3.0 |
| UNC-P | Highly Likely | Minor | Negligible | 6 to 12 hours | Less than 1 week | 2.3 |
| UNC-W | Highly Likely | Minor | Negligible | 6 to 12 hours | Less than 1 week | 2.3 |

## Hazard Description

Flooding is defined by the rising and overflowing of water onto normally dry land. As defined by FEMA, a flood is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties. Flooding can result from an overflow of inland waters or an unusual accumulation or runoff of surface waters from any source.

Flooding is the most frequent and costly of all-natural hazards in the United States. Approximately 90 percent of all natural disasters in the U.S. involve flooding.

### Sources and Types of Flooding

Flooding can be attributed to three main sources as noted below.

**Riverine Flooding:** Riverine flooding is defined as an event when a watercourse exceeds its “bank-full” capacity and is the most common type of flood event. Riverine floods result from precipitation over large areas. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include many independent river basins. Riverine flooding generally occurs as a result of prolonged rainfall, or rainfall that is combined with soils already saturated from previous rain events. The duration of riverine floods may vary from a few hours to many days. Factors that directly affect the amount of flood runoff include precipitation, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface areas due to urbanization. The area adjacent to a river channel is its floodplain. In its common usage, “floodplain” most often refers to that area that is inundated by the 100-year flood, the flood that has a 1-percent annual chance in any

given year of being equaled or exceeded. The 1-percent annual chance flood, or base flood event, is the national standard to which communities regulate their floodplains through the National Flood Insurance Program.

**Coastal Flooding:** All lands bordering the coast along the Atlantic Ocean and in low-lying coastal plains are susceptible to tidal effects and flooding. Coastal land such as sand bars, barrier islands and deltas provide a buffer zone that help protect life safety and property relative to the sea much as floodplains provide a buffer zone along rivers and other bodies of water. Coastal floods usually occur because of abnormally high tides or tidal waves, storm surge and heavy rains in combination with high tides, and tropical storms and hurricanes. Portions of New Hanover County and Pasquotank County are susceptible to coastal flooding, which normally occurs between June and November. Sea level rise may also affect coastal areas; however, based on NOAA sea level rise projections, the only exposure in the region to sea level rise is at ECSU, where impacts are not projected to occur until 2080 under a high-emissions scenario.

**Flash Flooding:** A flash flood occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, possibly from slow-moving intense thunderstorms and sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the NFIP and can also happen in areas not associated with floodplains. Flash flood hazards caused by surface water runoff are most common in urbanized areas, where greater population density generally equates to more impervious surface (e.g., pavement and buildings) which increases the amount of surface water generated.

Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood water moves at very fast speeds and can move boulders, tear out trees, scour channels, and destroy buildings and bridges. Flash flooding can result in higher loss of life, both human and animal, than slower developing river and stream flooding.

**Localized/Stormwater Flooding:** Localized stormwater flooding can occur throughout the UNC campuses. Localized stormwater flooding occurs when heavy rainfall and an accumulation of runoff overburden the stormwater drainage system. In certain areas, aging storm sewer systems are not designed to carry the capacity currently needed to handle the increased storm runoff. Stormwater runoff is often attributed to increasing development and large areas of impervious surface coverage, which limits ground absorption and increases surface water runoff.

Localized flooding may be caused by the following issues:

- **Inadequate Capacity –** An undersized/under capacity pipe system can cause water to back-up behind a structure which can lead to areas of ponded water and/or overtopping of banks.

- **Clogged Inlets** – Debris covering the asphalt apron and the top of grate at catch basin inlets may contribute to an inadequate flow of stormwater into the system. Debris within the basin itself may also reduce the efficiency of the system by reducing the carrying capacity.
- **Blocked Drainage Outfalls** – Debris blockage or structural damage at drainage outfalls may prevent the system from discharging runoff, which may lead to a back-up of stormwater within the system.
- **Improper Grade** – Poorly graded asphalt around catch basin inlets may prevent stormwater from entering the catch basin as designed. Areas of settled asphalt may create low spots within the roadway that allow for areas of ponded water.

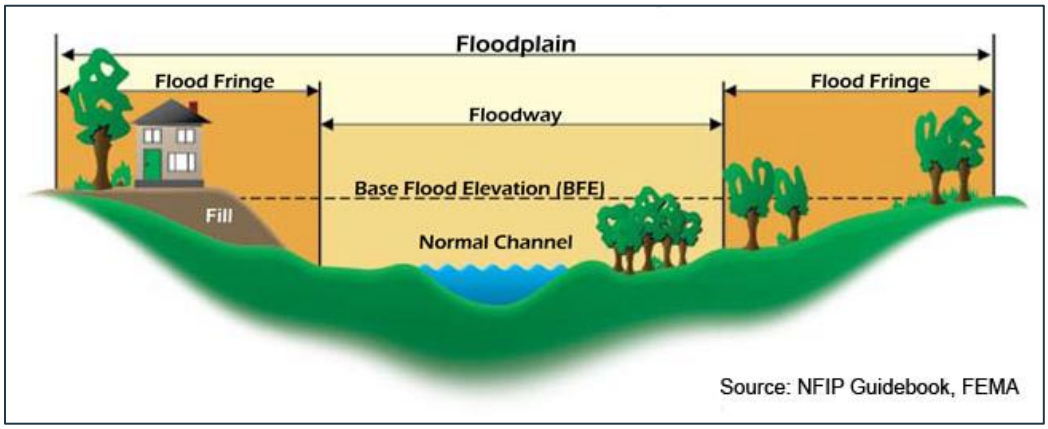
While localized flooding may not be as destructive as riverine or flash flooding, it is a chronic problem. The repetitive damage caused by such flooding can add up. Sewers may back up, yards can be inundated, and mechanical systems can be damaged when homes, businesses and vehicles are flooded. These impacts, and other localized flooding impacts, can create public health and safety concerns.

### Flooding and Floodplains

A floodplain, as shown in Figure 3.2, is flat or nearly flat land adjacent to a stream, river, or body of water that experiences occasional or periodic flooding. In riverine floodplains, it includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. Floodplains are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. When this occurs, sediments (including rocks and debris) are deposited that gradually build up over time to create the floor of the floodplain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream. In coastal floodplains, zones are distinguished by wave heights.

Floodplain boundaries are designated and routinely updated through cooperation between local governments, states and the FEMA. Flood Insurance Study (FIS) findings are shown on Flood Insurance Rate Maps (FIRMs) and 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 flood), as well as some areas of the 500-year floodplain (0.2-percent annual chance flood).

**Figure 3.2 – Characteristics of a Floodplain**




In its common usage, the floodplain most often refers to that area that is inundated by the "100-year flood," better defined as the "1-percent-annual-chance flood" because it is the flood that has a 1 percent chance in any given year of being equaled or exceeded. The NFIP utilizes the 1-percent-annual-chance flood as a basis for floodplain management. The "500-year flood" or "0.2-percent-annual-chance flood" is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. Flooding can also occur outside of mapped floodplains, especially local stormwater flooding, as discussed above.

The 1-percent-annual-chance flood, which is the minimum standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. Participation in the NFIP requires adoption and enforcement of a local floodplain management ordinance which is intended to prevent unsafe development in the floodplain, thereby reducing future flood damage. Participation in the NFIP allows for the federal government to make flood insurance available within the community as a financial protection against flood losses. Individual campuses are not required to maintain flood insurance as North Carolina is a self-insuring state. All state-owned facilities are covered by the NC General Assembly.

Since floods have an annual probability of occurrence, have a known magnitude, depth and velocity for each event, and in many cases, have a map indicating where they will likely occur, they are in many ways often the most predictable and manageable hazard.

While weather forecasting can project periods of heavy rain, the likelihood of flooding is difficult to predict, leaving limited warning time for flood events. Especially as heavy rain events become more common, as discussed below under Climate Change, warning time for flooding may decrease, thereby increasing risk to those in harm's way.

*Warning Time: 3 – 6 to 12 hours*

*Duration: 3 – Less than 1 week*

### Repetitive Loss Properties

The identification of repetitive loss properties, defined as those properties with two or more flood insurance claims totaling $1,000 or more within any 10-year period, is typically an important consideration of flood mitigation planning. For the UNC System Eastern Campuses, there are no repetitive loss properties because public buildings, including all UNC System campus buildings, are generally self-insured and therefore, there have not been claims made to the NFIP for any campus buildings. This does not mean that there has not been repeated property damage resulting from flooding on any campus. However, data was not available on past loss amounts or repetitively damaged buildings.

## Climate Change

Per the 2023 North Carolina Hazard Mitigation Plan, changing climate and weather patterns, environmental conditions, and urban and rural development may affect the frequency and intensity of flooding. Historical data and climate projections provided by the State Climate Office of North Carolina on the North Carolina Resilience Exchange website indicate that the region is expected to experience more days with extreme precipitation (2 inches or more of precipitation) shown in Table 3.7. This increased likelihood of extreme precipitation events due to climate change will result in greater risks of flash flooding and coastal flooding.

**Table 3.7 – Number of Days with Extreme Precipitation (2+ inches)**

| County | Historical[1] | Best Case Scenario[2] | Worst Case Scenario[3] |
|---|---|---|---|
| Cumberland | 14 | 16 | 18 |
| Durham | 9 | 13 | 14 |
| New Hanover | 25 | 30 | 31 |
| Orange | 12 | 16 | 18 |
| Pasquotank | 15 | 19 | 20 |
| Pitt | 16 | 18 | 20 |
| Robeson | 14 | 17 | 18 |
| Wake | 13 | 16 | 17 |

1. Days with 2 or more inches of precipitation on average between 1983-2014
2. Projected days with 2 or more inches of precipitation between 2045-2074 under a low emissions scenario
3. Projected days with 2 or more inches of precipitation between 2045-2074 under a high emissions scenario

Additionally, sea level rise will inundate low-lying coastal areas and exacerbate other flood risks, especially storm surge and coastal flooding. Based on data from NOAA and the North Carolina Resilience Exchange, the New Hanover, Pasquotank, and Pitt counties will experience 1.0 – 1.4 ft of sea level rise from 2020-2060. Based on these projections, sea level rise would not directly impact most of the UNC-W, ECSU, and ECU campuses, however compounded with other types of flooding, sea level rise could worsen future flood impacts.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Localized impact expected to be severe for incident areas and moderate to light for other adversely affected areas. |
| Responders | First responders are at risk when attempting to rescue people from their homes. They are subject to the same health hazards as the public. Flood waters may prevent access to areas in need of response or the flood may prevent access to the critical facilities themselves which may prolong response time. Damage to personnel will generally be localized to those in the flood areas at the time of the incident and is expected to be limited. |
| Continuity of Operations (including Continued Delivery of Services) | Floods can severely disrupt normal operations, especially when there is a loss of power. Damage to facilities in the affected area may require temporary relocation of some operations. Localized disruption of roads, facilities, and/or utilities caused by incident may postpone delivery of some services. |
| Property, Facilities and Infrastructure | Buildings and infrastructure, including transportation and utility infrastructure, may be damaged or destroyed. Impacts are expected to be localized to the area of the incident. Severe damage is possible. |
| Environment | Chemicals and other hazardous substances may contaminate local water bodies. Wildlife and livestock deaths possible. The localized impact is expected to be severe for incident areas and moderate to light for other areas affected by the flood or HazMat spills. Flood may also adversely affect water quality by increasing nutrient and sediment loads in waterbodies. |
| Economic Condition of the Jurisdiction | Local economy and finances will be adversely affected, possibly for an extended period of time. During floods (especially flash floods), roads, bridges, farms, houses and automobiles are destroyed. Additionally, the local government must deploy firemen, police and other emergency response personnel and equipment to help the affected area. It may take years for the affected communities to be re-built and business to return to normal. |
| Public Confidence in the Jurisdiction's Governance | Ability to respond and recover may be questioned and challenged if planning, response, and recovery are not timely and effective. |

## Problem Statements

Problem statements are provided below by campus, as applicable:

- ECU – Nine buildings are located in the SFHA. An educational/extracurricular building on main campus and a psychiatric services building on the health sciences campus could sustain over $77,000 in damage from the 1% annual chance flood event. The College Hill parking lot and the North Campus recreation area often experience localized flooding.
- ECSU – There are two structures on campus located in the SFHA but they are not expected to sustain damage from the 1% annual chance flood. Flash flooding has previously affected several campus streets.
- FSU – The Bronco Student Plaza, Health and Wellness Center, and adjacent roadways and located within the 0.2% annual chance floodplain.
- NCCU – The HMPC reports this as the biggest hazard concern for campus. Buildings and drains that experience impacts from localized flooding include the Administration Building,

Rush Residence Hall, Annie Day Shepard Residence Hall, the BRITE Building, and drains near the Greek Bowl.

- NCSU – Two buildings on the NCSU Central campus (Carmichael Gymnasium and Dail Softball Stadium Batting Cage) and two buildings on Centennial campus (in North Shore Residential Development) are located within the 1% annual chance floodplain but are not expected to sustain damage from the 1% annual chance flood.
- UNC-CH – There are 11 buildings within the SFHA, of which are estimated to sustain total structure and content loss of $844,301 from the 1% annual chance flood event. Seven of these buildings are located on South Campus.
- UNC-W - Tropical Storm Nicole caused flood damage at 34 UNC-W buildings. These buildings may be vulnerable to repeat flooding without mitigation.

# 3.4.6 Geological – Landslides & Sinkhole

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| | | | ✓ | | | ✓ | | |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| NCCU | Unlikely | Minor | Small | 6 to 12 hours | Less than 6 hours | 1.9 |
| UNC-CH | Possible | Minor | Small | 6 to 12 hours | Less than 6 hours | 1.7 |

## Hazard Description

### Landslide

A landslide is the downhill movement of masses of soil and rock, driven by gravity. Landslides occur when susceptible rock, earth, or debris moves down a slope under the force of gravity and water. They can be triggered by natural changes, such as heavy rains, snow melt, fires, and earthquakes; and human-caused changes, such as slope or drainage modifications. Landslides may be very small or very large and can move at slow to very high speeds.

There are several types of landslides: rock falls, rock topple, slides, and flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material. Mudflows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as heavy rainfall or rapid snowmelt, changing the soil into a flowing river of mud or “slurry.” Slurry can flow rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. As the flows reach flatter ground, the mudflow spreads over a broad area where it can accumulate in thick deposits.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas

that have not moved in the past, relatively flat-lying areas away from sudden changes in slope, and areas at the top or along ridges set back from the tops of slopes.

*Warning Time: 3 – 6 to 12 hours*

*Duration: 1 – Less than six hours*

### Sinkhole

Sinkholes are a natural and common geologic feature in areas with underlying limestone and other rock types that are soluble in natural water. Most limestone is porous, allowing the acidic water of rain to percolate through their strata, dissolving some limestone and carrying it away in solution. Over time, this persistent erosional process can create extensive underground voids and drainage systems in much of the carbonate rocks. Collapse of overlying sediments into the underground cavities produces sinkholes.

The three general types of sinkholes are: subsidence, solution, and collapse. Collapse sinkholes are most common in areas where the overburden (the sediments and water contained in the unsaturated zone, surficial aquifer system, and the confining layer above an aquifer) is thick, but the confining layer is breached or absent. Collapse sinkholes can form with little warning and leave behind a deep, steep sided hole. Subsidence sinkholes form gradually where the overburden is thin and only a veneer of sediments is overlying the limestone. Solution sinkholes form where no overburden is present, and the limestone is exposed at land surface.

Sinkholes occur in many shapes, from steep-walled holes to bowl or cone shaped depressions. Sinkholes can be dramatic because the land generally stays intact for a while until the underground spaces get too big. If there is not enough support for the land above the spaces, then a sudden collapse of the land surface can occur. Under natural conditions, sinkholes form slowly and expand gradually. However, human activities such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater can accelerate the rate of sinkhole expansions, resulting in the abrupt formation of collapse sinkholes.

Although a sinkhole can form without warning, specific signs can signal potential development:

- Slumping or falling fenceposts, trees, or foundations;
- Sudden formation of small ponds;
- Wilting vegetation;
- Discolored well water; and/or
- Structural cracks in walls, floors.

Sinkhole formation can be accelerated by urbanization. Development increases water usage, alters drainage pathways, overloads the ground surface, and redistributes soil. According to FEMA, the number of human-induced sinkholes has doubled since 1930, insurance claims for damage as a result of sinkholes has increased 1,200 percent from 1987 to 1991, costing nearly $100 million.

*Warning Time: 4 – Less than six hours*

*Duration: 1 – Less than six hours*

## Climate Change

NOAA research has found that extreme precipitation events are likely to become more common in the future as the climate warms, and in some areas, this may lead to a higher frequency of landslide activity.

Direct effects from changing climate conditions such as an increase in droughts and could also contribute to an increase in sinkholes. These changes raise the likelihood of extreme weather, meaning the torrential rain and flooding conditions which often lead to the exposure of sinkholes are likely to become increasingly common. Certain events such as heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Impacts are expected to be minimal to the larger population. Individuals may sustain injuries if they are in an affected structure or using affected infrastructure when the event occurs. Impacts for those effected could cause anxiety or depression about economic and property losses and personal injury. |
| Responders | First responders will be impacted similarly to other events that have advance warning. Personnel responsible for debris cleanup or roadway closures may face increased risk. |
| Continuity of Operations (including Continued Delivery of Services) | Temporary road closures may occur. Continuity of operations is generally not disrupted by sinkholes or landslide. |
| Property, Facilities and Infrastructure | Buildings and infrastructure may incur minor damage as a result of landslide. Although sinkhole extents are localized, buildings located on or adjacent to a sinkhole are susceptible to foundation damage or building collapse. If the building is located close enough to the sinkhole it can be completely destroyed or in worst cases, completely collapse into the sinkhole. Remediation costs can be high due to costly foundation shoring or cost of stabilization of the sinkhole itself. |
| Environment | Environmental impacts are expected to be minimal. Landslide may cause terrain and drainage changes and may temporarily increase sediment loads in nearby waterways. Sinkholes are natural occurring process and local plants and animals adjust quickly. Many naturally occurring sinkholes fill with rainwater creating new aquatic habitat. |
| Economic Condition of the Jurisdiction | Economic impacts are not expected from landslides. Sinkholes located in open areas or that impact only small numbers of buildings, while having a high impact to the local property owner, do not have substantial impacts to the economy. Sinkholes that open up in major traffic thoroughfares can include significant impact to daily work traffic and flow of goods. |

| Category | Consequences |
|---|---|
| Public Confidence in the Jurisdiction's Governance | Landslides and sinkholes in the planning area are unlikely to be severe and would not be expected to affect public confidence. |

## Problem Statements

- While landslides are an unlikely hazard event for most of the UNC Eastern Campuses, UNC-CH is susceptible to landslides due to slope and soil conditions. A landslide event could cause minor to moderate property damage to one or more buildings or cause localized damage to infrastructure. A landslide event may also result in the need for debris removal.
- Sinkholes are possible in the coastal plain where karst soils occur. Underground drainage pipe or infrastructure failures could result in sinkhole-like events elsewhere. The latter type of event could affect NCCU but would not be expected to be severe.

# 3.4.7 Hurricane & Coastal Hazards

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |
| ECSU | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |
| FSU | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| NCCU | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| NCSSM | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| NCSU | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| UNC-CH | Possible | Limited | Large | More than 24 hrs | Less than 24 hrs | 2.3 |
| UNC-P | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| UNC-W | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |

## Hazard Description

Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. Most hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in the Atlantic basin is about six.

While hurricanes pose the greatest threat to life and property, tropical storms and depressions also can be devastating. A tropical disturbance can grow to a more intense stage through an increase in sustained wind speeds. The progression of a tropical disturbance is described below.

- **Tropical Depression:** tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm:** tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane:** tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
- **Major Hurricane:** tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Damage during hurricanes may also result from inland flooding from associated heavy rainfall.

*Warning Time: 1 – More than 24 hours*

*Duration: 2 – Less than 24 hours*

## Climate Change

NOAA reports that climate change will likely cause more frequent, stronger storms in the future due to rising surface temperatures. 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 while there may be fewer hurricanes overall in any given year, when hurricanes do form, it is more likely that they will become larger storms with more destructive potential. Rapid intensification of storms is also projected to increase. Additionally, rainfall rates associated with tropical cyclones are expected to increase.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Impacts include injury or death, loss of property, outbreak of diseases, mental trauma and loss of livelihoods. Power outages and flooding are likely to displace people from their homes. Water can become polluted such that if consumed, diseases and infection can be easily spread. Residential, commercial, and public buildings, as well as critical infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed, resulting in cascading impacts on the public. |
| Responders | Localized impact expected to limit damage to personnel in the inundation area at the time of the incident. |
| Continuity of Operations (including Continued Delivery of Services) | Damage to facilities/personnel from flooding or wind may require temporary relocation of some operations. Operations may be interrupted by power outages. Disruption of roads and/or utilities may postpone delivery of some services. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult. Impact may reduce deliveries. |
| Property, Facilities and Infrastructure | Structural damage to buildings may occur; loss of glass windows and doors by high winds and debris; loss of roof coverings, partial wall collapses, and other damages requiring significant repairs are possible in a major (category 3 to 5) hurricane. |

| Category | Consequences |
|---|---|
| Environment | Hurricanes can devastate wooded ecosystems and remove all the foliation from forest canopies, and they can change habitats so drastically that the indigenous animal populations suffer as a result. Specific foods can be taken away as high winds will often strip fruits, seeds and berries from bushes and trees. Secondary impacts may occur; for example, high winds and debris may result in damage to an above-ground fuel tank, resulting in a significant chemical spill. |
| Economic Condition of the Jurisdiction | Local economy and finances adversely affected, possibly for an extended period of time, depending on damages. Intangible impacts also likely, including business interruption and additional living expenses. |
| Public Confidence in the Jurisdiction's Governance | Likely to impact public confidence due to possibility of major event requiring substantial response and long-term recovery effort. |

## Problem Statements

- Historical tracks of multiple hurricane events passed within 25-miles of all the UNC Eastern Campuses
- For the 25-year period from 2000 through 2024, there have been multiple hurricane events reported in the counties where each of the UNC Eastern Campuses are located:
- In Pasquotank County, 10 hurricanes and tropical storms caused $5.5 million in property damage and $500,000 in crop damage, but no deaths or injuries;
- In Pitt County, 10 hurricanes and tropical storms caused 3 deaths, 1 injury, approximately $12.2 million in property damage, and $38 million in crop damage.
- In Cumberland County, 8 hurricanes and tropical storms caused $4.1 million in property damage.
- In Durham County, 4 hurricane wind events caused over $1.4 million in property damage.
- In Wake County, 6 hurricane wind events caused over $3.6 million in property damage.
- In Orange County, 2 hurricane wind events caused $1,250,000 in property damage.
- In Robeson County, 5 hurricane wind events caused $71,000 in damage.
- In New Hanover County, 12 hurricane wind events caused $1,003,048 in damage.

## 3.4.8 Severe Winter Weather

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| ECSU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| FSU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCCU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCSSM | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| NCSU | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| UNC-CH | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| UNC-P | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Hazard Description

A winter storm can range from moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Events may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation and can be accompanied by extreme cold temperatures. Some winter storms might be large enough to affect several states, while others might affect only localized areas. Occasionally, heavy snow might also cause significant property damage, such as roof collapses on older buildings.

All winter storm events have the potential to present dangerous conditions to the affected area. Larger snowfalls pose a greater risk, reducing visibility due to blowing snow and making driving conditions treacherous. A heavy snow event is defined by the National Weather Service (NWS) as an accumulation of 4 or more inches in 12 hours or less. A blizzard is the most severe form of winter storm. It combines low temperatures, heavy snow, and winds of 35 miles per hour or more, which reduces visibility to a quarter mile or less for at least 3 hours. Winter storms are often accompanied by sleet, freezing rain, or an ice storm. Such freeze events are particularly hazardous as they create treacherous surfaces.

Ice storms are defined as storms with significant amounts of freezing rain and are a result of cold air damming (CAD). CAD is a shallow, surface-based layer of relatively cold, stably stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either super-cooled (liquid below the melting point of water) or re-freezes. In the former case, super-cooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet). Sleet is defined as partially frozen raindrops or refrozen snowflakes that form into small ice pellets before reaching the ground. They typically bounce when they hit the ground and do not stick to the surface. However, it does accumulate like snow, posing similar

problems and has the potential to accumulate into a layer of ice on surfaces. Freezing rain, conversely, usually sticks to the ground, creating a sheet of ice on the roadways and other surfaces. All winter storm elements – snow, low temperatures, sleet, ice, etcetera – have the potential to cause hazardous impacts to a community. Even small accumulations can down power lines and tree limbs and create hazardous driving conditions and disrupt communication and power for days.

Advancements in meteorology and forecasting usually allow for mostly accurate forecasting a few days in advance of an impending storm. Most storms have a duration of a few hours; however, impacts can last several days after the initial incident until cleanup is completed.

*Warning Time: 1 – More than 24 hours*

*Duration: 3 – Less than 1 week*

## Climate Change

According to the 2023 North Carolina Hazard Mitigation Plan, there is uncertainty associated with climate change impacts on future severe winter storms. Global temperature rise 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.

A shorter overall winter season and fewer days of extreme cold may have both positive and negative indirect impacts. Warmer winter temperatures may result in changing distributions of native plant and animal species and/or an increase in pests and non-native species. As both temperature and precipitation increase during the winter months, freezing rain will be more likely. Additional wintertime precipitation in any form will contribute to saturation and increase the risk and/or severity of spring flooding.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Localized impact expected to be severe for affected areas and moderate to light for other less affected areas. |
| Responders | Adverse impact expected to be severe for unprotected personnel and moderate to light for trained, equipped, and protected personnel. |
| Continuity of Operations (including Continued Delivery of Services) | Localized disruption of roads and/or utilities caused by incident may postpone delivery of some services. |
| Property, Facilities and Infrastructure | Localized impact to facilities and infrastructure in the areas of the incident. Power lines and roads most adversely affected. |
| Environment | Environmental damage to trees, bushes, etc. |
| Economic Condition of the Jurisdiction | Local economy and finances may be adversely affected, depending on damage. |
| Public Confidence in the Jurisdiction's Governance | Ability to respond and recover may be questioned and challenged if planning, response, and recovery not timely and effective. |

## Problem Statements

- ECU – There have been 28 severe winter weather related events in Pitt County during the 25-year period from 2000 through 2024. The events have also resulted in two presidential disaster declarations for the County.
- ECSU – There have been 35 severe winter weather related events in Pasquotank County during the 25-year period from 2000 through 2024. The events have also resulted in two presidential disaster declarations for the County.
- FSU – There have been 35 severe winter weather related events in Cumberland County during the 25-year period from 2000 through 2024. None of the events resulted in a presidential disaster declaration.
- NCCU, NCSSM – There have been 61 severe winter weather related events in Durham County during the 25-year period from 2000 through 2024. The events have also resulted in four presidential disaster declarations for the County.
- NCSU – There have been 58 severe winter weather related events in Wake County during the 25-year period from 2000 through 2024. The events have also resulted in six presidential disaster declarations for the County.
- UNC-CH – There have been 71 severe winter weather related events in Orange County during the 25-year period from 2000 through 2024. The events have also resulted in seven presidential disaster declarations for the County.
- UNC-P – There have been 28 severe winter weather related events in Robeson County during the 25-year period from 2000 through 2024. None of the events resulted in a presidential disaster declaration.

# 3.4.9 Tornadoes & Thunderstorms

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| ECSU | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| FSU | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| NCCU | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| NCSSM | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| NCSU | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| UNC-CH | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| UNC-P | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| UNC-W | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Hazard Description

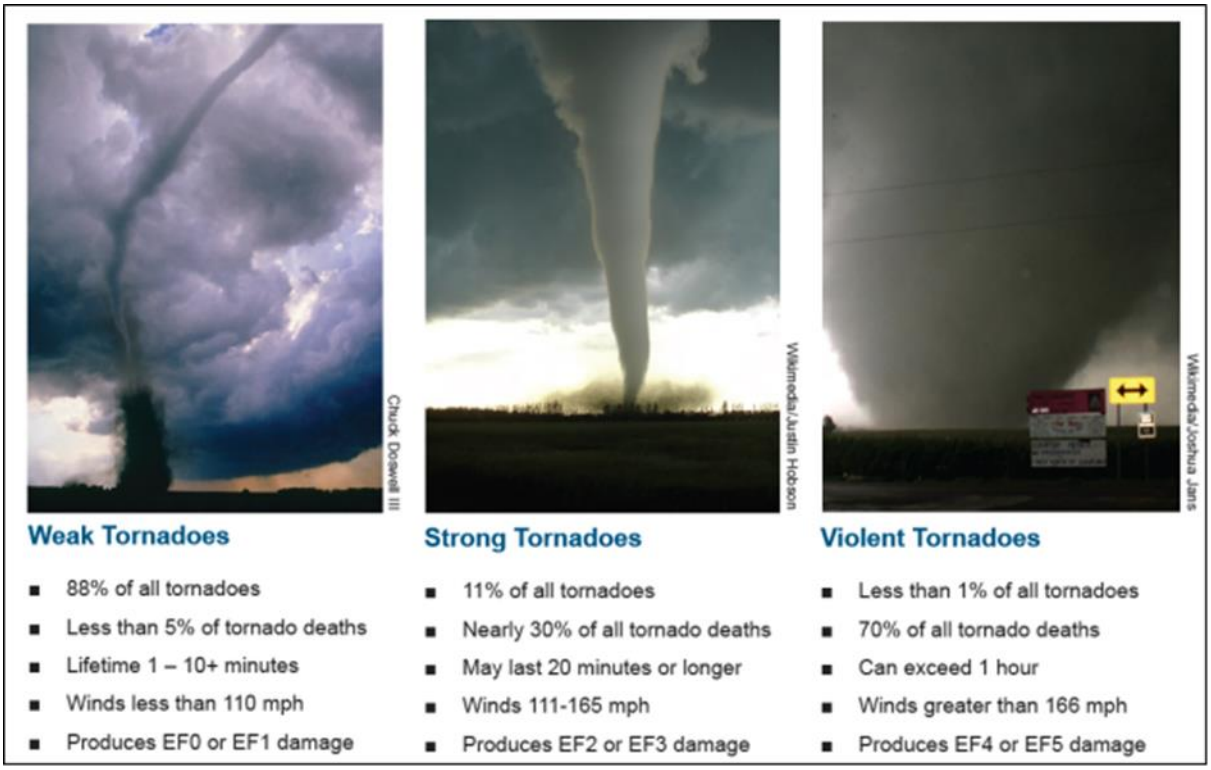
### Tornadoes

According to the Glossary of Meteorology (AMS 2000), a tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." Tornadoes can appear from any direction. Most move from southwest to northeast, or west to east. Some tornadoes have changed direction or even backtracked.

Tornadoes are commonly produced by land falling tropical cyclones. Those making landfall along the Gulf coast traditionally produce more tornadoes than those making landfall along the Atlantic coast. Tornadoes that form within hurricanes are more common in the right front quadrant with respect to the forward direction but can occur in other areas as well. According to the NHC, about 10% of the tropical cyclone-related fatalities are caused by tornadoes. Tornadoes are more likely to be spawned within 24 hours of landfall and are usually within 30 miles of the tropical cyclone’s center.

Tornadoes have the potential to produce winds in excess of 200 mph (EF5 on the Enhanced Fujita Scale) and can be very expansive – some in the Great Plains have exceeded two miles in width. Tornadoes associated with tropical cyclones, however, tend to be of lower intensity (EF0 to EF2) and much smaller in size than ones that form in the Great Plains.

**Table 3.8 – Summary of Tornado Occurrences and Impacts by Magnitude**



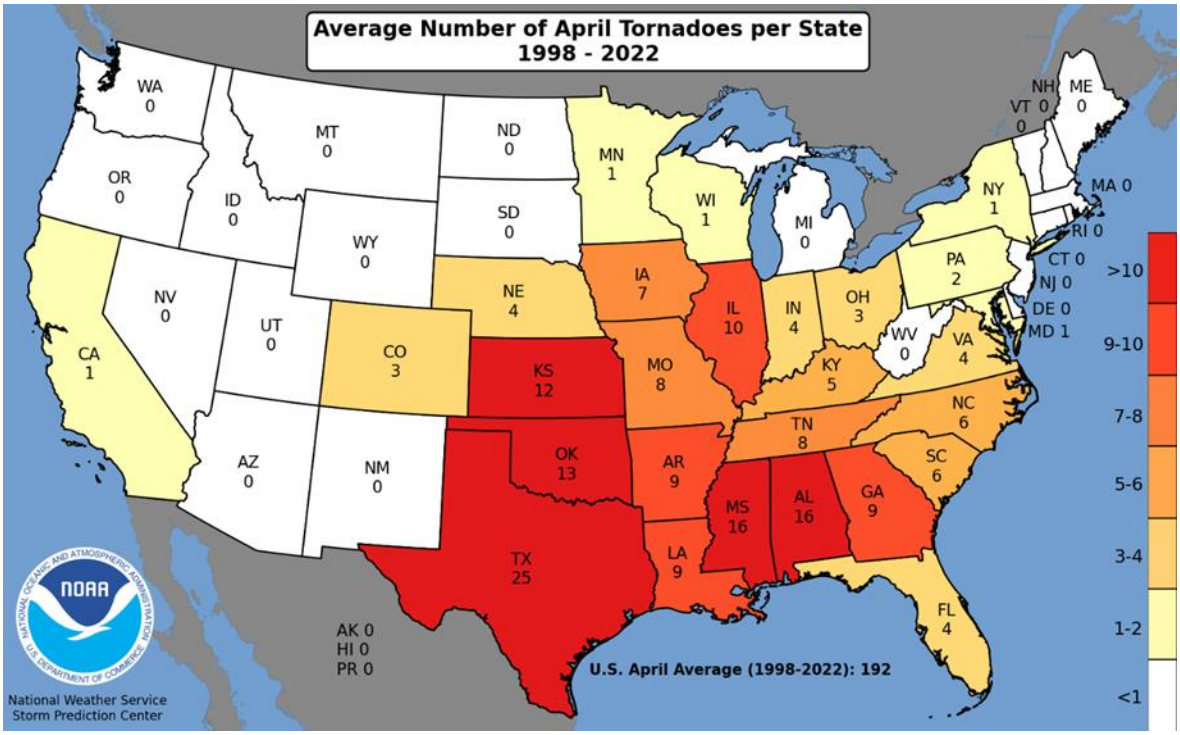

Source: NOAA National Weather Service

Figure 3.3 illustrates the average number of F3, F4, and F5 tornadoes recorded in the United States per state between 1998-2022 in the month of April. April is the beginning of the most active and dangerous three-month period for tornadoes in the U.S. The Midwest and South, including North Carolina, experienced substantially more tornadoes than the West or Northeast during this period.

The planning area is not located within the boundaries of “Tornado Alley,” which is an area found in the Central Great Plains that receives more tornadoes than anywhere else in the U.S. besides Florida. However, new research has shown that tornadic activity has risen substantially eastward of the Plains to portions of Mississippi, Alabama, Arkansas, Missouri, Illinois, Indiana, Tennessee and Kentucky.[1]

[1] Gensini, V.A., Brooks, H.E. Spatial trends in United States tornado frequency. *npj Clim Atmos Sci* **1**, 38 (2018). https://doi.org/10.1038/s41612-018-0048-2

**Figure 3.3 – Average Number of April Tornadoes per State 1998-2022**




Source: NOAA

Tornadoes and thunderstorms can occur anywhere in the region and do not have a defined vulnerability zone. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado isn't increased in one area of the county versus another. Tornadoes can be spawned by tropical cyclones; however, these tornadoes typically occur up to 2 days before and as many as 3 days after landfall of the tropical cyclone.

*Warning Time: 4 – Less than 6 hours*

*Duration: 1 – Less than 6 hours*

## Thunderstorm Winds

Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads out at earth's surface and causes strong winds associated with thunderstorms.

There are four ways in which thunderstorms can organize: single cell, multi-cell cluster, multi-cell lines (squall lines), and supercells. Even though supercell thunderstorms are most

frequently associated with severe weather phenomena, thunderstorms most frequently organize into clusters or lines. Warm, humid conditions are favorable for the development of thunderstorms. The average single cell thunderstorm is approximately 15 miles in diameter and lasts less than 30 minutes at a single location. However, thunderstorms, especially when organized into clusters or lines, can travel intact for distances exceeding 600 miles.

Thunderstorms are responsible for the development and formation of many severe weather phenomena, posing great hazards to the population and landscape. Damage that results from thunderstorms is mainly inflicted by downburst winds, large hailstones, and flash flooding caused by heavy precipitation. Stronger thunderstorms are capable of producing tornadoes and waterspouts. While conditions for thunderstorm conditions may be anticipated within a few hours, severe conditions are difficult to predict. Regardless of severity, storms generally pass within a few hours.

*Warning Time: 4 – Less than six hours*

*Duration: 1 – Less than six hours*

### Lightning

Lightning is a sudden electrical discharge released from the atmosphere that follows a course from cloud to ground, cloud to cloud, or cloud to surrounding air, with light illuminating its path. Lightning's unpredictable nature causes it to be one of the most feared weather elements.

All thunderstorms produce lightning, which often strikes outside of the area where it is raining and is known to fall more than 10 miles away from the rainfall area. When lightning strikes, electricity shoots through the air and causes vibrations, creating the sound of thunder. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start building and wildland fires, and damage electrical systems and equipment.

The watch/warning time for a given storm is usually a few hours. There is no warning time for any given lightning strike. Lightning strikes are instantaneous. Storms that cause lightning usually pass within a few hours.

*Warning Time: 4 – Less than six hours*

*Duration: 1 – Less than six hours*

### Hail

According to NOAA, hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere causing them to freeze. The raindrops form into small frozen droplets and then continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen rain droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 mph, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 mph. The largest hailstone recorded in the United States was found in Vivian, South Dakota on July 23, 2010; it measured eight inches in diameter, almost the size of a soccer ball. While soccer-ball-sized hail is the exception, even small pea sized hail can do damage.

Hailstorms in North Carolina cause damage to property, crops, and the environment, and kill and injure livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are the other things most commonly damaged by hail. Hail has been known to cause injury to humans; occasionally, these injuries can be fatal.

The onset of thunderstorms with hail is generally rapid. However, advancements in meteorological forecasting allow for some warning. Storms usually pass in a few hours.

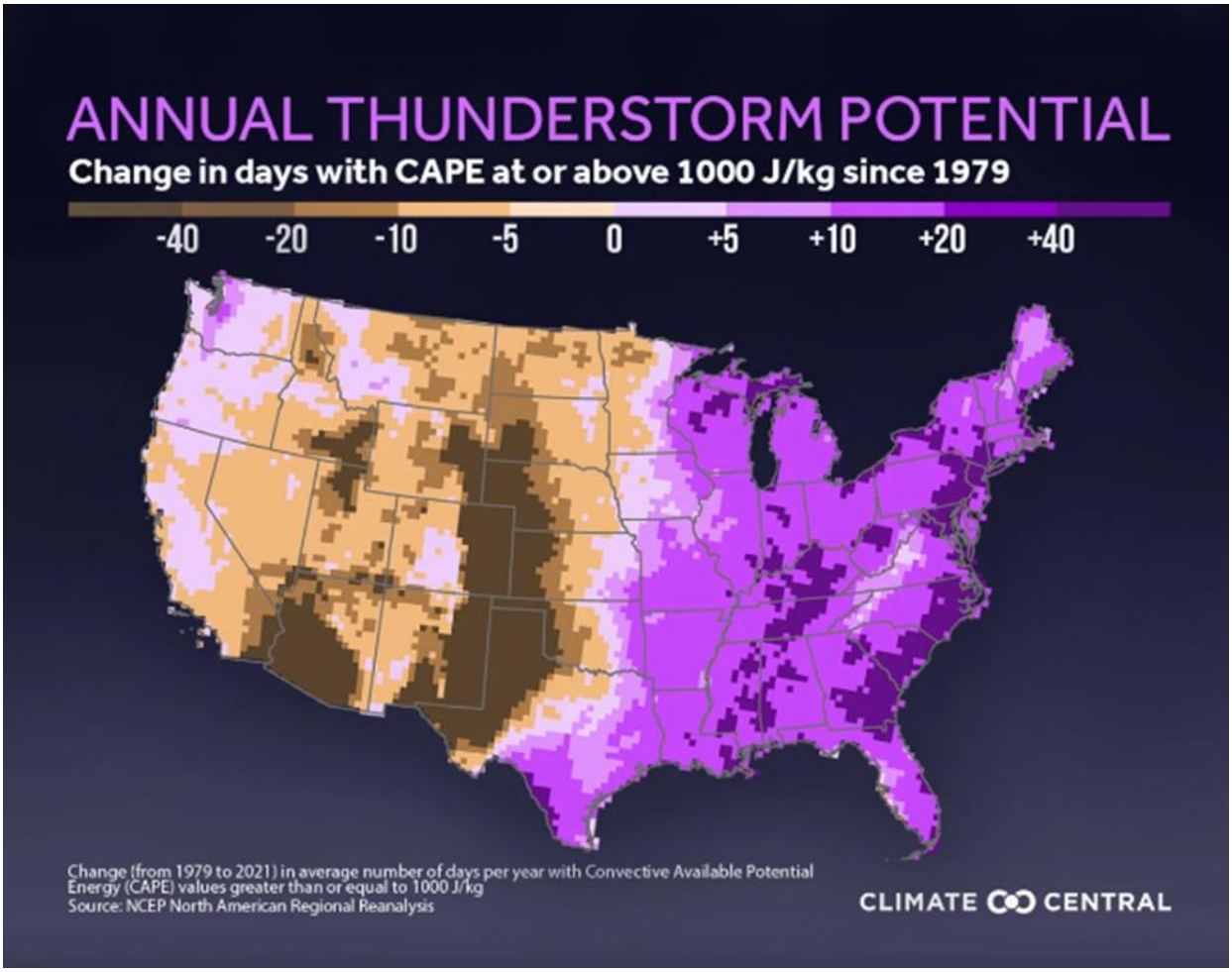
*Warning Time: 4 – Less than six hours*

*Duration: 1 – Less than six hours*

## Climate Change

According to the National Aeronautics and Space Administration (NASA), thunderstorm events in the future are likely to become more frequent in the southeast as a result of weather extremes. Thunderstorm 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. Between 1979 and 2021, the UNC Eastern Campuses experienced 2-0-40+ more days on average with CAPE at or above 1000 J/kg, which is considered a high cape value. Figure 3.4 below shows the change in days with high potential for thunderstorm nationwide.

**Figure 3.4 – Change in Days with High Thunderstorm Potential from 1979 to 2021**




Source: NCEP North American Regional Reanalysis, Climate Central 2022

NASA projects that by the period of 2072-2099, the CAPE in the southeastern United States will increase dramatically. Parts of North Carolina are in an area that will likely experience the greatest increase in CAPE in the United States, and the entire state is likely to experience at least some increase.

For a thunderstorm to become a supercell event, meaning that it produces more severe weather like large hail, damaging winds, and tornadoes, it relies on not only on warm moist air, but also wind at different levels moving in different directions at different speeds (wind shear). As the planet warms, wind shear, unlike warm, moist air, is expected to decrease. Therefore, it is difficult to predict if more supercell thunderstorm events and the tornadoes they can bring with them are more likely to occur.

Additionally, while supercell events are associated with tornadoes, only about 20% of supercell thunderstorms produce tornadoes. To complicate things further, no one fully understands how tornadoes are formed. Therefore, there is no identified conclusion on how climate change will impact tornadoes.

The relationship between hail and climate change is also unclear, however, a 2022 study shows that climate change could increase severe and/or significant spring hailstorms within the Central U.S.2 Lightning has a more direct correlation with increasing temperatures as it occurs more frequently when the temperature is hotter than when it is colder. Romps, et. al postulate that lightning will increase by 12% for every degree of rise in global average air temperature.3

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Injuries and fatalities possible |
| Responders | Injuries and fatalities unlikely; potential impacts to response capabilities due to storm impacts |
| Continuity of Operations (including Continued Delivery of Services) | Potential impacts to continuity of operations due to storm impacts; delays in providing services |
| Property, Facilities and Infrastructure | Possibility of structure fire ignition; potential for disruptions in power and communications infrastructure; destruction and/or damage to any exposed property, especially windows, cars and siding; mobile homes see increased risk |
| Environment | Potential fire ignition from lightning; hail damage to wildlife and foliage |
| Economic Condition of the Jurisdiction | Lightning damage contingent on target; can severely impact/destroy critical infrastructure and other economic drivers |
| Public Confidence in the Jurisdiction's Governance | Public confidence is not generally affected by severe weather events. |

## Problem Statements

Thunderstorms and tornadoes are frequent hazard events on all of the UNC Eastern Campuses. Problems statements for each campus are presented below:

### ECSU

- The most intense tornado to pass through Elizabeth City in the past 75 years was an F3 (EF3) on November 23, 1992. NCEI reports this event caused around $2.5 million in property damage and 21 injuries.
- The strongest recorded thunderstorm wind event for Elizabeth City occurred on January 14, 2006 with a measured gust of 69 mph. The event reportedly caused $10,000 in property damage.
- The average hailstone size recorded between 2000 and 2024 in Elizabeth City was a little over 1" in diameter; the largest hailstone recorded was 1.75".

[2] Fan, J., Zhang, Y., Wang, J., Jeong, J.-H., Chen, X., Zhang, S., et al. (2022). Contrasting responses of hailstorms to anthropogenic climate change in different synoptic weather systems. *Earth's Future*, 10, e2022EF002768. https://doi.org/10.1029/2022EF002768
[3] Romps DM, Seeley JT, Vollaro D, Molinari J. Climate change. Projected increase in lightning strikes in the United States due to global warming. Science. 2014 Nov 14;346(6211):851-4. doi: 10.1126/science.1259100. PMID: 25395536.

- Reported damages for the 25-year period from 2000-2024 include $126,000 for thunderstorm winds and $15,000 for lightning strikes. Between 1950 and 2024, Pasquotank County reported $5.2 million in property damage due to tornadoes.

**ECU**

- The most intense tornado to pass through Pitt County since 1950 was an F4 tornado on March 28, 1984 that killed 9 people, injured 153, and caused $25 million in crop damage.
- The strongest recorded thunderstorm wind event for Greenville occurred on July 1, 2012 with a measured gust of 75 mph.
- The average hailstone size recorded between 2000 and 2024 in Greenville was a little over 1” in diameter; the largest hailstone recorded in Greenville was 1.75”.
- Reported damages for the 25-year period from 2000-2024 within Greenville include $21,000 for thunderstorm winds, $151,000 for lightning strikes. Additionally, between 1950 and 2024, Pitt County reported $30 million in property damage from tornadoes.

**FSU**

- The most intense tornado to pass near Fayetteville in the past 75 years was an F4 (EF4) on April 8, 1957, which caused around $250,000 in property damage and 8 injuries.
- The strongest recorded thunderstorm wind event for Fayetteville occurred on July 8, 2015 with a measured gust of 74 mph.
- The average hailstone size recorded between 2000 and 2019 in Fayetteville was a little over 1” in diameter; the largest hailstone recorded was 2.5”.
- Thunderstorms are frequent hazard events in Cumberland County and the FSU campus. Reported damages for the 25-year period from 2000-2025 include $1,190,500 and for thunderstorm winds and $255,000 for lightning strikes. Between 1950-2024, Cumberland County experienced $100,525,000 in property damage due to tornadoes.

**NCCU and NCSSM**

- The most intense tornadoes to pass through Durham County in the past 75 years were 3 F2 tornadoes occurring in 1984, 1989, and 1998. Combined these incidents resulted in 5 injuries and caused $28.1 million in property damage.
- The strongest recorded thunderstorm wind event for Durham occurred on August 15, 2023 with the highest gusts recorded at 73 mph on August 15, 2023. The event did not result in fatalities or injuries but did cause $26,500 in property damage.
- The average hailstone size recorded between 2000 and 2024 in Durham was a little over 1” in diameter; the largest hailstone recorded was 1.75”.
- Reported damage for the 25-year period from 2000-2024 includes $361,250 from thunderstorm winds and $10,000 from lightning strikes. Between 1950-2024, Durham County experienced $28.7 million in property damage due to tornadoes.

**NCSU**

- The most intense tornado to pass through Wake County between 1950 and 2024 was an F4 (EF4) on November 28, 1988. NCEI reports this event causing around $250 million in

property damage, and narratives of the event reported two fatalities, 105 injuries, and severe property damage.

- The strongest recorded thunderstorm wind event for Raleigh between 2000 and 2024 occurred on March 4, 2008 with a measured gust of 70.2 mph.
- The average hailstone size recorded between 2000 and 2024 was a little over 1” in diameter; the largest hailstone recorded was 4 inches.
- Thunderstorms and tornadoes are frequent hazard events in Wake County and the NCSU campus. Reported damage for the 25-year period from 2000-2024 includes $201,500 from thunderstorm winds and $210,000 from lightning strikes. Between 1950 and 2024, Wake County experienced $116,163,000 in property damage due to tornadoes.

**UNC-CH**

- The most intense tornado to pass through Orange County in the past 75 years was an F3 on November 23, 1992 and resulted in 2 fatalities, 10 injuries, and $250,000 in damages.
- The strongest recorded thunderstorm wind event for Chapel Hill since 2000 occurred on June 13, 2013 and had a measured wind speed of 70.2 mph. The event reportedly resulted in $3,000 in property damage.
- Thunderstorms and tornadoes are frequent hazard events in Orange County and around the UNC-CH campus. Reported damages for the 25-year period from 2000-2024 include $263,500 for thunderstorm winds and $2,380,000 for lightning strikes.
- Between 1950 and 2024, tornadoes caused $2,902,500 in damage.

**UNC-P**

- The most intense tornado to pass through Robeson County in the past 75 years were 3 F4s, occurring in 1957 and 1984, that together resulted in 2 deaths, 307 injuries, and $3 million in property damage.
- The strongest recorded thunderstorm wind event for Robeson County occurred on May 11, 2014 with a measured gust of 125.5 mph. The event reportedly caused $878,000 in property damage and resulted in one injury.
- The average hailstone size recorded between 2000 and 2024 in Robeson County was a little over 1” in diameter; the largest diameter hail recorded in the County was 3 inches.
- Reported damage for Robeson County for the 25-year period from 2000-2024 includes $3,615,250 from thunderstorm winds, $506,500 from lightning, and $167,150 from hail.
- Between 1950 and 2024, tornadoes in the County caused $9,565,500 in property damage.

**UNC-W**

- The strongest recorded thunderstorm wind event for Wilmington occurred on May 31, 2003 with a measured gust of 100 mph. The event caused $750,000 in property damage.
- The average hailstone size recorded between 2000 and 2019 in Wilmington was a little under 1” in diameter; the largest hailstone recorded was 1.75”.
- Tornadoes have not reached beyond a magnitude of EF1 in New Hanover County in the past 75 years. Between 1950 and 2024, tornadoes caused $2,100,750 in damage.
- Thunderstorms and tornadoes are frequent hazard events in Wilmington and the UNC-W campus. Reported damage for the 25-year period from 2000-2024 include $1,237,000 from thunderstorm winds and $379,000 from lightning strikes.

# 3.4.10 Wildfire

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| ECSU | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| FSU | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |
| NCCU | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| NCSSM | Unlikely | Minor | Large | More than 24 hrs | More than 1 week | 1.8 |
| NCSU | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| UNC-CH | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| UNC-P | Likely | Limited | Large | More than 24 hrs | More than 1 week | 2.8 |
| UNC-W | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |

## Hazard Description

A wildfire is an uncontained fire that spreads through the environment. Wildfires have the ability to consume large areas, including infrastructure, property, and resources. When massive fires, or conflagrations, develop near populated areas, evacuations possibly ensue. Not only do the flames impact the environment, but the massive volumes of smoke spread by certain atmospheric conditions also impact the health of nearby populations. There are three general types of fire spread that are recognized.

- **Ground fires** – burn organic matter in the soil beneath surface litter and are sustained by glowing combustion.
- **Surface fires** – spread with a flaming front and burn leaf litter, fallen branches and other fuels located at ground level.
- **Crown fires** – burn through the top layer of foliage on a tree, known as the canopy or crown fires. Crown fires, the most intense type of fire and often the most difficult to contain, need strong winds, steep slopes and a heavy fuel load to continue burning.

Generally, wildfires are started by humans, either through arson or carelessness. Fire intensity is controlled by both short-term weather conditions and longer-term vegetation conditions. During intense fires, understory vegetation, such as leaves, small branches, and other organic materials that accumulate on the ground, can become additional fuel for the fire. The most explosive conditions occur when dry, gusty winds blow across dry vegetation.

Weather plays a major role in the birth, growth and death of a wildfire. In support of forecasting for fire weather, the National Weather Service Fire Weather Program emerged in response to a need for weather support to large and dangerous wildfires. This service is provided to federal

and state land management agencies for the prevention, suppression, and management of forest and rangeland fires.

North Carolina experiences a variety of wildfire conditions found in the Keetch-Byram Drought Index, which is described in Table 3.9. The Keetch-Byram Drought Index (KBDI) for October 7, 2024 is shown in Figure 3.5. The KBDI for the eastern campus counties at this time ranges from 200 to 670, with Pitt, Pasquotank, Cumberland, and Robeson with the highest index rating.

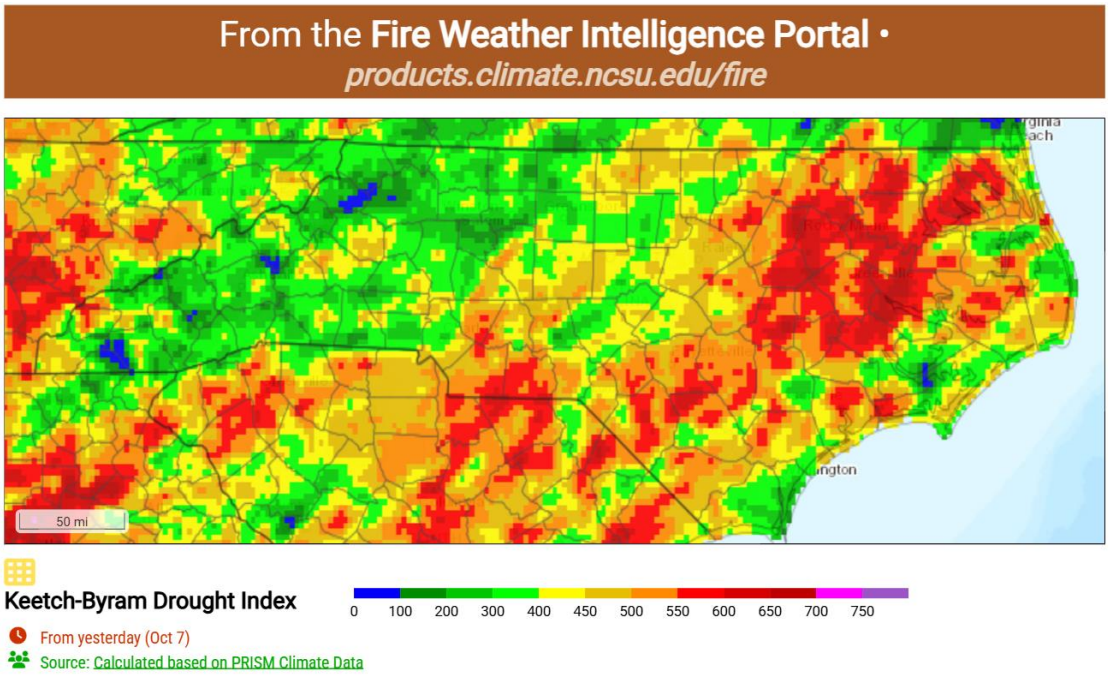
*Warning Time: 4 – Less than 6 hours*

*Duration: 3 – Less than 1 week*

**Table 3.9 – Keetch-Byram Index Fire Danger Rating System**

| KBDI | Description |
|---|---|
| 0-200 | Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in sports and patches. |
| 200-400 | Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night. |
| 400-600 | Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems. |
| 600-800 | Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity. |

**Figure 3.5 – Keetch-Byram Drought Index, October 2025**



## Climate Change

The North Carolina Climate Science Report predicts that conditions conducive to wildfire occurrence will likely increase in the future due to future increases in annual and seasonal average temperatures and associated increases in drying rates. Additionally, future droughts are very likely to be warmer, increasing the drying rate of fuels and leading to higher wildfire likelihood. However, changes in other climate elements that affect wildfire likelihood are uncertain.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Potential for fatalities. Diminished air quality poses health risks. Exposure to wildfire smoke can cause health problems, including asthma and pneumonia, and can worsen chronic heart and lung diseases. Vulnerable populations include children, the elderly, people with respiratory problems or with heart disease. |
| Responders | Public and firefighter safety is the priority in all wildland fire management activities. Wildfires are a significant threat to the health and safety of responders. Most fire-fighters in rural areas are 'retained', meaning they are part-time and can be called away from their normal work to attend to fires. |
| Continuity of Operations (including Continued Delivery of Services) | Wildfire events can result in a loss of power which may impact operations. Downed trees, power lines and damaged road conditions may prevent access to critical facilities and/or emergency equipment. |
| Property, Facilities and Infrastructure | Wildfire can damage infrastructure, including roadways, communication networks and facilities, power lines, transformers, cell phone towers, and water distribution systems. Efforts to restore roadways include the costs of maintenance and damage assessment teams, field data collection, and replacement or repair costs. Direct impacts to municipal water supply may occur through contamination of ash and debris during the fire, destruction of aboveground distribution lines, and soil erosion or debris deposits into waterways after the fire. |
| Environment | Wildfires damage or kill vegetation and animals. The risk of floods and debris flows increases after wildfires due to loss of vegetation and exposure of bare ground. Secondary effects include erosion, landslides, introduction of invasive species, and changes in water quality. |
| Economic Condition of the Jurisdiction | Wildfires, and extreme fire danger, may reduce recreation and tourism in and near the fires. If aesthetics are impaired, local property values can decline. Extensive fire damage to trees can alter the timber supply, both through a short-term surplus from timber salvage and a longer-term decline while the trees regrow. Post-fire erosion and stream sedimentation can degrade water supplies. |
| Public Confidence in the Jurisdiction's Governance | Wildfire events have very visible impacts on the community. Public confidence in governance may be influenced by pre-disaster actions to mitigate and prepare for impacts, including the amount of public education provided; efforts to provide warning to residents; response actions; and speed and effectiveness of recovery. |

## Problem Statements

- ECSU: The Information Technology Center is within an area of campus with secondary exposure to wildfire. Sprinkler systems in the Information Technology Center could cause loss of campus servers in the event of a fire.

## 3.4.11 Cyber Security

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| ECSU | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| FSU | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| NCCU | Highly Likely | Critical | Large | Less than 6 hrs | More than 1 week | 3.7 |
| NCSU | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| UNC-P | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| UNC-W | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

### Hazard Description

The State of North Carolina Hazard Mitigation Plan defines cyber attacks as “deliberate attacks on information technology systems in an attempt to gain illegal access to a computer, or purposely cause damage.” Cyber-attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that “cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated,” with implications for private- and public-sector networks.

There are many types of cyber-attacks. Among the most common is a direct denial of service, or DDoS attack. This is when a server or website will be queried or pinged rapidly with information requests, overloading the system and causing it to crash.

Malware, or malicious software, can cause numerous problems once on a computer or network, from taking control of users’ machines to discreetly sending out confidential information. Ransomware is a specific type of malware that blocks access to digital files and demands payment to release them. Hospitals, school districts, state and local governments, law enforcement agencies, businesses, and even individuals can be targeted by ransomware. Ransomware attacks are becoming increasingly common; in 2023, they caused an estimated $20 billion in damage globally.[4]

Per a 2025 paper in the Journal of Information Security, artificial intelligence (AI) presents an emerging threat in cyber security, with the use of AI to develop personalized phishing

[4] https://www.scirp.org/journal/paperinformation?paperid=142205

messages. Similarly, the continued expansion of the Internet of Things (IoT) increases cybersecurity vulnerabilities.

Cyber spying or espionage is the act of illicitly obtaining intellectual property, government secrets, or other confidential digital information, and often is associated with attacks carried out by professional agents working on behalf of a foreign government or corporation.

Major data breaches—when hackers gain access to large amounts of personal, sensitive, or confidential information—have become increasingly common. The Symantec report says more than seven billion identities have been exposed in data breaches over the last eight years. In addition to networked systems, data breaches can occur due to the mishandling of external drives, as has been the case with losses of some state employee data.

Cyber crime can refer to any of the above incidents when motivated primarily by financial gain or other criminal intent.

The most severe type of attack is cyber terrorism, which aims to disrupt or damage systems in order to cause fear, injury, and loss to advance a political agenda.

The North Carolina State Bureau of Investigation's Computer Crime Unit helps law enforcement across North Carolina solve sophisticated crimes involving digital evidence.

*Warning Time: 4 – Less than six hours*

*Duration: 4 – More than one week*

## Climate Change

Cyber Disruption is considered a human-caused/technological hazard and is not directly impacted by changes in weather patterns/climate. However, climate change and its implications can have destabilizing impacts on society. When livelihoods are in danger, this will spark insecurity and drive resource competition. Individuals that have no other means of providing for their families could turn to cybercrime, which is often seen as a low-risk activity with a potentially high yield. Additionally, as changes in climate increase the frequency and/or magnitude of natural hazard events, information technology systems can be threatened by the structural forces of the hazard event, inflationary factors, and the evolution of technology that may arise out of the event.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Cyber attacks can impact personal data and accounts. Injuries or fatalities could potentially result from a major cyber terrorist attacks against critical infrastructure. |
| Responders | First responder involvement may be needed in the event of a major cyber terrorist attack against critical infrastructure. |

| Category | Consequences |
|---|---|
| Continuity of Operations (including Continued Delivery of Services) | Agencies that rely on electronic backup of critical files are vulnerable. The delivery of services can be impacted since governments rely, to a great extent, upon electronic delivery of services. |
| Property, Facilities and Infrastructure | Rare. Most attacks affect only data and computer systems. Sabotage of utilities and infrastructure from a major cyber terrorist attacks could potentially result in system failures that damage property on a scale equal with natural disasters. Facilities and infrastructure may become unusable as a result of a cyber-attack. |
| Environment | Rare. A major attack could theoretically result in a hazardous materials release. |
| Economic Condition of the Jurisdiction | Could greatly affect the economy. In an electronic-based commerce society, any disruption to daily activities can have disastrous impacts to the economy. It is difficult to measure the true extent of the impact. |
| Public Confidence in the Jurisdiction's Governance | The government's inability to protect critical systems or confidential personal data could impact public confidence. An attack could raise questions regarding the security of using electronic systems for government services. Cyber crime and disinformation attacks may directly harm public trust in government and erode social cohesion. |

## Problem Statements

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- Each university has a specific Office and/or Division of Information Technology which addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.
- A public comment noted that more information and campus-level expertise is needed to fully evaluate this hazard.
- A public comment highlighted that cyber crime and disinformation attacks can be particularly harmful in conjunction with other hazards. Such threats can mean the public receive incorrect or incomplete information post-disaster which can erode trust for first responders and government and reduce social cohesion among the public.

# 3.4.12 Hazardous Substances

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Highly Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.3 |
| ECSU | Possible | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 1.7 |
| FSU | Highly Likely | Limited | Small | Less than 6 hrs | Less than 24 hrs | 2.8 |
| NCCU | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |
| NCSSM | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |
| NCSU | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |
| UNC-CH | Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.0 |
| UNC-P | Possible | Limited | Small | Less than 6 Hrs | Less than 24 Hrs | 2.2 |
| UNC-W | Highly Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.3 |

## Hazard Description

A hazardous substance is any substance that may cause harm to people, property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in increasing types and quantities. Each year over 1,000 new synthetic chemicals are introduced and as many as 500,000 products pose physical or health hazards and can be defined as “hazardous chemicals”. Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous material incidents generally affect a localized area.

### Fixed Hazardous Materials Incident

A fixed hazardous materials incident is the release of chemical substances or mixtures during production or handling at a fixed facility. Hazardous materials releases can be accidental or intentional, as with a terror attack, addressed in Section 3.4.14.

Fixed facilities with hazardous materials can include industrial, commercial, and federal facilities. The Emergency Planning and Community Right-to-Know Act (EPCRA) created several methods for tracking facilities with hazardous materials. Section 313 of the EPCRA created the Toxics Release Inventory (TRI). The TRI tracks toxic chemical releases and pollution prevention activities reported by industrial and federal facilities. TRI data is made publicly available by the U.S. Environmental Protection Agency (EPA). Section 312 of the EPCRA mandated additional reporting of hazard materials by businesses and organizations with quantities of hazardous materials over a certain threshold. Tier II reports must be submitted annually, and help local fire departments, Local Emergency Planning Committees (LEPC) and State Emergency Response Commissions (SERCs) plan for and respond to chemical emergencies.

### Transportation Hazardous Materials Incident

A transportation-related hazardous materials incident is the accidental release of chemical substances or mixtures during transport. Transportation-related hazardous materials incidents in North Carolina can occur during highway, air, or rail transport. Highway accidents involving hazardous materials pose a great potential for public exposures. Nearby populations and motorists can be impacted by accidents and releases. If trains or airplanes carrying hazardous cargo crash, or otherwise leak contaminated cargo, populations and the environment in the impacted area can become exposed.

### Pipeline Incident

A pipeline incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

*Warning Time: 4 – Less than six hours*

*Duration: 2 – Less than 24 hours*

## Climate Change

Accidental or incidental releases of hazardous materials are non-natural incidents and therefore, there are no implications for impacts from climate change. However, there is growing evidence that hazardous material releases triggered by natural hazards can pose significant risks. In these incidences, the impact of climate change is of a secondary nature. It may exacerbate the natural hazard event by triggering release of hazardous materials.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Contact with hazardous materials could cause serious illness or death. Those living and working closest to hazardous materials sites face the greatest risk of exposure. Exposure may also occur through contamination of food or water supplies. |
| Responders | Responders face similar risks as the general public but a heightened potential for exposure to hazardous materials. |
| Continuity of Operations (including Continued Delivery of Services) | A hazardous materials incident may cause temporary road closures or other localized impacts but is unlikely to affect continuity of operations. |
| Property, Facilities and Infrastructure | Some hazardous materials are flammable, explosive, and/or corrosive, which could result in structural damages to property. Impacts would be highly localized. |

| Category | Consequences |
|---|---|
| Environment | Consequences depend on the type of material released. Possible ecological impacts include loss of wildlife, loss of habitat, and degradation of air and/or water quality. |
| Economic Condition of the Jurisdiction | Clean up, remediation, and/or litigation costs may apply. Long-term economic damage is unlikely. |
| Public Confidence in the Jurisdiction's Governance | A hazardous materials incident may affect public confidence if the environmental or health impacts are enduring. |

## Problem Statements

- Highway transportation routes for hazardous materials are located adjacent to all campuses in the region.
- Pipeline transportation routes for hazardous materials are located adjacent to the NCCU and NCSU campuses.
- Rail transportation routes run directly through the FSU campus and are located adjacent to the UNC-P campus.
- Reported hazardous materials incidents have occurred in the past year in all communities encompassing the university campuses with the exception of Pembroke and UNC-P.

## 3.4.13 Infectious Disease

### Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |

### PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| ECU | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| ECSU | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| FSU | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| NCCU | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| NCSSM | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| NCSU | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| UNC-P | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| UNC-W | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

### Hazard Description

Infectious diseases are illnesses caused by germs (such as bacteria, viruses, and fungi) that enter the body, multiply, and cause an infection, which can lead to illness or death. Infectious diseases are a major threat around the world, killing millions globally each year. Many infectious diseases are communicable meaning that they can spread from one person or animal to another via contact with blood and bodily fluids; breathing in an airborne virus; or being bitten by an insect.

There are three classifications of disease impacts: endemic, epidemic, and pandemic. An endemic is consistently present but is somewhat contained and not spreading out of control, such as the common cold. An epidemic is an unexpected, severe outbreak of a disease in a specific geographical area, such as polio in the U.S. in the early to mid-20$^{th}$ century. Finally, a pandemic is when a disease's growth becomes exponential and affects a wide area, several countries, and populations, such as the COVID-19 pandemic from 2020 to 2023.

Examples of infectious diseases include:

- **Coronaviruses**: large family of viruses found in both animals and humans known to causes illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS), and Novel Coronavirus (COVID-19).
- **Lyme Disease**: disease that is caused by bacteria transmitted to humans by infected deer ticks. Following a tick bite, 90 percent of patients develop a rash accompanied by tiredness, fever, headache, stiff neck, muscle aches, and joint pain, and if left untreated, some patients may develop arthritis or neurological abnormalities.

- **Influenza**: common air-borne infection caused by influenza viruses. Symptoms include headache, body aches, and fever. Seasonal influenza is treatable, and the mortality rate remains low. Each year, scientists estimate which strain of flu is likely to spread and create a vaccine accordingly.
- **Measles**: viral respiratory illness that causes a blotchy rash, fever, dry cough, and runny nose. While it does not usually cause long-term medical issues, it can be serious and even deadly, especially for small children. Because of vaccination, measles has not been common in the US for a few decades.
- **Meningitis**: infection of fluid that surrounds a person's spinal cord and brain, and symptoms include high fever, headaches, and stiff neck. Generally, 10 to 14 percent are fatal and those who recover can suffer from permanent hearing loss, mental retardation, or loss of limbs. Meningitis is caused by a viral or bacterial infection and is transmitted through direct contact with respiratory secretions from an infected carrier.
- **Mpox**: disease caused by infection with a virus, known as Monkeypox virus, which is the same family as the virus that causes smallpox. It is a zoonic disease, meaning that it is spread between animals and people, and scientists suspect African rodents and non-human primates may harbor the virus and infect people. It causes a rash and flu-like symptoms and is usually mild.
- **Severe Acute Respiratory Syndrome**: respiratory virus that primarily spreads by close person-to-person contact and causes high fevers, headaches, body aches and can lead to hospitalization or death.
- **Tuberculosis:** infectious disease caused by a bacteria and that is spread by coughing or sneezing from person to another. The World Health Organization (WHO) estimates that one quarter of the global population is estimated to have been infected with TB bacteria and about 5-10% will eventually get symptoms and develop the disease.[5] TB disease is usually treated with antibiotics and can be fatal without treatment.
- **West Nile Virus**: flavivirus spread by infected mosquitoes and is commonly found in Africa, West Asia, and the Middle East but has been documented in the U.S. since 1999. Most people who become infected with West Nile virus will have either no symptoms or only mild effects; however, on rare occasions it can result in severe and sometimes fatal illness.

*Warning Time: 1 – More than 24 hours*

*Duration: 4 – More than one week*

## Climate Change

According to the U.S. Global Change Research Program, the influences of climate change on infectious disease include the threats of temperature extremes and precipitation changes and

[5] World Health Organization. (n.d.). Tuberculosis (TB). World Health Organization. https://www.who.int/news-room/fact-sheets/detail/tuberculosis

their connections to insects, which can be vectors of disease. Climate and weather can also affect water and food quality in particular areas, with implications for public health.

Higher temperatures and wetter conditions tend to increase mosquito and tick activity, leading to an increased risk of zoonotic diseases. Mosquitos are known to carry diseases such as West Nile Virus (WNV), La Crosse/California encephalitis, Jamestown Canyon virus, St. Louis encephalitis, and Eastern equine encephalitis. Ticks are also well-known disease vectors, carrying pathogens such as Lyme disease, anaplasmosis, Ehrlichiosis, Powassan virus, and Babesiosis.

The two major concerns associated with warmer and wetter conditions are that the mosquito species already present and the diseases that they carry will become more prevalent, and that new species carrying unfamiliar diseases will start to appear for the first time. Warmer winters with fewer hard freezes in areas that already see WNV-carrying mosquitos are likely to observe both a higher incidence of WNV and a longer WNV season, ultimately leading to an increase in human cases. Non-native mosquito species may move into the region if the climate becomes more suitable for them, bringing with them diseases such as Jamestown Canyon virus, Chikungunya, and Dengue Fever.

If these predictions come true, communities must contend with the human health impacts related to the increased prevalence of infectious diseases. Public health officials will need to focus on spreading information and enacting pest and disease reduction.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Exposure to emerging diseases will vary based on the type of threat and its potential transmission routes. Vaccinations are the best means of preventing transmission and infection. Public health information will be disseminated via the media to provide other preventive measures to limit or avoid exposure. |
| Responders | Responders can expect an increase in workload and should practice a higher level of precaution toward exposure. |
| Continuity of Operations (including Continued Delivery of Services) | Continuity of operations may be impacted if individuals in key roles are unable to perform their normal duties. Plans are in place to coordinate response and maintain operations, but a large-scale event could still interrupt normal operations. |
| Property, Facilities and Infrastructure | No direct impacts are expected to the built environment. Hospitals and emergency services would likely see increased demand. |
| Environment | Impacts will depend on the particular disease vector and whether the disease is transmittable to animal or plant life, or if it can be distributed through the water or food supply. |
| Economic Condition of the Jurisdiction | Local economy and finances may be adversely affected, possibly for an extended period of time, especially if shutdowns are required directly by the government or indirectly as a result of employee absence. Large scale events may need to be cancelled if an outbreak is large enough or has the potential to spread quickly and easily. |
| Public Confidence in the Jurisdiction's Governance | Public confidence in government and nongovernmental organizations may be impacted. The level of confidence the public possesses is based |

| Category | Consequences |
|---|---|
| | 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. |

## Problem Statements

- Following the COVID-19 pandemic, it is clear that all of the UNC Eastern Campus populations are susceptible to infectious disease.
- ECSU, ECU, NCCU, NCSU, UNC-P, and UNC-W each have a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# 3.4.14 Terrorism

## Applicable Campuses

| ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|
| | | | | | ✓ | | | ✓ |

## PRI Summary by Campus

| Campus | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| NCSU | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.5 |
| UNC-W | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.5 |

## Hazard Description

In a broad sense, terrorism is the use of violence and threats to intimidate or coerce, especially against civilians, in the pursuit of political aims. For this analysis, this hazard encompasses enemy attack, biological terrorism, agro-terrorism, chemical terrorism, conventional terrorism, and radiological terrorism. These hazards can occur anywhere and demonstrate unlawful force, violence, and/or threat against persons or property causing intentional harm for purposes of intimidation, coercion or ransom in violation of the criminal laws of the United States. These actions may cause massive destruction and/or extensive casualties. The threat of terrorism, both international and domestic, is ever present, and an attack can occur when least expected.

Enemy attack is an incident that could cause massive destruction and extensive casualties throughout the world. Some areas could experience direct weapons' effects: blast and heat; others could experience indirect weapons' effect. International political and military activities of other nations are closely monitored by the federal government and the State of North Carolina would be notified of any escalating military threats.

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidations, coercion, or ransom is conventional terrorism. Hazard effects are instantaneous; additional secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences and incremental structural failures. Conventional terrorism can also include tactical assault or sniping from remote locations.

Biological terrorism is the use of biological agents against people or property. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents vary in the amount of time they pose a threat. They can pose a threat for hours to years depending upon the agent and the conditions in which it exists.

Chemical terrorism involves the use or threat of chemical agents against persons or property. The effects of chemical contaminants are similar to biological agents.

Radiological terrorism is the use of radiological materials against people or property. Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers or by the detonation of a nuclear device underground, at the surface, in the air or at high altitude.

During 2024, the Southern Poverty Law Center (SPLC) reported tracking 44 active hate and antigovernment groups in North Carolina. The SPLC defines a hate group as any group with "beliefs or practices that attack or malign an entire class of people – particularly when the characteristics being maligned are immutable." It is important to note that inclusion on the SPLC list is not meant to imply that a group advocates or engages in violence or other criminal activity.

*Warning Time: 4 – Less than 6 hours*

*Duration: 2 – Less than 24 hours*

Generally, no warning is given for acts of terrorism. Duration is dependent on the parameters of the incident; while the incidents themselves are usually relatively short, residual impacts on the community can be long-lasting. This score takes into account a prolonged scenario with continuous impacts.

## Climate Change

There is not a direct link between climate change and terrorism, however the complex risks which arise from climate change can contribute to the emergence, and growth, of non-state armed groups. But climate change, coupled with other challenges such as poverty, inequality or marginalization, can provide a fertile ground for terrorist groups to thrive, and further contest authorities.

## Consequence Analysis

| Category | Consequences |
|---|---|
| Public | Illness, injury, or fatality are possible; these impacts would be highly localized to the attack. Widespread stress and psychological suffering may occur. Human impacts may be long-term based on attack vector. |
| Responders | Injuries; fatalities are possible. Responders face increased risks during an effort to stop an attack or rescue others while an attack is underway. Potential impacts to response capabilities may result from an attack. |
| Continuity of Operations (including Continued Delivery of Services) | Potential impacts to continuity of operations due to attack impacts; delays in providing services; impacts tied to attack vector |
| Property, Facilities and Infrastructure | Impacted roads; downed power lines and power loss; utility disruption. Several key critical sites could be targeted in an attack, causing cascading impacts to daily life in the region |
| Environment | Water and food supply could be contaminated by a biological or chemical attack. Remediation could be required. |
| Economic Condition of the Jurisdiction | The local economy could be disrupted, depending on the location and scale of an attack. |

| Category | Consequences |
|---|---|
| Public Confidence in the Jurisdiction's Governance | Loss of public confidence likely should an attack be carried out; additional loss of confidence and trust may result if response and recovery are not swift and effective |

## Problem Statement

- There are no records of past terrorism incidents for the NCSU or UNC-W Campuses.
- There are active hate groups within North Carolina.
- When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

# 3.5 Conclusions on Hazard Risk

### Priority Risk Index

As discussed in Section 3.3, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The results from the PRI have been classified into three categories based on the assigned risk value, as follows:

- **High Risk (≥ 3.0)** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk (2.0 – 2.9)** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk (< 2.0)** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal. This is not a priority hazard.

Table 3.10 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table 3.10 – Summary of PRI Results**

| Hazard | ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|---|
| Dam Failure | n/a | n/a | n/a | n/a | n/a | 2.4 | 2.4 | n/a | n/a |
| Drought | n/a | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | 2.5 |
| Earthquake | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Excessive Heat | 3.3 | 3.0 | 3.0 | 3.0 | 3.0 | 3.3 | 3.0 | 3.0 | 3.0 |
| Flooding | 2.8 | 2.5 | 2.5 | 3.1 | 1.5 | 2.8 | 3.0 | 2.3 | 2.3 |
| Geological | n/a | n/a | n/a | 1.9 | n/a | n/a | 1.7 | n/a | n/a |
| Hurricanes & Coastal Hazards | 3.2 | 3.2 | 2.9 | 2.9 | 2.9 | 2.9 | 2.3 | 2.9 | 3.2 |
| Severe Winter Weather | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | n/a |
| Tornadoes & Thunderstorms | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Wildfire | 2.2 | 2.2 | 2.5 | 2.2 | 1.8 | 2.2 | 2.2 | 2.8 | 2.5 |
| Cyber Security | 3.1 | 3.1 | n/a | 3.7 | n/a | 3.1 | n/a | 3.1 | 3.1 |
| Hazardous Substances | 2.3 | 1.7 | n/a | 2.3 | 2.3 | 2.3 | 2.0 | 2.2 | 2.3 |
| Infectious Disease | 2.8 | 2.8 | n/a | 2.8 | 2.8 | 2.8 | n/a | 2.8 | 2.8 |
| Terrorism | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | n/a | 2.5 |

# 4. Mitigation Strategy

**Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.**

This section describes the mitigation strategy process and mitigation action plan development for the UNC Eastern Campuses Hazard Mitigation Plan. It describes how the campuses met Step 6: Set Goals, Step 7: Review Possible Activities, and Step 8: Draft an Action Plan from the 10-step planning process. This section contains the following subsections:

- 3.1 Goals and Objectives
- 3.2 Identification and Analysis of Mitigation Activities

Mitigation action plans are located in each campus annex.

## 4.1 Goals and Objectives

**Requirement §201.6(c)(3)(i): [The mitigation strategy section shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.**

Section 3 and the campus annexes document the hazards and associated risks that threaten the UNC Eastern Campuses, including the vulnerability of structures, infrastructure, and critical facilities. Based on this understanding of risks, the HMPC must identify mitigation actions to reduce exposure, vulnerability, and overall risk. The intent of goal setting is to guide the review of possible mitigation actions. This Hazard Mitigation Plan needs to make sure that recommended actions are consistent with what is appropriate for the campuses. Mitigation goals should reflect campus priorities and should be consistent with other campus, local, and regional plans.

- **Goals** are general guidelines that explain what is to be achieved. They are usually broad-based, long-term policy type statements that represent global visions. Goals help define the benefits that the plan is trying to achieve.
- **Objectives** are short term aims which, when combined, form a strategy or course of action to meet a goal. Objectives provide more specific methods for achieving goals.

### 4.1.1 Goal Setting

At the third planning meetings, the HMPC reviewed and discussed the goals from the 2021 plan. One key consideration in evaluating these goals was to ensure that the goals of the Hazard Mitigation Plan align with other planning efforts such as campus strategic and master

plans as well as local and regional comprehensive and land use plans. These documents are important guides for future growth on the campuses and within the surrounding communities. Therefore, the HMPC should strive to achieve consistency in these plans' goals.

The HMPC reviewed and validated the goals and objectives for their continued relevance to mitigation planning within the UNC Eastern Campuses region. One change was made to goal one to make it more concise and encompass all campus buildings and infrastructure. The goals and objectives approved by the HMPC are presented below.

### 4.1.2 Resulting Goals and Objectives

**Goal 1: Reduce the impact of hazards on campus buildings and infrastructure.**

**Objective 1.1**: Retrofit or otherwise protect critical facilities and infrastructure.

**Objective 1.2**: Protect critical research and campus operations.

**Objective 1.3**: Preserve and protect natural systems and resources that provide hazard mitigation benefits.

**Goal 2: Protect the public health, safety, and welfare of people on campus from hazard risk.**

**Objective 2.1**: Implement outreach activities to create a culture of preparedness by educating campus communities on local risks, property protection, and personal protection.

**Objective 2.2**: Improve hazard monitoring and warning systems to enable earlier response actions.

**Objective 2.3**: Create or update existing campus evacuation and shelter in place procedures.

**Goal 3: Build campus resilience to minimize interruption and ensure speedy recovery from hazard events.**

**Objective 3.1**: Develop or revise plans, policies, and regulations to reduce vulnerability of new construction on campus.

**Objective 3.2**: Improve campus mitigation and response capabilities.

## 4.2 Identification and Analysis of Mitigation Activities

**Requirement §201.6(c)(3)(ii): [The mitigation strategy section shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.**

To identify and select mitigation projects that support the mitigation goals and objectives, the risks and vulnerabilities associated with all hazards identified in Section 3 Risk Assessment were evaluated for mitigation opportunities. The HMPC analyzed viable mitigation options that

supported the identified goals and objectives, addressed key problems, risks, or vulnerabilities, and aligned with other local plans and efforts. The HMPC was provided with the following list of mitigation categories which are utilized as part of the CRS planning process but are also applicable to multi-hazard mitigation. Acronyms used in the Mitigation Action Plans to identify each action's category are listed in parentheses.

- Prevention (P)
- Property Protection (PP)
- Natural Resource Protection (NRP)
- Emergency Services (ES)
- Structural Projects (SP)
- Public Information and Outreach (PIO)

The HMPC was also provided with examples of potential mitigation actions for each of the above categories. The HMPC was instructed to consider both future and existing buildings in evaluating possible mitigation actions. Facilitated discussions took place to examine and analyze mitigation options. The HMPC also considered which actions from the previous plan that were not already completed should be continued in this action plan.

### 4.2.1 Prioritization Process

In the process of identifying continuing and new mitigation actions, the HMPC was provided with a set of prioritization criteria to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. The prioritization criteria were grouped into three categories: Suitability, Risk Reduction, and Cost. The criteria for the prioritization process included the following:

**Suitability**

- Appropriateness of Action
- Community Acceptance
- Technical and Administrative Feasibility
- Environmental Impact
- Legal Conformance
- Consistency with Existing Plans and Other Community Goals

**Risk Reduction**

- Scope of Benefits
- Potential to Save Lives
- Importance of Benefits
- Level of Inconvenience or Unintended Consequence
- Losses Avoided
- Number of People to Benefit

**Cost**

- Estimate of Upfront Cost

- Estimate of Ongoing Cost
- Benefit to Cost Ratio
- Financing Availability
- Affordability
- Elimination of Repetitive Damages

In accordance with the DMA requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority, as reflected in the prioritization criteria above. For each action, the HMPC considered the benefit-cost analysis in terms of:

- Ability of the action to address the problem
- Contribution of the action to save life or property
- Available technical and administrative resources for implementation
- Availability of funding and perceived cost-effectiveness

The consideration of these criteria helped to prioritize and refine mitigation actions but did not constitute a full benefit-cost analysis. The cost-effectiveness of any mitigation alternative will be considered in greater detail through performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this plan.

The prioritization ranking, simplified as High, Medium, or Low, for each mitigation action considered by the HMPC is provided in the Mitigation Action plans found in each campus' annex.

# 5. Plan Implementation and Maintenance

**Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.**

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This section discusses how the Mitigation Action Plans will be implemented by each campus and outlines the method and schedule for monitoring, updating, and evaluating the plan. This section also discusses incorporating the plan into existing planning mechanisms and how the public will continue to be involved in the planning process. It consists of the following three subsections:

- 8.1 Implementation
- 8.2 Monitoring, Evaluation, and Enhancement
- 8.3 Continued Public Involvement

## 5.1 Implementation

Each campus participating in this plan update has its own Mitigation Action Plan (found in each campus annex) and is responsible for implementing their own specific mitigation actions. This approach enables individual campuses to implement, update, and revise their own unique mitigation action list as needed without altering the broader focus of the regional plan. Proposed actions in each Mitigation Action Plan are assigned to specific campus departments to ensure responsibility and accountability and to increase the likelihood of subsequent implementation.

In addition to the assignment of a campus lead department, an implementation timeline or a specific implementation date or window has been assigned to each mitigation action to help assess whether reasonable progress is being made toward implementation. The participating campuses may seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. Where applicable, potential funding sources have been identified for proposed actions listed in the Mitigation Action Plan.

An important implementation mechanism that is highly effective and low-cost is incorporation of the Hazard Mitigation Plan recommendations and their underlying principles into other plans and planning mechanisms. Where possible, plan participants will use existing plans and/or programs to implement the Mitigation Action Plan. It will be the responsibility of the HMPC representatives from each participating campus to determine and pursue opportunities for integrating the requirements of this plan with other local planning documents and ensure that the goals and strategies of new and updated planning documents for their campus and/or local

community are consistent with the goals and actions of the Hazard Mitigation Plan and will not contribute to increased hazard vulnerability in the campus planning areas. Methods for integration may include:

- Monitoring other planning/program agendas;
- Attending other planning/program meetings;
- Participating in other planning processes; and
- Monitoring community budget meetings for other community program opportunities.

Opportunities to integrate the requirements of this Plan into other planning mechanisms shall continue to be identified through future meetings of the HMPC and through the five-year review process described herein. Although it is recognized that there are many possible benefits to integrating components of this plan into other campus planning mechanisms, the development and maintenance of this stand-alone Hazard Mitigation Plan is deemed by the HMPC to be the most effective and appropriate method to implement campus hazard mitigation actions at this time.

Since the 2021 plan was adopted, each campus has worked to integrate the hazard mitigation plan into other planning mechanisms where applicable and feasible. Table 5.1 details each campus' plan integration efforts and opportunities.

**Table 5.1 – Integration Efforts**

| Campus | Integration of 2021 plan | Intended integration of this plan update |
|---|---|---|
| ECU | ECU utilized components of the 2021 plan to develop regular updates to their campus EOP. | ECU will continue to integrate findings and projects from this plan with future EOP updates. Findings from the HMP will also be integrated with updates to the Campus Master Plan and will inform capital improvement budgeting. |
| ECSU | ECSU utilized components of the 2021 plan to develop regular updates to their campus EOP and reviewed the HMP when updating the Campus Master Plan. | ECSU will continue to integrate findings and projects from this plan with future EOP updates and will use the HMP to inform capital improvement budgeting. |
| FSU | FSU utilized components of the 2021 plan to develop regular updates to their campus EOP and reviewed the HMP when updating the Campus Master Plan. | FSU will continue to integrate findings and projects from this plan to guide resilience efforts in future EOP updates. |
| NCCU | NCCU utilized components of the 2021 plan to develop regular updates to their campus EOP. | NCCU will continue to integrate findings and projects from this plan to guide resilience efforts in future EOP updates. Findings from the HMP will also be integrated with updates to the Campus Master Plan and will inform Facilities Management budgeting. |

| Campus | Integration of 2021 plan | Intended integration of this plan update |
|---|---|---|
| NCSSM | NCSSM utilized components of the 2021 plan to develop their campus Emergency Preparedness and Crisis Response Plan. | NCSSM will continue to integrate findings and projects from this plan with future EOP updates. |
| NCSU | NCSU utilized components of the 2021 plan to develop regular updates to their campus EOP and reviewed the HMP when updating the Campus Master Plan and Capital Development Plan. | NCSU will continue to integrate findings and projects from this plan with future EOP updates and will integrate the HMP with updates to the Capital Development Plan. |
| UNC Chapel Hill | UNC-CH utilized components of the 2021 plan to develop regular updates to their campus EOP. | UNC-CH will continue to integrate findings and projects from this plan with future EOP updates. Findings from the HMP will also be integrated with updates to the Master Plan and will inform capital improvement budgeting. |
| UNC Pembroke | UNC-P utilized components of the 2021 plan to develop regular updates to their campus EOP and reviewed the HMP when updating the Master Plan and Capital Improvements Plan. | UNC-P will continue to integrate findings and projects from this plan with future EOP updates and will integrate the HMP with updates to the Capital Improvements Plan. |
| UNC Wilmington | UNC-W utilized components of the 2021 plan to develop regular updates to their campus EOP and reviewed the HMP when updating the Master Plan. | UNC-W will continue to integrate findings and projects from this plan with future EOP updates. Findings from the HMP will also inform capital project budgeting. |

## 5.2 Monitoring, Evaluation, and Enhancement

### 5.2.1 Role of HMPC in Implementation, Monitoring and Maintenance

With adoption of this plan, each campus will be responsible for the implementation and maintenance of their mitigation actions. The emergency management coordinators or other campus safety staff were assigned as the planning leads for each campus. Each identified campus lead will oversee all plan monitoring and update procedures for their campus. As such, the campus leads agree to continue their relationship with the campus HMPCs and:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure hazard mitigation remains a consideration for community decision makers;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommended revisions to the local governing boards; and

- Inform and solicit input from the public.

The primary duty of the campus HMPCs moving forward is to see the plan successfully carried out and report to the campus administration, NCEM, FEMA, and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about mitigation, passing concerns on to appropriate entities, and providing relevant information for continued public involvement.

Simultaneous to these efforts, it will be important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the costlier recommended actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding becomes available, the campuses will be positioned to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal earmarked funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

## 5.2.2 Maintenance Schedule

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized. Each campus lead will be responsible for convening their HMPC and initiating regular reviews. Regular maintenance will take place through an annual meeting of the HMPC. The HMPC will also convene to review the plan after significant hazard events. If determined appropriate or as requested, an annual report on the plan will be developed and presented to campus administration to report on implementation progress and recommended changes.

The five-year written update to this plan will be submitted to the NCEM and FEMA Region IV, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With this plan update anticipated to be adopted and fully approved by 2026, the next plan update for the UNC Eastern Campuses will be completed by 2031.

## 5.2.3 Maintenance Evaluation Process

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or
- Increased vulnerability as a result of new development (and/or annexation).

Updates to this plan will:

- Consider changes in vulnerability due to project implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;

- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes; and
- Incorporate new project recommendations or changes in project prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the HMPC will follow the following process:

- The HMPC representatives from each campus will be responsible for tracking and reporting on their mitigation actions. Representatives should provide input on whether the action as implemented met the defined objectives and/or is likely to successfully reduce vulnerability.
- If the action does not meet identified objectives, the HMPC representatives will determine what additional measures may be implemented and will make any required modifications to the plan.
- All monitoring and implementation information will be reported to the full HMPC during annual meetings. An annual plan maintenance report may be drafted as deemed necessary.

Changes will be made to the plan as needed to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high priority but were identified as potential mitigation activities will be reviewed during the monitoring and update of the plan to determine feasibility of future implementation. Updating of the mitigation action plans will be by written changes and submissions, as is appropriate and necessary, and as approved by campus administration.

Following a disaster declaration, the plan will be revised as necessary to reflect lessons learned, or to address specific issues and circumstances arising from the event. It will be the responsibility of campus leads to reconvene the HMPC and ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

## 5.3 Continued Public Involvement

Continued public involvement is imperative to the overall success of the plan's implementation. The annual review process will provide an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. Efforts to involve the public in the maintenance, evaluation and revision process may include:

- Advertising HMPC meetings in campus news, public bulletin boards and/or campus office buildings and community spaces;
- Designating willing members of the public as official members of the HMPC;
- Utilizing campus media to update the public of any maintenance and/or review activities;

- Utilizing campus websites and social media to advertise any maintenance and/or review activities;
- Maintaining copies of the plan in campus libraries or other appropriate venues;
- Posting annual progress reports on the plan to campus websites;
- Heavy publicity of the plan and potential ways for the public to be involved after significant hazard events, tailored to the event that has just happened;
- Keeping websites, social media outlets, etc. updated;
- Drafting articles for the campus newspapers/newsletters.

## Public Involvement for Five-year Update

When the HMPC reconvenes for the five-year update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. In reconvening, the HMPC will be responsible for coordinating the activities necessary to involve the greater public, including disseminating information through a variety of media channels detailing the plan update process. As part of this effort, public meetings will be held and public comments will be solicited on the plan update draft.

# 6. Plan Adoption

**Requirement §201.6(c)(5): [The plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).**

The purpose of formally adopting this plan is to secure buy-in from all participating campuses, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of DMA 2000. Each participating campus will adopt the Hazard Mitigation Plan by passing a resolution. Copies of these adoption resolutions are provided in the following pages.

THE UNIVERSITY OF NORTH CAROLINA SYSTEM



# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

## Annex A: East Carolina University

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# Annex A. East Carolina University

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to East Carolina University (ECU). This section contains the following subsections:

- A.1 Planning Process Details
- A.2 Campus Profile
- A.3 Asset Inventory
- A.4 Hazard Identification
- A.5 Hazard Profiles, Analysis, and Vulnerability
- A.6 Capability Assessment
- A.7 Mitigation Strategy

## A.1 Planning Process Details

The table below lists the HMPC members who represented ECU during the planning process.

**Table A.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Phil Lewis | Director, Environmental Health and Safety |
| Aspen Lawrence | Emergency Manager, Environmental Health and Safety |
| Bill Koch | Associate Vice Chancellor, Campus Safety and Auxiliary Service |
| Jason Sugg | Chief of Police, ECU Police |
| Chris Sutton | Deputy Chief, ECU Police |
| Kelly Shook | EHS Professional, Environmental Health and Safety |
| Nick Agresta | Emergency Management Specialist, Environmental Health and Safety |
| Bill Bagnell | Associate Vice Chancellor; Campus Operations |
| Ricky Hill | Director; Facilities Services (Main Campus) |
| Griff Avin | Director; Facilities Services (Health Sciences Campus) |
| Peter Groenendyk | Associate Vice Chancellor; Campus Living |
| Gretchen Brockman | Director; Housing Operations |
| Mike O'Driscoll | Associate Professor; Department of Coastal Studies |
| Merrill Flood | Director of Planning and Development; Community Engagement and Research |
| Anuradha Mukherji | Associate Professor; Geography, Planning, and Environment |
| Randy Gentry | Director; Pitt County Emergency Management |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table A.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| ECU Comprehensive Campus Master Plan, 2021 | The ECU Comprehensive Campus Master Plan, developed in 2012, was referenced for the Campus Profile in Section A.2 and the Capability Assessment in Section A.6 |
| ECU Strategic Plan, 2023-2028 | The ECU Strategic Plan was referenced to update the Capability Assessment in Section A.6 |
| Pitt County and Incorporated Areas Flood Insurance Study (FIS), 1/17/2025 | The FIS report and associated Flood Insurance Rate Maps were referenced in the preparation of flood hazard profile in Section A.5. |
| Neuse River Regional Hazard Mitigation Plan, 2025 | The Neuse River Regional Hazard Mitigation Plan, which includes Greenville, was referenced in compiling the Hazard Identification and Risk Assessment in Sections A.4 and A.5. |

# A.2 Campus Profile

This section provides a general overview of the East Carolina University (ECU) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## A.2.1 Location and Setting

ECU Main Campus is located in an urban residential area of downtown Greenville. The University sits on 565 acres of land and offers 84 bachelor's degree programs, 68 master's degree programs, and 13 doctoral programs, and 164 online degrees and certificate programs. A wide variety of cultural and educational resources are accessible to ECU students as well, and over 425 student organizations are available on campus to help cater to any area of interest a student may have and promote a sense of belonging. ECU is dedicated to the integration of teaching, mentoring, research, and service and is the only University in North Carolina with a dental school, medical school, and college of engineering at the same institution.

United States Highways 13 and 264 make ECU easily accessible by automobile. The University provides shuttle services on and off campus, including to the airport in Raleigh. ECU also has a bicycle rental program and they maintain bicycle and pedestrian amenities.

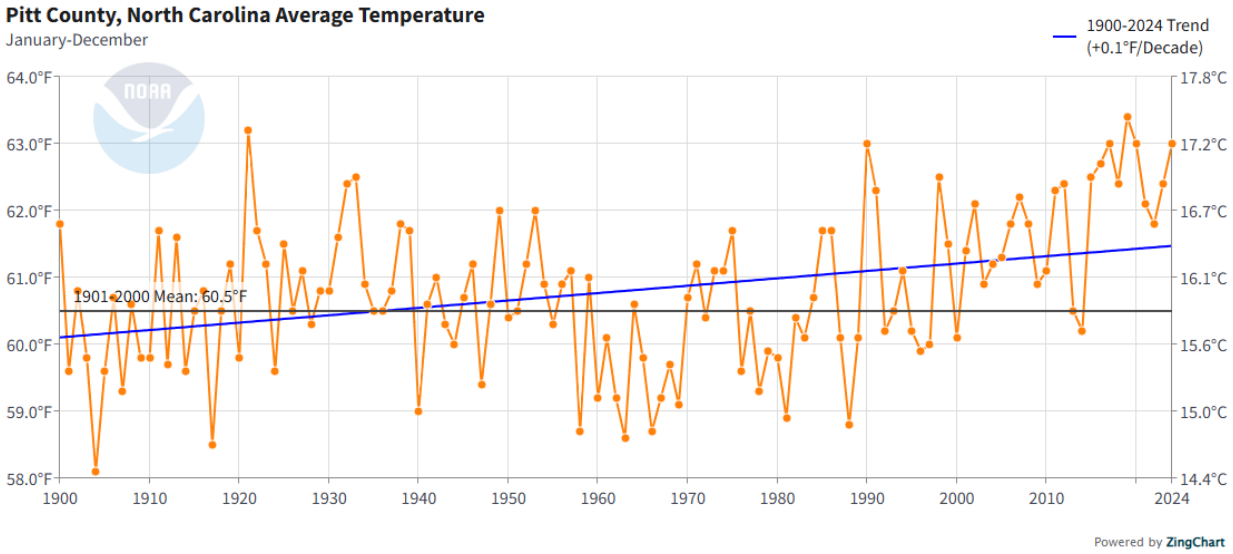
Figure A.3 provides a base map of the campus. For more details on campus buildings and critical facilities, see Section A.3.

## A.2.2 Geography and Climate

ECU is located in Greenville, which is in the Coastal Plain region of the state. This region sits between the Piedmont and the Atlantic Ocean. The topography of the Coastal Plain can be seen as the result of erosion. This area represents a mixture of maritime, pine and hardwood

forests. Greenville has mild climate with minimum temperatures of 31 degrees Fahrenheit on average in January and maximum temperatures of 89 degrees Fahrenheit in July on average. Average annual precipitation is 49 inches per year.

### Figure A.1 – Average Annual Temperature, Pitt County




### Figure A.2 – Average Annual Precipitation, Pitt County

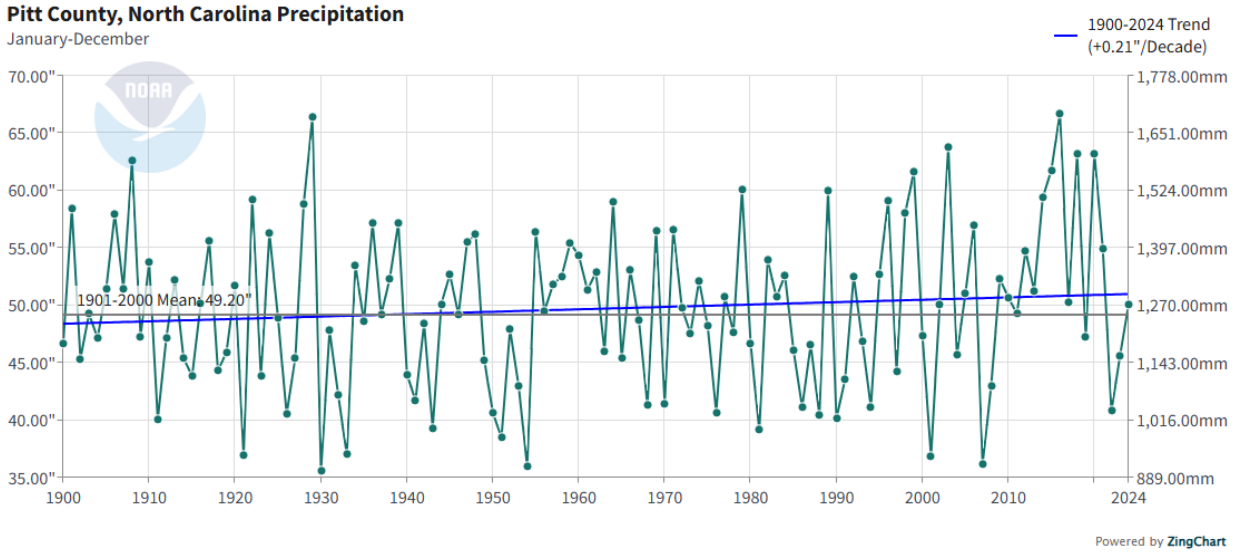
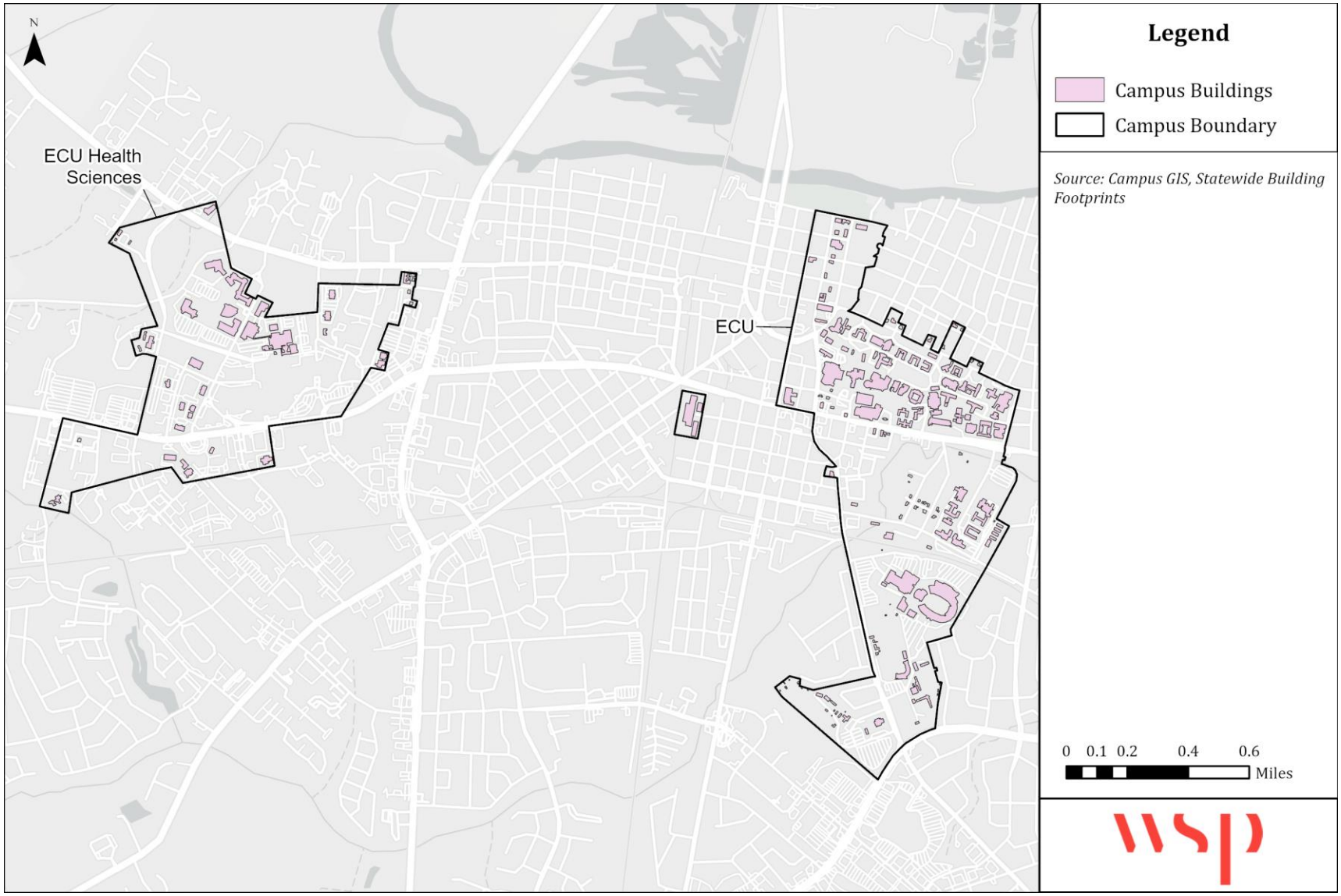


**Figure A.3 – ECU Campus Base Map**



## A.2.3 Population and Demographics

Table A.3 provides population counts for East Carolina University from Fall 2025, including the number of students, faculty, and staff. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students.

**Table A.3 – Population Counts for East Carolina University, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students[1]** | **27,153** |
| *Undergraduate Students* | 21,693 |
| *Graduate Students* | 5,460 |
| *Full-Time Students* | 23,846 |
| *In-State Residency* | 24,018 |
| *Out-of-State Residency* | 3,135 |
| **Faculty & Staff[2]** | **5,728** |
| *EHRA Faculty* | 1,990 |
| *EHRA Non-Faculty & Postdoctoral Scholars* | 950 |
| *EHRA Senior Academic & Administrative Officers* | 143 |
| *CSS Clinical Support Services* | 803 |
| *SHRA Staff* | 1,842 |

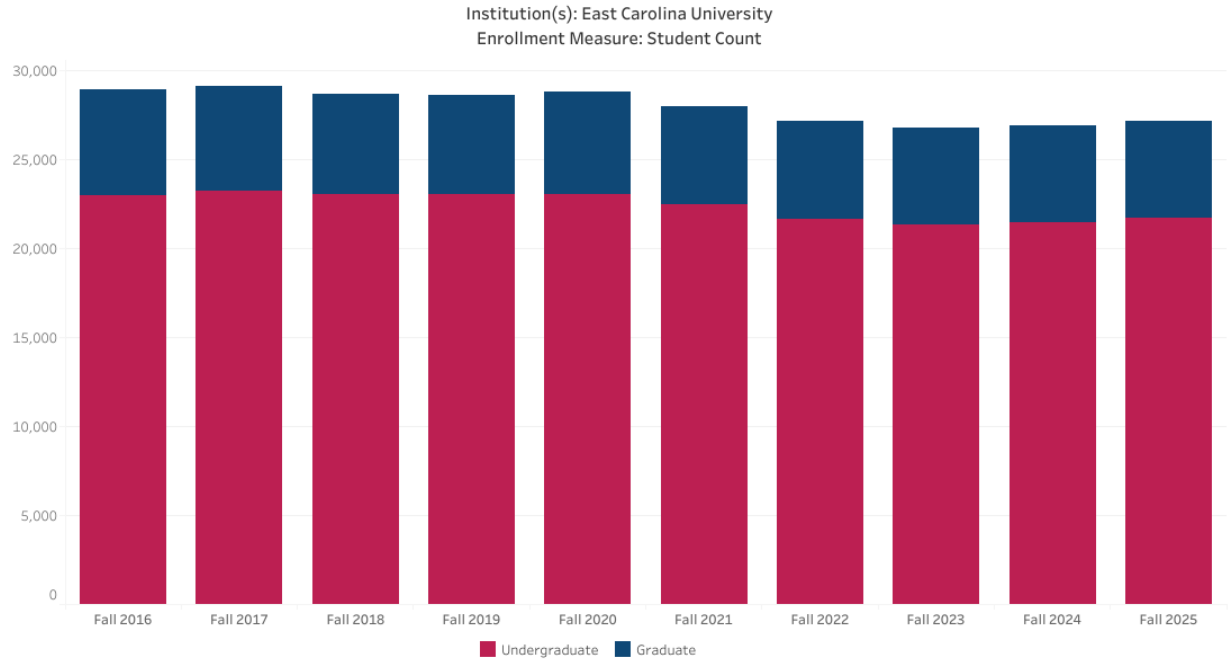
[1]Source: UNC System Interactive Data Dashboards

[2]Source: ECU by the Numbers, https://facts.ecu.edu/

According to ECU's "East Carolina University by the Numbers" webpage, all 100 North Carolina counties, 49 states, and 73 countries are represented throughout the University's student body. Among the ECU student population, the most popular majors for undergraduates were Nursing, Management, and Psychology. The top graduate majors were Business Administration, Nursing (MSN plus DNP), and Medicine.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure A.4. Enrollment has decreased slightly over the last five years.

**Figure A.4 – ECU Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 22,969 | 23,265 | 23,071 | 23,081 | 23,056 | 22,463 | 21,688 | 21,328 | 21,445 | 21,693 |
| Graduate | 5,993 | 5,866 | 5,647 | 5,570 | 5,742 | 5,558 | 5,463 | 5,457 | 5,495 | 5,460 |
| Total | 28,962 | 29,131 | 28,718 | 28,651 | 28,798 | 28,021 | 27,151 | 26,785 | 26,940 | 27,153 |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table A.4.

**Table A.4 – ECU Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 127 | 0.5% |
| Black or African American | 4,302 | 15.8% |
| Hispanic or Latino | 2,282 | 8.4% |
| Two or More Races | 1,044 | 3.8% |
| Asian | 752 | 2.8% |
| Native Hawaiian or Other Pacific Islander | 20 | 0.1% |
| White | 14,766 | 54.4% |
| Race/Ethnicity Unknown | 3,555 | 13.1% |
| U.S. Nonresident | 305 | 1.1% |

Source: UNC System Interactive Data Dashboards

## A.2.4 Growth and Development Trends

Articles on ECU's website mention several building and renovation updates including at the Whichard Building, the Howell Science Complex South, Howell North, and Legacy Hall. ECU's

new medical education building is underway on the Health Science Campus and is expected to be completed in 2027. Additional information is summarized in ECU News at https://news.ecu.edu/2025/07/01/summer-2025-campus-construction-roundup/.

# A.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the ECU campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## A.3.1 Building Exposure

Table A.5 and Table A.6 provide total building exposure for ECU's Main campus and the Health Sciences campus, which was estimated by summarizing building footprints and building replacement values provided by the North Carolina Emergency Management (NCEM) iRisk database. ECU staff supplemented this inventory with university data for additional buildings not included in iRisk. These buildings are reflected in the asset inventory but are not necessarily accounted for in loss estimates in the vulnerability assessment. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table A.5 – ECU Main Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 41 | $105,782,509.08 |
| Educational/Extracurricular | 109 | $998,199,336.13 |
| Housing | 22 | $306,419,940.43 |
| **Total** | **172** | **$1,410,401,785.64** |

Source: NCEM iRisk database; ECU

**Table A.6 – ECU Health Sciences Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 29 | $224,388,009.24 |
| Educational/Extracurricular | 14 | $246,250,068.56 |
| Housing | 0 | 0.00 |
| **Total** | **43** | **$470,638,077.80** |

Source: NCEM iRisk database; ECU

## A.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines

that, if damaged during an emergency event, would disrupt continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by ECU's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the ECU HMPC maintained most critical facilities from the previous plan. Some revisions were made due to changes in where certain departments are located on campus. Factors considered for critical building evaluation included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for ECU are listed below:

- Contanche Building
- Eppes Carpentry Shop 126B
- Steam Plant
- Jones Residence Hall
- Blount House
- Todd Dining
- Joyner East
- Eppes Facilities Services 126A
- Eppes Building Services 126D

Campus building classifications and critical facilities are shown in Figure A.5 and Figure A.6.

**Figure A.5 – ECU Building and Critical Facility Inventory, Main Campus**

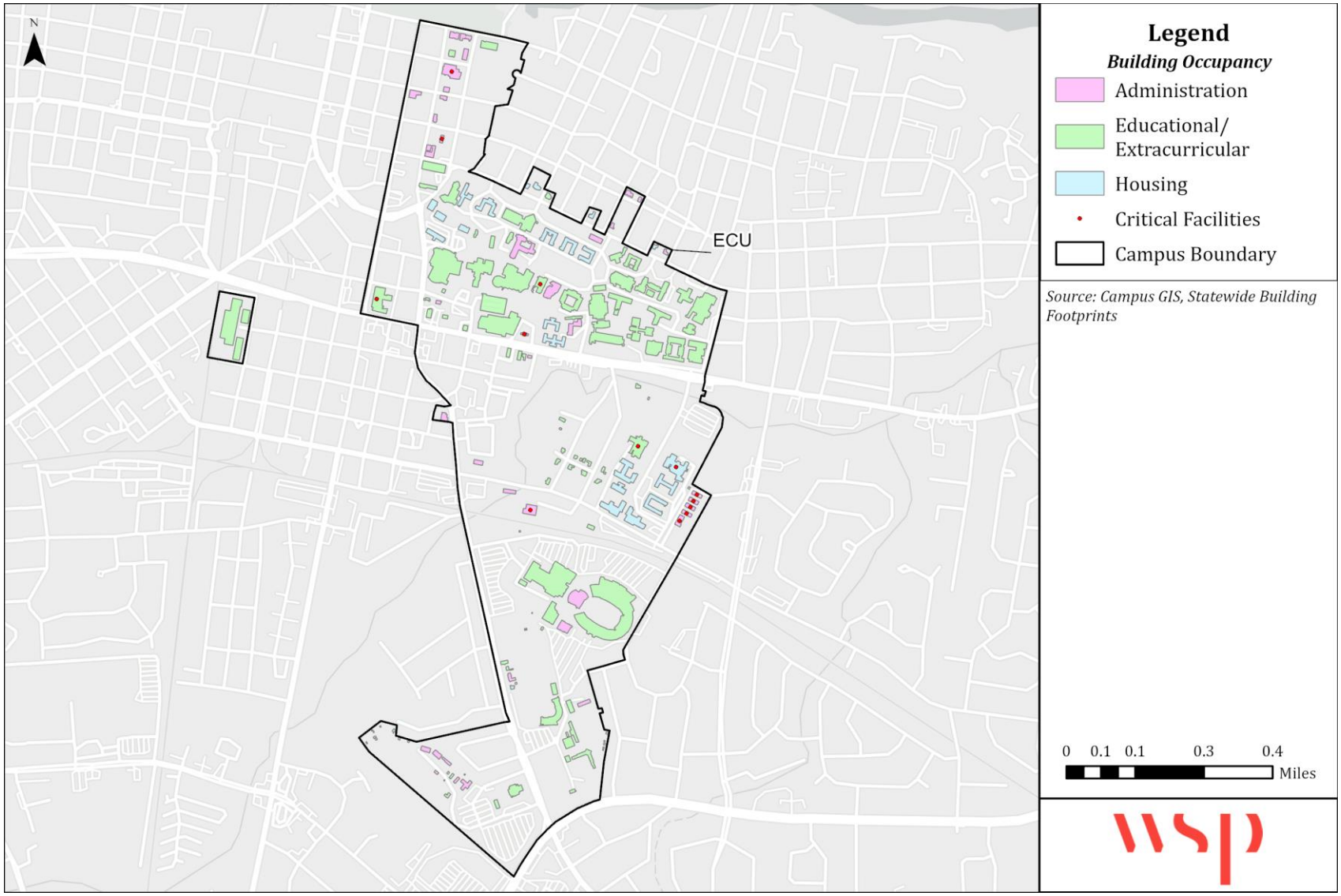
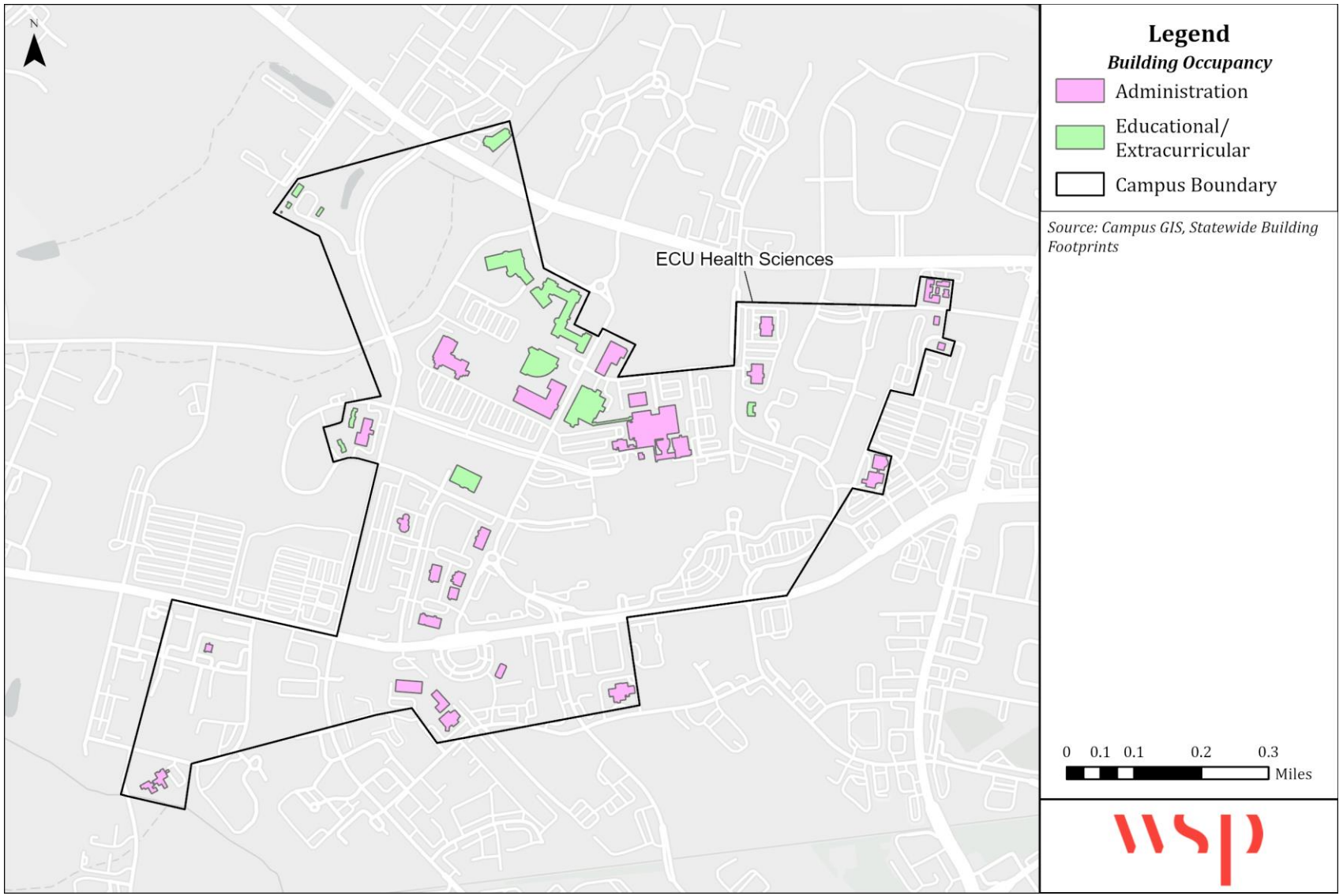


**Figure A.6 – ECU Building and Critical Facility Inventory, Health Sciences Campus**



# A.4 Hazard Identification & Risk Assessment

## A.4.1 Hazard Identification

To identify a full range of hazards relevant to ECU, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the ECU Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table A.7. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table A.7 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP ECU Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes & Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Excessive Heat | Yes | No |
| Earthquake | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failure | Yes | No |
| Drought | Yes | No |
| Tornadoes & Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | Yes |

ECU's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State HMP and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. The database contains records of tornado events since 1950, thunderstorm wind and hail

events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damage, as well as narrative descriptions of past impacts.

Data for Pitt County was used to approximate past events that may have affected the ECU campus. The NCEI database contains 426 records of storm events that occurred in Pitt County in the 25-year period from 2000 through 2024. Table A.8 summarizes these events.

**Table A.8 – NCEI Severe Weather Data for Pitt County, 2000-2024**

| Type | Event Count | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Drought | 7 | $0 | $0 | 0 | 0 |
| Excessive Heat | 2 | $0 | $0 | 0 | 0 |
| Flash Flood | 44 | $150,000 | $100,000 | 1 | 0 |
| Flood | 14 | $0 | $0 | 0 | 0 |
| Frost/Freeze | 1 | $0 | $0 | 0 | 0 |
| Funnel Cloud | 1 | $0 | $0 | 0 | 0 |
| Hail | 116 | $150,000 | $800,000 | 0 | 0 |
| Heat | 2 | $0 | $0 | 3 | 0 |
| Heavy Rain | 10 | $0 | $0 | 0 | 0 |
| Heavy Snow | 5 | $0 | $0 | 0 | 0 |
| High Wind | 4 | $5,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 3 | $2,200,000 | $300,000 | 0 | 0 |
| Ice Storm | 1 | $0 | $0 | 0 | 0 |
| Lightning | 3 | $151,000 | $0 | 0 | 0 |
| Strong Wind | 6 | $3,100 | $0 | 0 | 0 |
| Thunderstorm Wind | 162 | $374,000 | $0 | 1 | 3 |
| Tornado | 17 | $1,890,000 | $0 | 0 | 5 |
| Tropical Storm | 7 | $10,035,000 | $38,000,000 | 3 | 1 |
| Winter Storm | 12 | $0 | $0 | 0 | 2 |
| Winter Weather | 9 | $0 | $0 | 0 | 0 |
| **Total** | **426** | **$14,958,100** | **$39,200,000** | **8** | **11** |

Source: National Center for Environmental Information Events Database, retrieved October 2025

Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Pitt County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Pitt County has been designated in 23 major disaster declarations, as detailed in Table A.9, and 13 emergency declarations, as detailed in Table A.10.

**Table A.9 – FEMA Major Disaster Declarations, Pitt County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-234-NC | 10-Feb-68 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | N/A |
| DR-699-NC | 30-Mar-84 | Tornado | Severe Storms & Tornadoes | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard of 96 | N/A | N/A | N/A |
| DR-1127-NC | 18-Jul-96 | Hurricane | Hurricane Bertha | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1240-NC | 27-Aug-98 | Hurricane | Hurricane Bonnie | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7790 | $21,289,504 | $18,285,917 |
| DR-1942-NC | 14-Oct-10 | Severe Storm(s) | Severe Storms, Flooding, And Straight-Line Winds | 2037 | $8,587,054 | $19,065,881 |
| DR-1969-NC | 20-Apr-11 | Severe Storm(s) | Severe Storms, Tornadoes, And Flooding | 1778 | $5,391,278 | N/A |
| DR-4019-NC | 31-Aug-11 | Hurricane | Hurricane Irene | 10270 | $37,238,655 | $88,847,065 |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28971 | $98,842,213 | $291,092,954 |

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34713 | $133,948,455 | $632,937,402 |
| DR-4465-NC | 04-Oct-19 | Hurricane | Hurricane Dorian | N/A | N/A | $28,138,271 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |
| DR-4568-NC | 14-Oct-20 | Hurricane | Hurricane Isaias | N/A | N/A | $1,454,222 |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance; IAH = Individuals and Households; PA = Public Assistance

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table A.10 – FEMA Emergency Declarations, Pitt County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3254-NC | 15-Sep-05 | Hurricane | Hurricane Ophelia |
| EM-3314-NC | 02-Sep-10 | Hurricane | Hurricane Earl |
| EM-3327-NC | 25-Aug-11 | Hurricane | Hurricane Irene |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 01-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 06-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area to decide which hazards to include in this plan update. Table A.11 summarizes the determination made for each hazard.

### Table A.11 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in 2021 ECU Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in 2021 ECU Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 ECU Annex<br>▪ Modeled building damage in iRisk database show some vulnerability and potential for losses due to earthquake |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 ECU Annex<br>▪ Pitt County has had four disaster declarations related to flooding and 14 disaster declarations for hurricanes or tropical storms which may have involved flooding |
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Included in 2021 ECU Annex but minimal to no landslide risk found<br>▪ Not included in the Neuse River Regional Hazard Mitigation Plan |
| Hurricane & Coastal Hazards | Yes | ▪ Included in 2021 ECU Annex and rated a high-risk hazard<br>▪ Pitt County has had 14 disaster declarations related to hurricanes |
| Severe Winter Weather | Yes | ▪ Included in 2021 ECU Annex and rated a high-risk hazard<br>▪ Potential for power outages, freezing temperatures, and dangerous travel conditions presents risk to campus |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 ECU Annex<br>▪ Pitt County has received two disaster declarations for events that included tornadoes. |
| Wildfire | Yes | ▪ Included in 2021 ECU Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in 2021 ECU Annex<br>▪ Fixed facility sites and transportation routes with hazardous materials are present in and around the campus |
| Infectious Disease | Yes | ▪ Included in 2021 ECU Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in 2021 ECU Annex<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |
| Terrorism | No | ▪ Not included in 2021 ECU Annex<br>▪ HMPC did not express interest in evaluating this hazard; best addressed by State and federal planning and emergency response |

# A.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on ECU's campuses the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record is used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Pitt County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses

specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Neuse River Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the number and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Pitt County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table A.12 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Earthquake** | USGS, NCEI | County | iRisk | Campus |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricanes & Coastal Hazards** | NHC | County | iRisk | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the ECU planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table A.13.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile. The results of the risk assessment and overall PRI scoring are provided in Section A.5.11 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table A.13 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF | **1** | **30%** |
| | **LIMITED** | MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 | **3** | |
| | **CATASTROPHIC** | HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

## A.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

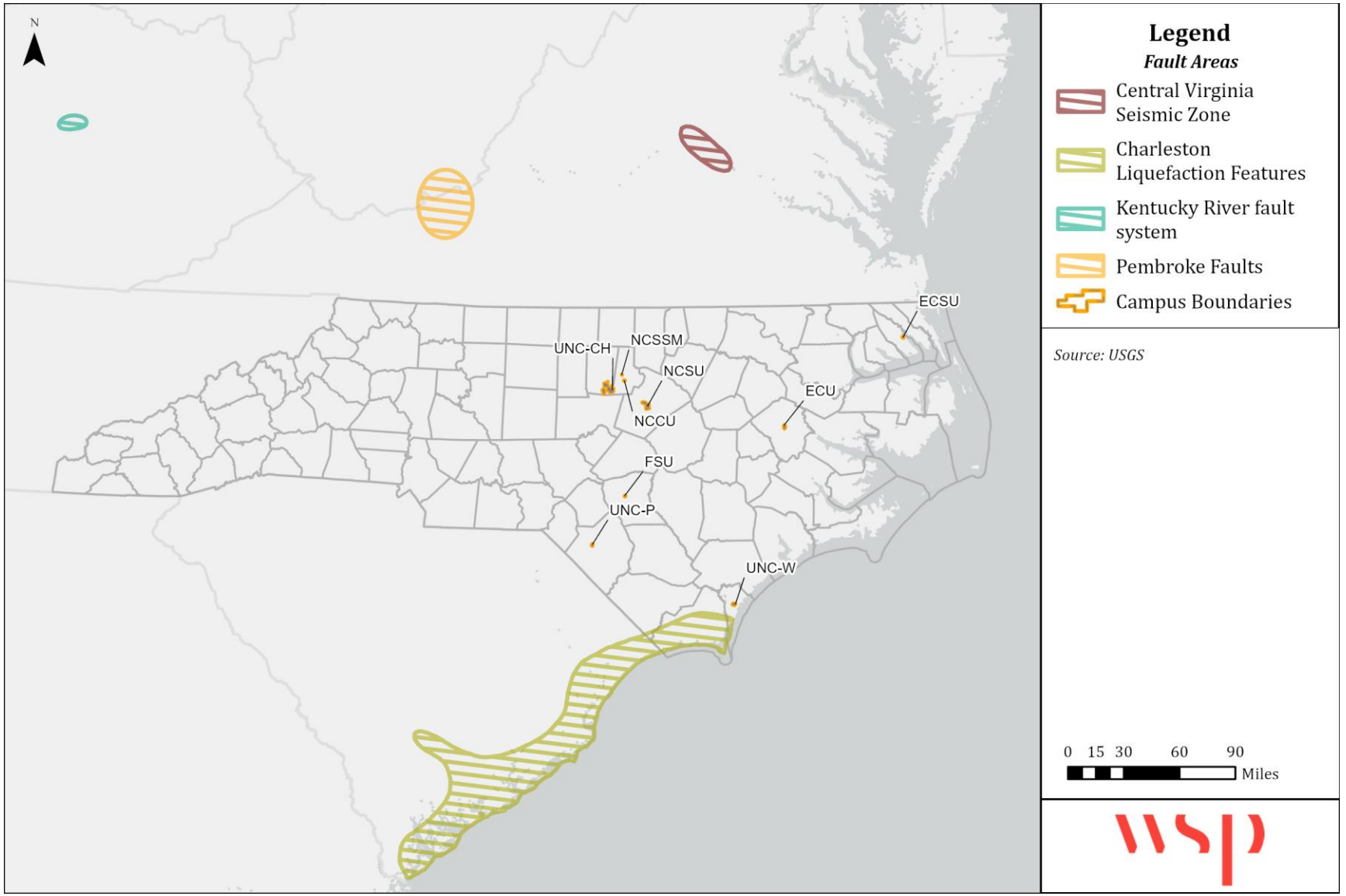
Figure A.7 reflects the quaternary faults that present an earthquake hazard for the ECU planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Pitt County would likely be felt across the ECU campus.

*Spatial Extent: 4 – Large*

**Figure A.7 – U.S. Quaternary Faults**



## Extent

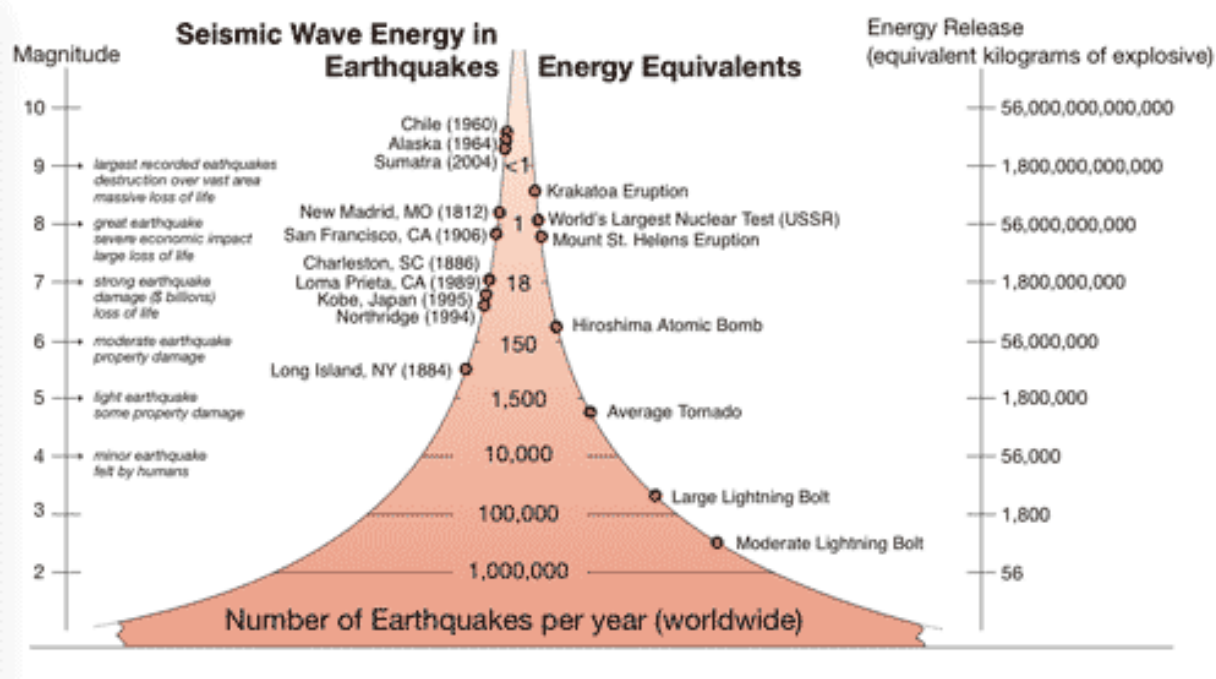
Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure A.8.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table A.14 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Earthquake events are not expected to affect the ECU campus with more than a mild intensity such that shaking may be felt but damage would not likely occur.

*Impact: 1 – Minor*

**Figure A.8 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table A.14 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of all historical earthquakes of a magnitude 2.5 and greater. Earthquake events that occurred within 100 miles of ECU include only two events that both occurred in Pamlico County. One event in the Town of Bayboro in 2014 and one in the unincorporated community of Hobucken in 1994. Table A.15 lists the historical earthquakes to occur within 100 miles of Pitt County, and Figure A.9 shows the epicenter of these events.

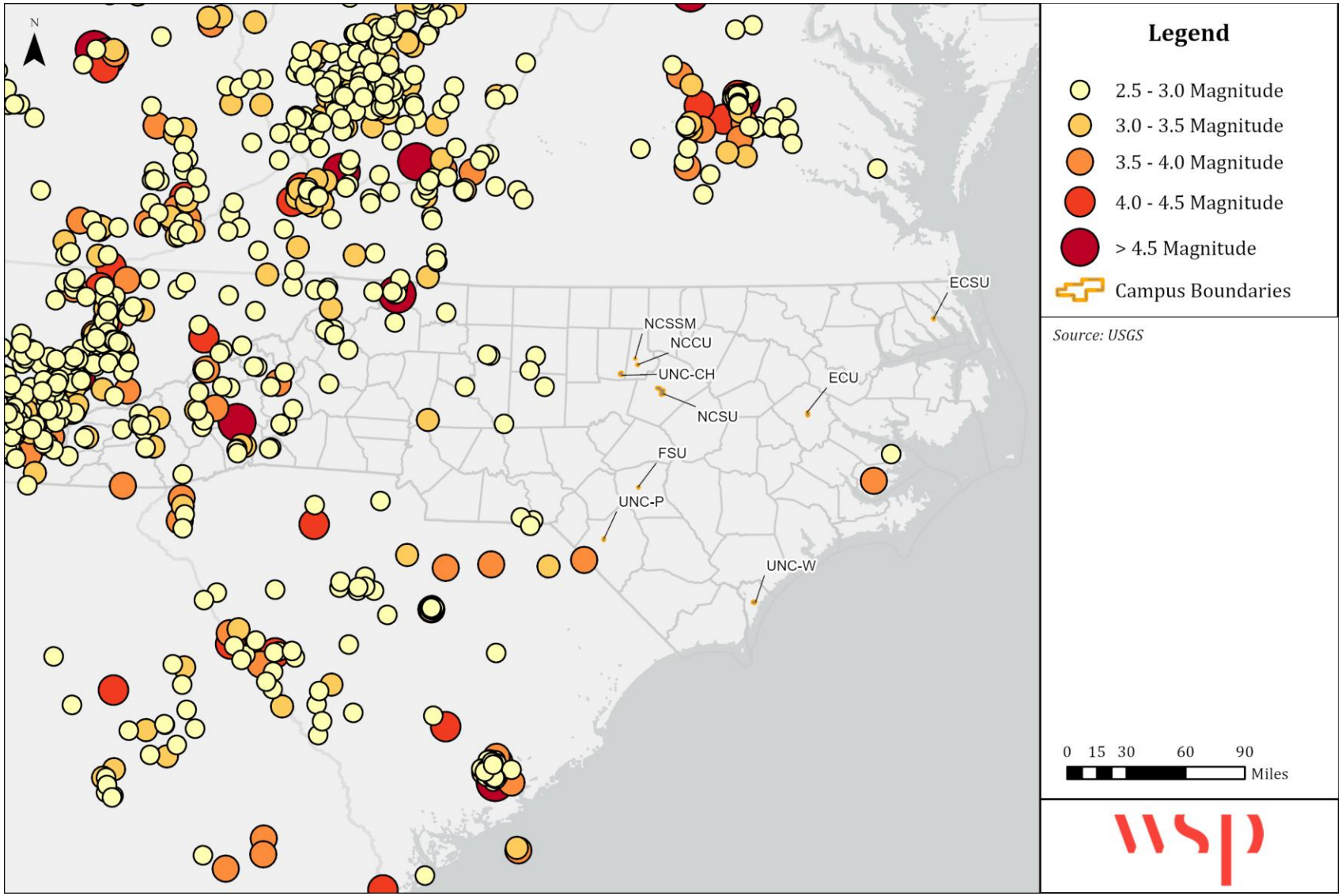
**Table A.15 – Historical Earthquakes within 100 Miles of ECU, 1900-2024**

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 8/6/1994 | 3.6 | 7 km NW of Hobucken, North Carolina |
| 2/11/2014 | 2.9 | 4 km SSW of Bayboro, North Carolina |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there was one earthquake felt in Greenville. This event occurred on September 1, 1886.

**Figure A.9 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

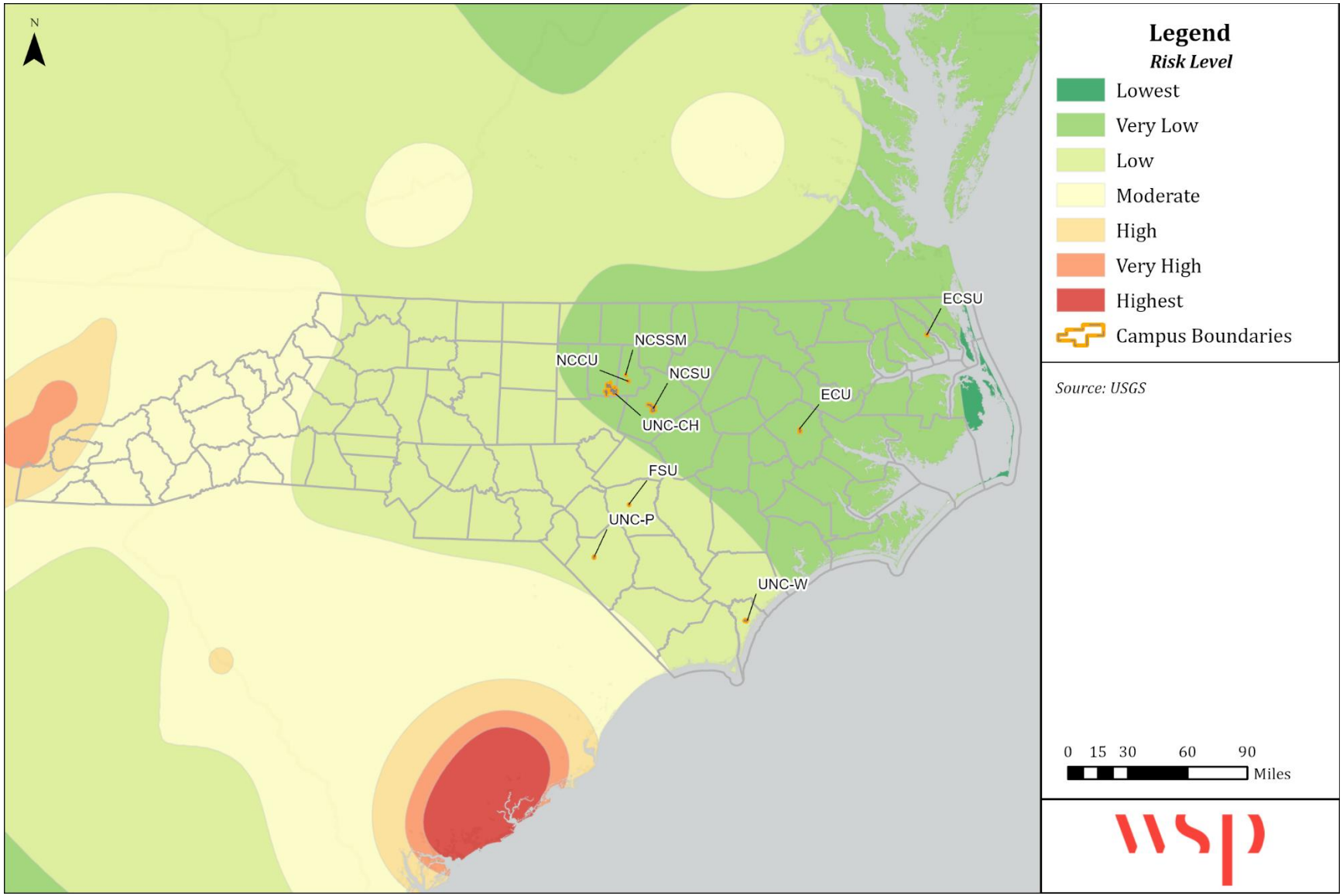
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure A.10 on the following page reflects the seismic hazard for Pitt County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Pitt County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting ECU is unlikely.

*Probability: 1 – Unlikely*

**Figure A.10 – Seismic Hazard Information for Pitt County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on ECU's campuses.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also damage infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause over $145,000 of building damage on ECU main campus and over $1.3 million of damage on the Health Sciences campus.

Pitt County has not been impacted by an earthquake with more than a low intensity, so damage to the built environment is unlikely. Table A.16 and Table A.17 detail the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event on ECU Main campus and ECU Health Sciences campus.

**Table A.16 – Estimated Building Damage by Earthquake Event on ECU Main Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $36.67 | $2.97 | $39.64 |
| Educational | $215.27 | $43.09 | $258.36 |
| Housing | $112.46 | $63.31 | $175.77 |
| **Total** | **$364.40** | **$109.37** | **$473.77** |
| **500-Year Earthquake Event** | | | |
| Administration | $14,612.55 | $11,157.22 | $25,769.77 |
| Educational | $48,958.89 | $40,548.88 | $89,507.77 |
| Housing | $17,543.81 | $12,185.95 | $29,729.76 |
| **Total** | **$81,115.25** | **$63,892.05** | **$145,007.30** |
| **1,000-Year Earthquake Event** | | | |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Administration | $59,388.13 | $46,785.64 | $106,173.77 |
| Educational | $254,147.60 | $201,063.17 | $455,210.77 |
| Housing | $91,269.39 | $48,559.72 | $139,829.11 |
| **Total** | **$404,805.12** | **$296,408.53** | **$701,213.65** |

Source: NCEM iRISK Database

**Table A.17 – Estimated Building Damage by Earthquake Event on ECU Health Sciences Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $7,553.94 | $11,323.22 | $18,877.16 |
| Educational | $0.00 | $0.00 | $0.00 |
| **Total** | **$7,553.94** | **$11,323.22** | **$18,877.16** |
| **500-Year Earthquake Event** | | | |
| Administration | $555,396.61 | $745,311.38 | $1,300,707.99 |
| Educational | $20,467.48 | $34,350.49 | $54,817.97 |
| **Total** | **$575,864.09** | **$779,661.87** | **$1,355,525.96** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $2,206,404.09 | $2,387,759.60 | $4,594,163.69 |
| Educational | $127,461.70 | $207,528.05 | $334,989.75 |
| **Total** | **$2,333,865.79** | **$2,595,287.65** | **$4,929,153.44** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Pitt County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on USGS seismic probability data and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the ECU campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings, and zoning for the local jurisdiction.

Development changes at ECU have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statements

- While earthquakes are an unlikely hazard event for the ECU campus, an estimated $1.5 million in damage could occur in the case of a 500-year earthquake event.

## A.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Critical | Large | More than 24 hours | Less than 1 week | 3.3 |

### Location

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The NWS Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

The highest temperature recorded in Greenville is 104°F on July 9, 1977. While this measure is helpful, a better measure of maximum temperature reached is based on the heat index. Heat index records maintained by the North Carolina Climate Office indicate that Greenville regularly experiences heat index temperatures above 100°F. Table A.18 provides counts of heat index values by threshold recorded from 2001-2024 at the Pitt-Greenville Airport in Greenville. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Greenville experiences an average of 75 hours per year with heat index values at or above 100°F.

*Impact: 3 – Critical*

**Table A.18 – Historical Heat Index Counts, Pitt-Greenville Airport (KPGV) in Greenville, NC, 2001-2024**

| Year | Heat Index Value | | | | Total Hours |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| **2001** | 41 | 10 | 8 | 0 | 59 |
| **2002** | 27 | 4 | 0 | 0 | 31 |
| **2003** | 37 | 4 | 0 | 0 | 41 |
| **2004** | 12 | 0 | 0 | 0 | 12 |
| **2005** | 83 | 28 | 1 | 0 | 112 |

| Year | Heat Index Value | | | | Total Hours |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| **2006** | 65 | 26 | 1 | 0 | 92 |
| **2007** | 61 | 26 | 13 | 13 | 113 |
| **2008** | 25 | 1 | 0 | 0 | 26 |
| **2009** | 2 | 0 | 0 | 0 | 2 |
| **2010** | 58 | 13 | 0 | 0 | 71 |
| **2011** | 29 | 8 | 0 | 0 | 37 |
| **2012** | 32 | 13 | 2 | 0 | 47 |
| **2013** | 34 | 4 | 0 | 0 | 38 |
| **2014** | 42 | 4 | 0 | 0 | 46 |
| **2015** | 76 | 33 | 1 | 0 | 110 |
| **2016** | 109 | 99 | 12 | 0 | 220 |
| **2017** | 53 | 25 | 2 | 0 | 80 |
| **2018** | 41 | 1 | 0 | 0 | 42 |
| **2019** | 78 | 28 | 0 | 4 | 110 |
| **2020** | 49 | 44 | 0 | 0 | 93 |
| **2021** | 53 | 9 | 0 | 0 | 62 |
| **2022** | 86 | 33 | 0 | 0 | 119 |
| **2023** | 146 | 37 | 11 | 1 | 195 |
| **2024** | 111 | 79 | 9 | 2 | 201 |
| **Sum** | **1,350** | **529** | **60** | **20** | **1,959** |
| **Average** | **52** | **20** | **2** | **1** | **75** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

Pitt County experienced four heat-related incidents according to NCEI between 2000 and 2024. Two of the incidents in 2008 resulted in a total of 3 fatalities.

- **June 10, 2008** – Very hot temperatures led to the death of a man in Pitt County. It is estimated the man died on June 10th. A man was found dead on June 13th near Greenville in Pitt County. The coroner decided the cause of death was extreme heat and estimated the man died on June 10th. High temperatures were around 100 degrees at this time.
- **June 13, 2008** – A man and a woman were found dead in a trailer on June 16th. It is believed they died on June 13th due to extreme heat. The trailer they were found in had no air conditioning and all the windows were closed despite temperatures well into the 90s. Smoke from a large wildfire to the east had spread over the region on June 13th and may have led to the deceased individuals closing the windows despite the hot temperatures.
- **August 15, 2023** – A three-day heatwave ended with excessive heat A three-day heatwave ended with excessive heat being observed across Eastern NC. The heatwave began on Sunday, August 13th, with heat indices of 105 to 100 degrees. This pattern continued on

Monday, August 14th with similar values. The heat and humidity intensified on Tuesday, August 15th ahead of a cold front that would move into Eastern NC. Widespread heat indices of 110 to 115 degrees were recorded, with some places even higher that 115 for a short time. The heatwave broke with the cold front moving in and producing widespread showers and thunderstorms during the evening hours. Greenville recorded a peak heat index of 117 degrees.

- **July 15, 2024** – A very hot airmass with temperatures well into the 90s combined with extremely high dewpoints in the upper 70s to low 80s to produce excessively high heat indices generally between 110 and 115 degrees during the daytime hours. The excessive heat affected all of Eastern NC except for the Outer Banks. Greenville reported heat indices up to 112 degrees, with several CWOP stations reporting 114 degrees.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Pitt-Greenville Airport weather station. Based on 24 years of data (2001 to 2024), the Pitt-Greenville station averages 25.9 days per year with a heat index at or above 100 degrees. The frequency of extreme heat is projected to increase due to climate change.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat. In 2008, three people died in Pitt County from excessive heat.

### Property

Extreme heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat-induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized “heat islands.” Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statements

- ECU is located in Greenville which currently averages 75 hours per year with heat index values at or above 100°F and there is a 100% annual chance of heat index values meeting or exceeding 100°F in any given year.
- Outdoor workers and athletes are most vulnerable to heat-related illness.
- Critical systems and temperature sensitive spaces on campus should be protected from potential power outages with redundant power systems.

# A.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Limited | Small | 6 to 12 hrs | Less than 1 week | 2.8 |

## Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the ECU Campus using the FIRM dated July 7, 2014. Figure A.11 and Figure A.12 reflect the 2014 mapped flood insurance zones. Table A.19 summarizes some of the flood insurance zones identified by a Digital FIRM (DFIRM). Note that not all flood zones outlined in Table A.19 intersect the ECU campus.

Primary sources of flooding include Greens Mill Run and the Tar River.

The HMPC noted that ECU's Outer Banks campus, which houses the Coastal Studies Institute, is highly vulnerable to coastal flooding. Figure A.13 shows mapped flood insurance zones and Figure A.16 shows the 1% annual chance flood depth on this satellite campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Greenville and the ECU campus. Flood risk is not limited to the 1%-annual-chance floodplain.

Although this assessment focuses on riverine flooding, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. Areas with common localized flooding challenges include the College Hill parking lot and the North Campus recreation area.

*Spatial Extent: 2 – Small*

### Table A.19 – Mapped Flood Insurance Zones

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood |

| Zone | Description |
|---|---|
| | sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure A.11 – FEMA Flood Hazard Areas in ECU Main Campus**

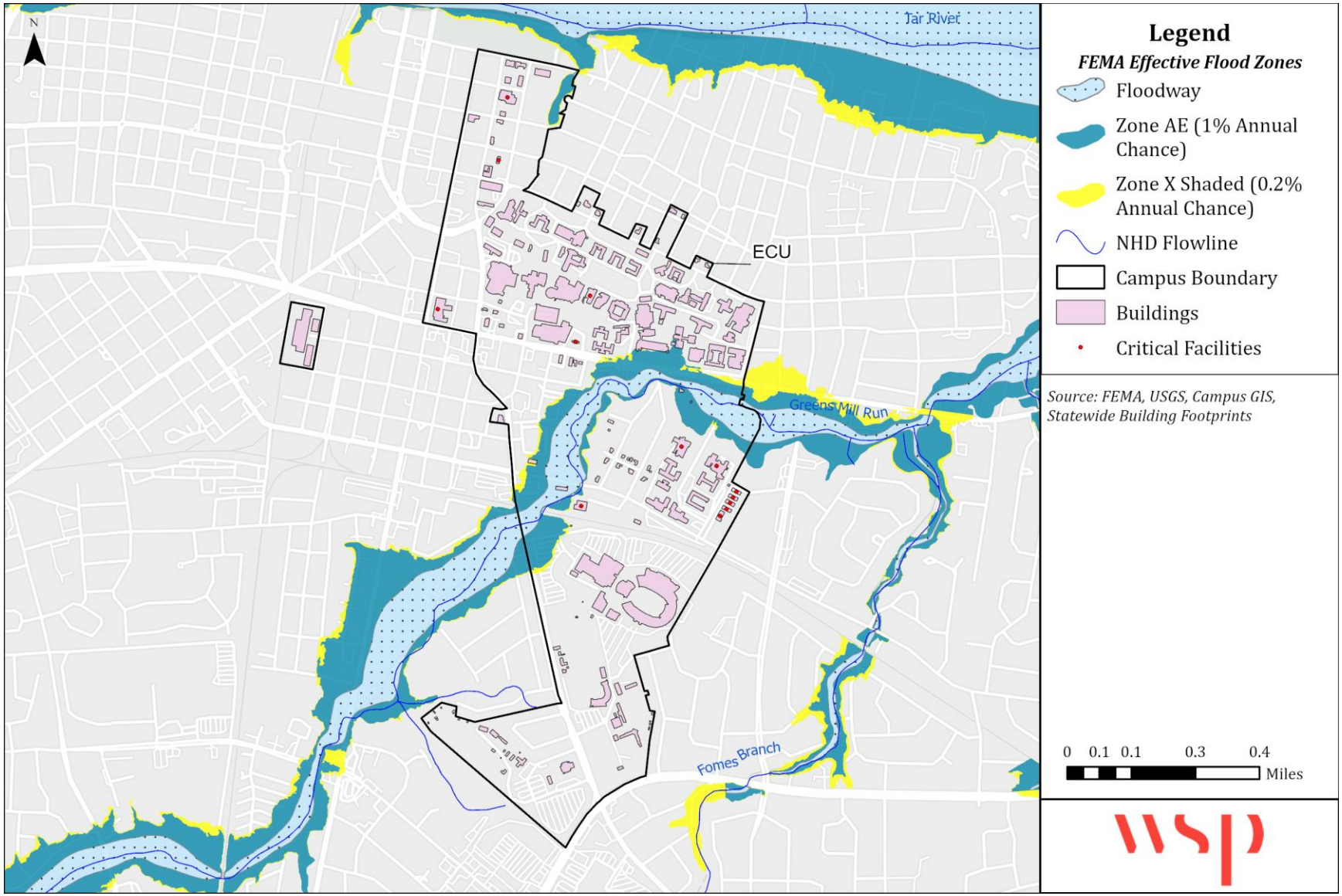


**Figure A.12 – FEMA Flood Hazard Areas in ECU Health Sciences Campus**

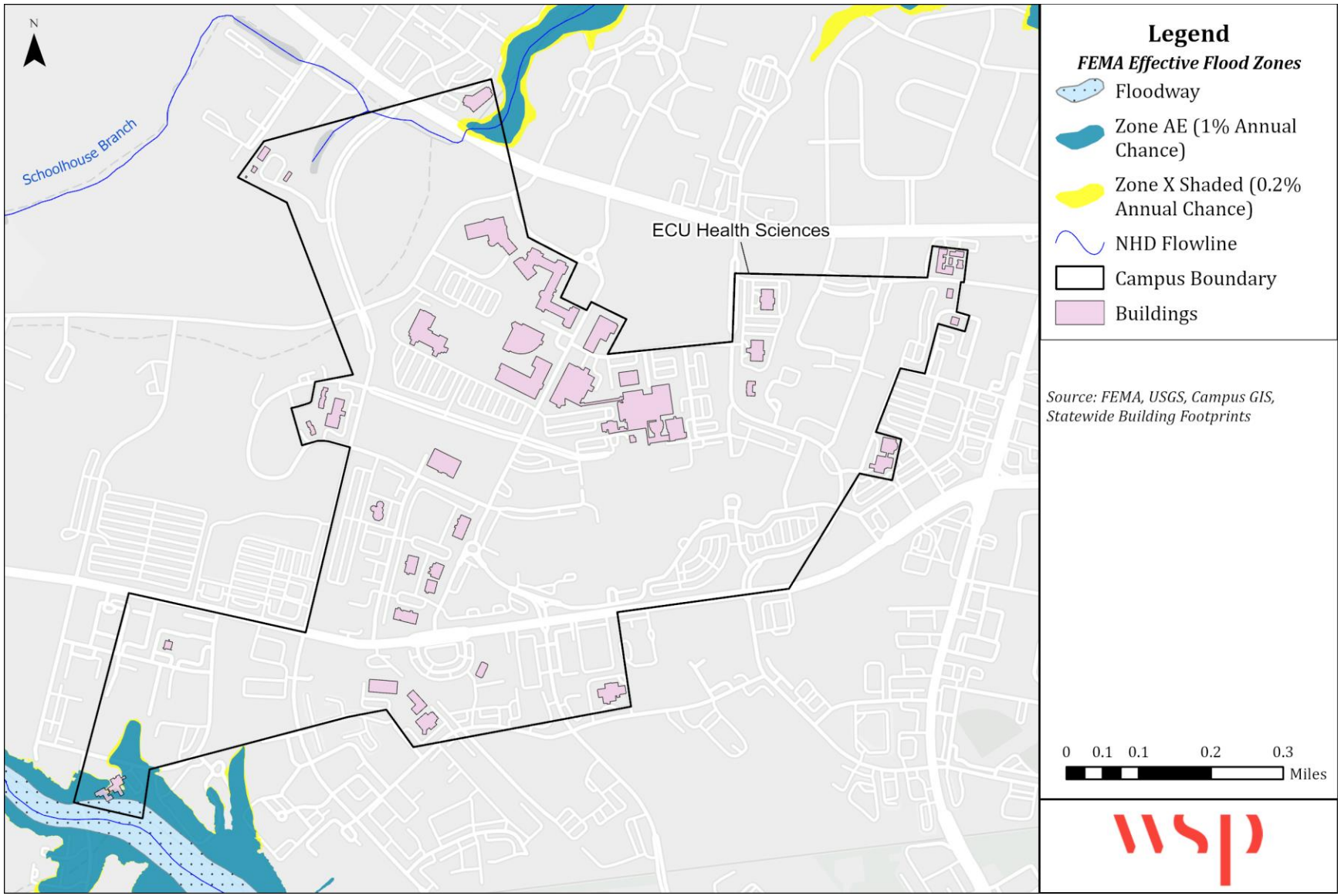
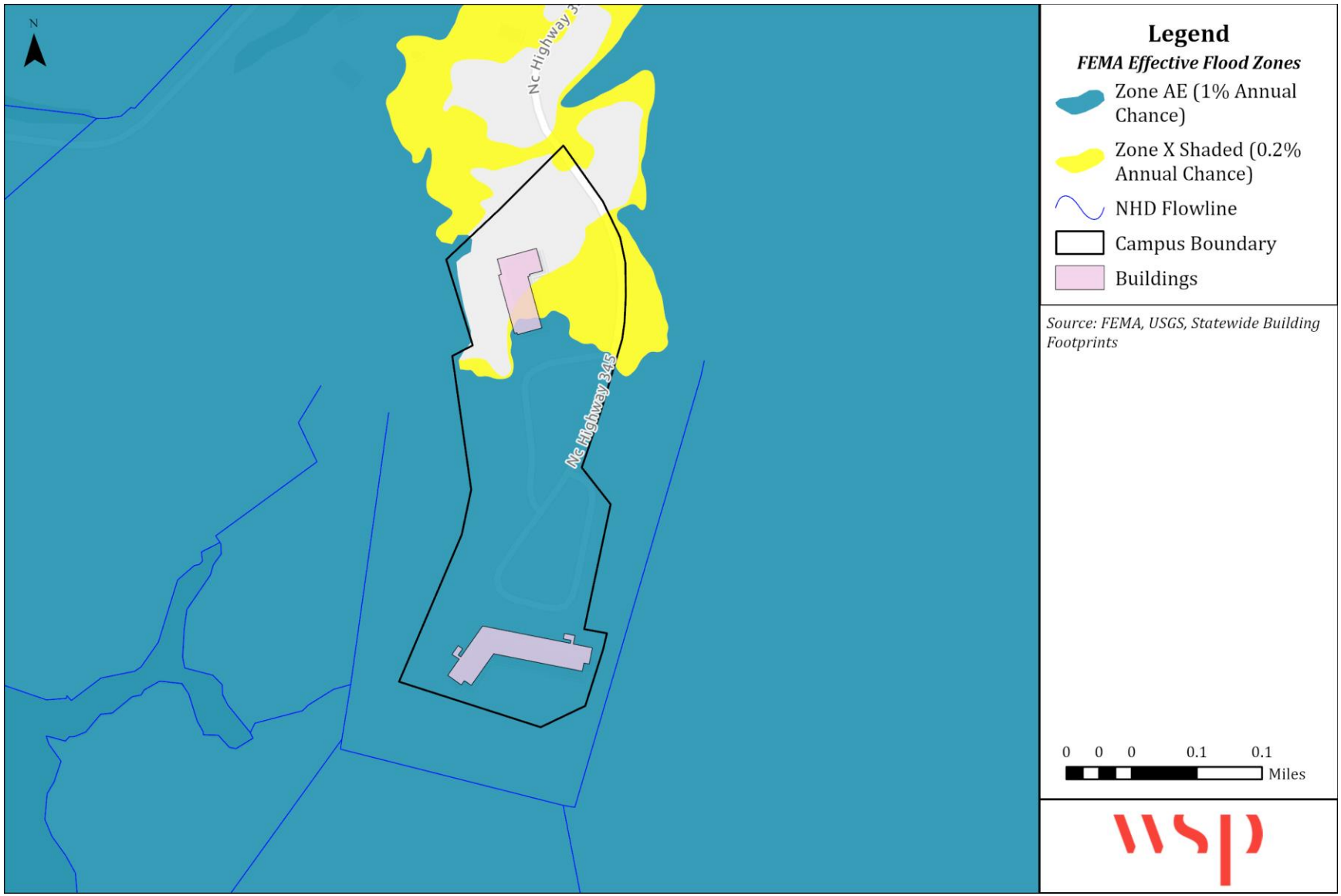


**Figure A.13 – FEMA Flood Hazard Areas in ECU Outer Banks Campus**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Over 11 percent of the ECU main campus and only 1.4 percent of the Health Sciences campus fall within the SFHA. Just over one percent of the campuses is in the lower risk 0.2%-annual-chance flood zone. The majority of these campuses, almost 87 percent of main campus and over 98 percent of Health Science campus, is outside of any floodplain. Table A.20 and Table A.21 provide a summary of the ECU campuses' total area by flood zone on the 2014 effective DFIRM. Figure A.14 and Figure A.15 show the depth of flooding predicted from a 1%-annual-chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

*Impact: 2 – Limited*

### Table A.20 – Flood Zone Acreage on ECU Main Campus

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 57.16 | 11.6% |
| Floodway* | 25.30 | 5.0% |
| 0.2% Annual Chance Flood | 4.72 | 1.0% |
| Unshaded X | 430.64 | 87.4% |
| **Total** | **492.52** | **--** |
| **SFHA Total** | **57.16** | **11.6%** |

Source: FEMA 2014 DFIRM

*Floodway is part of the AE zone. Floodway acreage is accounted for in AE totals.

### Table A.21 – Flood Zone Acreage on ECU Health Sciences Campus

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 4.98 | 1.4% |
| Floodway* | 0.93 | 0.3% |
| 0.2% Annual Chance Flood | 0.86 | 0.2% |
| Unshaded X | 340.82 | 98.3% |
| **Total** | **346.65** | **--** |
| **SFHA Total** | **4.98** | **1.4%** |

Source: FEMA 2014 DFIRM

*Floodway is part of the AE zone. Floodway acreage is accounted for in AE totals.

**Figure A.14 – Flood Depth, 1-Percent-Annual-Chance Flood, ECU Main Campus**

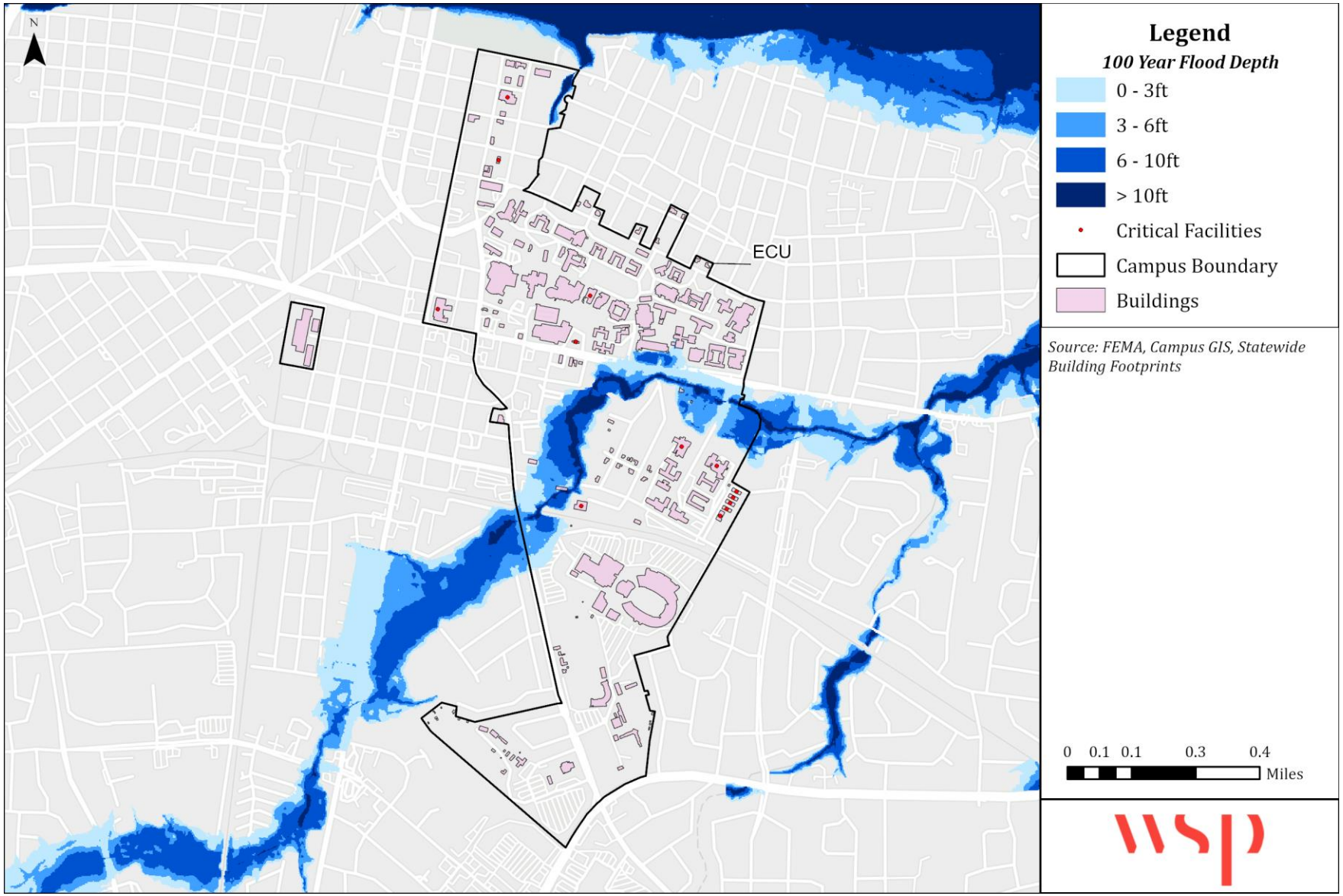


**Figure A.15 – Flood Depth, 1-Percent-Annual-Chance Flood, ECU Health Sciences Campus**

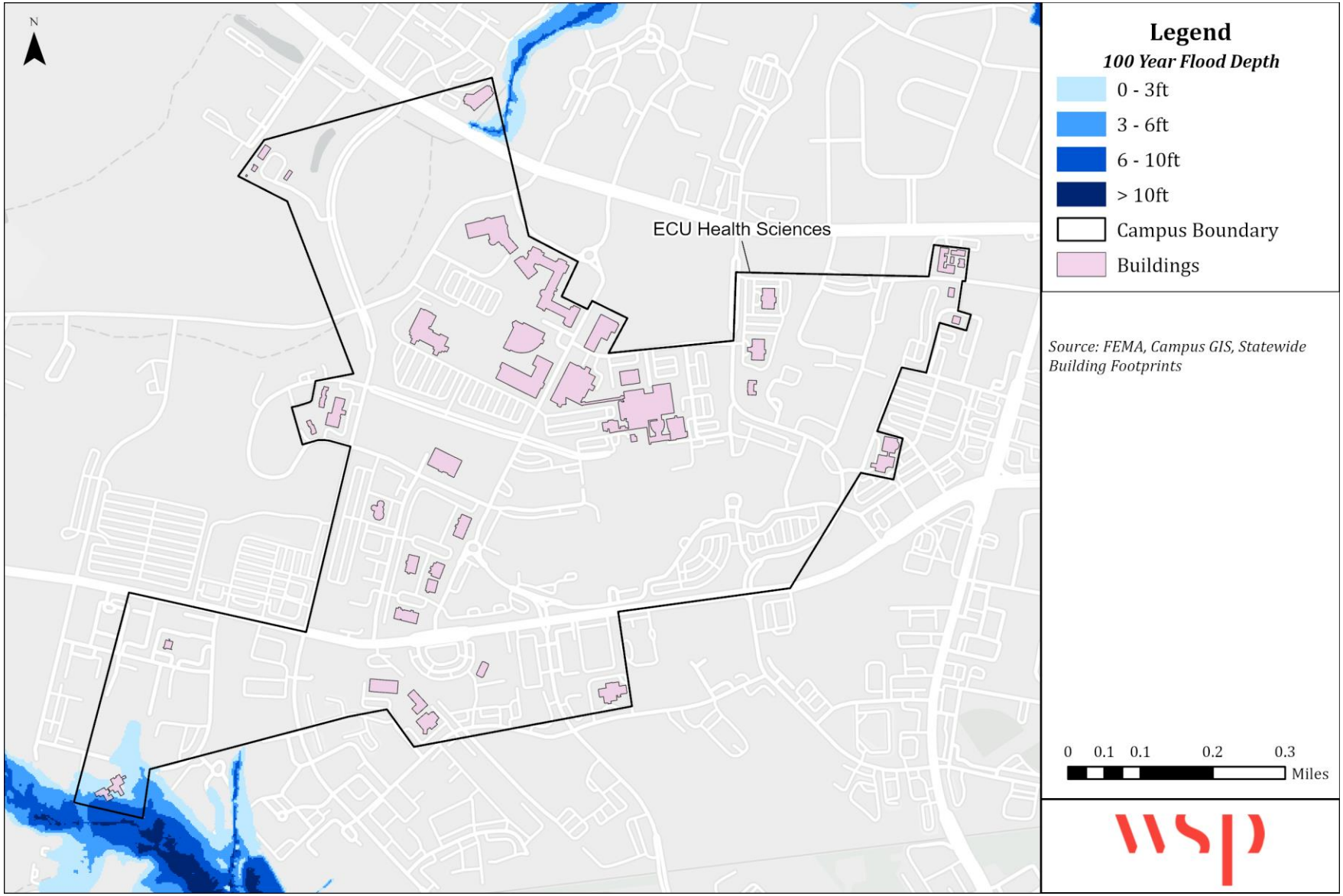
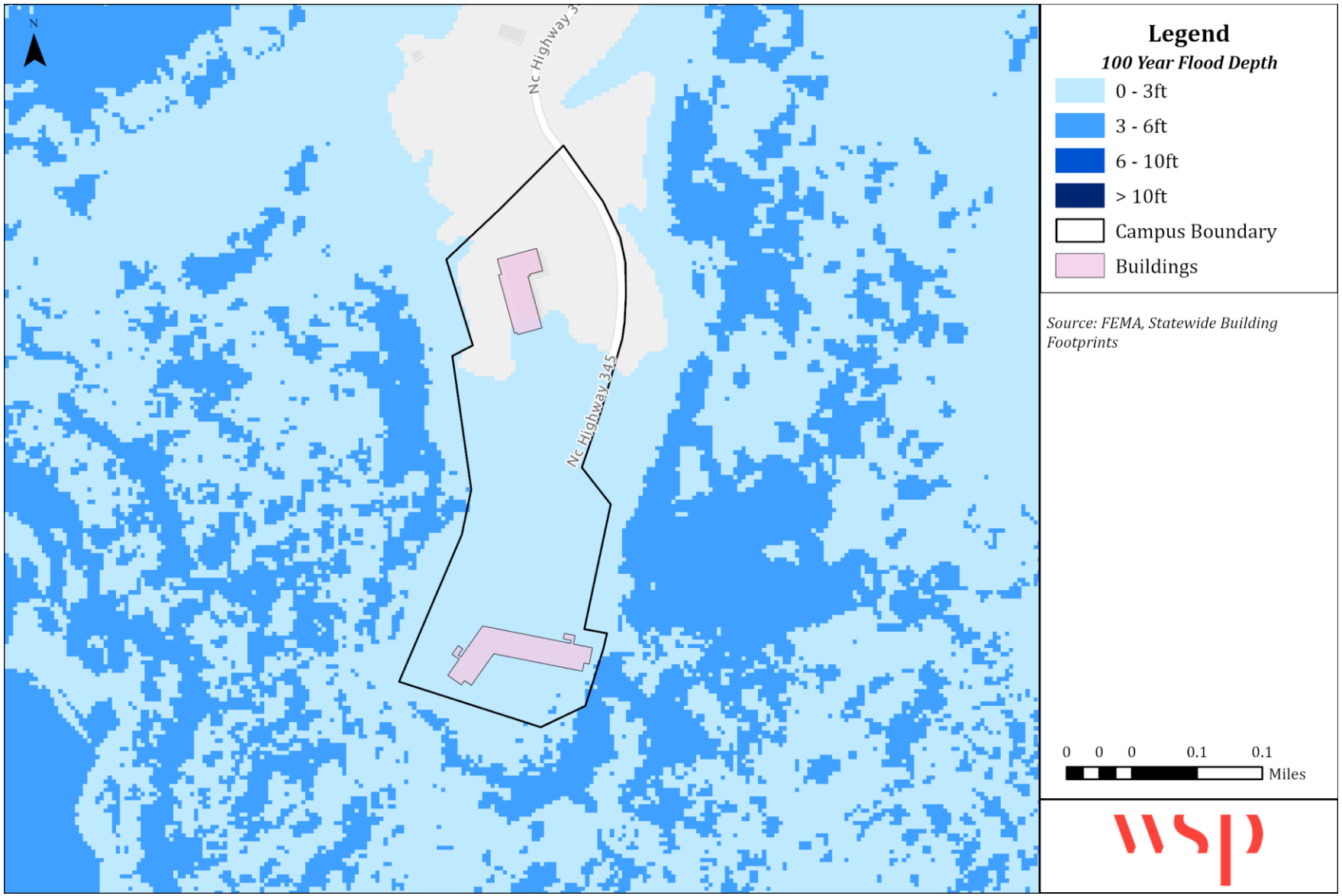


**Figure A.16 – Flood Depth, 1-Percent-Annual-Chance Flood, ECU Outer Banks Campus**



## Historical Occurrences

Table A.22 details the historical occurrences of flooding for Greenville and Pitt County identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 29 recorded flood-related events occurred on 16 separate days in Greenville and Pitt County from 2000 to 2024 causing $20,000 in property damage, and no injuries, fatalities, or crop damage. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table A.22 – Summary of NCEI Records of Flooding, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Greenville | 10/11/2002 | 0 | $0 | $0 |
| Greenville | 8/5/2003 | 0 | $0 | $0 |
| Countywide | 8/14/2004 | 0 | $0 | $0 |
| Greenville | 7/29/2005 | 0 | $0 | $0 |
| Greenville | 10/8/2005 | 0 | $0 | $0 |
| Greenville | 10/8/2016* | 0 | $0 | $0 |
| Greenville | 9/1/2017 | 0 | $0 | $0 |
| Greenville/Farmville | 11/12/2020 | 0 | $0 | $0 |
| Greenville | 7/14/2022* | 0 | $20,000 | $0 |
| Greenville | 9/23/2023 | 0 | $0 | $0 |
| Greenville | 7/11/2024 | 0 | $0 | $0 |
| Greenville | 7/22/2024* | 0 | $0 | $0 |
| Greenville/Bell Fork | 8/30/2024* | 0 | $0 | $0 |
| **Flood** | | | | |
| Greenville | 7/10/2010 | 0 | $0 | $0 |
| Greenville | 7/29/2010 | 0 | $0 | $0 |
| Greenville | 5/23/2012* | 0 | $0 | $0 |
| | **Total** | **0/0** | **$20,000** | **$0** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **October 11, 2002** – Up to 4 to 6 inches of rain fell across Pitt County as the remnants of Tropical Storm Kyle moved across the area. Numerous roads were closed in and around Greenville. Several vehicles became flooded and were abandoned.
- **September 30, 2010** – Torrential rain moved across most of Pitt County during the evening of September 30th as the remnants of Tropical Storm Nicole moved north across the region. This rain fell on saturated ground from very heavy rain the previous few days. Significant

flash flooding developed especially for areas from Greenville east toward Simpson. A few homes were flooded especially near Chicod Creek near Simpson. Some crops were also damaged from the flooding.

- **October 8, 2016** – Flooding from Tyson creek has flooded Windham Road making it impassable. High water from severe flooding has trapped several cars along Fire Tower Road near Arlington Boulevard. Roundtree Road collapsed due to severe flooding near Ayden. Severe flooding with water to the tops of cars near Pirates Place Apartments in Greenville. High water flowing swiftly over Williams Road near Dickenson Avenue. Severe flooding at the intersection of Arlington Boulevard and Fire Tower Road; both roads were impassable.
- **July 14, 2022** – A stalled front across Pitt County allowed multiple rounds of heavy rain and thunderstorms to move over the same area during the evening. With a very moist atmosphere in place, localized heavy rain over the City of Greenville caused flash flooding throughout the city. Multiple water rescues occurred due to cars stranded in water. The hardest hit area was Downtown Greenville. Multiple vehicles were stranded in flood waters near the intersection of 1st Street and Meade Street in Greenville.
- **September 21, 2023** – Tropical storm Ophelia made landfall during the early morning hours near Emerald Isle, NC. Ophelia continued north through the heart of Eastern North Carolina on Saturday, September 23rd. Ophelia brought widespread heavy rainfall, gusty winds, and significant river and storm surge flooding to portions of Eastern North Carolina. Significant storm surge flooding occurred along the Neuse, Pamlico, and Pungo Rivers. Inland, significant flooding occurred in the Greenville area due to flash flooding and a rapidly rising Green Mill Run. Several road closures occurred including 14$^{th}$ street and 1$^{st}$ street (Elm St. to Oak St.).
- **August 30, 2024** – Slow moving thunderstorms produced very heavy rain and several areas of flash flooding across Eastern NC. Flooding reported along Cotanche Street and Stantonsburg Road. A submerged car was reported on Brimley Road.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which have also included damages associated with flooding. Pitt County has had two FEMA Major Disaster Declarations for severe storms that include elements of flooding in 2010 and 2011. Additionally, ten Major Disaster Declarations were made for Hurricanes in 1996, 1998, 1999, 2003, 2011, 2016, 2017, 2018, 2019, and 2020 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The ECU campus has some area of land in FEMA-mapped flood hazard areas. This delineation is a useful way to identify the most at-risk areas, but the City of Greenville and the ECU campus are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Greenville and impacts from past flood events have been noted by NCEI. NCEI reports 29 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability of over 100%. Therefore, the probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. In total, there are 215 buildings on ECU's Main campus and Health Sciences campus; of these, 9 are located within the SFHA, including one building located within the floodway. These buildings were evaluated as part of this analysis. There is also one building located within the moderate risk Shaded X zone.

Flood damage is directly related to the depth of flooding by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a specific percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure A.14 and Figure A.15 depict the depth of flooding that can be expected within the ECU's campus during the 1-percent-annual-chance flood event.

The nine exposed buildings are shown in Figure A.17 and Figure A.18 on the following pages. Note that two of these buildings were provided by the campus and not included in the iRisk inventory; therefore first-floor elevations were unknown and vulnerability to flooding could not be assessed.

**Figure A.17 – Buildings Exposed to Flood Risk on ECU Main Campus**

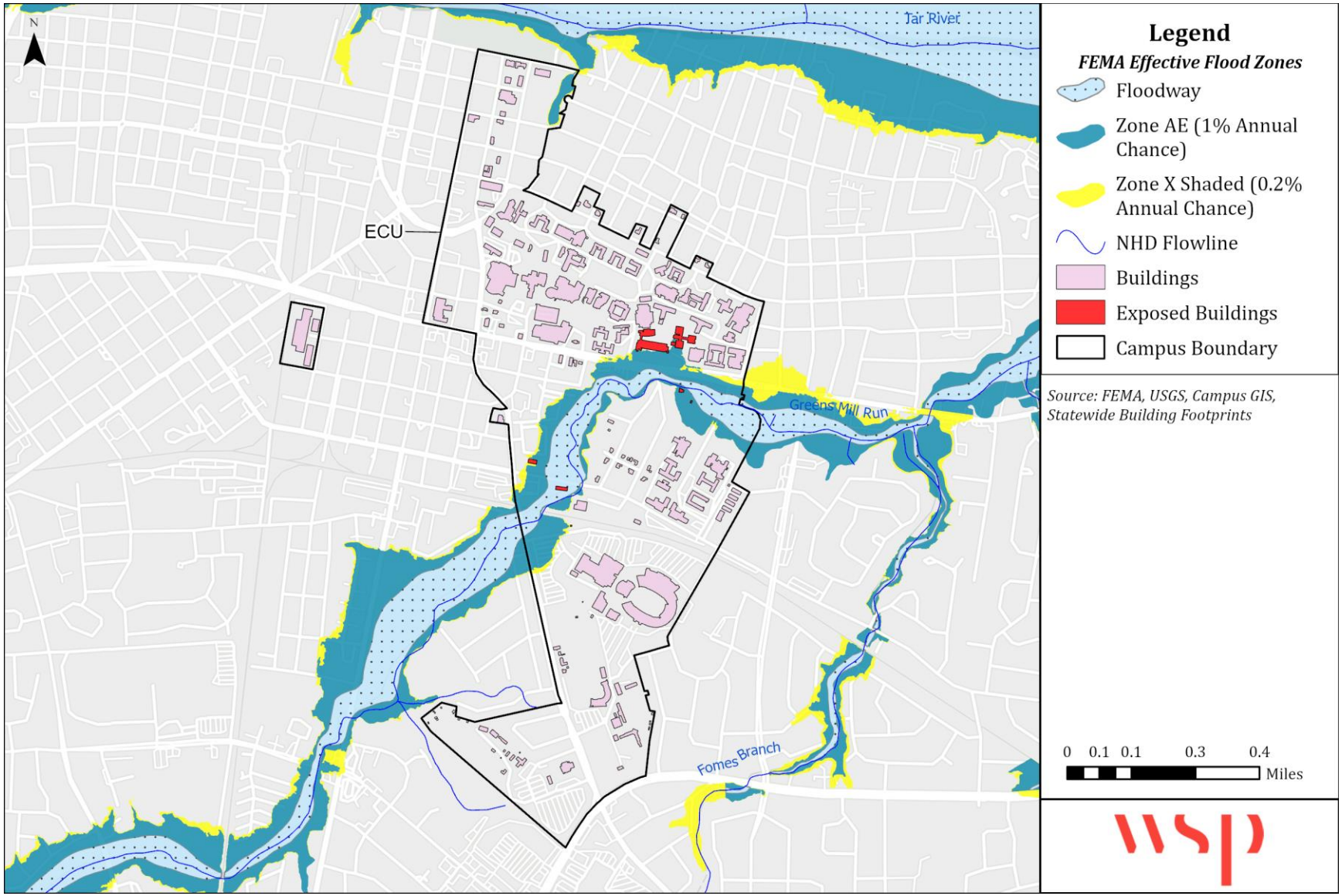
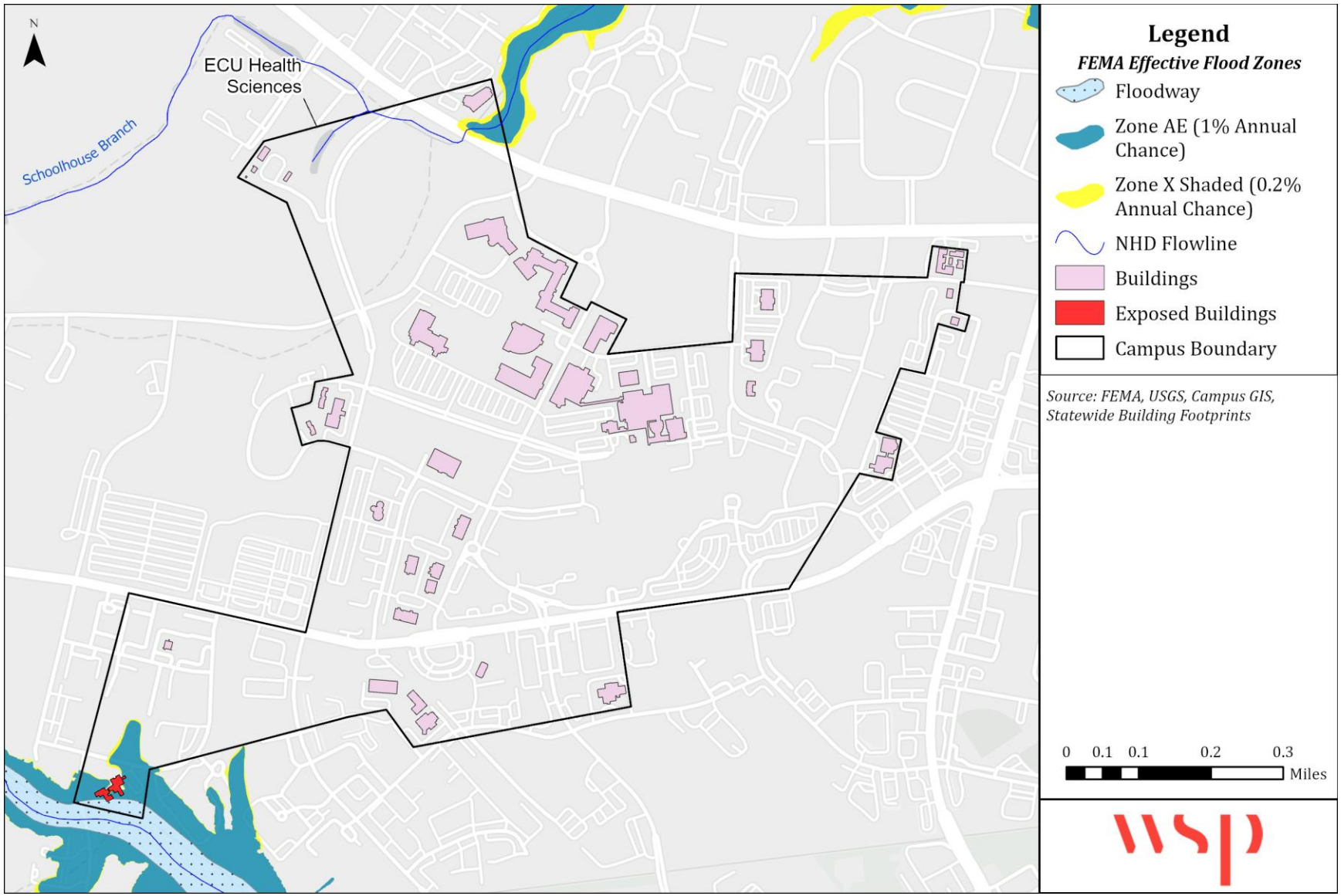


**Figure A.18 – Buildings Exposed to Flood Risk on ECU Health Sciences Campus**



## People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.

- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths in Greenville caused by flooding.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

Of the seven buildings in the iRisk inventory that intersect the SFHA, five have a first-floor elevation that is higher than the modeled 1% annual chance flood water surface elevation, so these structures are not expected to sustain losses. Two buildings, an educational/extracurricular building on main campus and an ECU Psychiatric Services building on the Health Sciences campus, are expected to sustain some damage from the 1% annual chance flood. These damage estimates are summarized in Table A.23.

**Table A.23 – Estimated Building Damage from a 1% Annual Chance Flood Event**

| Building | Occupancy | Estimated Structure Damage | Estimated Contents Damage | Estimated Damage Total |
|---|---|---|---|---|
| ECU Unknown | Educational/ Extracurricular | $7,443.41 | $60,291.61 | $67,735.02 |
| ECU Psychiatric Services | Administration | $9,808.28 | $0.00 | $9,808.28 |

None of the critical facilities identified for ECU are located within the 1%-annual-chance floodplain, therefore there is no estimated damage to critical facilities.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the ECU Facilities Services works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statements

- The 1%-annual-chance floodplain extends onto almost 12 percent of the ECU Main campus and less than 2% of the Health Sciences campus.
- There are no critical facilities within the SFHA; however, nine buildings on the ECU campus are impacted by the 1% annual chance floodplain and one of these buildings is located within the floodway.
- Nine buildings are located within the SFHA, of which two have a first-floor elevation below the base-flood elevation; these buildings are estimated to sustain over $77,000 in damage from the 1% annual chance flood event.
- Flooding is not limited to the SFHA. Localized flooding can still impact facilities, roadways, and other locations on campus.
- The College Hill parking lot and the North Campus recreation area often experience localized flooding.

## A.5.4 Hurricane & Coastal Hazards

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. Hurricane-related events can occur anywhere within Pitt County.

Storm surge is limited to the coastal counties of North Carolina. Although ECU's main campus and Health Sciences campus are not located on the coast, storm surge can propagate up the Tar River which is tidally influenced and is impacted by the storm surges of Category 4 and Category 5 hurricanes. Figure A.19 through Figure A.22 below shows the different storm surge extents related to ECU's campus for hurricane categories 2-5. The Category 1 storm surge is not shown because the extent of surge is not close enough to the campus boundary to be seen in the figure. Between 1% to 10% of the campus is inundated during a Category 5 storm surge event.

The HMPC noted that ECU's Outer Banks campus, which houses the Coastal Studies Institute, is more vulnerable to coastal hazards including storm surge. Figure A.23 through Figure A.27 show the potential impacts of storm surge by storm category on this satellite campus.

Hurricane winds can impact the entire campus, so the spatial extent of this hazard was determined to be large.

*Spatial Extent: 4 – Large*

**Figure A.19 -- Category 2 Storm Surge Inundation Areas, ECU**

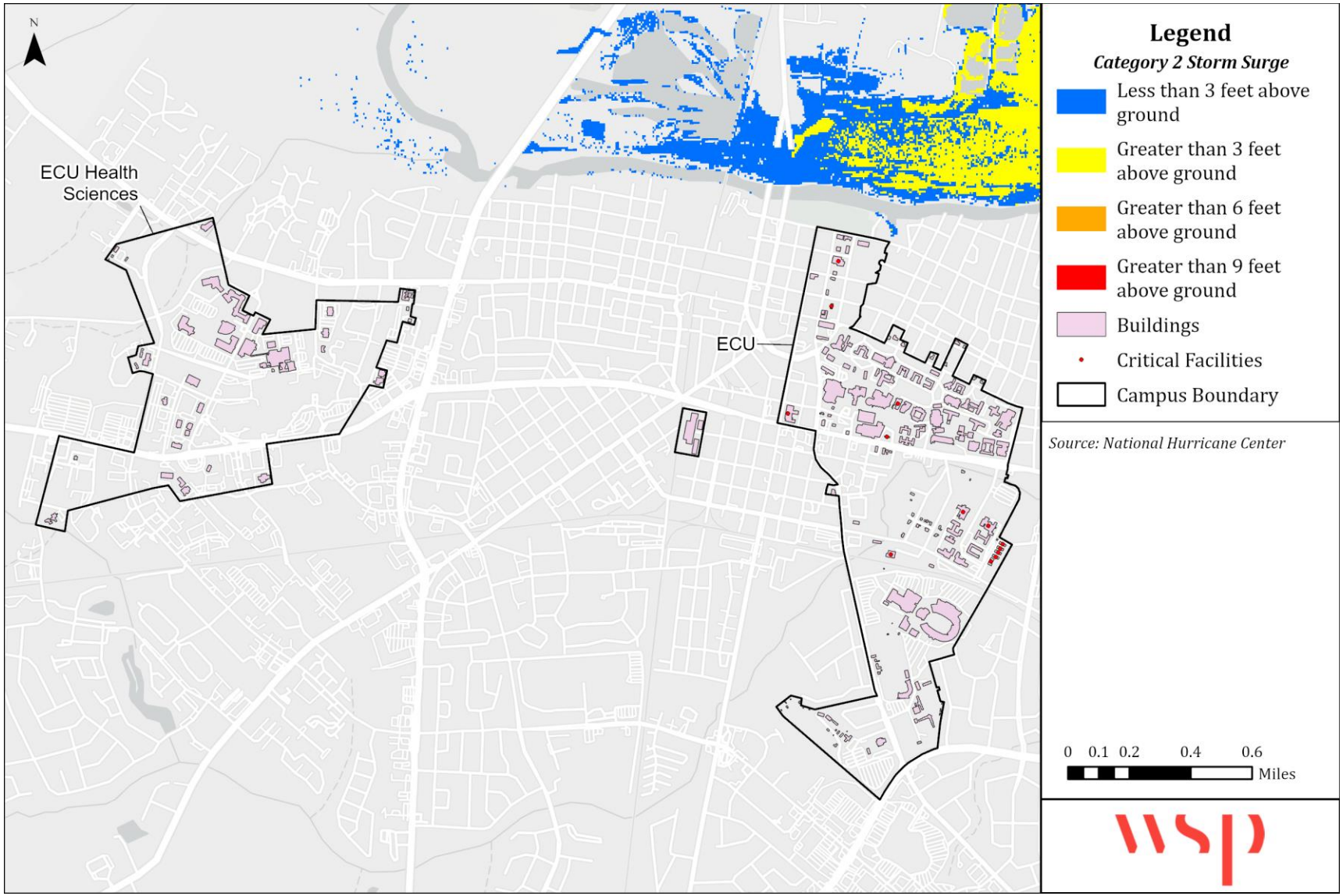


**Figure A.20 -- Category 3 Storm Surge Inundation Areas, ECU**

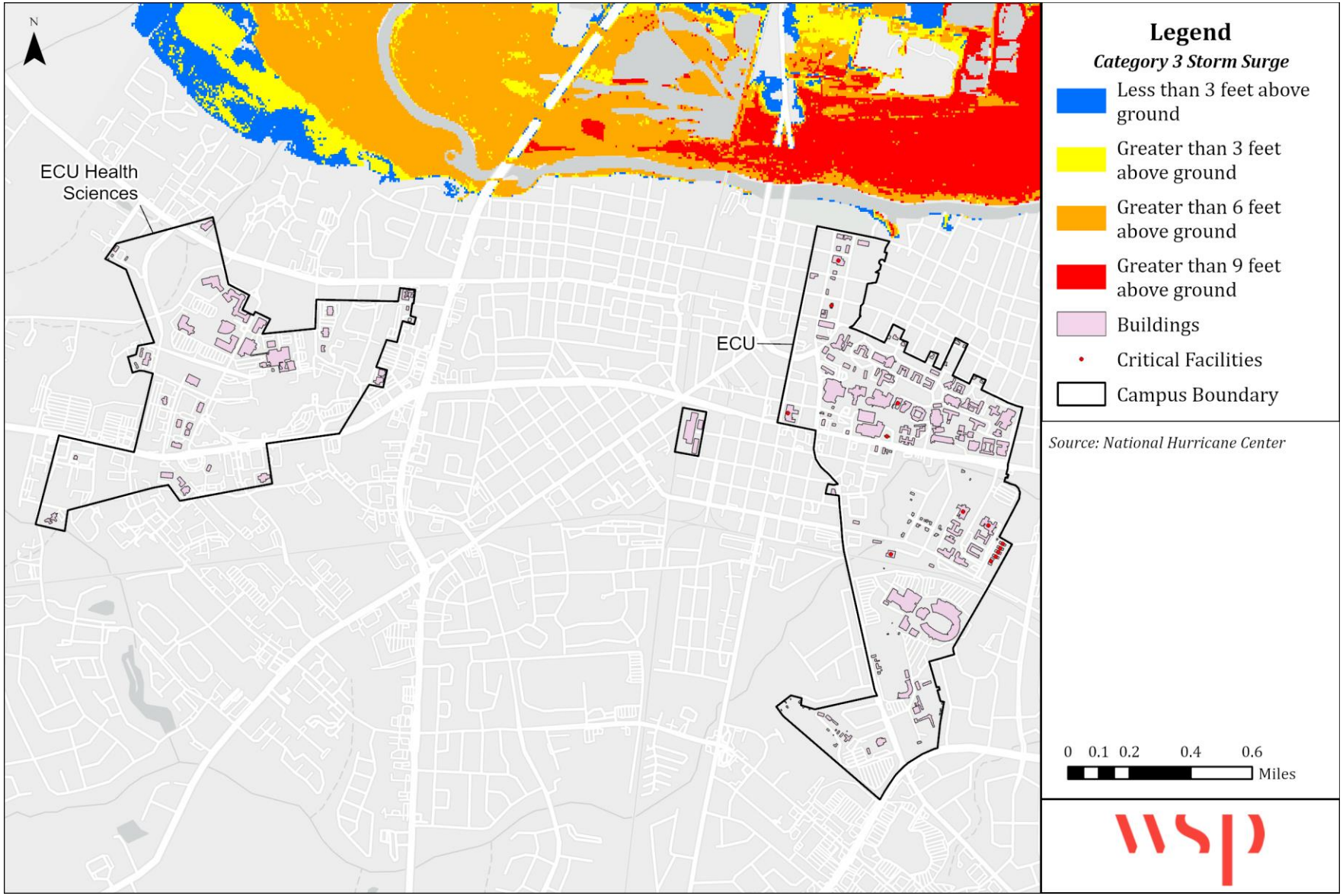


**Figure A.21 -- Category 4 Storm Surge Inundation Areas, ECU**

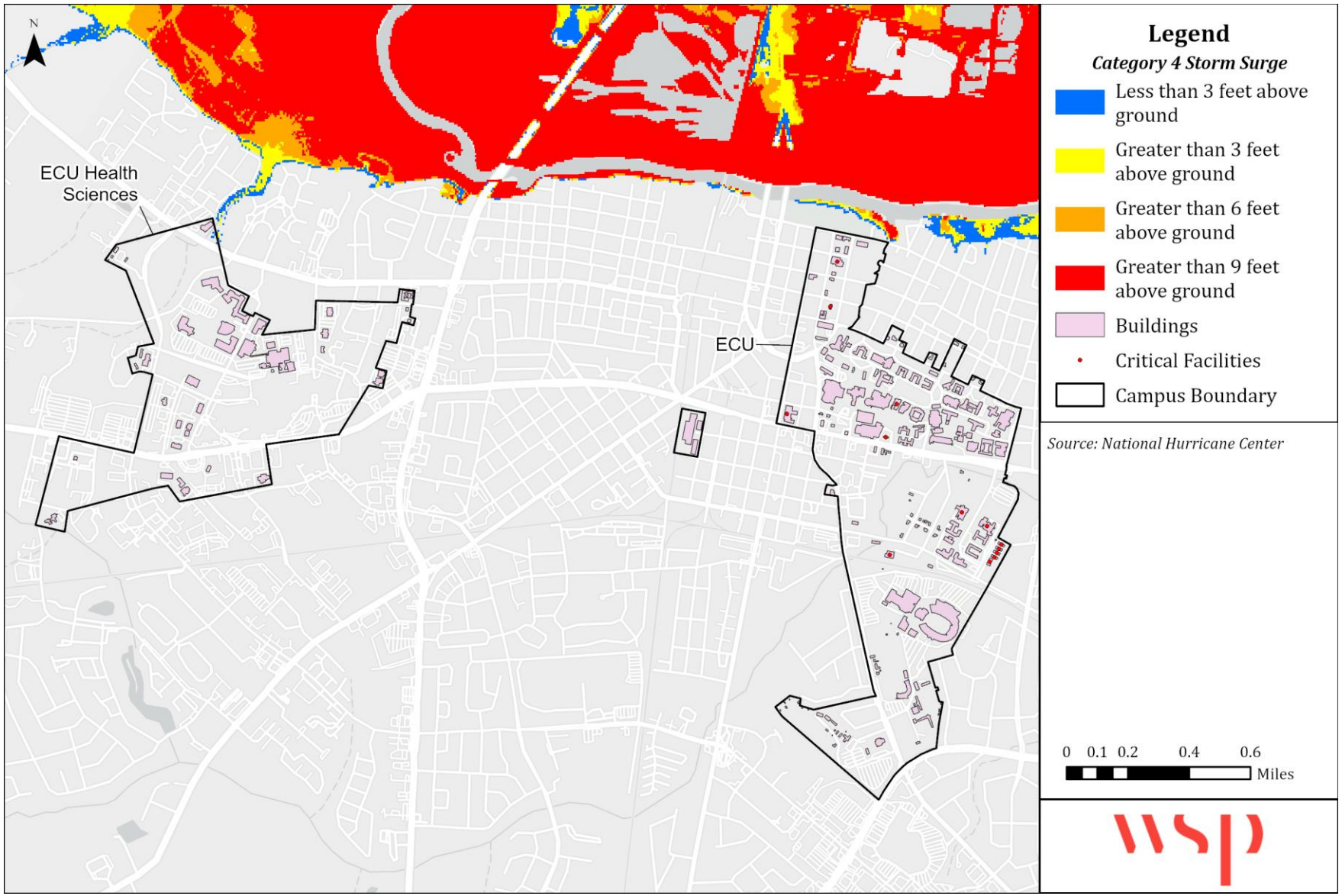


**Figure A.22 -- Category 5 Storm Surge Inundation Areas, ECU**

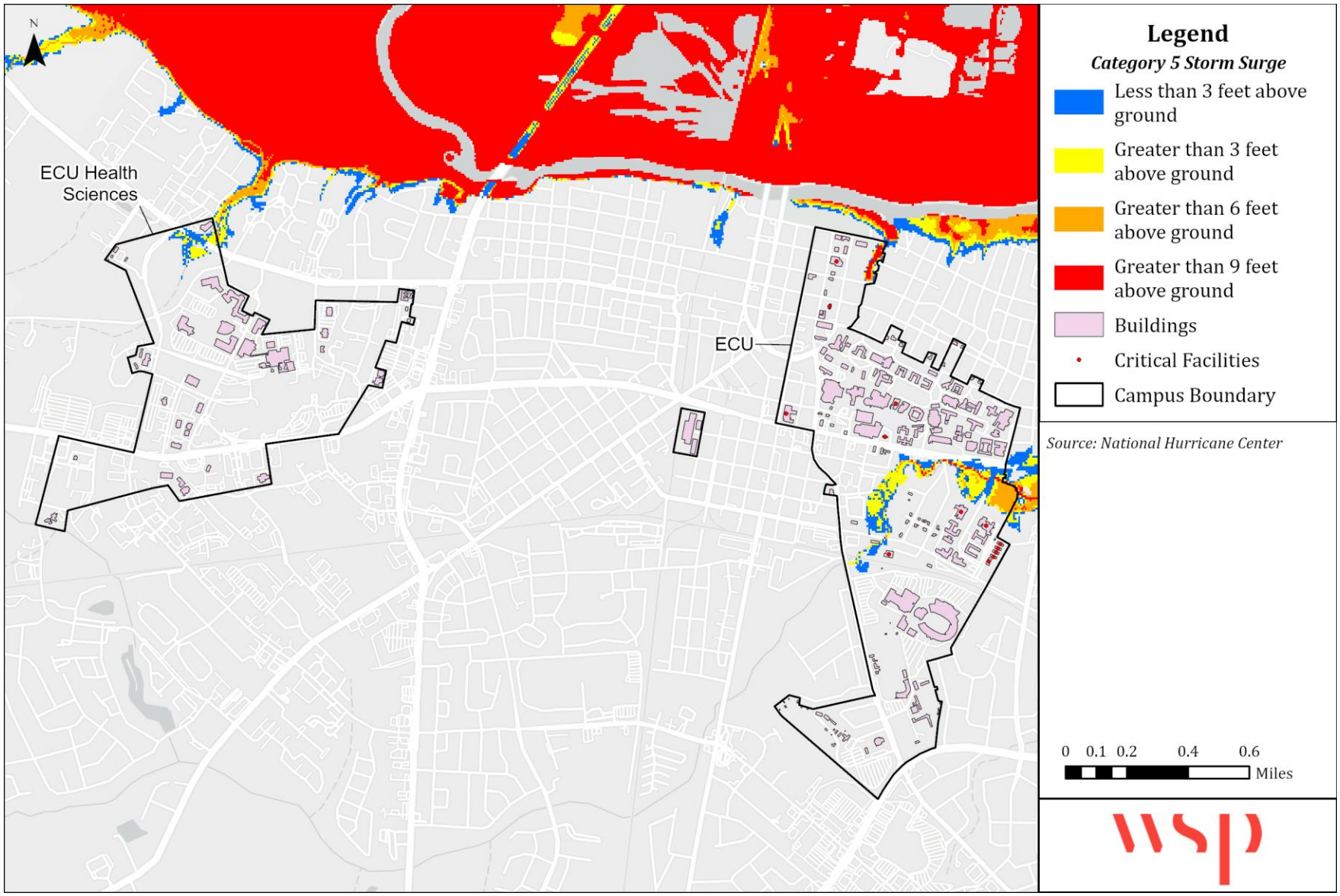


**Figure A.23 – Category 1 Storm Surge Inundation Areas, ECU OBX Campus**

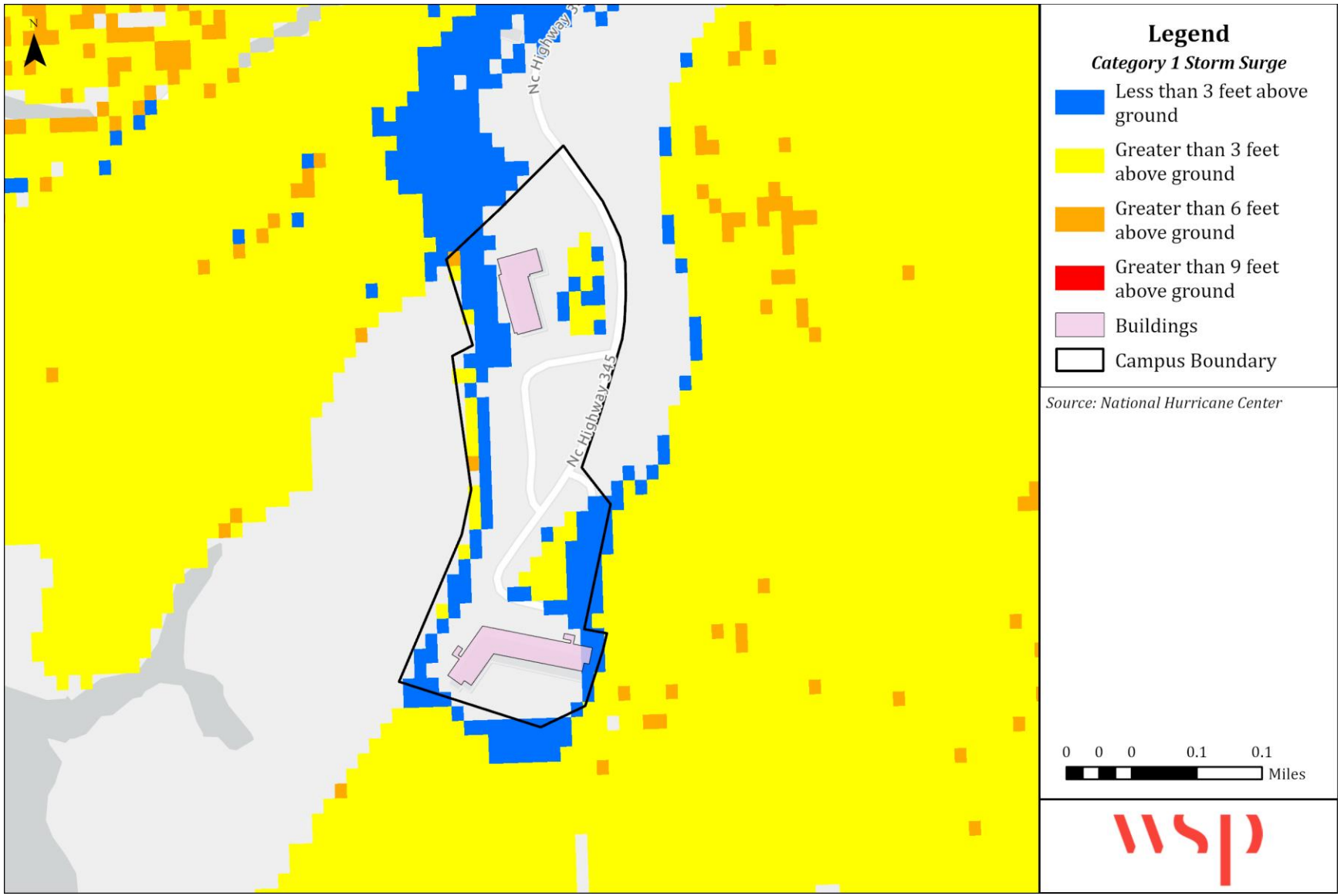


**Figure A.24 – Category 2 Storm Surge Inundation Areas, ECU OBX Campus**

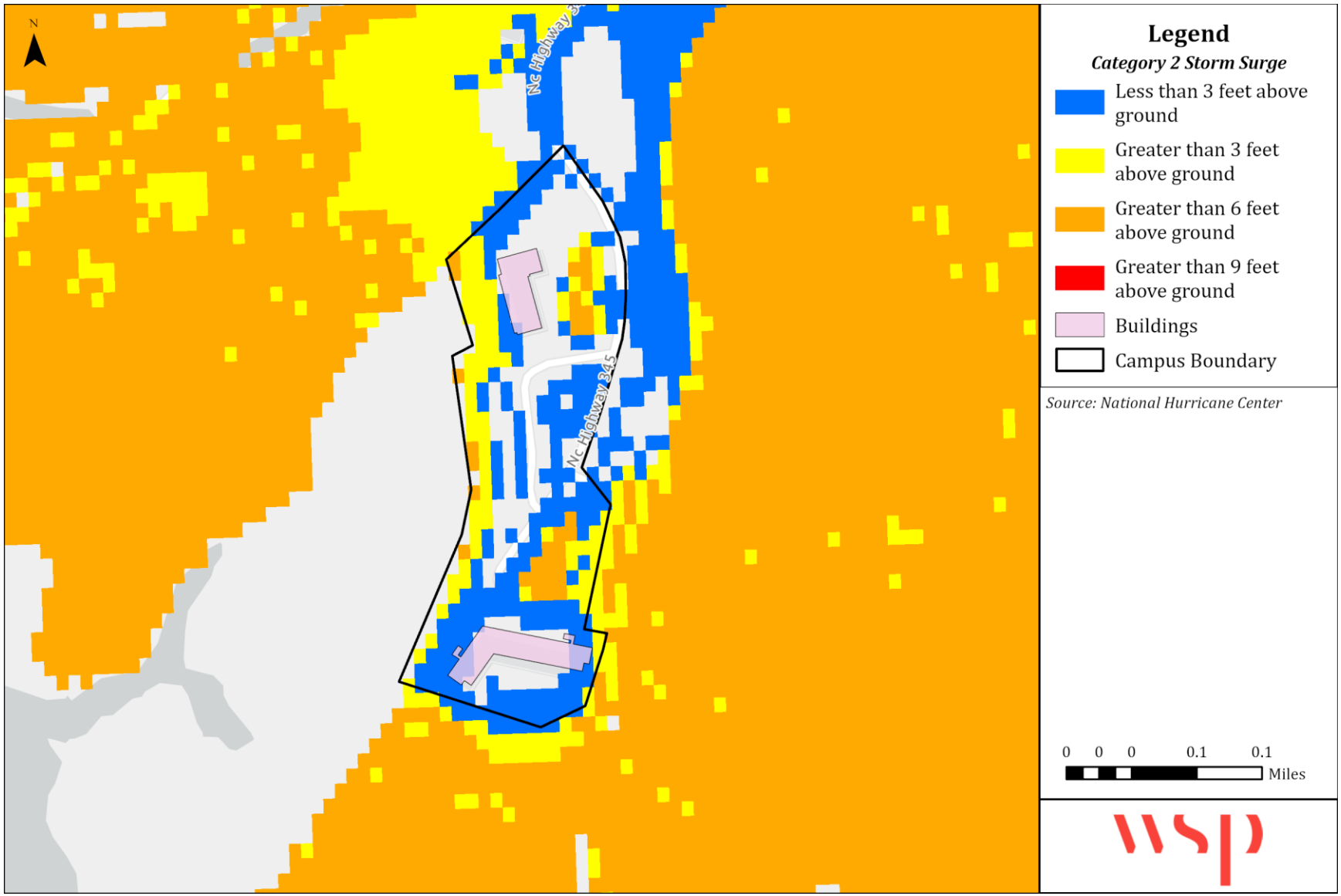


**Figure A.25 – Category 3 Storm Surge Inundation Areas, ECU OBX Campus**

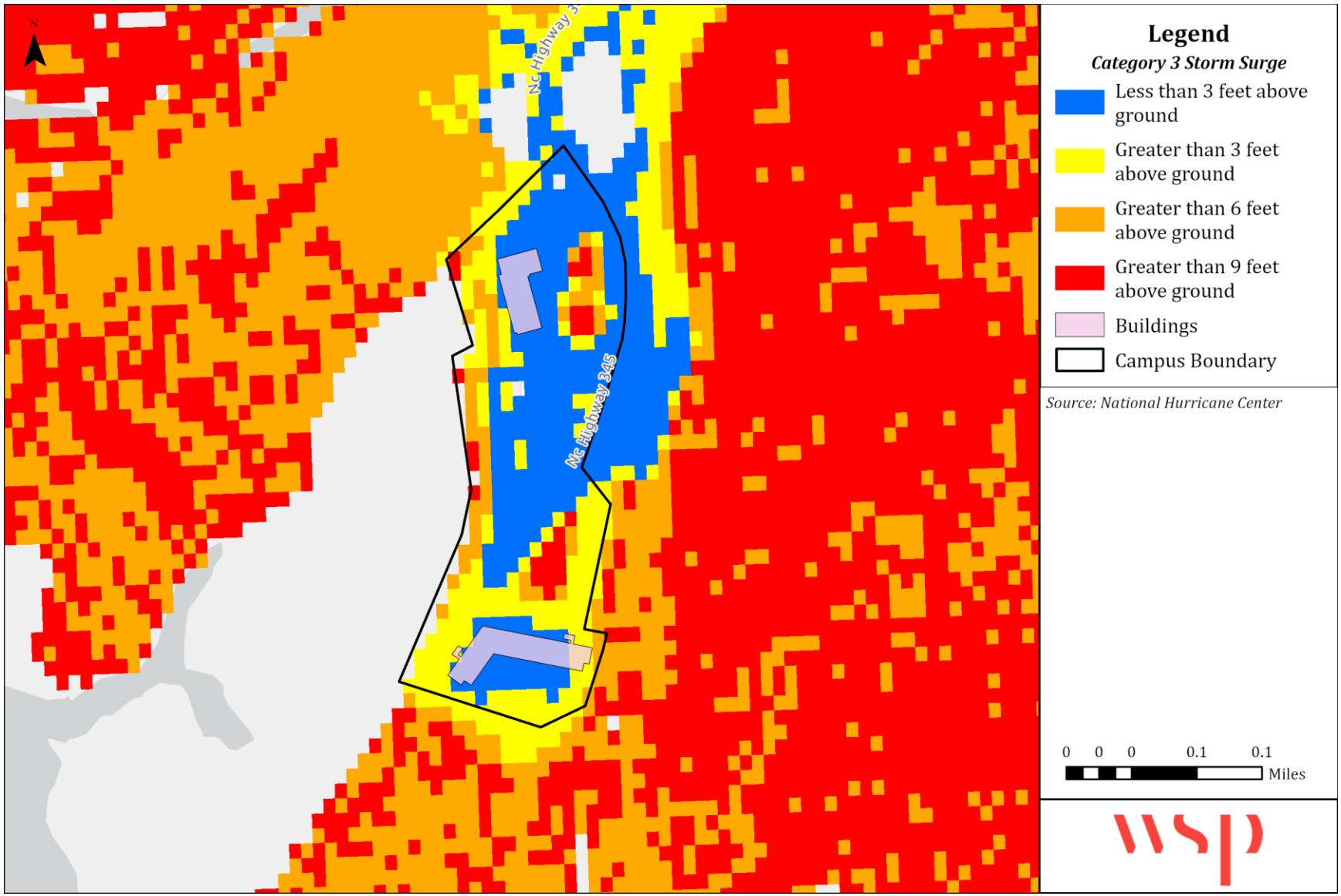


**Figure A.26 – Category 4 Storm Surge Inundation Areas, ECU OBX Campus**

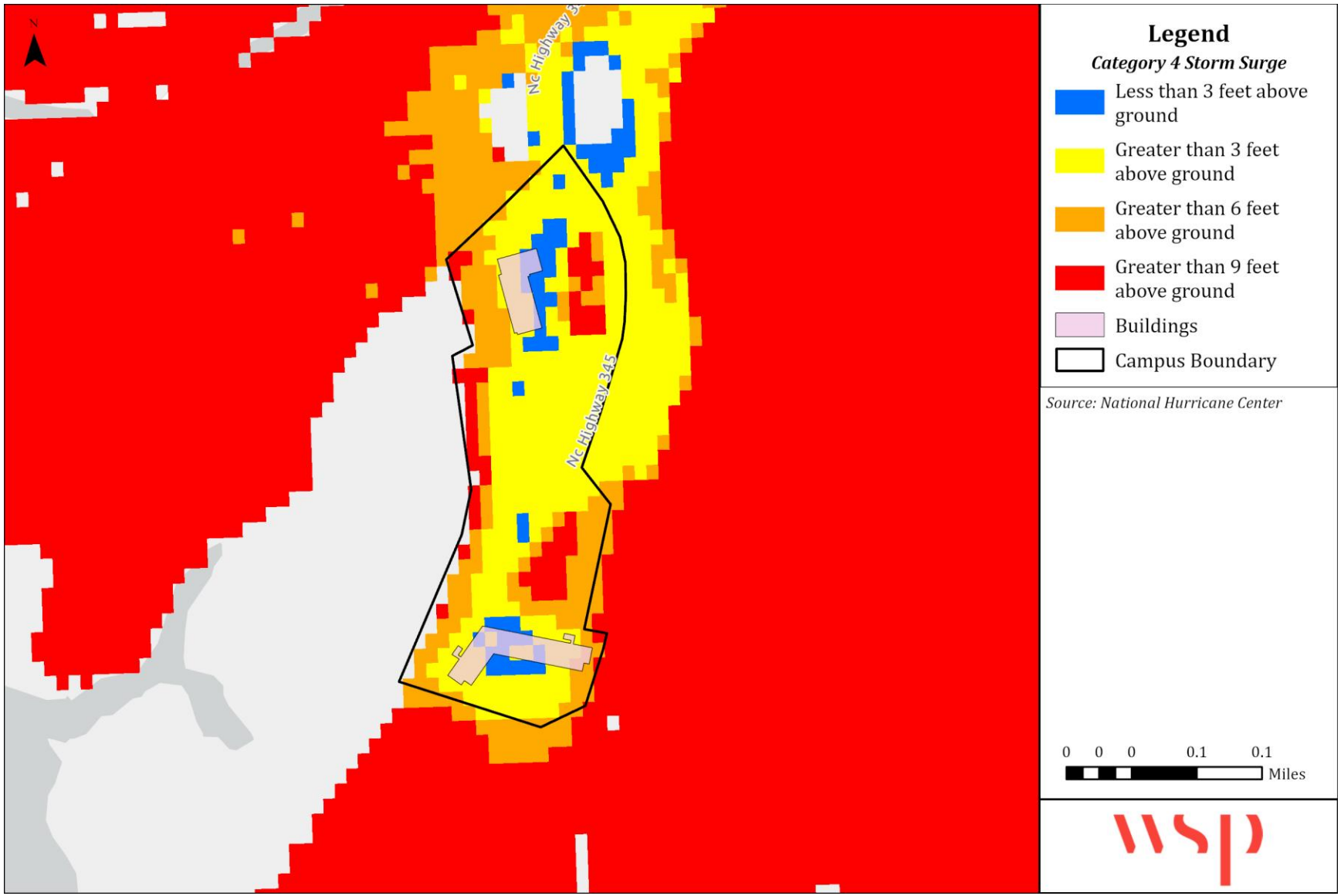
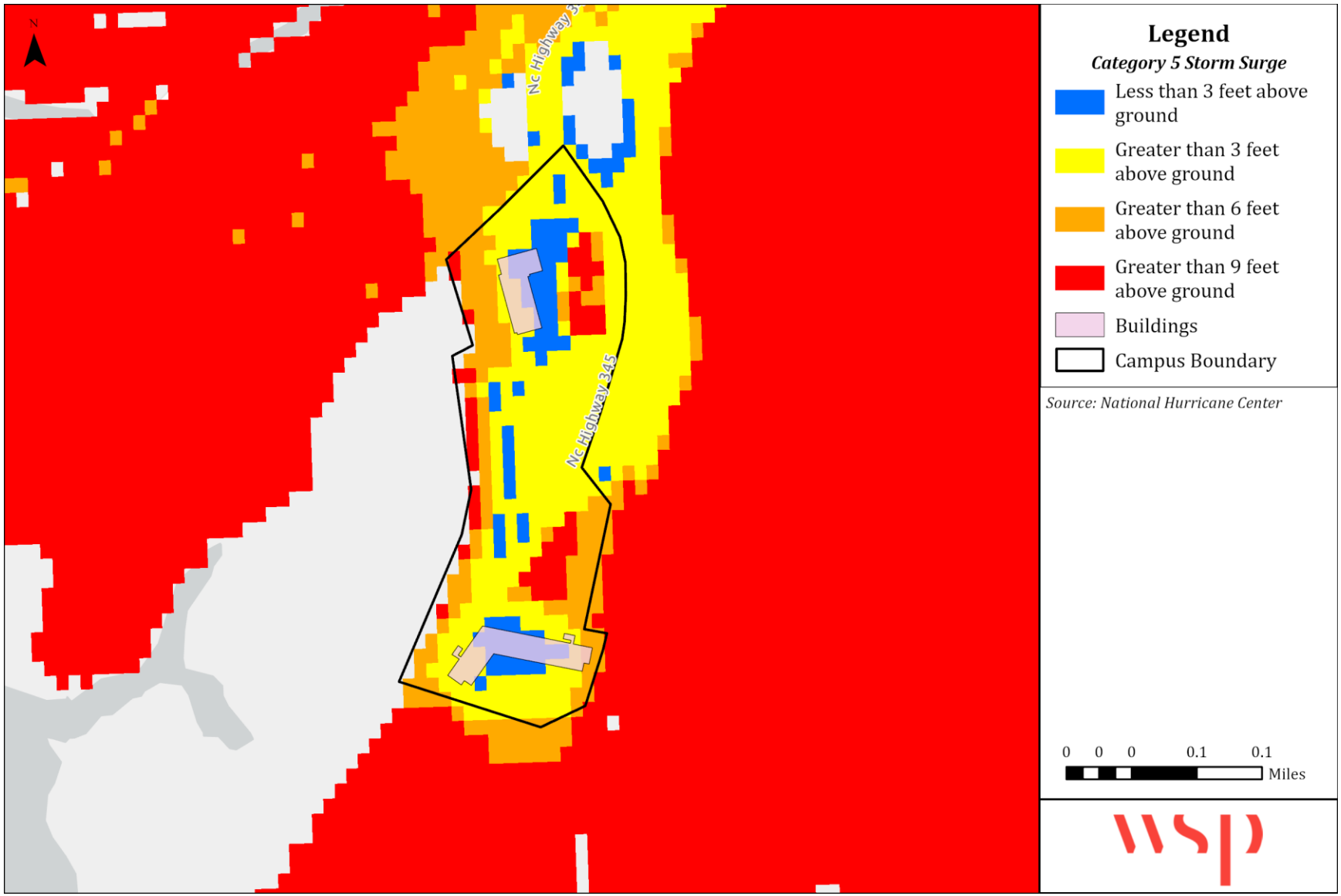


**Figure A.27 – Category 5 Storm Surge Inundation Areas, ECU OBX Campus**



## Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table A.24), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

### Table A.24– Saffir-Simpson Scale

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table A.25 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table A.25 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Pitt County may experience any category of hurricane force winds. Hurricane Bertha brought the most intense hurricane winds to pass directly through ECU's campus since 1900 on July 14, 1996 with wind speeds up to 65 mph.

*Impact: 4 – Catastrophic*

## Historical Occurrences

The NCEI database reports 10 tropical storms, tropical depression, and hurricane events occurring in Pitt County over 10 separate days between 2000 and 2024. In total, these events caused 3 deaths, 1 injury, approximately $12.2 in property damage, and $38 million in crop damage. Injuries, fatalities, property and crop damage from each of these events, as reported in NCEI, are summarized in Table A.26.

**Table A.26 – Recorded Hurricane and Tropical Storm Events for Pitt County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/17/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $2,000,000 | $0 |
| 8/14/2004 | Hurricane (Typhoon) | Hurricane Charley | 0/0 | $200,000 | $300,000 |
| 9/13/2005 | Hurricane (Typhoon) | Hurricane Ophelia | 0/0 | $0 | $0 |

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 8/31/2006 | Tropical Storm | Tropical Storm Ernesto | 0/0 | $25,000 | $0 |
| 9/5/2008 | Tropical Storm | Tropical Storm Hanna | 0/0 | $10,000 | $0 |
| 8/26/2011 | Tropical Storm | Hurricane Irene | 2/0 | $10,000,000 | $38,000,000 |
| 6/6/2013 | Tropical Storm | Tropical Storm Andrea | 0/0 | $0 | $0 |
| 10/8/2016 | Tropical Storm | Hurricane Matthew | 1/1 | $0 | $0 |
| 9/6/2019 | Tropical Storm | Hurricane Dorian | 0/0 | $0 | $0 |
| 8/4/2020 | Tropical Storm | Hurricane Isias | 0/0 | $0 | $0 |
| | | **Total** | **3/1** | **$12,235,000** | **$38,300,000** |

Source: NCEI

Events are summarized in following narratives and provide detail on select storms from the NCEI database:

- **September 6, 2008** – Tropical Storm Hannah resulted in winds of 50-60 mph resulted in minor wind damage across the county with some trees and power lines down and sporadic power outages.
- **August 28, 2011** – Hurricane Irene caused winds gusted near hurricane force resulting in minor to major structural damage to 2000 homes and businesses, mainly due to fallen trees. Agricultural losses were estimated at 38 million dollars from flooding and winds. Storm total rainfall was 7 to 13 inches with flooding of roads and low lying areas. Two direct deaths were reported from Hurricane Irene. One fatality was due to a tree falling on a house, and a second fatality resulted from a car that struck a tree.
- **June 7, 2013** - Tropical Storm Andrea moved across the area on the 7th with wind gusts up to 40 mph. This resulted in minor damage mainly to trees.
- **October 8, 2016** – Hurricane Matthew caused widespread heavy rain and strong winds across the region from the afternoon of October 8th through the morning of October 9th. Rainfall was generally 7 to 11 inches over the county with a storm total of 10.74 inches reported in Farmville. The heavy rainfall produced significant flash flooding with many roads washed out. One fatality occurred when a car drove into flood waters during the early morning hours of October 9th east of Greenville. Devastating river flooding developed along the Tar River days after the rainfall ended. The Tar River crested at 24.46 feet at Greenville in major flood well above the 13 foot flood stage. Many homes and businesses were flooded and damaged with numerous roads closed for days. Gusty north winds developed on the backside of Matthew with a peak wind gust of 59 mph recorded at the Greenville Airport at 745 pm on October 8th. The gusty winds combined with saturated ground led to many downed trees with widespread power outages.
- **September 6, 2019** – Hurricane Dorian caused 48 mph winds in Greenville at 5:35 AM EDT.
- **August 4, 2020** - Some tropical storm force wind gusts affected the area during the overnight and early morning hours due to Hurricane Isaias. A peak wind gust of 54 MPH was recorded at Greenville at 3:55 AM EDT.

According to the NOAA Historical Hurricane Tracks dataset, 31 hurricanes or tropical storms, passed within 25 miles of ECU since 1900. 3 of these events, occurring in 1964, 1965, and

1996, passed directly through ECU's campus. These events are listed in Table A.27, and storm tracks are mapped in Figure A.28.

**Table A.27 – Hurricane Tracks within 25 Miles of ECU, 1900-2024**

| Storm Name | Date | Storm Category |
|---|---|---|
| Unnamed | 6/15/1912 | Tropical Storm |
| Unnamed | 5/17/1916 | Tropical Storm |
| Unnamed | 9/7/1916 | Tropical Depression |
| Unnamed | 10/1/1924 | Tropical Storm |
| Unnamed | 9/20/1928 | Category 1 |
| Unnamed | 9/20/1928 | Category 1 |
| Unnamed | 9/26/1947 | Tropical Storm |
| Flossy | 9/28/1956 | Tropical Storm |
| Flossy | 9/28/1956 | Tropical Storm |
| Brenda | 7/31/1960 | Tropical Storm |
| Unnamed | 9/15/1961 | Tropical Storm |
| Unnamed* | 7/24/1964 | Tropical Depression |
| Isbell | 10/17/1964 | Tropical Storm |
| Unnamed* | 6/17/1965 | Tropical Storm |
| Unnamed | 6/19/1967 | Tropical Depression |
| Agnes | 6/22/1972 | Tropical Storm |
| Diana | 9/15/1984 | Tropical Storm |
| Bertha* | 7/14/1996 | Tropical Storm |
| Earl | 9/5/1998 | Tropical Storm |
| Dennis | 9/6/1999 | Tropical Storm |
| Floyd | 9/17/1999 | Category 1 |
| Helene | 9/24/2000 | Tropical Storm |
| Isabel | 9/19/2003 | Category 2 |
| Charley | 8/15/2004 | Tropical Storm |
| Alberto | 6/15/2006 | Tropical Storm |
| Ernesto | 9/2/2006 | Tropical Storm |
| Ana | 5/12/2015 | Tropical Depression |
| Julia | 9/22/2016 | Tropical Depression |
| Isaias | 8/5/2020 | Tropical Storm |
| Claudette | 6/22/2021 | Tropical Storm |
| Ophelia | 9/24/2023 | Tropical Storm |
| Unnamed | 6/15/1912 | Tropical Storm |
| Unnamed | 5/17/1916 | Tropical Storm |
| Unnamed | 9/7/1916 | Tropical Depression |
| Unnamed | 10/1/1924 | Tropical Storm |
| Unnamed | 9/20/1928 | Category 1 |
| Unnamed | 9/20/1928 | Category 1 |
| Unnamed | 9/26/1947 | Tropical Storm |
| Flossy | 9/28/1956 | Tropical Storm |
| Flossy | 9/28/1956 | Tropical Storm |
| Brenda | 7/31/1960 | Tropical Storm |
| Unnamed | 9/15/1961 | Tropical Storm |

| Storm Name | Date | Storm Category |
|---|---|---|
| Unnamed | 7/24/1964 | Tropical Depression |
| Isbell | 10/17/1964 | Tropical Storm |
| Unnamed | 6/17/1965 | Tropical Storm |
| Unnamed | 6/19/1967 | Tropical Depression |
| Agnes | 6/22/1972 | Tropical Storm |
| Diana | 9/15/1984 | Tropical Storm |
| Bertha | 7/14/1996* | Tropical Storm |
| Earl | 9/5/1998 | Tropical Storm |
| Dennis | 9/6/1999 | Tropical Storm |
| Floyd | 9/17/1999 | Category 1 |
| Helene | 9/24/2000 | Tropical Storm |
| Isabel | 9/19/2003 | Category 2 |
| Charley | 8/15/2004 | Tropical Storm |
| Alberto | 6/15/2006 | Tropical Storm |
| Ernesto | 9/2/2006 | Tropical Storm |
| Ana | 5/12/2015 | Tropical Depression |
| Julia | 9/22/2016 | Tropical Depression |
| Isaias | 8/5/2020 | Tropical Storm |
| Claudette | 6/22/2021 | Tropical Storm |
| Ophelia | 9/24/2023 | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

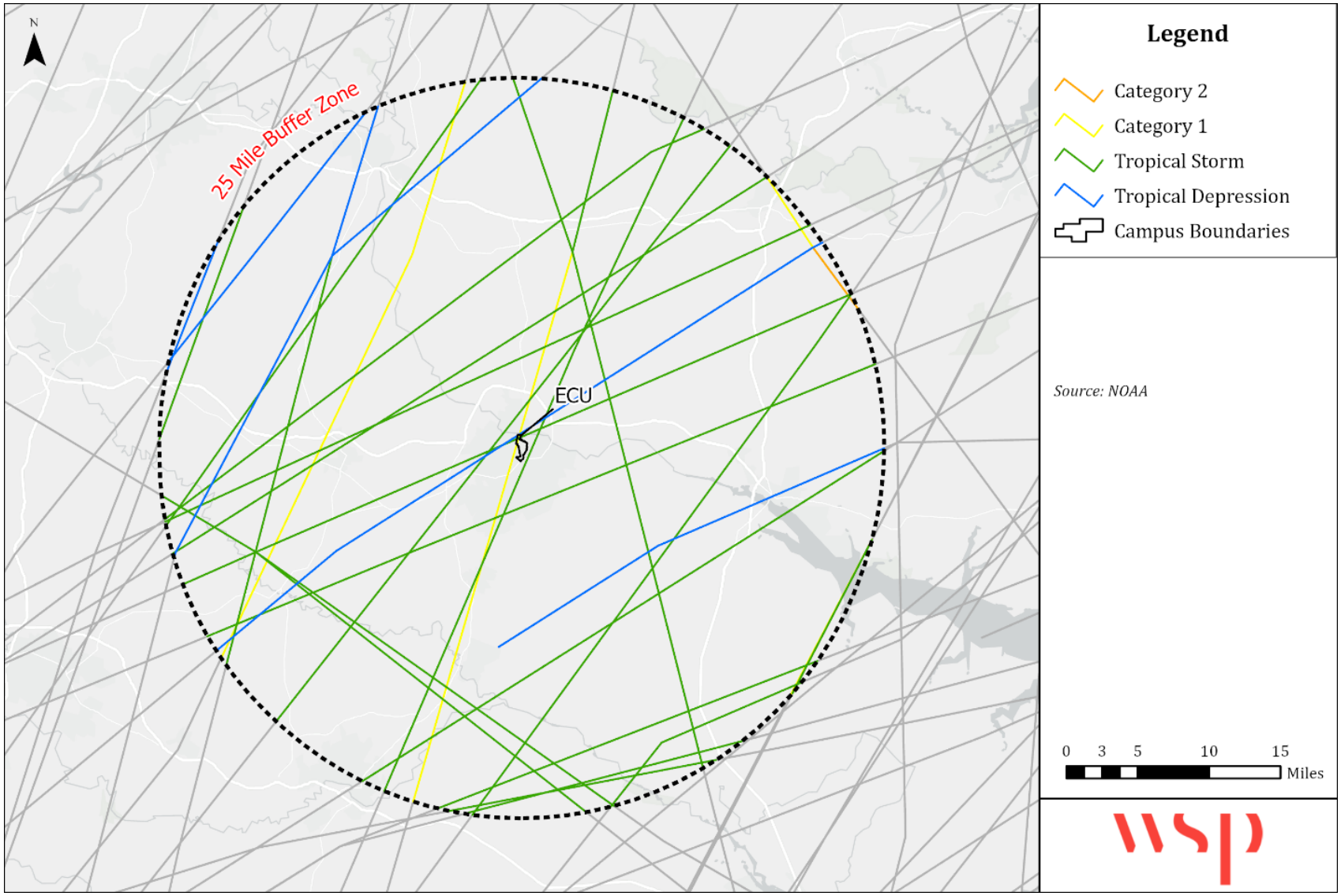
*Event passed directly through ECU's campus.

Pitt County has received 9 major disaster and 12 emergency declarations for hurricane and tropical storm events summarized in Table A.28.

**Table A.28 – Hurricane-Related Disaster Declarations & Emergency Declarations**

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 7/18/1996 | DR-1127-NC | Hurricane Bertha |
| 8/27/1998 | DR-1240-NC | Hurricane Bonnie |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina |
| 9/14/2005 | EM-3254-NC | Hurricane Ophelia |
| 9/1/2010 | EM-3314-NC | Hurricane Earl |
| 8/31/2011 | EM-3327-NC & DR-4019-NC | Hurricane Irene |
| 10/10/2016 | EM-3380-NC & DR-4285-NC | Hurricane Matthew |
| 9/10/2018 | EM-3401-NC& DR-4393-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC & DR-4465-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |
| 8/6/2024 | EM-3608-NC | Tropical Storm Debby |
| 9/26/2024 | EM-3617-NC | Hurricane Helene |

**Figure A.28 – Historic Hurricane and Tropical Storm Tracks 1900-2024**



## Probability of Future Occurrence

In a 25-year period from 2000 through 2024, 10 hurricanes and tropical storms have impacted Pitt County, which equates to a 40 percent annual probability of hurricane winds impacting the county. Overall, the probability of a hurricane or tropical storm impacting the county is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are only for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. On-campus students may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause over $2.9 million of estimated total building damage on ECU's main campus and over $14.4 million on the Health Sciences campus.

Table A.29 through Table A.30 detail the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table A.29 – Estimated Building Damage by Hurricane Winds, ECU Main Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $305,242.64 | $75,094.58 | $380,337.22 |
| Educational | $1,595,987.21 | $279,875.08 | $1,875,862.29 |
| Housing | $564,563.35 | $105,135.23 | $669,698.58 |
| **Total** | **$2,465,793.20** | **$460,104.89** | **$2,925,898.09** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **300-Year Hurricane Wind Event** | | | |
| Administration | $3,314,876.28 | $1,502,432.67 | $4,817,308.95 |
| Educational | $13,550,733.48 | $5,311,715.87 | $18,862,449.35 |
| Housing | $5,446,048.09 | $2,091,409.91 | $7,537,458.00 |
| **Total** | **$22,311,657.85** | **$8,905,558.45** | **$31,217,216.30** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $7,240,620.07 | $3,631,273.40 | $10,871,893.47 |
| Educational | $29,742,757.88 | $13,599,569.25 | $43,342,327.13 |
| Housing | $11,705,263.67 | $5,287,491.79 | $16,992,755.46 |
| **Total** | **$48,688,641.62** | **$22,518,334.44** | **$71,206,976.06** |

Source: NCEM iRISK Database

**Table A.30 – Estimated Building Damage by Hurricane Winds, ECU Health Sciences Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $7,458,229.96 | $4,332,606.21 | $11,790,836.17 |
| Educational | $2,042,400.82 | $652,993.50 | $2,695,394.32 |
| **Total** | **$9,500,630.78** | **$4,985,599.71** | **$14,486,230.49** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $96,907,375.36 | $105,458,387.19 | $202,365,762.55 |
| Educational | $7,560,203.14 | $3,629,355.54 | $11,189,558.68 |
| **Total** | **$104,467,578.50** | **$109,087,742.73** | **$213,555,321.23** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $96,907,375.36 | $105,458,387.19 | $202,365,762.55 |
| Educational | $7,560,203.14 | $3,629,355.54 | $11,189,558.68 |
| **Total** | **$104,467,578.50** | **$109,087,742.73** | **$213,555,321.23** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering, and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statements

- Historical tracks of multiple hurricane events pass within 25 miles of the ECU Campus.
- For the 25-year period from 2000 through 2024, there have been 10 hurricane events causing over $12.2 million dollars in damage for Pitt County.
- The 100-year hurricane wind event could cause an estimated $17.4 million in property damage to ECU's campus.

## A.5.5 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Pitt County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI) shown in Table A.31 for the Pitt County area, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in higher severity. The county may experience any level on the RSI scale. Pitt County receives an average of 2 to 4 inches of snowfall per year. According to NCEI, the greatest snowfall amounts to impact Pitt County have been between 7-10 inches on December 26, 2010. During this snowstorm, the County was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

**Table A.31 – Regional Snowfall Index (RSI) Values**

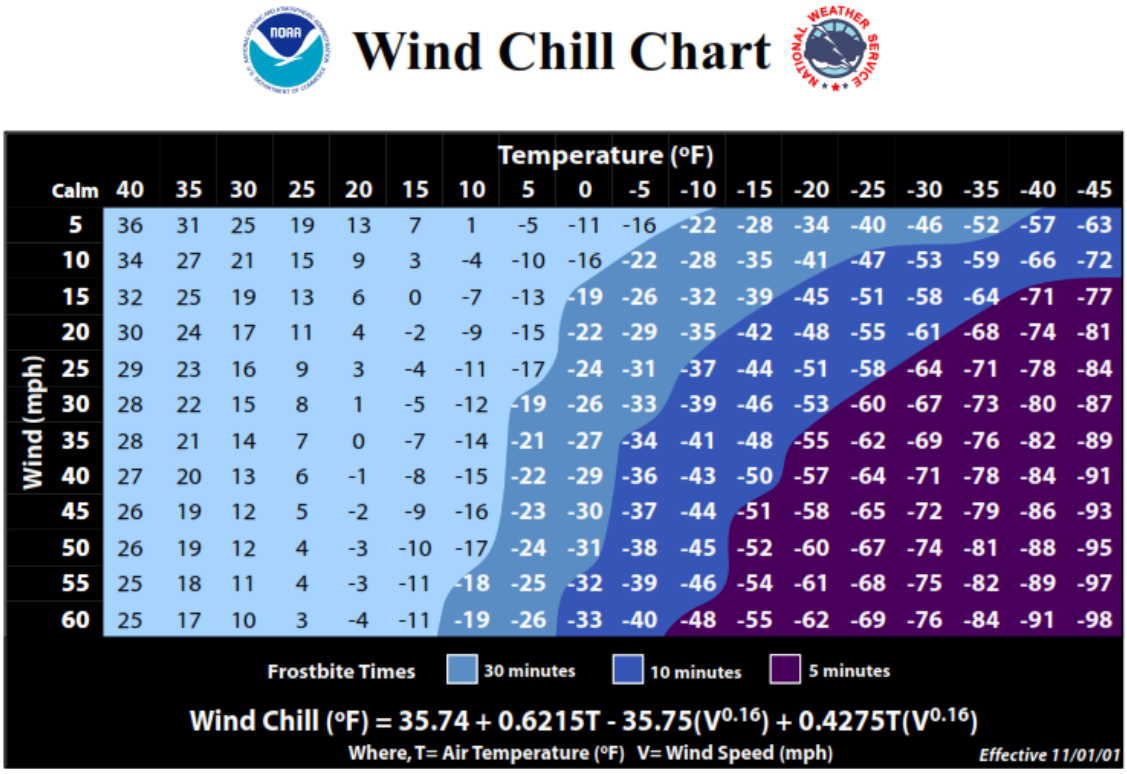
| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure A.29, provides a formula for calculating the dangers of

winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure A.29 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Pitt County took place February 18th, 1896, with a recorded depth of 13 inches of snow occurring in the City of Greenville.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.

- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24 hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one frost/freeze event, five heavy snow events, one ice storm, and 21 combined winter storm/winter weather events in Pitt County during the 25-year period from 2000 through 2024. These events caused two injuries. There were not any reported fatalities, property damage, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Pitt County by type are recorded in Table A.32.

**Table A.32 – Recorded Severe Winter Weather Events in Pitt County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Frost/Freeze | 1 | 0 | 0 | $0 | $0 |
| Heavy Snow | 5 | 0 | 0 | $0 | $0 |
| Ice Storm | 1 | 0 | 0 | $0 | $0 |
| Winter Storm | 12 | 0 | 2 | $0 | $0 |
| Winter Weather | 9 | 0 | 0 | $0 | $0 |
| **Total** | **28** | **0** | **2** | **0** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **January 2, 2002** – The coastal plain of North Carolina experienced winter weather on January 2nd and again on the 3rd. Snow, sleet and freezing rain blanketed inland areas with one to two inches of accumulation late on January 2nd. Gusty winds of 20 mph on the morning of the 3rd caused numerous trees and power lines to fall causing minor damage and numerous power outages. A second snow event began on the evening of the 3rd and dropped anywhere from 4 to 8 inches of snow across the region. Snowfall rates of over 2 inches per hour were observed in many locations. Two injuries occurred in a head-on collision between two vehicles in Pitt County due to ice-covered roads.
- **December 26, 2010** – Widespread snow developed during the early morning hours and continued into the afternoon. Total snowfall amounts across the county were in the 7 to 10 inch range.
- **January 28, 2014** – Snow began during the afternoon of January 28th and continued into the early morning hours of January 29th. The snow mixed with sleet and freezing rain at times. Total snow accumulations were 3 to 6 inches across the county. Roads were icy for several days during and after the event.
- **January 17, 2018** – Widespread snow developed during the evening of January 17th and continued through the early morning of January 18th. Snowfall across the county ranged from ½ to 1 inch. Many roads were snow and ice covered with hazardous travel conditions.
- **January 21, 2022** – A wintry mix of freezing rain and sleet changed over to all snow in the evening, with a period of snow throughout the overnight ending before daybreak. Sleet covered the ground in many spots before the transition to all snow late in the evening. Snowfall ranged from 3 to 6 inches throughout the county. Specific totals included 6 inches near Falkland, 5 inches in Fountain, and between 3 and 4 inches in Greenville and Winterville. Many roads remained snow covered through early to mid-morning.

Pitt County received two FEMA Major Disaster Declarations for a severe ice storm in 1968 and a blizzard in 1996.

## Probability of Future Occurrence

NCEI records 28 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $578,295, which assumes that 10% of the student population is impacted.

**Table A.33 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 27,153 | 2,715 | $578,295 |

### Property

No property damage was reported in association with any winter weather events recorded by the NCEI between 2000 and 2024 for Pitt County. Therefore, no annualized loss estimate could be calculated for this hazard.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. ECU may wish to consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statements

- Severe winter weather events are highly likely for Pitt County and the ECU campus. The events have also resulted in two presidential disaster declarations for the county.

# A.5.6 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Thunderstorm wind, lightning, hail, and tornado events do not have a defined vulnerability zone. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damage is more likely to occur where exposure is greater in more densely developed urban areas. All of ECU is exposed to tornadoes and thunderstorms. Overall, due to the small size of the planning area, any given event will likely impact most, if not all, of the planning area, so the spatial extent of a tornado or thunderstorm event is considered large.

*Spatial Extent: 4 – Large*

### TORNADOES

Tornados can occur anywhere on ECU's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado is not increased in one area of the campus versus another.

### THUNDERSTORM WINDS

The entirety of ECU's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is a highly localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADOES

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28)

and associated degrees of damage, allowing for more detailed analysis, better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado.

**Table A.34 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

Source: NWS Storm Prediction Center

The most intense tornado to pass through Pitt County since 1950 occurred on March 28, 1984. The F4 tornado killed 9 people, injured 153 people, and resulted in $25 million in crop damage.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, and Thunderstorm Wind, which were evaluated for this assessment. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Greenville occurred on July 1, 2012 with a measured gust of 75 mph. The associated storm caused numerous downed trees and damage to structures across eastern North Carolina.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity on a specific categorical scale. The LAL, shown in Table A.35, is a common parameter that is part of fire weather forecasts nationwide.

**Table A.35– Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

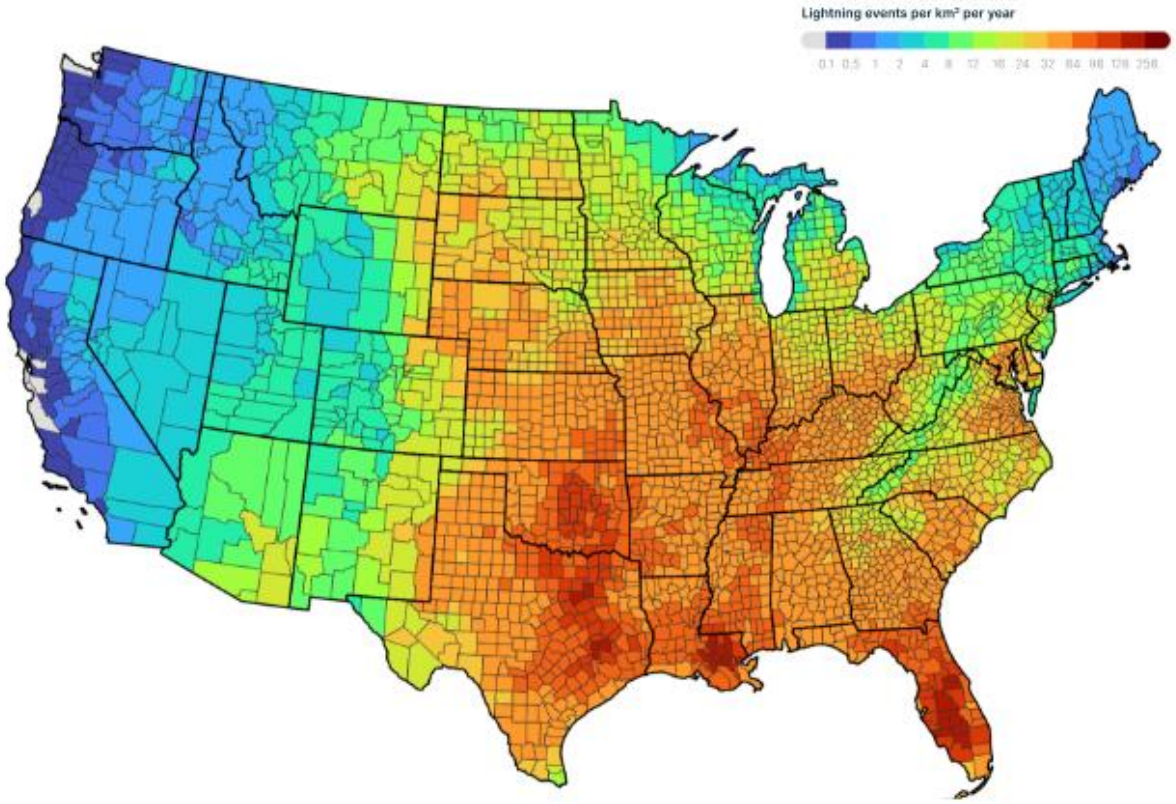
Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption to quality of life.

*Impact: 1 – Minor*

According to the Vaisala flash density map, shown in Figure A.30, Pitt County experiences between 16 to 24 lightning flashes per kilometer per year. It should be noted that future lightning occurrences may exceed these figures.

**Figure A.30 – Lightning Density in the U.S. (2024)**




## HAIL

The NWS classifies hail by diameter and uses corresponding everyday objects to help relay scope and severity to the population. Table A.36 lists the NWS hailstone measurements.

**Table A.36– Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table A.37 describes typical intensity and damage impacts of the various sizes of hail.

**Table A.37 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls damaged |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Greenville was a little over 1" in diameter; the largest hailstones recorded in Greenville were 1.75", recorded on June 6, 2006, March 28, 2007, April 20, 2009, and August 29, 2011.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Pitt County experienced 33 tornadoes between 1950 and 2024, causing 9 deaths, 164 injuries, and approximately $30 million in property damage. There was no crop damage. Table A.38 documents historical

tornadoes in Pitt County during this period, and Figure A.31 shows tornado paths within 10 miles of Greenville.

**Table A.38 – Recorded Tornadoes in Pitt County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 5/12/1950 | 1400 | F1 | 0 | 0 | $25,000 |
| - | 5/31/1950 | 1530 | F1 | 0 | 0 | $2,500 |
| - | 7/26/1950 | 1530 | F1 | 0 | 0 | $0 |
| - | 4/16/1953 | 1100 | F2 | 0 | 0 | $25,000 |
| - | 6/11/1955 | 1500 | F2 | 0 | 0 | $250,000 |
| - | 3/18/1956 | 1330 | F1 | 0 | 0 | $2,500 |
| - | 6/4/1959 | 1500 | F1 | 0 | 0 | $25,000 |
| - | 8/31/1964 | 1500 | F1 | 0 | 2 | $250,000 |
| - | 5/15/1972 | 1958 | F3 | 0 | 2 | $2,500,000 |
| - | 5/29/1973 | 1330 | F0 | 0 | 0 | $25,000 |
| - | 2/23/1980 | 1700 | F0 | 0 | 0 | $0 |
| - | 3/28/1984 | 2020 | F4 | 9 | 153 | $25,000,000 |
| Greenville | 4/15/1996 | 1610 | F1 | 0 | 0 | $25,000 |
| Greenville | 4/15/1996 | 1610 | F0 | 0 | 0 | $25,000 |
| Farmville | 4/11/1999 | 1508 | F0 | 0 | 0 | $0 |
| Greenville | 9/15/1999 | 1440 | F0 | 0 | 0 | $0 |
| Falkland | 10/11/2002 | 1215 | F1 | 0 | 0 | $10,000 |
| Ayden | 7/2/2003 | 2030 | F0 | 0 | 0 | $3,000 |
| Stokes | 11/19/2003 | 1410 | F0 | 0 | 0 | $5,000 |
| Greenville | 6/4/2004 | 1309 | F0 | 0 | 0 | $0 |
| Stokes | 6/4/2004 | 1315 | F0 | 0 | 0 | $0 |
| Farmville | 6/11/2004 | 2143 | F0 | 0 | 0 | $0 |
| Winterville | 8/14/2004 | 1500 | F0 | 0 | 0 | $10,000 |
| Bethel | 5/14/2006 | 1925 | F0 | 0 | 0 | $0 |
| Pactolus | 2/18/2008 | 430 | EF1 | 0 | 0 | $50,000 |
| Farmville | 4/12/2008 | 1459 | EF0 | 0 | 0 | $0 |
| Farmville arpt | 9/26/2008 | 0 | EF0 | 0 | 0 | $2,000 |
| Cannon xrds | 3/27/2009 | 1705 | EF1 | 0 | 0 | $200,000 |
| Shelmerdine | 5/5/2009 | 1630 | EF0 | 0 | 0 | $10,000 |
| Marlboro | 4/16/2011 | 1659 | EF1 | 0 | 5 | $1,000,000 |
| Arthur | 4/25/2014 | 1618 | EF0 | 0 | 0 | $0 |
| Shelmerdine | 4/25/2014 | 1822 | EF2 | 0 | 0 | $600,000 |
| Whitehurst | 6/5/2017 | 1825 | EF1 | 0 | 0 | $0 |
| | | | **Total** | **9** | **162** | **$30,045,000** |

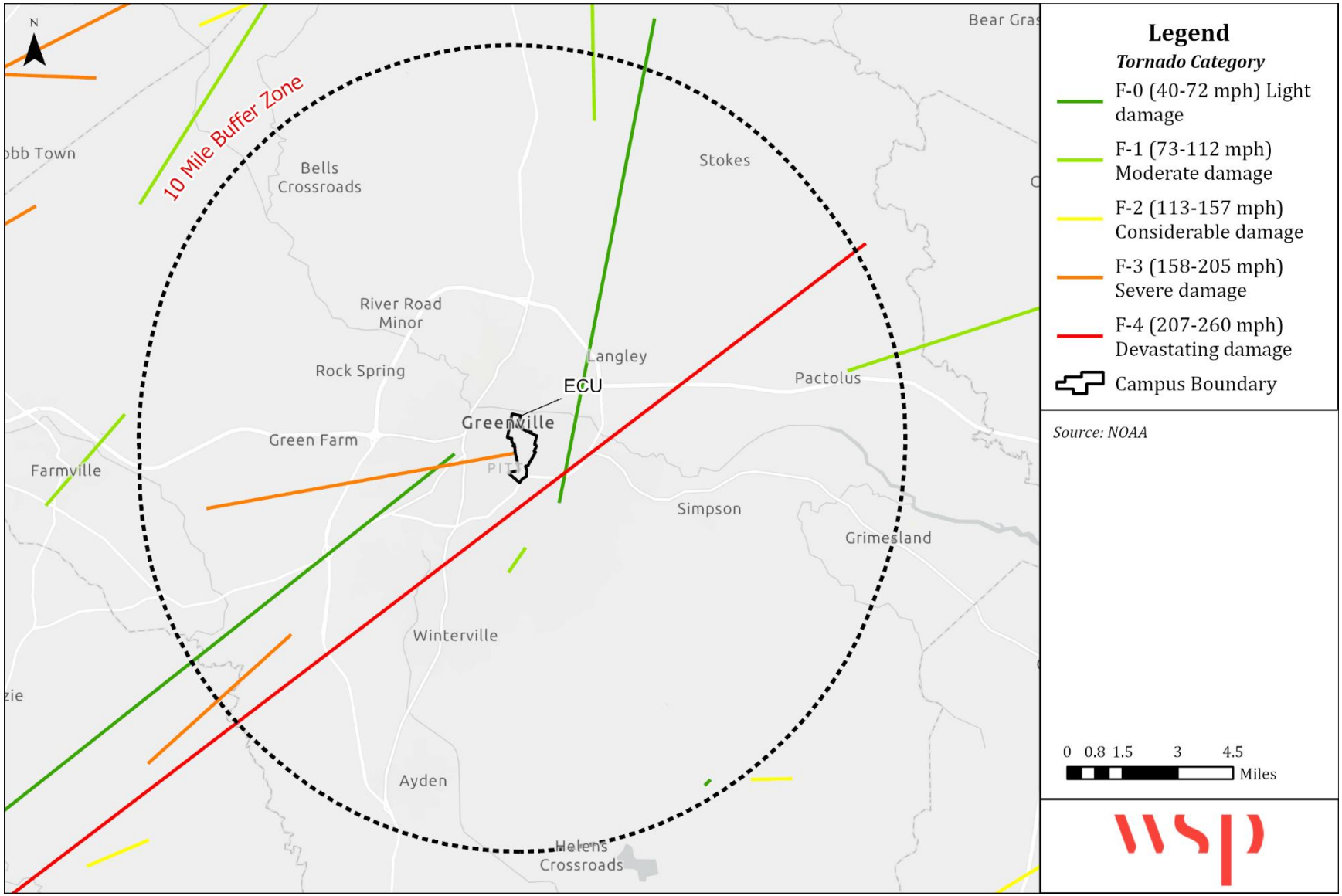
Source: NCEI

Specific incidents with significant impact include:

- **May 15, 1972** – F3 tornado moved eastward from Bell Arthur through Red Oak section south of Greenville. Sixteen homes and a church were demolished, and many more homes were damaged. Several mobile homes were demolished, farm, buildings, equipment, and vehicles destroyed or damaged. It also resulted in 2 injuries.

- **March 28, 1984** – The most destructive tornado outbreak to sweep through the Carolinas since the 1884 Enigma Outbreak occurred during the afternoon and evening hours of March 28, 1984. The deadliest tornado of the entire outbreak occurred in Greene and Pitt counties. The tornado was up to ¾ mile wide and caused extensive damage to the southeastern suburbs of Greenville including damage at East Carolina University. Nine people were killed in Pitt County, and 153 people were injured in Lenoir, Greene, and Pitt counties.
- **March 27, 2009** - NWS survey revealed an EF-1 tornado with winds estimated between 85 and 90 mph touched down just southeast of Greenville. The tornado was on the ground a little over one half mile and was about one hundred yards wide. The tornado did minor damage to about forty homes off Ashcroft Drive resulting in about two hundred thousand dollars in damage**.**
- **March 25, 2014** - A cold front approached eastern North Carolina during the afternoon of April 25th 2014. Warm southerly winds ahead of the front produced good instability over the region and numerous showers and thunderstorms crossed during the afternoon and evening. Two super-cell thunderstorms produced the bulk of the severe weather with multiple tornadoes reported in parts of Greene, Pitt and Beaufort counties.

**Figure A.31 – Tornado Paths within 10 miles of Greenville, 1950-2024**



## THUNDERSTORM WINDS

Between January 1, 2000 and December 31, 2024, the NCEI recorded wind speeds for 25 separate incidents of thunderstorm winds, occurring on 19 separate days, for Greenville. These events caused $21,000 in recorded property damage and no injuries or fatalities. The recorded gusts averaged 62 miles per hour, with the highest gusts recorded at 75 mph on July 1, 2012. Of these events, two caused property damage that was reported in NCEI. Wind gusts with property damage recorded averaged $10,500 in damage, with the highest reported damage being $20,000 on May 27, 2000. These incidents are aggregated by the date the events occurred and are recorded in Table A.39.

**Table A.39 – Recorded Thunderstorm Winds, Greenville, 2000-2024**

| Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|
| 5/27/2000 | N/A | 0 | 0 | $20,000 |
| 5/26/2001 | 70 | 0 | 0 | $0 |
| 5/13/2002 | 60 | 0 | 0 | $0 |
| 11/11/2002 | 60 | 0 | 0 | $1,000 |
| 7/10/2003 | 58 | 0 | 0 | $0 |
| 7/11/2003* | 58 | 0 | 0 | $0 |
| 1/14/2006 | 60 | 0 | 0 | $0 |
| 4/3/2006 | 63 | 0 | 0 | $0 |
| 1/7/2009 | 58 | 0 | 0 | $0 |
| 4/5/2011 | 58 | 0 | 0 | $0 |
| 6/23/2011 | 58 | 0 | 0 | $0 |
| 7/1/2012* | 75 | 0 | 0 | $0 |
| 4/30/2014 | 60 | 0 | 0 | $0 |
| 2/16/2016 | 60 | 0 | 0 | $0 |
| 6/22/2016* | 58 | 0 | 0 | $0 |
| 7/6/2017 | 71 | 0 | 0 | $0 |
| 4/13/2020 | 58 | 0 | 0 | $0 |
| 4/13/2020 | 58 | 0 | 0 | $0 |
| 6/17/2022 | 58 | 0 | 0 | $0 |
| 4/30/2023 | 60 | 0 | 0 | $0 |
| **Total** | | **0** | **0** | **$21,000** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **May 27, 2000** – A roof was blown off a house just south of Greenville.
- **July 1, 2012** – Public reported a 10 by 20 barn destroyed by strong winds.
- **June 22, 2016** – Strong winds blew down a four foot by eight foot sign on Greenville Blvd in Greenville. Strong winds also blew down a tree near Arlington Blvd in Greenville.

## LIGHTNING

According to NCEI data, there were three damaging lightning strikes reported between 2000 and 2024. These events caused $151,000 in property damage. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. These lightning strike events averaged $50,333 in damage, with the highest reported damage being $100,000 on August 15, 2002. Table A.40 details NCEI-recorded lightning strikes from 2000 through 2024 for Greenville.

**Table A.40 – Recorded Lightning Strikes in Greenville, 2000-2024**

| Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|
| 7/27/2002 | 1730 | 0 | 0 | $1,000 |
| 8/15/2002 | 1900 | 0 | 0 | $100,000 |
| 7/29/2010 | 1430 | 0 | 0 | $50,000 |
| | **Total** | **0** | **0** | **$151,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Greenville:

- **August 15, 2002** – Lightning struck a Pitt County Office Building main transformer and caused substantial damage to the building and electronics.
- **July 29, 2010** – House caught on fire and burned after lightning strike.

## HAIL

Between January 1, 2000 and December 31, 2024 the NCEI recorded 28 separate hail incidents, occurring on 21 separate days, for Greenville. These events caused $50,000 in recorded property damage, $300,000 in recorded crop damage, and no injuries or fatalities. The largest diameter hail recorded in the City was 1.75 inches, which occurred on four separate occasions: June 6, 2006, March 28, 2007, April 20, 2009, and August 29, 2011. The average hail size of all events in the City was just over one inch in diameter. Table A.41 summarizes hail events for Greenville. In some cases, hail was reported for multiple locations on the same day.

**Table A.41 – Summary of Hail Occurrences in Greenville**

| Date | Hail Diameter |
|---|---|
| 8/13/2000 | 1.25 |
| 5/26/2001 | 0.75 |
| 7/4/2002* | 0.88 |
| 7/5/2002 | 1 |
| 7/10/2002 | 0.75 |
| 5/22/2004 | 0.75 |
| 8/3/2005 | 1 |
| 4/3/2006 | 0.75 |
| 6/6/2006 | 1.75 |

| Date | Hail Diameter |
|---|---|
| 7/29/2006 | 0.75 |
| 3/28/2007 | 1.75 |
| 5/12/2007 | 0.75 |
| 4/20/2008 | 0.75 |
| 4/20/2009* | 1.75 |
| 6/26/2009 | 0.75 |
| 8/29/2011 | 1.75 |
| 5/23/2012* | 1 |
| 2/24/2016 | 1.25 |
| 6/22/2016 | 0.75 |
| 5/31/2019 | 1 |
| 5/10/2024 | 1.25 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **March 28, 2007 –** Spotters, media and public reported golf ball sized hail in Greenville that lasted 5 to 10 minutes.
- **August 29, 2011 –** Golf ball size hail reported near Highway 43 and Highway 264 near Greenville.
- **February 24, 2016 –** Report of half dollar size hail in Greenville.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Greenville averages approximately 0.8 days with wind events per year. Over this same period, three lightning events were reported as having caused death, injury, or property damage, which equates to an average of 0.15 damaging lightning strikes per year.

The average hailstorm in Greenville occurs in the evening and has a hail stone with a diameter of just over one inch. Over the 25-year period from 2000 through 2024, Greenville experienced 21 days with reported hail incidents; this is on average approximately 0.8 days per year with reported incidents somewhere in the planning area.

In a 75-year span between 1950 and 2024, Pitt County experienced 33 tornado events. This correlates to a 44% annual probability that the County will experience a tornado somewhere in its boundaries.

Based on these historical occurrences, there is between a 10% to 100% chance that Greenville will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodology and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on ECU's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water. Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes.

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Individuals who work outdoors may face increased risk during severe weather events. Residents living in mobile homes are also more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $578,295, which assumes that 10% of the student population is impacted.

**Table A.42 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 27,153 | 2,715 | $578,295 |

Between 2000 and 2024, the NCEI recorded no fatalities or injuries caused by hail, lightning, or wind. However, tornadoes occurring between 1950 to 2024 resulted in 9 deaths and 164 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damage through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Greenville, two of the events with significant recorded property damage were due to both property damage caused by fire and secondary impacts due to lightning striking a transformer.

NCEI records lightning impacts over 25 years (2000-2024), with $151,000 in property damage recorded throughout three separate events occurring in 2002 and 2010. Based on these records, the planning area experiences an annualized loss of $6,040 in property damage. The average impact from lightning per incident in Greenville is $50,333.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Greenville, NCEI reported $50,000 in property damage and $300,000 in crop damage as a direct result of hail. This damage was caused by only two storms.

It should be noted that property damage due to hail is usually insured loss, with damage covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damage in Greenville, thus the NCEI is still used to form a baseline.

When strong enough, wind events can cause significant direct damage to buildings and infrastructure. Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $21,000 in property damage, which equates to an annualized loss of $840 across the planning area.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damage and losses attributed to secondary hazards spawned by the tornado, or due to the damage caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

During the 75-year span from 1950 to 2024, tornadoes caused approximately $30,045,000 in property damage, which equates to an annualized loss of $400,600. It should be noted that this number is skewed by an F4 tornado in 1984, which resulted in $25 million in property damage. Per the iRisk analysis, an F2 tornado event could cause over $302 million of estimated total building damage on ECU's main campus.

Table A.43 through Table A.44 detail the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table A.43 – Estimated Building Damage by Tornado Events, ECU Main Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $1,666,177.77 | $1,161,387.84 | $2,827,565.61 |
| Educational | $6,457,081.60 | $4,255,576.04 | $10,712,657.64 |
| Housing | $1,598,767.65 | $852,155.76 | $2,450,923.41 |
| **Total** | **$9,722,027.02** | **$6,269,119.64** | **$15,991,146.66** |
| **F1 Tornado Event** | | | |
| Administration | $10,884,369.43 | $7,162,385.52 | $18,046,754.95 |
| Educational | $46,761,092.78 | $30,385,401.69 | $77,146,494.47 |
| Housing | $12,228,955.44 | $6,462,017.00 | $18,690,972.44 |
| **Total** | **$69,874,417.65** | **$44,009,804.21** | **$113,884,221.86** |
| **F2 Tornado Event** | | | |
| Administration | $29,477,217.36 | $20,191,757.58 | $49,668,974.94 |
| Educational | $126,593,319.73 | $85,094,177.53 | $211,687,497.26 |
| Housing | $35,329,652.84 | $18,882,796.52 | $54,212,449.36 |
| **Total** | **$191,400,189.93** | **$124,168,731.63** | **$315,568,921.56** |
| **F3 Tornado Event** | | | |
| Administration | $42,740,439.13 | $29,300,633.35 | $72,041,072.48 |
| Educational | $185,405,522.49 | $125,183,858.25 | $310,589,380.74 |
| Housing | $52,139,223.54 | $27,962,249.38 | $80,101,472.92 |
| **Total** | **$280,285,185.16** | **$182,446,740.98** | **$462,731,926.14** |
| **F4 Tornado Event** | | | |
| Administration | $44,917,440.69 | $31,032,631.59 | $75,950,072.28 |
| Educational | $192,118,201.11 | $129,986,592.73 | $322,104,793.84 |
| Housing | $53,702,856.97 | $28,844,729.46 | $82,547,586.43 |
| **Total** | **$290,738,498.77** | **$189,863,953.78** | **$480,602,452.55** |

Source: NCEM iRISK Database

**Table A.44 – Estimated Building Damage by Tornado Events, ECU Health Sciences Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $17,693,448.27 | $25,770,803.00 | $43,464,251.27 |
| Educational | $2,482,533.51 | $3,139,701.32 | $5,622,234.83 |
| **Total** | **$20,175,981.78** | **$28,910,504.32** | **$49,086,486.10** |
| **F1 Tornado Event** | | | |
| Administration | $139,945,656.76 | $204,826,469.62 | $344,772,126.38 |
| Educational | $17,733,522.50 | $22,305,678.53 | $40,039,201.03 |
| **Total** | **$157,679,179.26** | **$227,132,148.15** | **$384,811,327.41** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F2 Tornado Event** | | | |
| Administration | $493,701,573.00 | $730,146,458.44 | $1,223,848,031.44 |
| Educational | $59,612,247.29 | $75,143,668.55 | $134,755,915.84 |
| **Total** | **$553,313,820.29** | **$805,290,126.99** | **$1,358,603,947.28** |
| **F3 Tornado Event** | | | |
| Administration | $780,079,729.15 | $1,156,984,655.02 | $1,937,064,384.17 |
| Educational | $93,394,946.30 | $117,659,614.68 | $211,054,560.98 |
| **Total** | **$873,474,675.45** | **$1,274,644,269.70** | **$2,148,118,945.15** |
| **F4 Tornado Event** | | | |
| Administration | $807,880,436.68 | $1,198,405,311.13 | $2,006,285,747.81 |
| Educational | $96,773,922.53 | $121,892,398.00 | $218,666,320.53 |
| **Total** | **$904,654,359.21** | **$1,320,297,709.13** | **$2,224,952,068.34** |

Source: NCEM iRISK Database

### Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornadoes at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statements

- The strongest tornado ever recorded in Greenville occurred on March 28, 1984 causing 9 deaths, 164 injuries, and approximately $30 million in property damage.
- Thunderstorms and tornadoes are frequent hazard events in Pitt County and the ECU campus. Reported damage for the 25-year period from 2000-2024 within Greenville includes $21,000 for thunderstorm winds and $151,000 for lightning strikes.
- Between 1950 and 2024, NCEI reports $30 million in property damage from tornadoes in Pitt County.

# A.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 10 percent of the ECU main campus and 4 percent of the ECU Health Sciences campus are within the primary exposure category. Additionally, 78 percent of ECU main campus and 80 percent of the ECU Health Sciences campus are within the secondary exposure category of the Functional WUI. Table A.45 and Table A.46 detail the Functional WUI acreage by campus, and Figure A.32 and Figure A.33 below shows the Functional WUI areas. On a county level, the majority of Pitt County,

particularly the outer perimeter, is predominately classified as Wildfire Transmission Zone with very little to no housing density. Central Pitt County has a higher concentration of area classified as secondary exposure with some primary exposure – buildings within closer proximity to burnable land cover.

The expansion of development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

*Spatial Extent: 4 – Large*

**Table A.45 – Functional Wildland Urban Interface, ECU Main Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 49 | 10% |
| | Secondary Exposure | 385 | 78% |
| | Sources of Ember Load to Buildings | 10 | 2% |
| | Wildfire Transmission Zone | 49 | 10% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **493** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table A.46 – Functional Wildland Urban Interface, ECU Health Sciences Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 15 | 4% |
| | Secondary Exposure | 279 | 80% |
| | Sources of Ember Load to Buildings | 18 | 5% |
| | Wildfire Transmission Zone | 35 | 10% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **347** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure A.32 – Functional Wildland Urban Interface, ECU Main Campus**

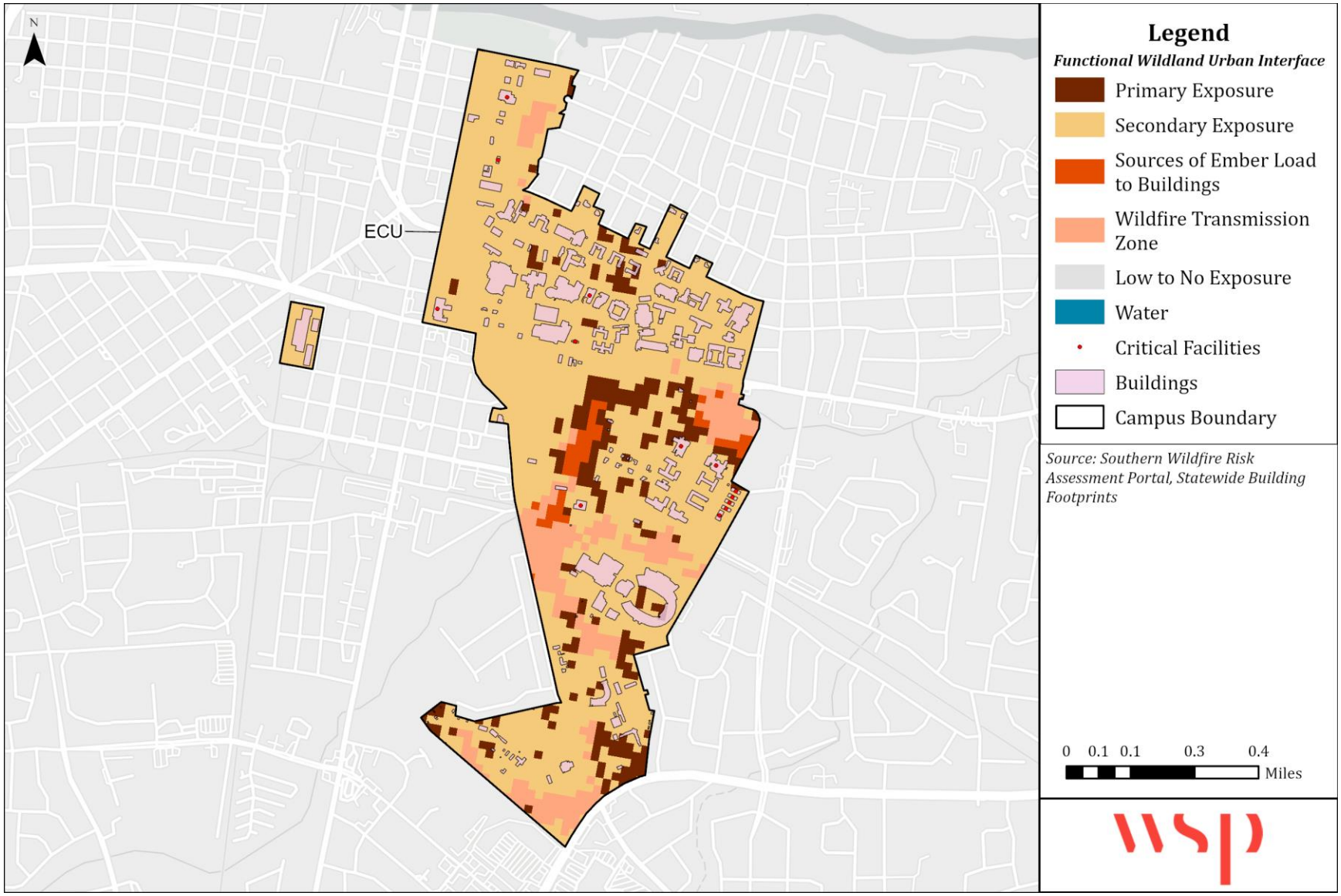
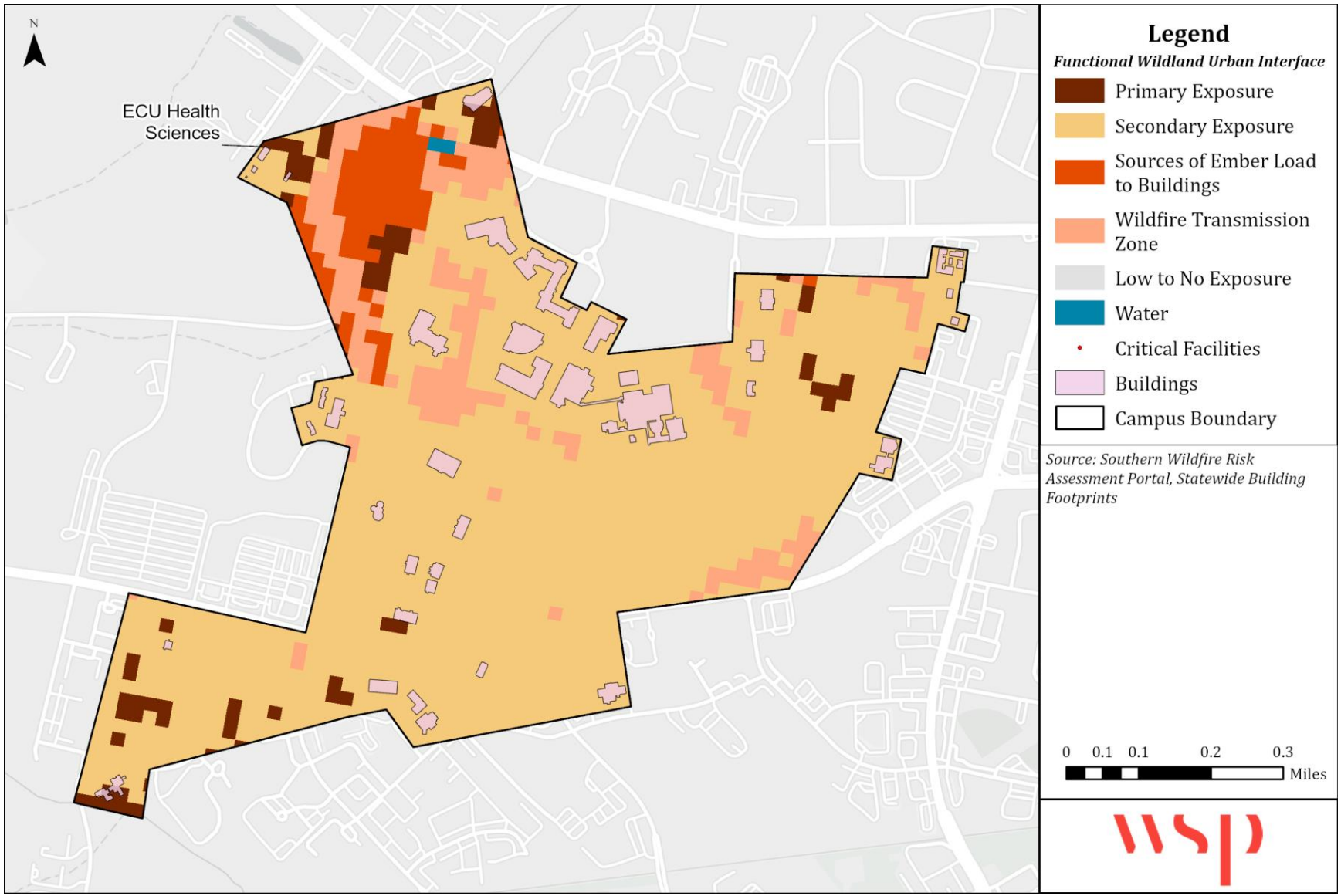


**Figure A.33 – Functional Wildland Urban Interface, ECU Health Sciences Campus**



## Extent

Factors such as drought conditions or high levels of fuel on the forest floor may make wildfire more likely or intense in certain areas.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table A.47, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table A.48 and Table A.49 and Figure A.34 and Figure A.35 detail the characteristic fire intensity scale across both ECU campuses.

### Table A.47 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

### Table A.48 – Characteristic Fire Intensity, ECU Main Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 430 | 87% |
| | 1 - Very Low | 20 | 4% |
| | 1.5 | 3 | 1% |
| | 2 - Low | 33 | 7% |
| | 2.5 | 1 | 0% |
| | 3 - Moderate | 2 | 0% |
| | 3.5 | 3 | 1% |
| | 4 - High | 1 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **493** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table A.49 – Characteristic Fire Intensity, ECU Health Sciences Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 313 | 90% |
| | 1 - Very Low | 8 | 2% |
| | 1.5 | 6 | 2% |
| | 2 - Low | 13 | 4% |
| | 2.5 | 2 | 0% |
| | 3 - Moderate | 1 | 0% |
| | 3.5 | 2 | 1% |
| | 4 - High | 2 | 1% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **347** | **100%** |

Source: Southern Wildfire Risk Assessment

The majority of the ECU main campus (87%) and Health Sciences campus (90%) are rated non-burnable on the characteristic fire intensity scale. Class 4 is the highest classification that either campus is exposed to with less than one percent of the total main campus acreage and 1 percent rated as class 4 fire intensity. Class 4 fire intensity can result in significant harm or damage to life and property. The areas with greatest potential fire intensity are within the WUI. Around 1 percent of the main campus and 2 percent of the Health Sciences campus may experience Class 3-3.5 fire intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the ECU main campus (12%) and ECU Health Sciences campus (8%) would face a Class 1 to Class 2.5 fire intensity, which is easily suppressed.

*Impact: 2 – Limited*

**Figure A.34 – Characteristic Fire Intensity, ECU Main Campus**

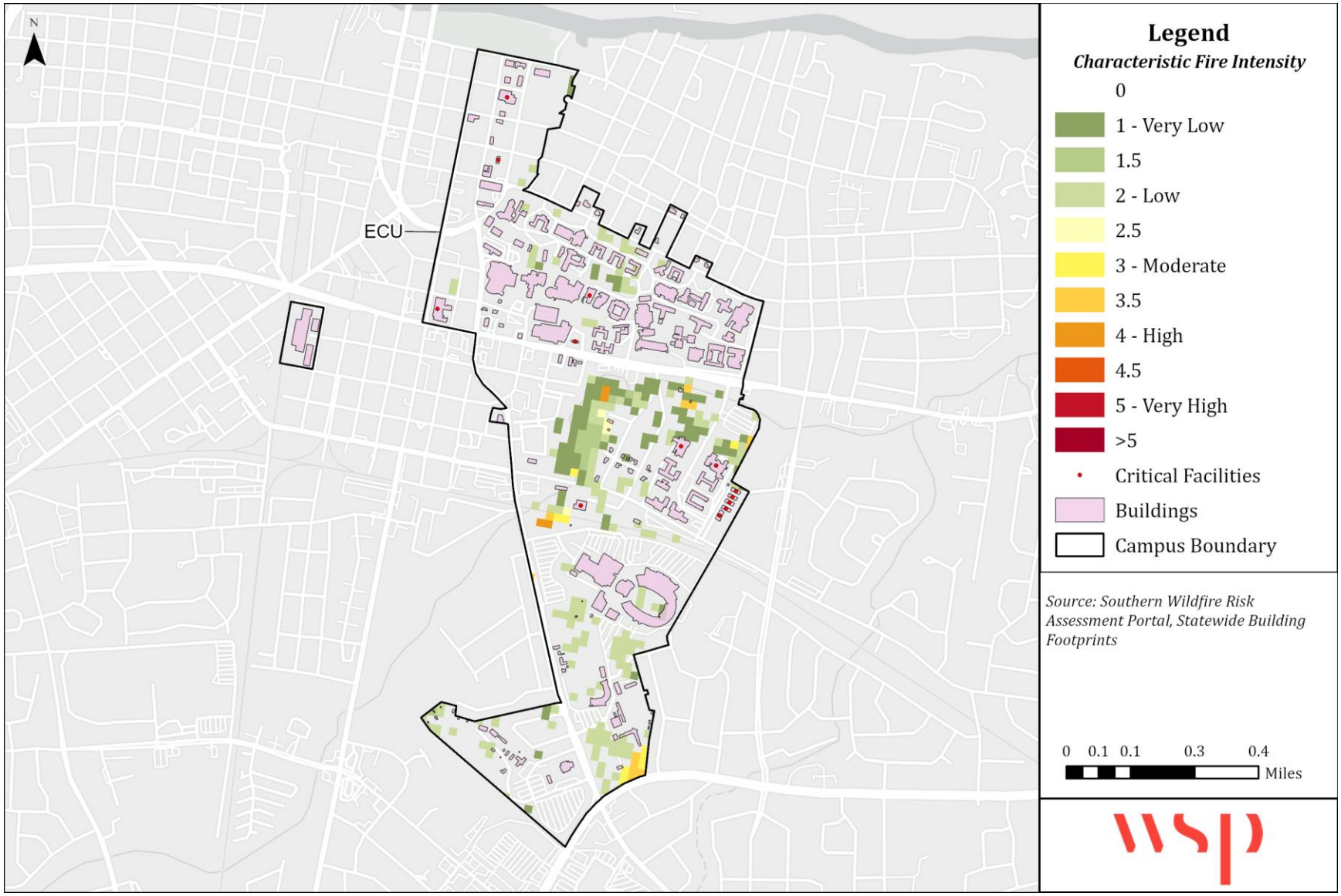
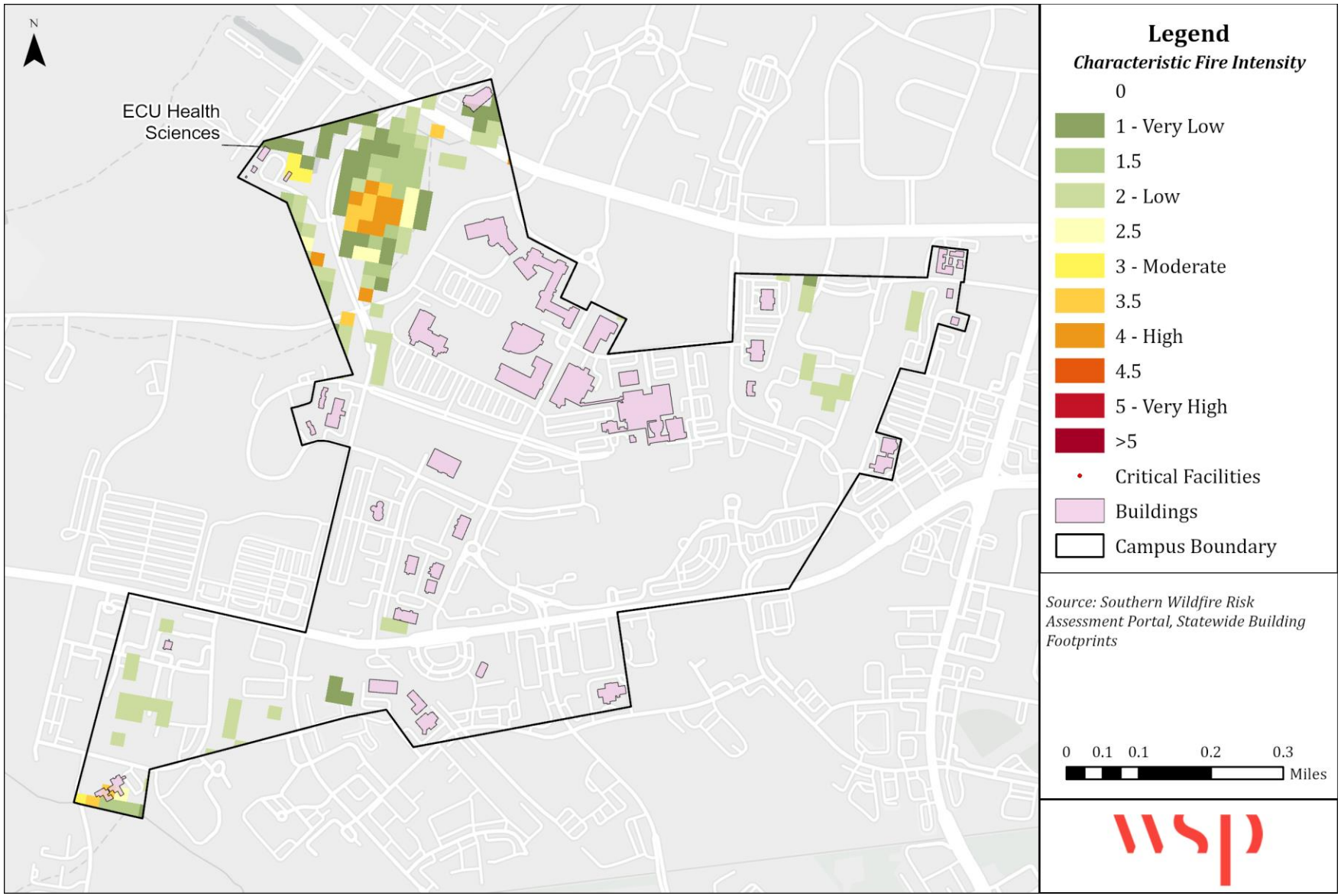


**Figure A.35 – Characteristic Fire Intensity, ECU Health Sciences Campus**



## Historical Occurrences

Table A.50 lists past occurrences of wildfire in Pitt County from 2000-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 457 noted wildfires within Pitt County between 2000 and 2024. The total acreage burned during this period was 1,485 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Pitt County experiences 18.3 fires and 59.4 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 3.18 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table A.50 – Records of Wildfire in Pitt County, 2000-2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 2000 | 22 | 59.30 | 2.69 |
| 2001 | 49 | 71.40 | 1.46 |
| 2002 | 17 | 86.90 | 5.11 |
| 2003 | 2 | 1.00 | 0.50 |
| 2004 | 10 | 24.20 | 2.42 |
| 2005 | 21 | 55.70 | 2.65 |
| 2006 | 29 | 137.70 | 4.74 |
| 2007 | 50 | 118.50 | 2.37 |
| 2008 | 35 | 223.70 | 6.39 |
| 2009 | 13 | 15.60 | 1.20 |
| 2010 | 18 | 14.40 | 0.80 |
| 2011 | 17 | 18.10 | 1.06 |
| 2012 | 16 | 22.00 | 1.37 |
| 2013 | 9 | 10.60 | 1.17 |
| 2014 | 14 | 98.40 | 7.02 |
| 2015 | 8 | 21.11 | 2.64 |
| 2016 | 5 | 7.01 | 1.40 |
| 2017 | 17 | 18.34 | 1.08 |
| 2018 | 11 | 5.39 | 0.49 |
| 2019 | 13 | 30.17 | 2.32 |
| 2020 | 9 | 20.12 | 2.24 |
| 2021 | 11 | 20.82 | 1.89 |
| 2022 | 31 | 219.40 | 7.07 |
| 2023 | 10 | 94.53 | 9.45 |
| 2024 | 20 | 90.60 | 4.53 |
| **Total** | **457** | **1484.99** | **3.18** |

Source: North Carolina Forest Service

## Probability of Future Occurrence

The SWRA provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for both ECU campuses are presented in Table A.51 and Table A.52 and illustrated in Figure A.36 and Figure A.37.

### Table A.51 – Burn Probability, ECU Main Campus

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 491 | 100% |
| | 2/10 | 0.0001000 - 0.0002154 | 2 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **493** | **100%** |

Source: Southern Wildfire Risk Assessment

### Table A.52 – Burn Probability, ECU Health Sciences Campus

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 342 | 99% |
| | 2/10 | 0.0001000 - 0.0002154 | 5 | 1% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | **Total** | | **347** | **100%** |

Source: Southern Wildfire Risk Assessment

Both the ECU Main Campus and Health Sciences Campus have very low to low burn probability. Almost the entirety of both campuses, 99 percent has very low probability, and the remaining 1 percent of the campuses have low probability of experiencing wildfire. Based on the SWRA results, the probability of wildfire across the campus is considered unlikely.

*Probability: 1 – Unlikely*

**Figure A.36 – Burn Probability, ECU Main Campus**

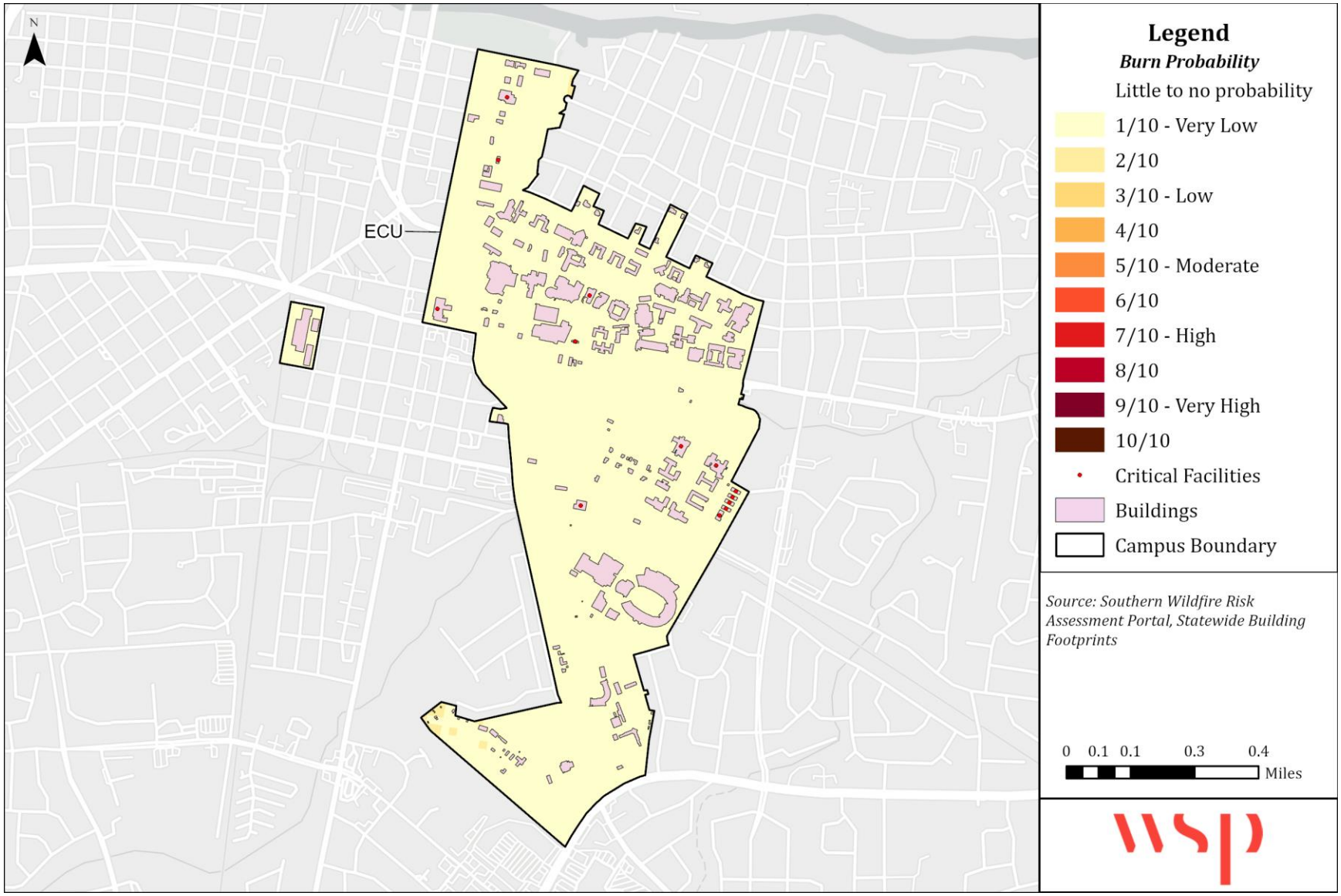
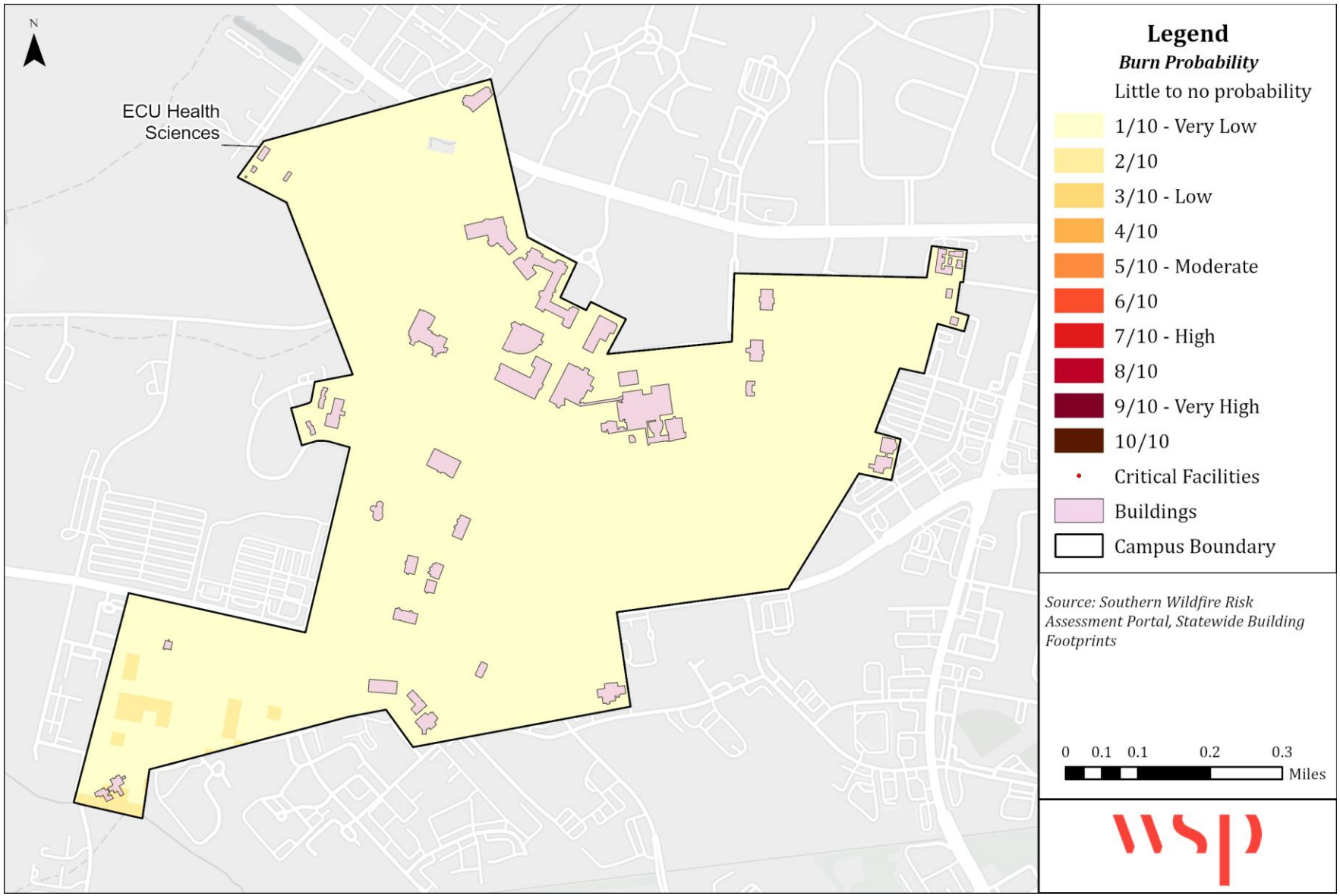


**Figure A.37 – Burn Probability, ECU Health Sciences Campus**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10.

All structures assessed on both the ECU main campus and ECU Health Sciences campus have a wildfire exposure score of either 2/10 or 3/10 which equates to relatively low vulnerability. Table A.53 and Table A.54 show the number and value of campus buildings by occupancy type that fall within Wildfire Exposure Scores 2 and 3.

**Table A.53 – Building Counts and Values by Wildfire Exposure Score, ECU Main Campus**

| Occupancy | Wildfire Exposure Score 2 | | Wildfire Exposure Score 3 | |
|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 41 | $105,782,509 | 0 | $0 |
| Extracurricular/Educational | 108 | $998,149,785 | 1 | $49,551 |
| Housing | 22 | $306,419,940 | 0 | $0 |
| **Total** | **171** | **$1,410,352,234** | **1** | **$49,551** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

**Table A.54 – Building Counts and Values by Wildfire Exposure Score, ECU Health Sciences Campus**

| Occupancy | Wildfire Exposure Score 2 | | Wildfire Exposure Score 3 | |
|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 27 | $223,024,247 | 2 | $1,363,762 |
| Extracurricular/Educational | 14 | $246,250,069 | 0 | $0 |
| **Total** | **41** | **$469,274,316** | **2** | **$1,363,762** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the ECU campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. The Pitt County Fire Marshal's Office completes blueprint and site plan reviews which ensure that new construction and major renovation projects meet fire and safety requirements before work begins. The Fire Marshal's team reviews building plans to ensure compliance with the North Carolina Fire Code and other applicable standards, helping protect occupants, first responders, and property. Although a wildfire community protection plan exists for the state of North Carolina, there are no community wildfire protection plans and no wildfire-specific mitigation review requirements or regulations for development in the wildland-urban interface in Pitt County.

## Problem Statements

- The entire both ECU campuses are located within an identified functional WUI area but have very low fire intensity and burn probability.
- Pitt County experiences wildfires on an annual basis with 18.3 fires and 59.4 acres burned annually, as reported by the NCFS. The actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire department.
- Coordination with the Town of Greenville and/or Pitt County is recommended to reduce fuel efforts and establish a local wildfire management plan.
- All buildings located on both ECU campuses fall within areas with a Wildfire Exposure score of either 2/10 or 3/10 representing low burn probability and low damage potential.

# A.5.8 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

## Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the ECU campus, the Information Security Division of Information Technology Services (ITS) is responsible for safeguarding the confidentiality, integrity, and availability of all information processed, stored or transmitted using university electronic resources while also taking proactive measures to counter threats, vulnerabilities and cyber-attacks. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

## Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the ECU campus could cause significant disruption and impact a large number of records.

*Impact: 3 – Critical*

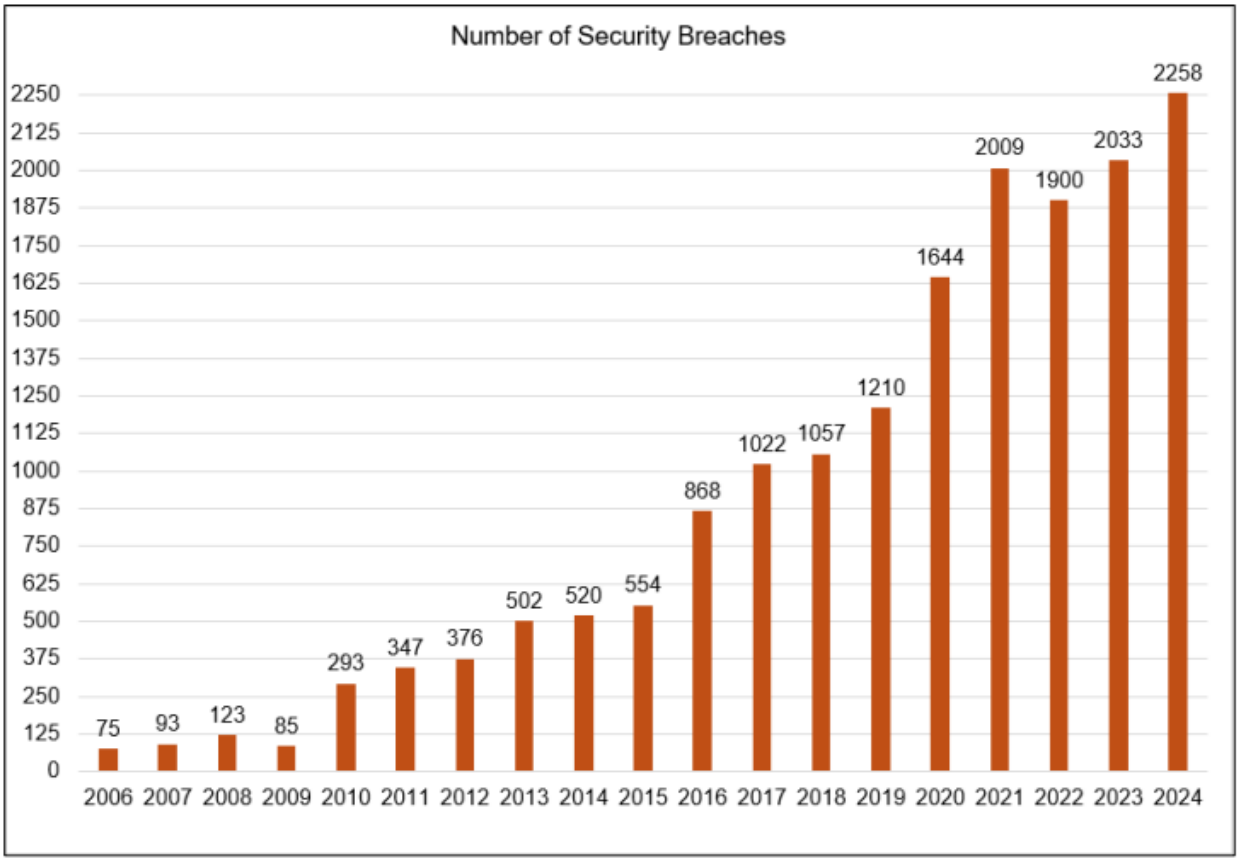
## Historical Occurrences

According to local news reports, the most recent cyber attacks occurred with third party businesses that work within ECU systems. In September of 2023, a ransomware gang known

as CLOP attacked a third party vendor with ECU Health. This attack resulted in the release of individual demographic information and information about services received by patients. Additionally, in July of 2020, another third-party vendor called Blackbaud suffered from a ransomware attack. Blackbaud is a cloud-computing private company contracted to provide constituent relationship management services for ECU. This attack led to constituent names, addresses, and birthdates being released from those who were in the Blackbaud system or had used their services.

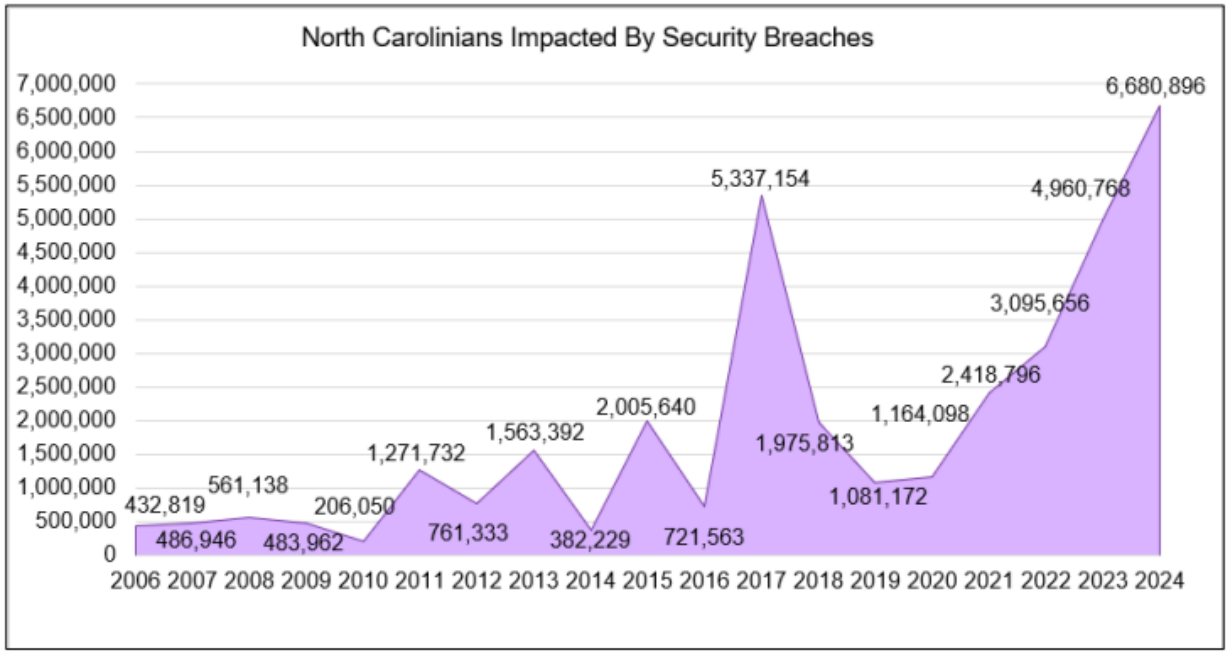
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure A.38 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure A.39 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been some notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included. (https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/)

- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).

## Probability of Future Occurrence

Cyber attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of ECU are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the University are less likely but cannot be ruled out.

*Probability: 2 – Possible*

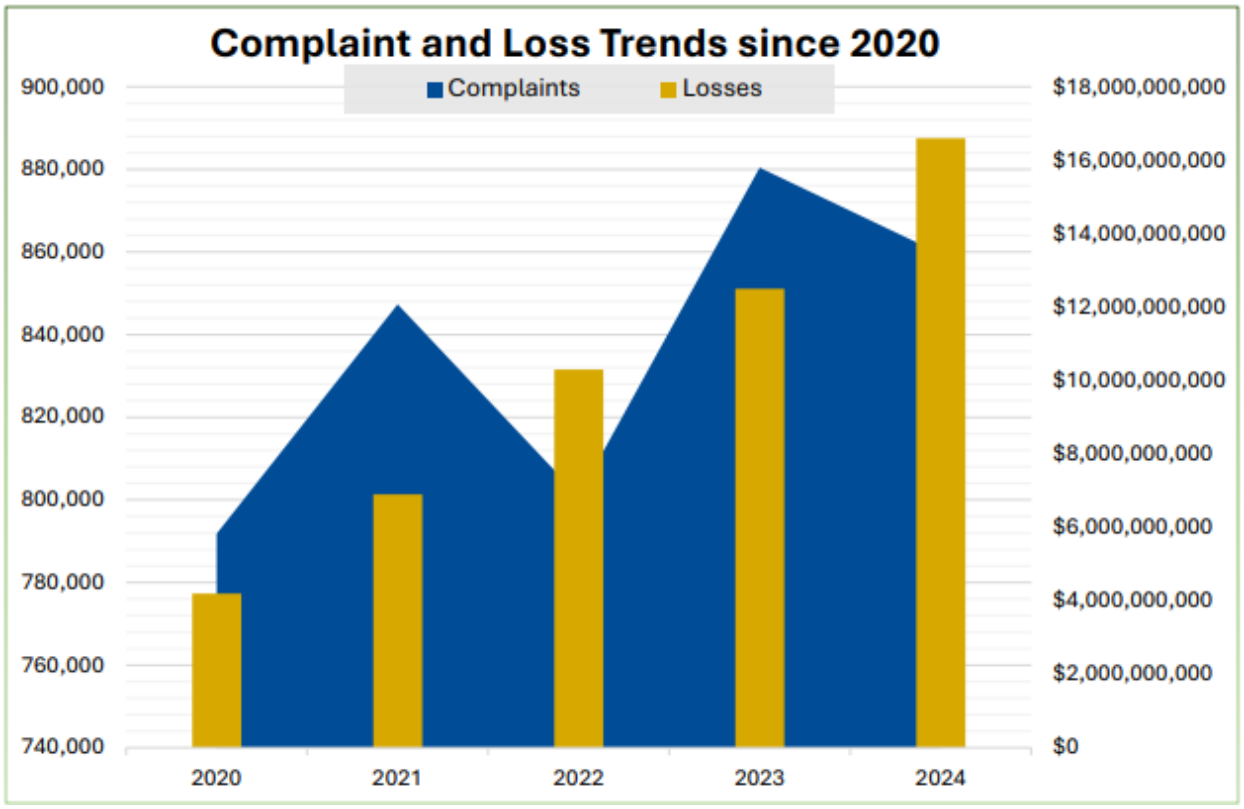
## Vulnerability Assessment

As discussed above, the impacts from a cyber attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure A.40.

**Figure A.40 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers continued usage of online services, such as banking and shopping, increase vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber security threats is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment increasing since the last plan, the number of users of campus networks and software have significantly increased.

For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statements

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Information Security division addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.

# A.5.9 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.3 |

## Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory recorded 1 site with hazardous materials within 1 mile of ECU campus. This site is detailed by location and sector in Table A.55 and shown in Figure A.41. The HMPC identified one critical facility on ECU's campus with hazardous materials, the Steam Plant.

**Table A.55 – Toxic Release Inventory Sites within 1 Mile of ECU Campus**

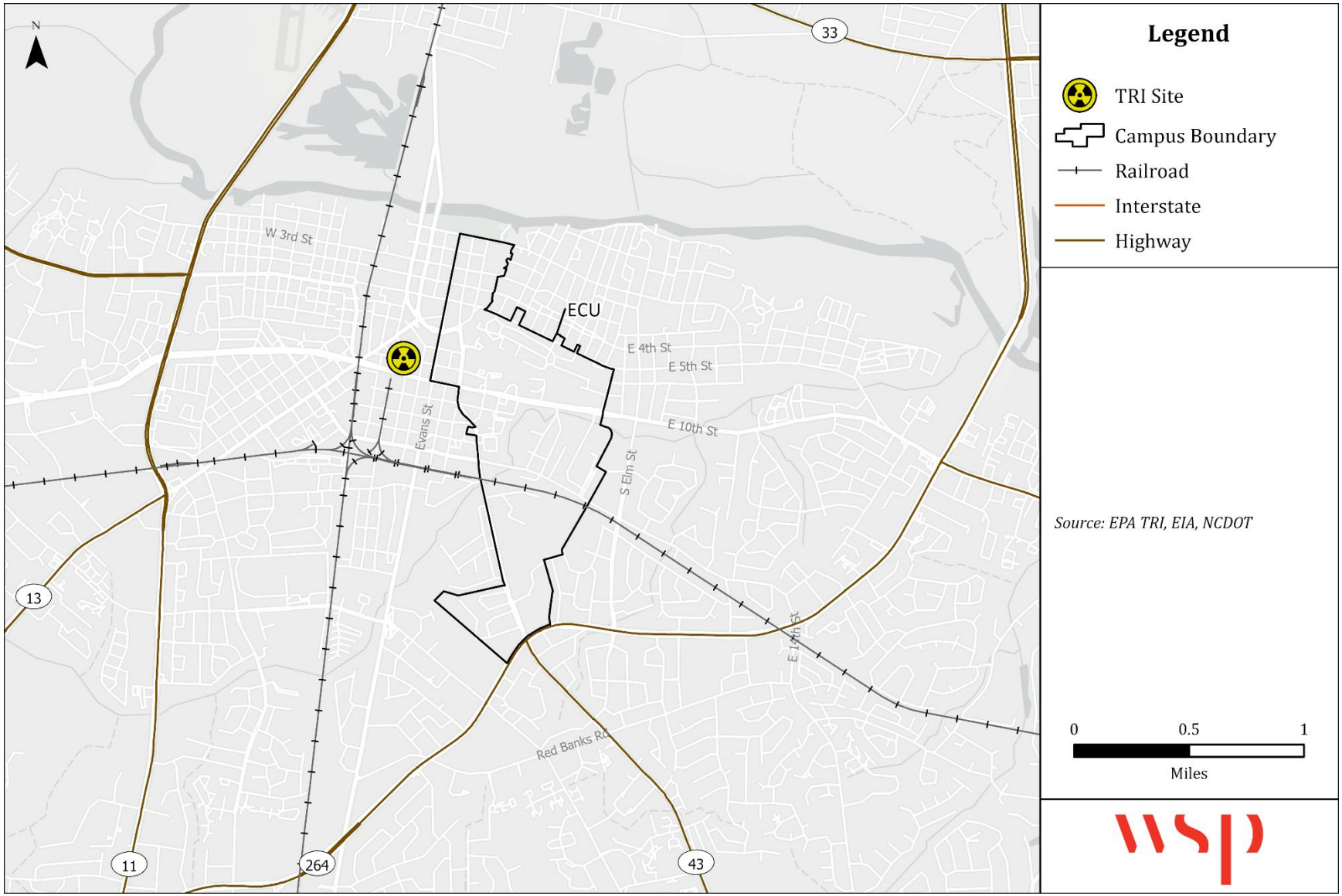
| Facility Name | Address | Sector | Chemicals Present |
|---|---|---|---|
| UNX-Christeyns LLC | 200 W 9th St Greenville, NC | Chemicals | Nonylphenol Ethoxylates |

Source: EPA Toxic Release Inventory

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials Incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure A.41 below shows the modes of transportation for hazardous materials adjacent to or through ECU's campus.

*Spatial Extent: 1 – Negligible*

**Figure A.41 – Hazardous Materials Facilities and Major Transportation Routes, ECU**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

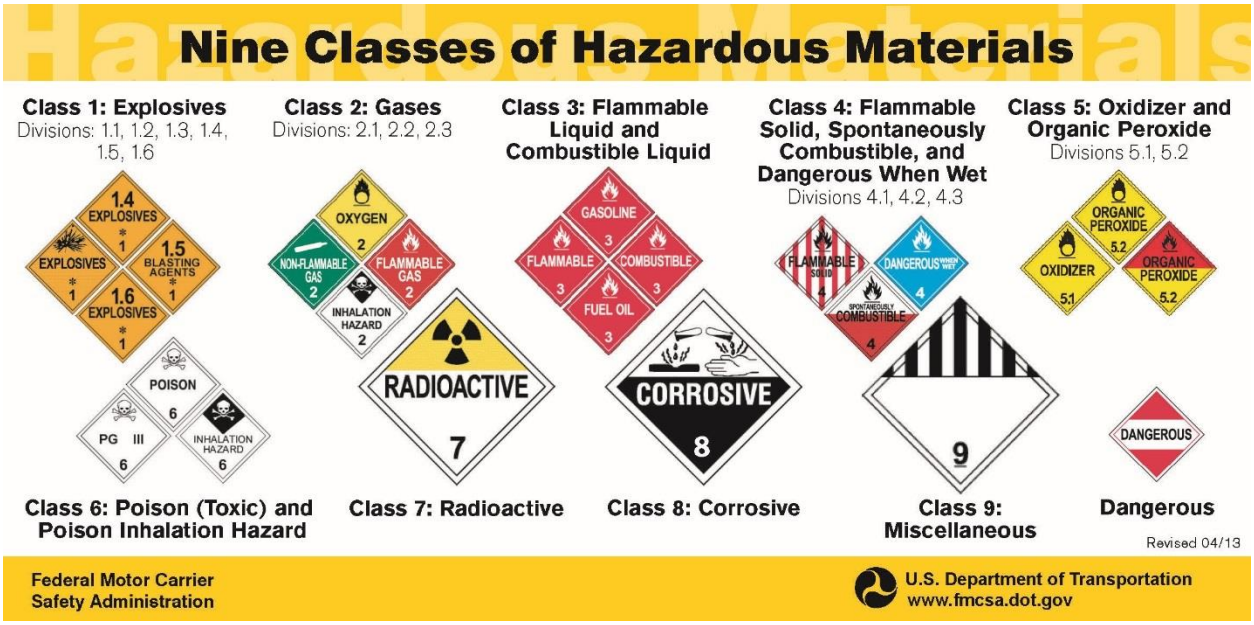
The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 144 recorded releases in Greenville from 2000 through 2024. Of these events, only two were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $717,599 in damage with all incidents occurring on highways and roads except for two incidents which occurred by airplane. The most common materials spilled in the city were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure A.42 describes all nine hazard classes.

**Figure A.42 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 144 incidents of hazardous materials released in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Greenville.

However, the number of serious incidents is significantly lower: only 2 in 25 years or an average of 0.08 serious incidents per year. Based on historical data, there is a less than one percent annual chance of the campus experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However, there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $717,599 in damage, which equates to an annualized loss of $28,703 across Greenville.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statements

- Transportation routes for hazardous materials are located within and adjacent to the ECU campus.
- The number of reported incidents within Greenville can be approximated to over a 100 percent annual probability.

# A.5.10 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table A.56 , according to the World Health Organization.

**Table A.56 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. assort |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

When an epidemic scales, diseases can lead to high infection rates in the population causing isolation, quarantine, and potential mass fatalities. An especially severe influenza or coronavirus pandemic or other major disease outbreak can lead to high levels of illness, death, social disruption, and economic loss. As was seen during the COVID-19 pandemic, impacts can range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Another way to measure the extent of an infectious disease is by using the case-fatality rate. The case-fatality rate does not represent the overall spread of the disease but rather the proportion of people diagnosed with the disease who die from it. It should be noted that the case-fatality rate has limitations because it does not take into account unreported cases.

The John Hopkins Coronavirus Resource Center reports that between March 2020 and March 2023, COVID-19 had a case fatality rate of 1.1%. The COVID-19 pandemic disproportionately killed older people, so case-fatality rate does vary significantly amongst age groups.

*Impact: 3 – Critical*

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one and four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the

east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Pitt County experienced 67,576 cases of COVID-19 and 410 deaths. Per 100,000 people, Pitt County experienced 212 deaths, lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Pitt County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 38 deaths to certain infectious and parasitic diseases, excluding COVID-19. Most of these deaths (23) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Infectious Gastroenteritis, Tuberculosis, Viral Encephalitis, Viral Hepatitis, and HIV.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

Given the record of past events with known or possible impacts at ECU or in Pitt County, the probability of future occurrence is considered possible (1-10 percent annual chance).

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

Enrollment at ECU increased slightly between 2024 and 2025. While the increase has not been significant, more students on campus does increase the likelihood of an infection spreading.

## Problem Statements

- Based on the recent COVID-19 pandemic, it is clear the ECU campus population is susceptible to the infectious disease pandemic.
- ECU has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# A.5.11 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section A.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table A.57 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table A.57 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hrs | Less than 6 hrs | 1.9 |
| Excessive Heat | Highly Likely | Critical | Large | More than 24 hrs | Less than 1 week | 3.3 |
| Flooding | Highly Likely | Limited | Small | 6 to 12 hrs | Less than 1 week | 2.8 |
| Hurricane & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.3 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table A.58:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.

**Table A.58 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Hurricane & Coastal Hazards<br>Severe Winter Weather<br>Tornadoes & Thunderstorms |
| **Moderate Risk (2.0 – 2.9)** | Flooding<br>Wildfire<br>Hazardous Substances<br>Infectious Disease |
| **Low Risk (< 2.0)** | Earthquake |

# A.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- A.6.1 Overview of Capability Assessment
- A.6.2 Planning and Regulatory Capability
- A.6.3 Administrative and Technical Capability
- A.6.4 Fiscal Capability

## A.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## A.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table A.59 lists these local resources currently in place at ECU.

**Table A.59 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | ECU Strategic Plan 2023-2028 |
| Campus Master Plan | Y | ECU Campus Master Plan 2012 |
| Capital improvements plan | Y | ECU Budget Priorities |
| Local emergency operations plan | Y | ECU Continuity of Operations Plan<br>Emergency Preparedness |

More details on several relevant tools are provided below:

- **Strategic Master Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth. ECU's 2023-2028 Strategic Plan sets commitments for future growth and identified responsibilities and areas of distinction.
- **Campus Master Plan** addresses improvements to ECU's existing programs, circulation systems, open space network, and infrastructure for both the Main Campus and Health Sciences Campus.
- **Capital Improvement Plan** is a planning document that provides an outlook for anticipated capital projects designed to facilitate decision making in the replacement of capital assets. ECU's Budget Priorities are used to plan for large capital expenditures. Additionally, each UNC System campus creates and maintains its own 6-year CIP, which helps inform the UNC System's overall CIP.
- **Emergency Operations Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster. ECU has a Campus Emergency Operations Plan, Emergency Coordination operating procedures, and an Information Technology Services Disaster Recovery Plan.

## A.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table A.60 provides a summary of the administrative and technical capabilities for ECU.

**Table A.60 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Facilities Services |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Facilities Services |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Office of Environmental Health and Safety |
| Personnel skilled in GIS | Yes | Facilities Services |
| Emergency Manager | Yes | Office of Environmental Health and Safety |
| Grant Writer | Yes | Office of Research Administration |
| Public Information Officer | Yes | Office of Public Relations, University Communications |
| Student Engagement | Yes | Student Affairs |
| Warning Systems | Yes | ECU Alert |

The following support services and resources may provide administrative capability to implement mitigation:

- **Facilities Engineering and Architectural Services** is responsible for development of the real property of the University. All the traditional services of urban planners, architects, engineers, and other environmental design disciplines are procured and managed by this department.
- **Enterprise Risk Management** provides leadership and management experience to better identify and manage the university's strategic, financial, operational, regulatory compliance, and reputational risks holistically as an enterprise.
- **Environmental Health and Safety** operates in collaboration with the Office of Prospective Health, university committees, and the campus community to provide policies, education, program management, and consultative services that support the mission of the University while continuously improving the safety, health and sustainability of the campus environment.

## A.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table A.61 provides a summary of the fiscal resources at ECU.

**Table A.61 – Fiscal Resources**

| Resource | Ability to Use for Mitigation? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |

| Resource | Ability to Use for Mitigation? Y/N |
|---|---|
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y |

### A.6.5 Past Mitigation Efforts

Following Hurricane Floyd, ECU provided flood protection for several buildings that experienced damage. ECU retrofitted Bate Building, Howell Science Building, and Christenbury Gym with drain back flow preventers, as well as a flood gate at the Howell Science basement.

## A.7 Mitigation Strategy

### A.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table A.62 summarizes the status of mitigation actions from the 2021 plan. Table A.63 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section A.7.2. in the Mitigation Action Plan.

**Table A.62 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| ECU | 16 | 3 | 8 |

## Table A.63 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| ECU1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Blount House, Cotanche Building; Edward Nelson Warren Life Science Building; Eppes Complex; Jones Hall; Joyner East; Medical Central Utility Plant; Steam Plant; and Todd Dining Hall. | Completed | N/A |
| ECU2 | Campus-Wide – Upgrade back-up power capabilities to critical facilities including, but not limited to: Leo W. Jenkins Cancer Center; and Medical Central Utility Plant. | Completed | N/A |
| ECU7 | Brody Medical Sciences - The radio and paging system closets in the mechanical penthouse do not have smokeheads or temperature sensors. Install smokeheads and temperature sensors to monitor vital radio and paging systems. | Completed | N/A |
| ECU8 | Brody Medical Sciences - The exterior façade of the building suffers extensive water infiltration during intense storms. Seal the exterior façade of the building to prevent water infiltration and prevent further damage and/or mold growth. | Completed | Study Completed. Design in process. Construction estimate is over $20 Million. Project to be phased based on funding availability. |
| ECU11 | Edward Nelson Warren Life Science Building - The guy wires on exhaust stacks for the BSL level 3 lab are slack. Guy wires supporting exhaust stacks should be tensioned to reduce wind induced movement. | Completed | N/A |
| ECU12 | Eppes Complex - The buildings are not sprinklered and many areas have only a pull station with no fire detection equipment. This includes areas such as the paint shop and carpentry shop that contain flammable materials. Areas that store flammable materials should have adequate fire suppression and/or detection equipment installed. | Delete | Paints and solvents are stored in NFPA approved storage cabinets. Facilities is not pursing sprinklers or fire protections for these facilities. Code does not require for this size building. |
| ECU13 | Eppes Complex - There is an unreinforced window above the server area that, if broken, could permit water damage to equipment. Windows in areas containing sensitive electronics should have a film coating and water catchment system to minimize the likelihood of damage resulting from wind borne debris and rain. | Completed | N/A |
| ECU14 | Jones Hall - The fire pump building, emergency generator, and chiller have large trees adjacent to them. The trees adjacent to the generator, chiller, and fire pump building should be routinely inspected and pruned by an arborist to mitigate the potential for wind related damage. | Completed | N/A |

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| ECU15 | Joyner East - There are pipes collecting water from roof drains suspended from the ceiling over sensitive electronic equipment. Pipes above sensitive electronics should have a secondary catchment in the event of a leak. | Completed | N/A |
| ECU16 | Joyner East - There are a number of pipes in a crawlspace adjacent to the network hub that could burst and cause water damage. A water detection system should be installed to monitor for the presence of water in the crawlspace. | Delete | Sensitive equipment has been removed from this location |
| ECU17 | Medical Central Utility Plant - There are several pine trees surrounding the well pumps. Have an arborist inspect and trim/remove the adjacent to the well pumps. | Completed | N/A |
| ECU19 | Steam Plant - There are large trees overhanging the Greenville Run utility crossing, fuel tanks, fuel pumps, and primary switchgear for campus. Large trees overhanging critical equipment and utilities should be regularly pruned and inspected by an arborist to minimize the likelihood of storm related damage. The largest trees near the steam crossing should be cut down. | Completed | N/A |
| ECU20 | Steam Plant - Beams supporting the main natural gas line have deteriorating concrete encasement that appears to be causing corrosion to the gas pipe in addition to posing a debris hazard to workers below. The deteriorating concrete should be removed from above the gas line and the corrosion repaired. | Completed | N/A |
| ECU21 | Steam Plant - While the facility is out of the 100-year floodplain, the transformer yard is in the 100-year flood plain. Ensure all critical components in the transformer yard have sufficient freeboard above anticipated floodwater elevation. | Delete | ECU equipment is not in flood plain. |
| ECU22 | Todd Dining Hall - There is a large tree adjacent to the emergency generator which could fall and damage the generator and/or chiller. The large tree adjacent to the generator and chiller should be routinely pruned to reduce the possibility of wind related damage to the equipment. | Completed | N/A |
| ECU23 | Todd Dining Hall - There are trees adjacent to the facility which grow over the roof and deposit debris which could clog roof drains. Trees should be pruned back from the facility to prevent trees from depositing debris on the roof and potentially clogging roof drains. | Completed | N/A |
| ECU24 | Post hazard mitigation information, along with other public University resources, plans, and links to outside agency resources, on the University website. Disseminate information to the campus community that explains the risk of hazards and outline precautionary measures that can be taken to help reduce impacts of disaster to themselves and property. | Completed | N/A |
| ECU25 | Provide periodic training sessions on hazard mitigation to Chancellor's executive council, Crisis Policy Team and Emergency Management Team. | Completed | N/A |

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| ECU26 | Disseminate information on emergency action plans, including evacuation and shelter-in-place procedures, to the campus community (residential and non-residential) and conduct periodic drills/exercises to test and evaluate plans. | Completed | N/A |

## A.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for ECU. Each mitigation action recommended for implementation is listed in this table along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table A.40 – Mitigation Action Plan, ECU**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ECU1 | Blount House - The windows in the dispatch area are unreinforced against wind-borne debris impact. The windows in the dispatch area should be reinforced to prevent shattering as a result of wind-borne debris impact. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.1 | M | Property Protection | Campus Safety & Auxiliary Services | <$5,000 | Operating Budget | 2026-2030 | Carry Forward | Two of the three windows have been reinforced by eliminating the windows in prior years. One window remains. |
| ECU2 | Blount House - The basement sump pump is undersized relative to the rate of water infiltration during intense storms. A secondary or single large sump pump should be installed in the basement to prevent flooding. | Flooding, Hurricanes & Coastal Hazards | 1.1 | M | Structural Projects | Facilities Services | <$5,000 | State/Federal Grants | 2026-2030 | Carry Forward | Facilities to investigate increasing capacity of the existing pump. |
| ECU3 | Blount House - There is only one direct fiber optic link with Joyner East. If this line were severed, there would be a significant disruption to VOIP and data services. A redundant fiber path should be on standby to maintain normal operations in the event the existing Blount- Joyner fiber path is damaged. | All Hazards | 2.2 | M | Structural Projects | ITCS | $5,000-$25,000 | State/Federal Grants | 2026-2030 | Carry Forward | Will need to investigate new path from Cotanche building down Cotanche Street to Life Science and Biotechnology Building then to the Blount House. This will provide a redundant fiber path. |
| ECU4 | Blount House - The room designated as the EOC is too small to house even a partially staffed EOC. The room also has several unreinforced windows. The dispatch area is too small to allow consolidation of the primary and Brody Hall 911 call centers. The EOC should be relocated to another facility to allow a fully staffed EOC to meet in a single location. The 911 call/dispatch centers from Blount and Brody should be consolidated into this new facility. | All Hazards | 3.2 | M | Emergency Services | Campus Safety & Auxiliary Services | >$100,000 | Operating Budget, State/Federal Grants | 2026-2030 | Carry Forward | The Brody Building dispatch center was consolidated into the main Police Department dispatch center prior to this action plan, thus consolidating dispatch centers. Identifying and upgrading a new EOC is contingent upon space and funding, neither of which appear currently available to fully complete this item. |
| ECU5 | Brody Medical Sciences - The data center is in a room with wet sprinklers. Replace the wet sprinklers in the data center with a gas-based fire suppression system. | Cyber Security | 1.1 | M | Property Protection | Facilities Services | $25,000-$100,000 | State/Federal Grants | 2026-2030 | Carry Forward | Study was completed to upgrade to FM200 system. No funding to support the change. |
| ECU6 | Cotanche Building - The EOC telecommunication equipment relies on the (non-redundant) fiber connection to Joyner East. An alternate fiber path to Joyner East should be on standby, or some other redundant communication system in place, allowing the EOC to communicate in the event that the Joyner East fiber hub is offline. | All Hazards | 2.2 | M | Structural Projects | ITCS | $25,000-$100,000 | State/Federal Grants | 2026-2030 | Carry Forward | Will need further information as to the fiber requirements for this service |
| ECU7 | Steam Plant - The facility does not have the ability to back-feed power to any existing EOC location during outages. Relocate the EOC to a facility with redundant connections to campus voice/data networks and on a circuit which can be back-fed from either of campus's two points of back-up power delivery. | All Hazards | 1.2 | M | Emergency Services | Campus Safety & Auxiliary Services | >$100,000 | Operating Budget, State/Federal Grants | 2026-2030 | Carry Forward | Deferred as related to item #6. |
| ECU8 | Evaluate vulnerability for Outer Banks Campus, Dental Community Service-Learning Centers and other satellite locations. | All Hazards | 1.2 | H | Prevention | EH&S | <$5,000 | Operating Budget | 2026-2030 | Carry Forward | Vulnerability assessments for satellite locations remain in progress. |
| ECU9 | Improve drainage conditions through the identification and implementation of capital improvements projects. | Flooding, Hurricanes & Coastal Hazards | 1.1 | M | Structural Projects | Facilities Services | To be determined | State/Federal Grants | 2026-2030 | New | |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ECU10 | Campus-Wide – Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational when normal power supply is not available. | All Hazards | 1.2 | M | Property Protection | Facilities Services | $25,000-$100,000 per site | State/Federal Grants | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM



# UNC System Eastern Campuses

# Regional Hazard Mitigation Plan

## Annex B: Elizabeth City State University

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# Annex B. Elizabeth City State University

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to Elizabeth City State University (ECSU). This section contains the following subsections:

- B.1 Planning Process Details
- B.2 Campus Profile
- B.3 Asset Inventory
- B.4 Hazard Identification
- B.5 Hazard Profiles, Analysis, and Vulnerability
- B.6 Capability Assessment
- B.7 Mitigation Strategy

## B.1 Planning Process Details

Table B.1 lists the HMPC members who represented ECSU during the planning process.

**Table B.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Danny Clipper | EM/EHS Coordinator; University Police |
| Dennis Leary | Director of Facilities Management |
| Amanda Brooks | Interim AVC Design & Construction, Campus Facilities & Planning |
| Ernest Cuthbertson | Director of Public Safety; University Police |
| Lee Brown | Chief of Staff; Office of the Chancellor |
| Sabrina Williams (Kellogg) | Director of Housing and Residence Life |
| Kevin Wade | Associate Vice Chancellor; Student Affairs |
| Kevin Kupietz | Emergency Management Coordinator; Assistant Professor, Aviation & Emergency Management |
| Robert Thibeault | Director of Budgets; Business and Finance |
| S Keith Hargrove | Chancellor; Office of the Chancellor |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

Table B.2 lists campus and community resources referenced throughout the planning process and incorporated into the plan development.

**Table B.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| ECSU Campus Master Plan | The ECSU Campus Master Plan, developed in 2022, was referenced for the Campus Profile in Section B.2 as well as the Capability Assessment in Section B.6 |
| Pasquotank County and Incorporated Areas Flood Insurance Study (FIS), Revised 12/21/2018 | The FIS report was referenced in the preparation of flood hazard profile in Section B.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section B.5. The plan was additionally used to track implementation progress and develop the mitigation plan (Section B.7). |
| Albemarle Regional Hazard Mitigation Plan, 2025 | The Albemarle Regional Hazard Mitigation Plan, which includes Elizabeth City, was referenced in compiling the Hazard Identification and Risk Assessment in Section B.5. |

# B.2 Campus Profile

This section provides a general overview of the Elizabeth City State University (ECSU) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## B.2.1 Location and Setting

Located in the historic Albemarle area near the mouth of the Pasquotank River, ECSU offers students the opportunity to receive an excellent education while enjoying a wide variety of recreational and cultural amenities. Favored by a mild climate and proximity to the world-renowned Outer Banks recreation area, ECSU has features that help make student living and learning both exciting and fulfilling. In addition, the university offers students a variety of social programs, cultural programs, religious and musical organizations and clubs. Honor and Recognition societies, as well as fraternities and sororities are also available to students. ECSU also has a variety of athletic sports events.

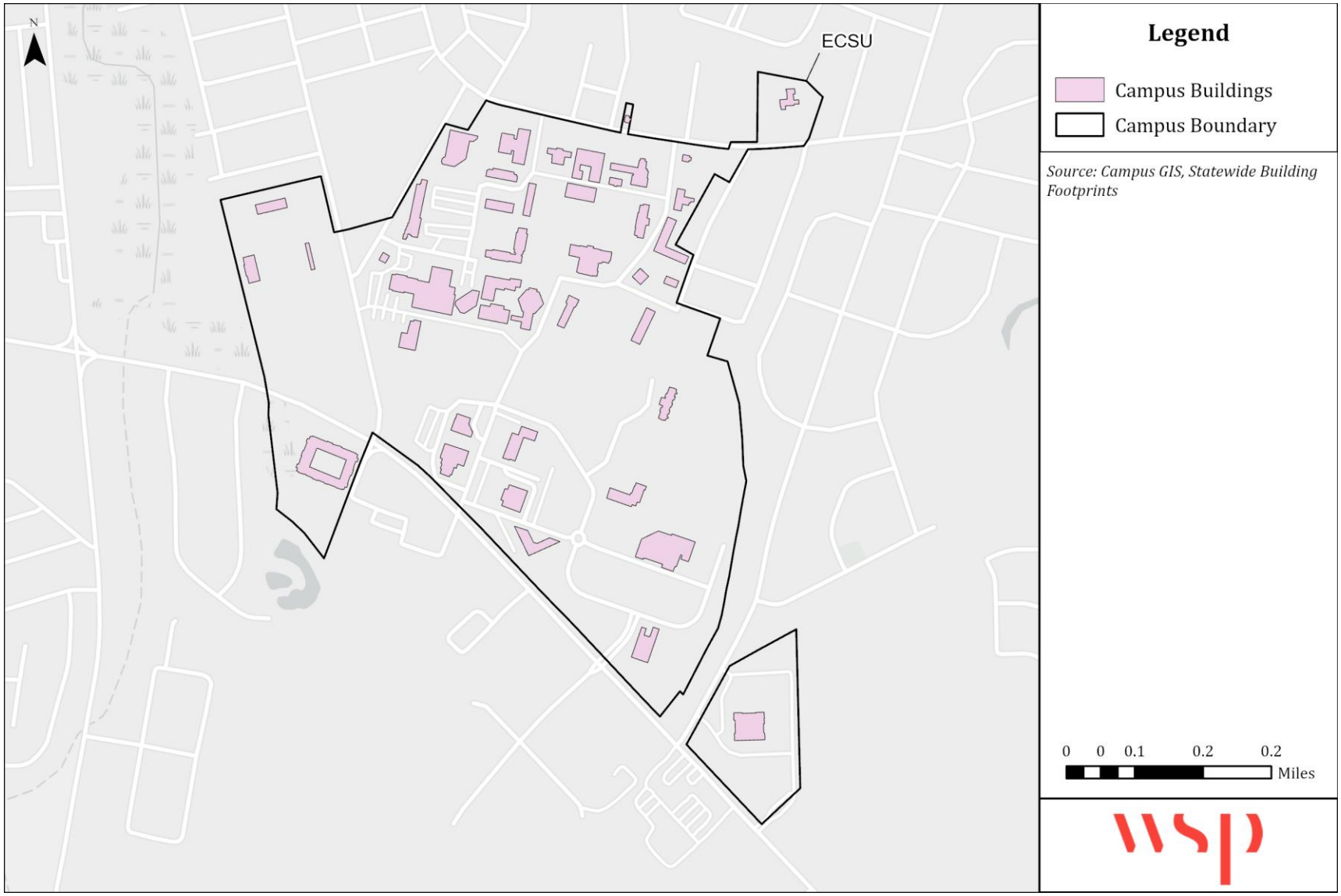
Students may also wish to take advantage of the historical sites in the greater Albemarle and southeastern Virginia areas. Williamsburg, Jamestown, Roanoke Island, Yorktown, several antebellum plantations, beaches and waterways are among sites within an easy drive from the campus.

United States Highways 17 and 158 make the city and the university easily accessible by automobile. City bus routes, hotels and motels are available to accommodate overnight visitors, and the university is just over an hour's drive from the Norfolk (Virginia) International Airport.

The university is situated on 114 acres which represent the campus proper. Another 68 acres comprise the former farm on Weeksville Road (N.C. 34); a 639-acre tract in Currituck County helps preserve the nation's diminishing wetlands and provides for educational research; and 35 acres serve residential or expansion purposes. There are also small sites in Utah and Virginia used, respectively, for geological instruction and institutional enhancement.

Figure B.1 provides a base map of the main campus. For more details on on-campus buildings and critical facilities, see Section B.3.

**Figure B.1 – ECSU Campus Base Map**



## B.2.2 Geography and Climate

Elizabeth City is part of the low-lying Coastal Plain of North Carolina, which slopes from about 300 feet in elevation at the Piedmont to sea level at the coast. Elizabeth City is relatively flat and sits approximately 12 feet above sea level. Elizabeth City State University is conveniently located just fifty miles from the Atlantic coast beaches. In recent years, Elizabeth City was named one of the "100 Best Small Towns in America" and was additionally ranked as one of the best places to live on the East Coast. Elizabeth City is located on the Pasquotank River, in eastern North Carolina. Elizabeth City has a mild climate, with maximum average temperature dropping to 50 degrees Fahrenheit in January and climbing to 87 degrees Fahrenheit in July. The annual precipitation for the city is approximately 48 inches per year. Average annual temperature and precipitation for Pasquotank County are shown in Figure B.2 and Figure B.3.

**Figure B.2 – Average Annual Temperature, Pasquotank County**

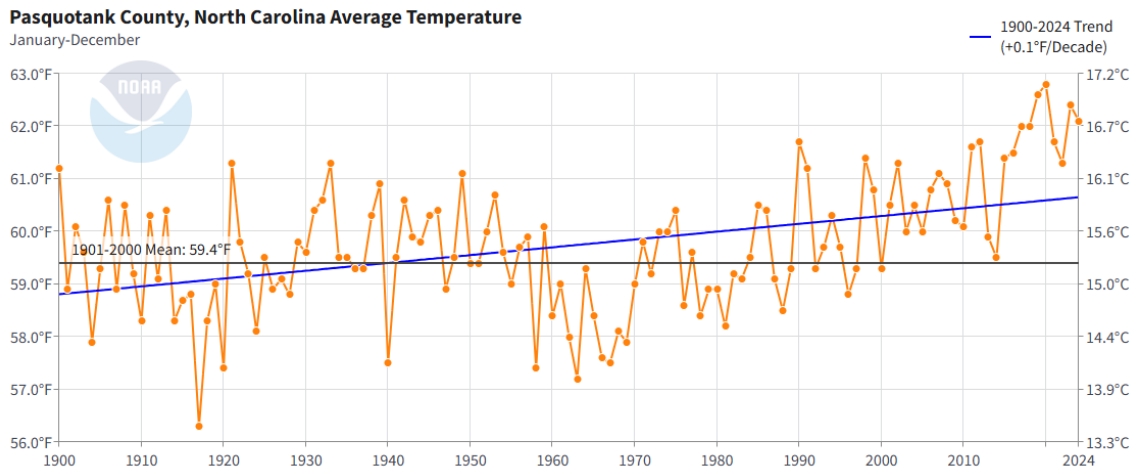
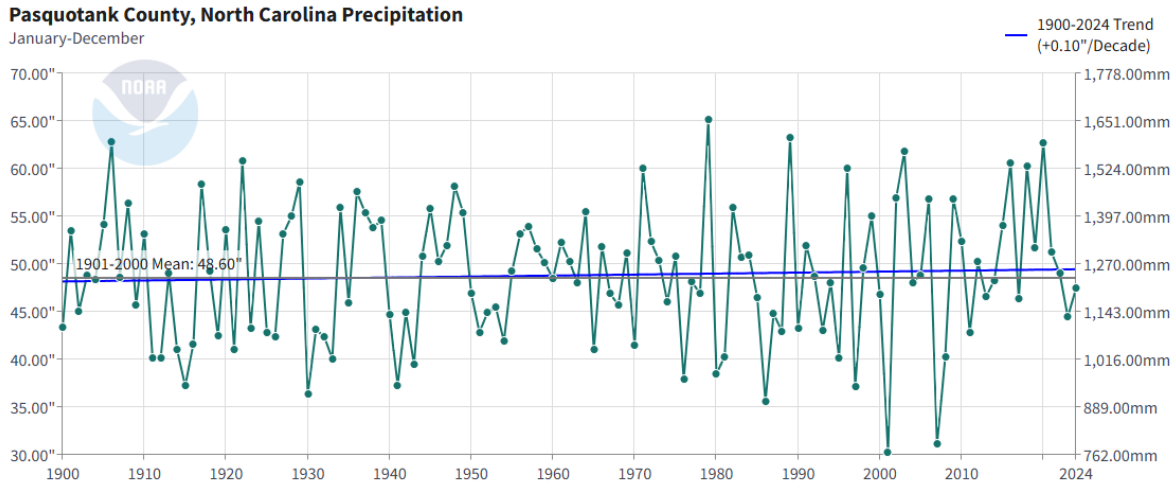



**Figure B.3 – Average Annual Precipitation, Pasquotank County**



## B.2.3 Population and Demographics

Table B.3 provides population counts for Elizabeth City State University from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to ECSU's website, as of fall 2025 the campus has a student to faculty ratio of 20 to 1.

**Table B.3 – Population Counts for Elizabeth City State University, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **2,358** |
| *Undergraduate Students* | 2,252 |
| *Graduate Students* | 106 |
| *Full-Time Students* | 2,082 |
| *In-State Residency* | 1,720 |
| *Out-of-State Residency* | 638 |

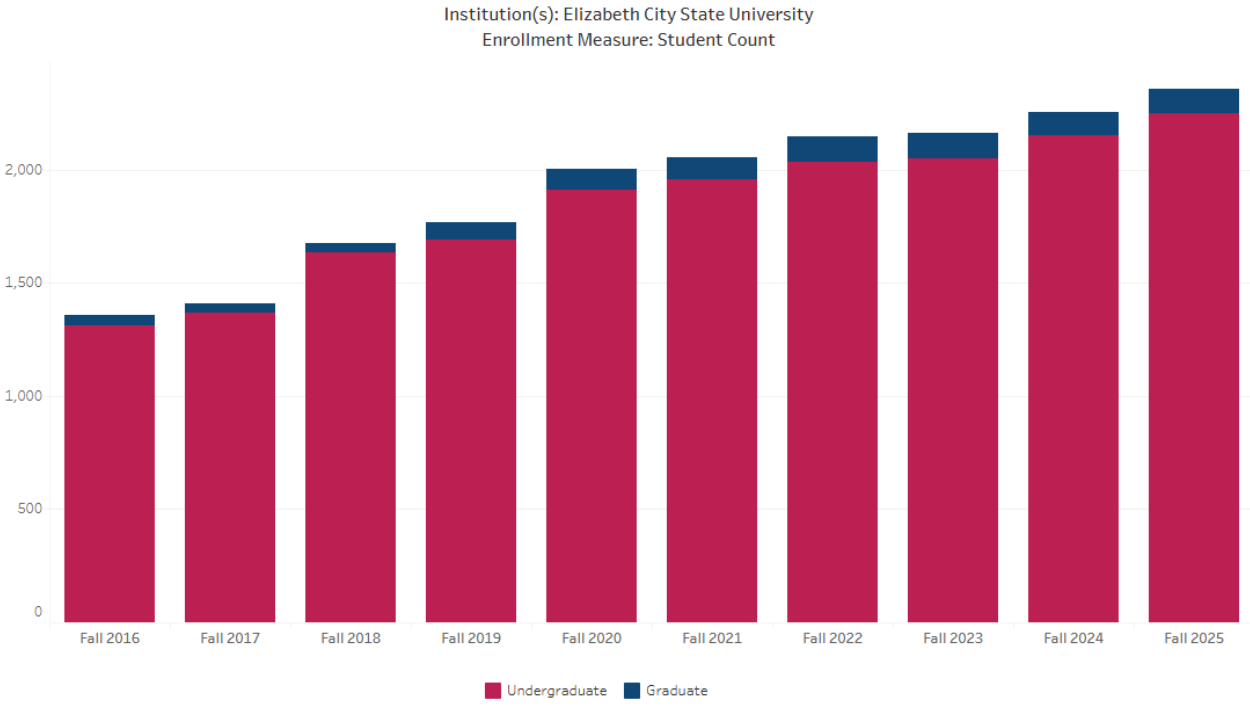
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Pasquotank, Wake, and Mecklenburg Counties as well as other counties located in the northeast region of North Carolina. Approximately 17.6% of all enrolled students come from Pasquotank County.

Among the ECSU student population, the most popular majors for undergraduates were Transportation and Materials Moving, Business Management, and Multi/Interdisciplinary Studies. Only three master's programs are offered at ECSU which are: Mathematics and Statistics, Education, and Biological and Biomedical Sciences.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure B.4. Enrollment has increased slightly over the last five years.

**Figure B.4 – ECSU Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 1,310 | 1,368 | 1,636 | 1,692 | 1,910 | 1,956 | 2,033 | 2,048 | 2,154 | 2,252 |
| Graduate | 47 | 43 | 41 | 77 | 92 | 98 | 116 | 117 | 104 | 106 |
| **Total** | **1,357** | **1,411** | **1,677** | **1,769** | **2,002** | **2,054** | **2,149** | **2,165** | **2,258** | **2,358** |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table B.4.

**Table B.4 – ECSU Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 6 | 0.3% |
| Black or African American | 1,440 | 61.1% |
| Hispanic or Latino | 149 | 6.3% |
| Two or More Races | 143 | 6.1% |
| Asian | 15 | 0.6% |
| Native Hawaiian or Other Pacific Islander | 1 | 0.0% |
| White | 468 | 19.8% |
| Race/Ethnicity Unknown | 99 | 4.2% |
| U.S. Nonresident | 37 | 1.6% |

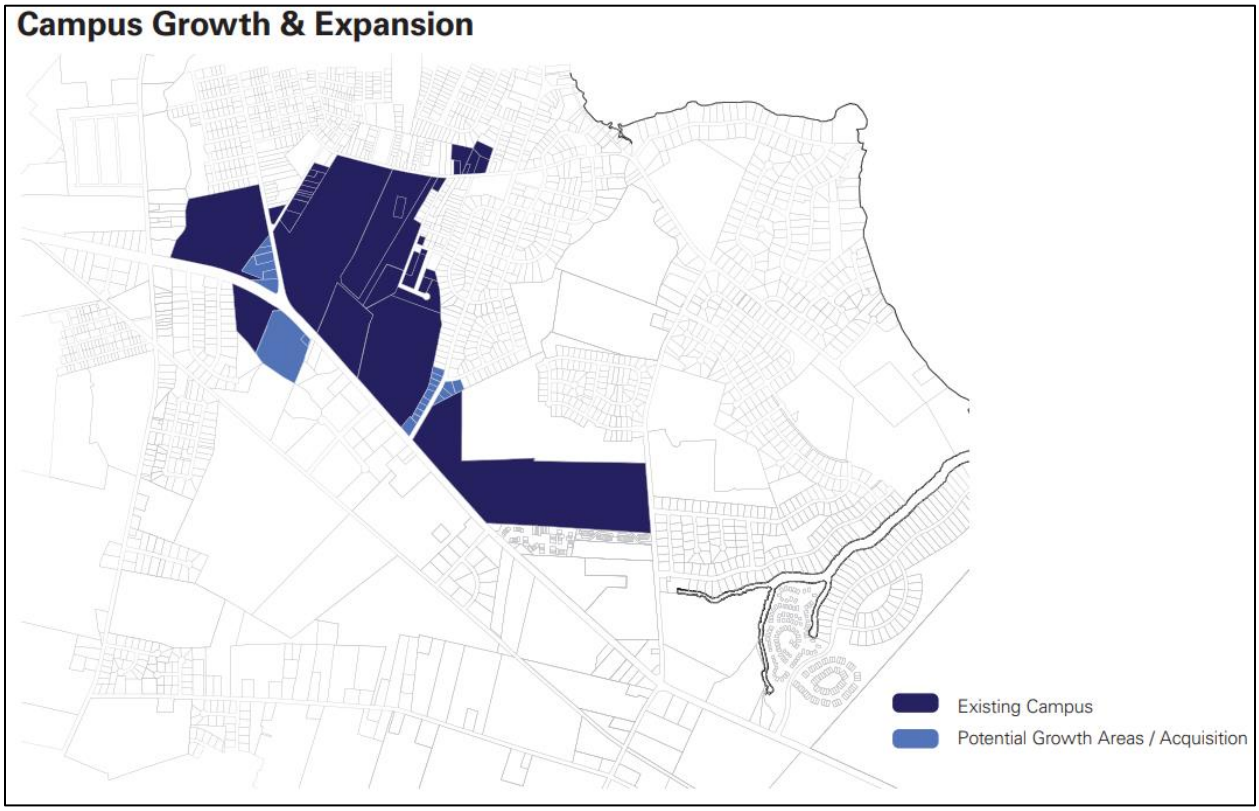
Source: UNC System Interactive Data Dashboards

## B.2.4 Growth and Development Trends

Articles on ECSU's website mention several building and renovation updates including a new residence hall, dining hall, aviation building, G.R. Little Library, and a new sky bridge across

Weeksville Road. The 2022 ECSU Campus Master Plan highlights potential areas of growth and expansion as shown in Figure B.5.

**Figure B.5 – ECSU Areas of Future Growth and Expansion**




Source: 2022 ECSU Campus Master Plan

# B.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the ECSU campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## B.3.1 Building Exposure

Table B.5 provides total building exposure for the campus, which was estimated by summarizing building footprints and property values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table B.5 – ECSU Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 5 | $3,229,622.84 |
| Educational/Extracurricular | 30 | $58,977,099.79 |
| Housing | 9 | $22,612,735.96 |
| **Total** | **44** | **$84,819,458.59** |

Source: NCEM iRisk database

## B.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by ECSU's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the ECSU HMPC maintained most critical facilities from the previous plan and made some revisions to account for changes to the building inventory. Factors considered for this ranking included:

- the building's use for emergency response,
- the building's use for essential campus operations,
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for ECSU are listed below:

- Robert L Vaughan Center
- KE White Graduate & Continuing Education Center
- C W Griffin Center
- Information Technology Center
- Marion Thorpe Administration
- Thomas-Jenkins Building
- STEM Complex
- Jimmy R Jenkins Science Complex
- Moore Hall
- EV Wilkins Academic Computing Center

C. W. Griffin Center and the Thorpe Administration Building serve as primary Emergency Operations Centers for the campus. The STEM building will serve as a backup EOC. The Thomas-Jenkins Building provides essential campus functions, including only telecommunications center on campus, as well as maintenance and public safety functions.

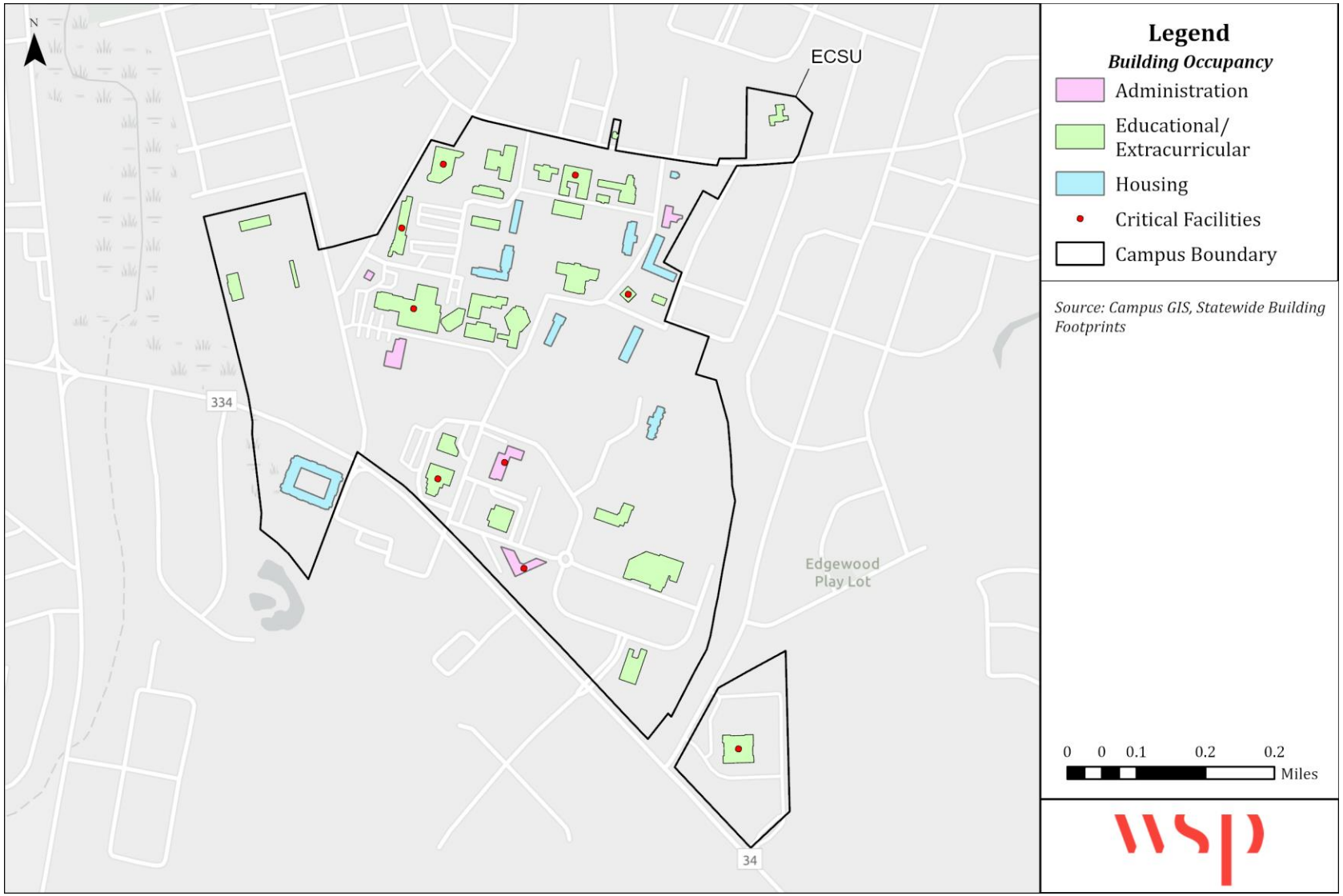
The Robert L Vaughan Center and KE White Center serve as shelters and provide essential sheltering services. The KE White Center is used by the Red Cross and also serves as a backup phone center.

The STEM building and Vaughan Center store hazardous materials on site. The STEM building also houses aviation simulators and will be the home of an EM/UAS lab. The Jimmy Jenkins Complex has the potential to be used for sensitive research and may store specialized chemicals or equipment.

Moore Hall is significant as a historical building. The Thorpe Administration building, STEM building, KE White Center, and Vaughan Center house important records, artwork, and/or artifacts of significance to the campus. The Thorpe Building is also significant as the face of ECSU.

Campus building classifications and critical facilities are shown in Figure B.6.

**Figure B.6 – ECSU Map of Buildings and Critical Facilities**



# B.4 Hazard Identification & Risk Assessment

## B.4.1 Hazard Identification

To identify a full range of hazards relevant to ECSU, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the ECSU Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table B.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table B.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP ECSU Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Extreme Heat | Yes | No |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | No |
| Drought | Yes | No |
| Tornadoes/Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | No |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | Yes |

ECSU's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Pasquotank County was used to approximate past events that may have affected the ECSU campus. The NCEI database contains 204 records of storm events that occurred in Pasquotank County in the 25-year period from 2000 through 2024. Table B.7 summarizes these events.

**Table B.7 – NCEI Severe Weather Data for Pasquotank County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Blizzard | 1 | $0 | $0 | 0 | 0 |
| Coastal Flood | 3 | $0 | $0 | 0 | 0 |
| Excessive Heat | 1 | $0 | $0 | 0 | 0 |
| Flash Flood | 18 | $5,000 | $0 | 0 | 0 |
| Flood | 6 | $250,000 | $0 | 0 | 0 |
| Frost/Freeze | 3 | $0 | $0 | 0 | 0 |
| Funnel Cloud | 2 | $0 | $0 | 0 | 0 |
| Hail | 17 | $0 | $0 | 0 | 0 |
| Heat | 1 | $0 | $0 | 0 | 0 |
| Heavy Rain | 32 | $0 | $0 | 0 | 0 |
| High Wind | 7 | $136,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 2 | $5,000,000 | $500,000 | 0 | 0 |
| Lightning | 3 | $15,000 | $0 | 0 | 2 |
| Strong Wind | 7 | $31,000 | $0 | 0 | 0 |
| Thunderstorm Wind | 54 | $209,000 | $1,000 | 0 | 0 |
| Tornado | 8 | $1,615,000 | $0 | 0 | 2 |
| Tropical Storm | 8 | $550,000 | $0 | 0 | 0 |
| Winter Storm | 19 | $0 | $0 | 0 | 0 |
| Winter Weather | 12 | $0 | $0 | 0 | 0 |
| **Total** | **204** | **$7,811,000** | **$501,000** | **0** | **4** |

Source: National Center for Environmental Information Events Database, retrieved November 2025
Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Pasquotank County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Pasquotank County has been designated in 16 major disaster declarations, as detailed in Table B.8, and 13 emergency declarations, as detailed in Table B.9.

**Table B.8 – FEMA Major Disaster Declarations, Pasquotank County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 1-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-234-NC | 10-Feb-68 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard Of 96 | N/A | N/A | N/A |
| DR-1240-NC | 27-Aug-98 | Hurricane | Hurricane Bonnie | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7790 | $21,289,504 | $18,285,917 |
| DR-4019-NC | 31-Aug-11 | Hurricane | Hurricane Irene | 10270 | $37,238,655 | $88,847,065 |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28971 | $98,842,213 | $291,092,954 |
| DR-4465-NC | 4-Oct-19 | Hurricane | Hurricane Dorian | N/A | N/A | $28,138,271 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |

Source: FEMA Disaster Declarations Summary, October 2025

Note: Number of applications approved, and all dollar values represent totals for all counties included in disaster declaration.

### Table B.9 – FEMA Emergency Declarations, Pasquotank County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 5-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3254-NC | 15-Sep-05 | Hurricane | Hurricane Ophelia |
| EM-3314-NC | 2-Sep-10 | Hurricane | Hurricane Earl |
| EM-3327-NC | 25-Aug-11 | Hurricane | Hurricane Irene |
| EM-3380-NC | 7-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 4-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 2-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 1-Oct-22 | Hurricane | Hurricane Ian |
| EM3608-NC | 6-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table B.10 summaries the determination made for each hazard.

### Table B.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in the 2021 ECSU Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in the 2021 ECSU Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Modeled building damages in iRisk database show some vulnerability and potential for losses due to earthquake |
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Pasquotank County has had 6 disaster declarations for hurricanes, which may have involved flooding. |
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Landslide was included in the 2021 ECSU Annex but was determined to present no risk to the campus |
| Hurricane & Coastal Hazards | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Pasquotank County has had 6 disaster declarations for hurricanes. |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Severe Winter Weather | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Pasquotank County has had two disaster declarations related to snow and ice. |
| Tornadoes & Thunderstorms | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Up to an F3 tornado has passed within 10 miles of campus; a past tornado track when through the campus |
| Wildfire | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ There are fixed facility sites and transportation routes with hazardous materials in/near the campus |
| Infectious Disease | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in the 2021 ECSU Annex<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |
| Terrorism | No | ▪ Not included in the 2021 ECSU Annex<br>▪ HMPC did not express interest in evaluating this hazard; best addressed by State and federal planning and emergency response |

# B.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on ECSU's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record is used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Pasquotank County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;

- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Albemarle Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Pasquotank County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table B.11 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Earthquake** | USGS, NCEI | County | iRisk | Campus |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricanes & Coastal Hazards** | NHC | County | iRisk | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the ECSU planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table B.12 on the following page.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile. The results of the risk assessment and overall PRI scoring are provided in Section B.5.11 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table B.12 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | 1 | 30% |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | 2 | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | 3 | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | 4 | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF | 1 | 30% |
| | **LIMITED** | MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF | 2 | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 | 3 | |
| | **CATASTROPHIC** | HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS. | 4 | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | 1 | 20% |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | 2 | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | 3 | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | 4 | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | 1 | 10% |
| | **12 TO 24 HRS** | SELF DEFINED | 2 | |
| | **6 TO 12 HRS** | SELF DEFINED | 3 | |
| | **LESS THAN 6 HRS** | SELF DEFINED | 4 | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | 1 | 10% |
| | **LESS THAN 24 HRS** | SELF DEFINED | 2 | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | 3 | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | 4 | |

## B.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

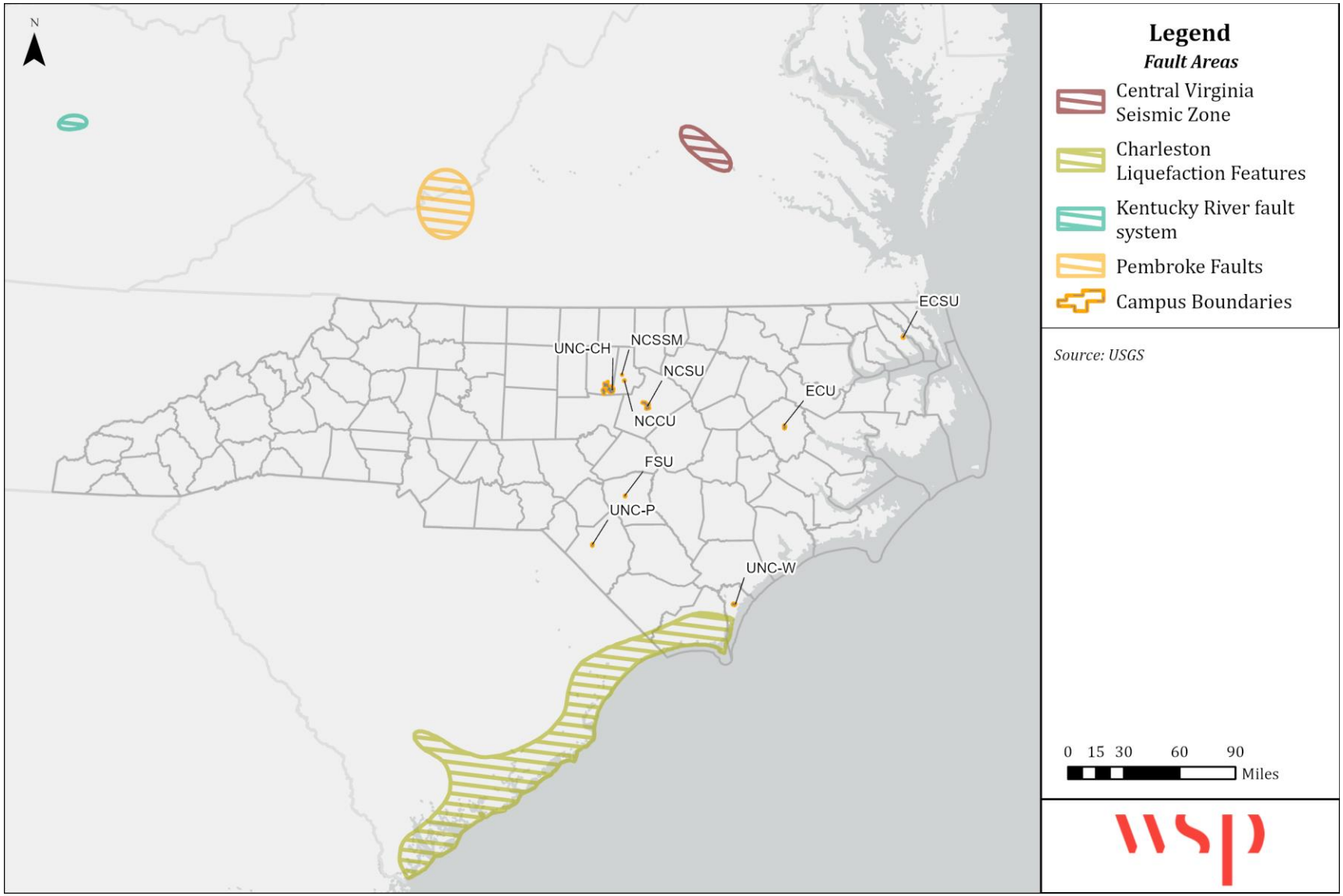
Figure B.7 reflects the quaternary faults that present an earthquake hazard for the ECSU planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Pasquotank County is likely to be felt across the ECSU campus.

*Spatial Extent: 4 – Large*

**Figure B.7 – U.S. Quaternary Faults**



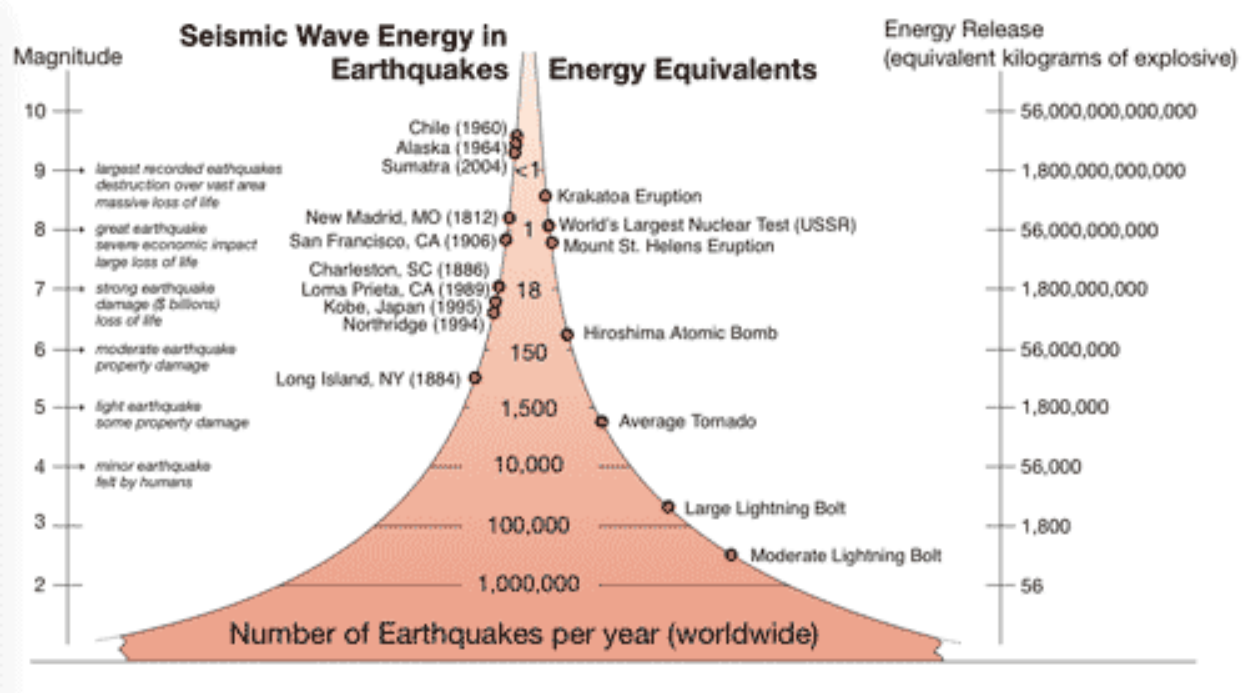
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure B.8.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table B.13 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure B.8 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table B.13 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |

| MMI | Shaking | Description/Damage |
|---|---|---|
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of all historical earthquakes of a magnitude 2.5 and greater. One of the closest historic earthquake events to occur near ECSU included one event in the town of Bayboro, North Carolina within Pamlico County. This historic event was a 2.9 magnitude earthquake on February 11, 2014. Table B.14 lists six historical earthquakes that have occurred within 100 miles of ECSU, and Figure B.9 shows the epicenter of these events.

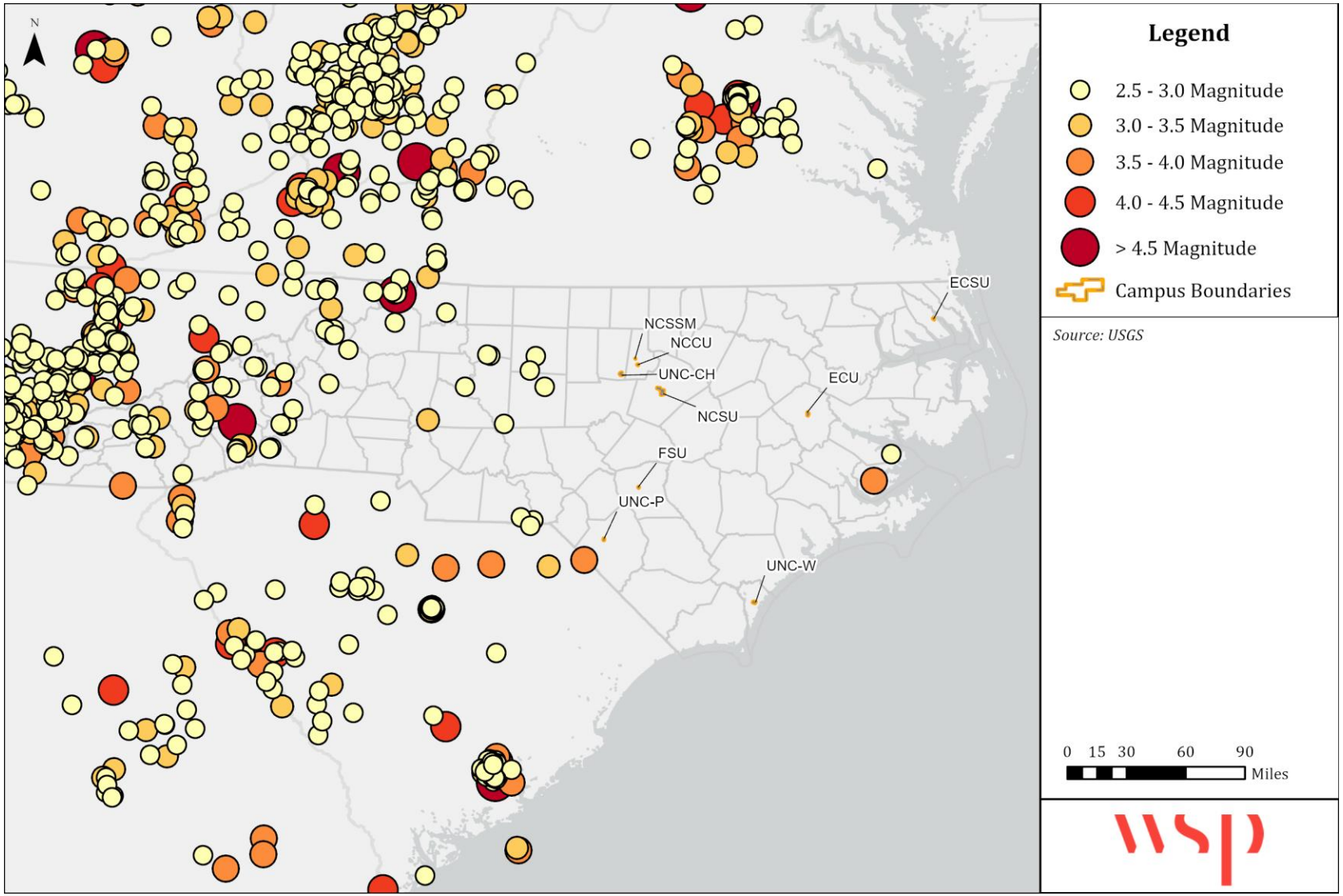
**Table B.14 – Historical Earthquakes within 100 Miles of ECSU, 1900-2024**

| Date of Occurrence | Location | MMI (Intensity) |
|---|---|---|
| 12/21/1985 | 2 km NNW of Glen Allen, Virginia | 2.6 |
| 12/10/1986 | 2 km SSE of Lakeside, Virginia | 2.5 |
| 8/6/1994 | 4 km SSW of Bayboro, North Carolina | 3.6 |
| 8/3/1995 | 13 km N of Williamsburg, Virginia | 2.9 |
| 4/29/2000 | 3 km N of Glen Allen, Virginia | 2.5 |
| 2/11/2014 | 7 km NW of Hobucken, North Carolina | 2.9 |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, no earthquakes were felt in and around Elizabeth City.

**Figure B.9 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

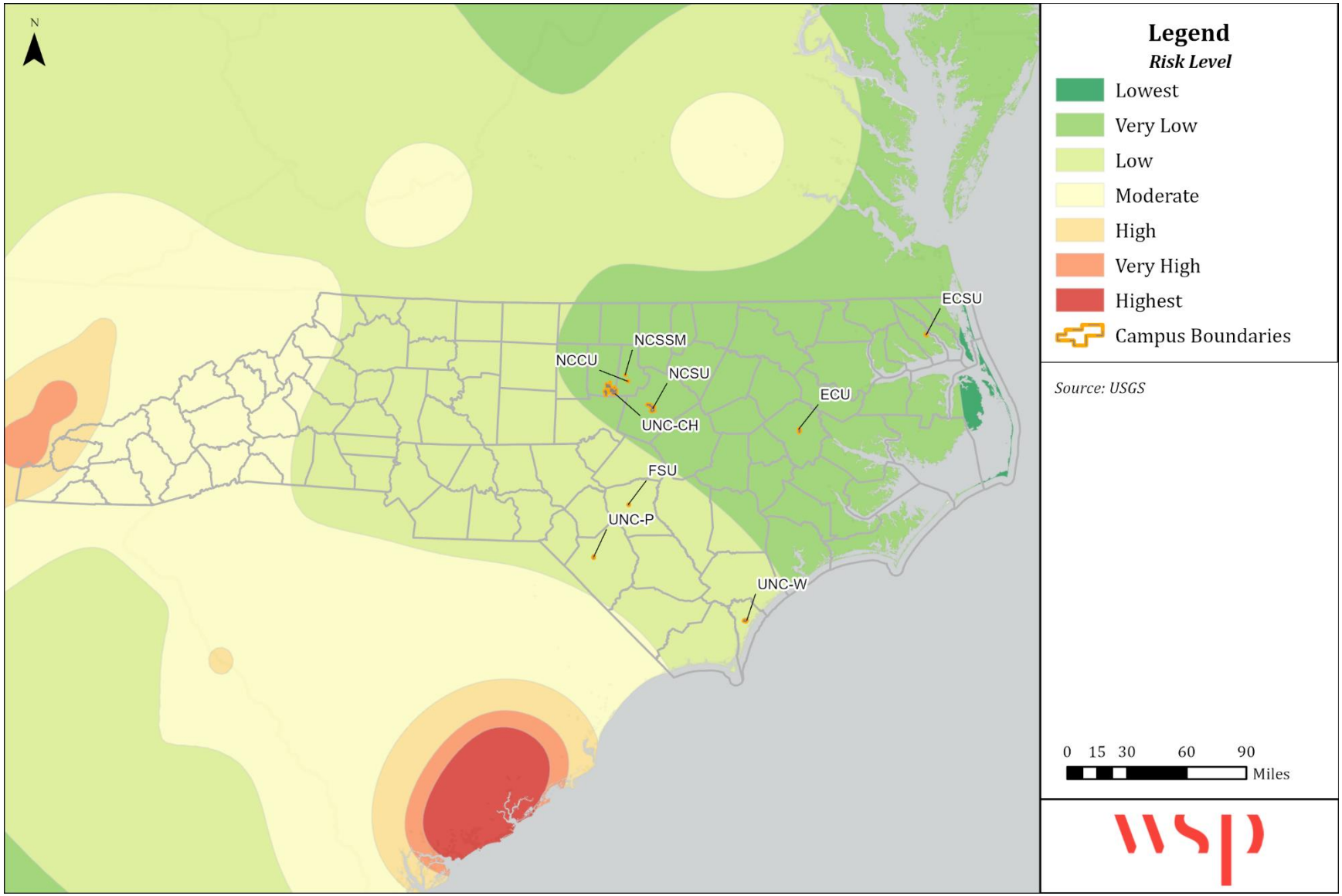
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure B.10 reflects the seismic hazard for Pasquotank County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the recurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Pasquotank County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting ECSU is unlikely.

*Probability: 1 – Unlikely*

**Figure B.10 – Seismic Hazard Information for Pasquotank County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on ECSU's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also damage infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRISK analysis, a 500-year earthquake event could cause $12,201 of estimated total building damages.

Pasquotank County has not been impacted by an earthquake with more than a low intensity, so damage to the built environment is unlikely. Table B.15 details the estimated buildings impacted by a 500- and 1,000-year earthquake event. The iRISK analysis estimated that a 250-year earthquake event wouldn't result in any building damage to ECSU campus.

**Table B.15 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **500-Year Earthquake Event** | | | |
| Administration | $226.12 | $203.49 | $429.61 |
| Educational | $3,889.73 | $4,161.10 | $8,050.83 |
| Housing | $2,167.72 | $1,553.19 | $3,720.91 |
| **Total** | **$6,283.57** | **$5,917.78** | **$12,201.35** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $1,201.34 | $1,605.05 | $2,806.39 |
| Educational | $21,695.16 | $28,831.87 | $50,527.03 |
| Housing | $11,510.54 | $9,453.06 | $20,963.60 |
| **Total** | **$34,407.04** | **$39,889.98** | **$74,297.02** |

Source: NCEM iRISK Database

Note: Analysis results estimated that a 250-year earthquake event wouldn't result in any building damages to ECSU campus.

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Pasquotank County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type of damage is unlikely based on USGS seismic probability data and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the ECSU campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at ECSU have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statements

- While earthquakes are an unlikely hazard event for the ECSU campus, an estimated $12,201 of total building damage could occur in the case of a 500-year earthquake event.

## B.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experienced heat index temperatures above 100°F. Table B.16 provides counts of heat index values by threshold recorded from 2001-2024 at the Elizabeth City Regional Airport in Pasquotank County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Elizabeth City experiences an average of 85 hours per year with heat index values at or above 100°F.

*Impact: 3 – Critical*

**Table B.16 – Historical Heat Index County, Elizabeth City Regional Airport, Pasquotank County, NC, 2000-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2000 | 25 | 11 | 0 | 0 | 36 |
| 2001 | 46 | 12 | 3 | 0 | 61 |
| 2002 | 68 | 16 | 12 | 0 | 96 |
| 2003 | 53 | 10 | 7 | 0 | 70 |
| 2004 | 43 | 10 | 1 | 0 | 54 |
| 2005 | 48 | 15 | 4 | 0 | 67 |
| 2006 | 34 | 14 | 4 | 0 | 52 |
| 2007 | 19 | 9 | 6 | 0 | 34 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2008 | 24 | 0 | 0 | 0 | 24 |
| 2009 | 31 | 0 | 0 | 0 | 31 |
| 2010 | 94 | 27 | 19 | 1 | 141 |
| 2011 | 97 | 27 | 14 | 0 | 138 |
| 2012 | 90 | 50 | 25 | 2 | 167 |
| 2013 | 18 | 0 | 0 | 0 | 18 |
| 2014 | 16 | 0 | 0 | 0 | 16 |
| 2015 | 53 | 8 | 0 | 0 | 61 |
| 2016 | 97 | 34 | 3 | 0 | 134 |
| 2017 | 66 | 25 | 12 | 0 | 103 |
| 2018 | 115 | 20 | 0 | 0 | 135 |
| 2019 | 83 | 25 | 3 | 0 | 111 |
| 2020 | 124 | 61 | 36 | 5 | 226 |
| 2021 | 63 | 16 | 0 | 0 | 79 |
| 2022 | 81 | 13 | 1 | 0 | 95 |
| 2023 | 67 | 16 | 3 | 1 | 87 |
| 2024 | 69 | 31 | 1 | 0 | 101 |
| **Sum** | **1,524** | **450** | **154** | **9** | **2,137** |
| **Average** | **61** | **18** | **6** | **0** | **85** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

NCEI reported two heat-related incidents in Pasquotank County between 2000 and 2024, which are summarized below.

- **July 21-23, 2011** – An extended period of excessive heat and humidity occurred across most of northeast North Carolina from July 21st to July 23rd. High temperatures ranged from 96 to 103 degrees during the afternoons, with heat index values ranging from 110 to 119. Overnight lows only fell into the lower 70s to lower 80s.
- **July 5 – July 8, 2012** – High temperatures ranged from the mid-90s to lower 100s, and low temperatures ranged from the mid-70s to lower 80s across the county from July 5th through July 8th.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Elizabeth City Regional Airport in Pasquotank County, NC. Based on 25 years of data (2001 to 2024), the Elizabeth City station averages 21.5 days per year with a heat index at or above 100 degrees.

*Probability: 4 – Highly Likely*

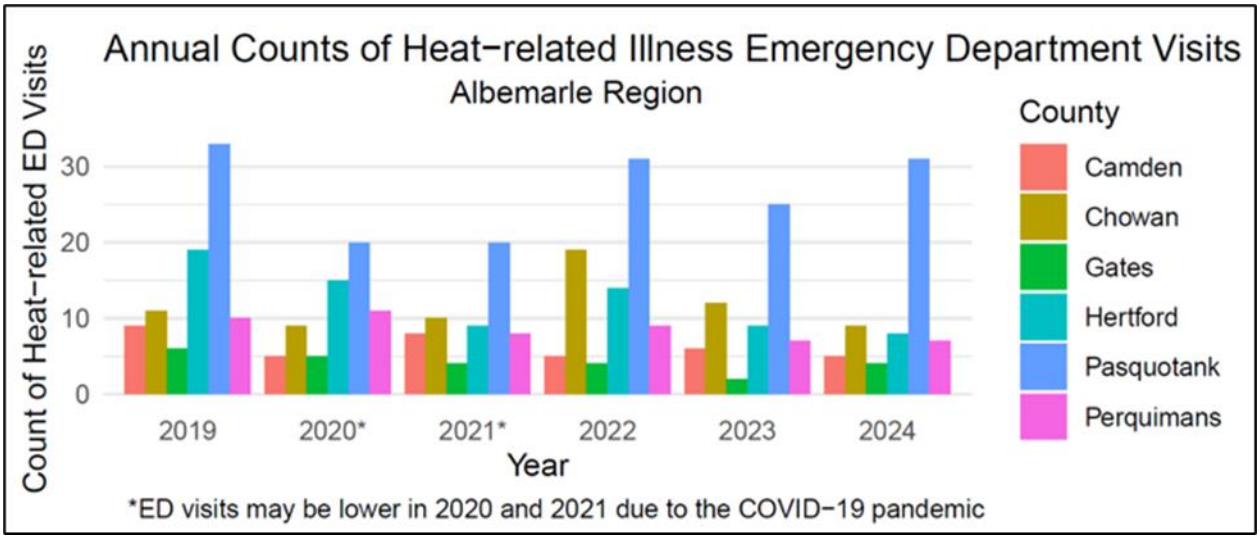
## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

Emergency department visits for heat related illnesses notably increase when heat index temperatures exceed 100°F. Using public health syndromic surveillance system data from NC DETECT, shows the annual count of emergency department visits for heat-related illness in Pasquotank County. Between 2019 and 2024, Pasquotank County experienced between 20 to 35 heat-related emergency department visits per year.

**Figure B.11 – Annual Costs of Heat-Related Illness Emergency Department Visits, Pasquotank County**




Source: North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC Detect)

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat-induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized “heat islands.” Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statements

- ECSU is located in Pasquotank County, which currently averages 61 hours per year with heat index values at or above 100°F and there is a 100% annual chance of heat index values meeting nor exceeding 100°F in any given year.

## B.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Minor | Small | 6 to 12 hrs | Less than 1 week | 2.5 |

### Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the ECSU campus using the FIRM dated December 21, 2018. Figure B.12 reflects the 2018 mapped flood insurance zones. Table B.17 summarizes some of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table B.17 intersect the ECSU campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Elizabeth City and the ECSU campus. Flood risk is not limited to the 1%-annual-chance floodplain.

Although this assessment focuses on riverine flooding, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. Data was not available to evaluate the location or extent of stormwater flooding on campus.

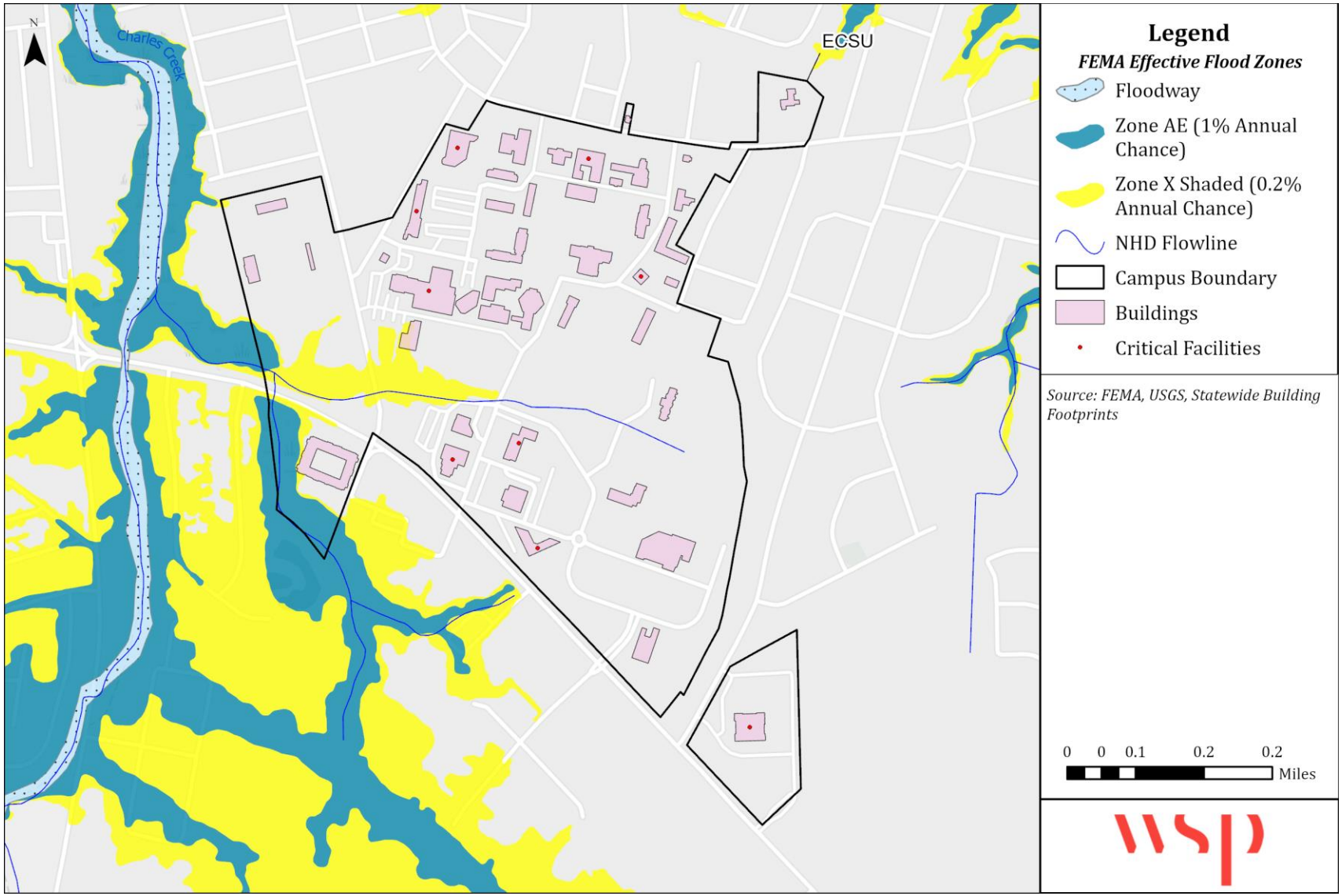
*Spatial Extent: 2 – Small*

**Table B.17 – Mapped Flood Insurance Zones**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 |

| Zone | Description |
|---|---|
| | and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure B.12 – FEMA Flood Hazard Areas in ECSU's Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Approximately 2.4 percent of the ECSU Campus falls within the SFHA. The majority of the campus, almost 93 percent, is outside of any floodplain. Table B.18 provides a summary of the ECSU campus' total area by flood zone on the 2018 effective DFIRM. Figure B.13 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

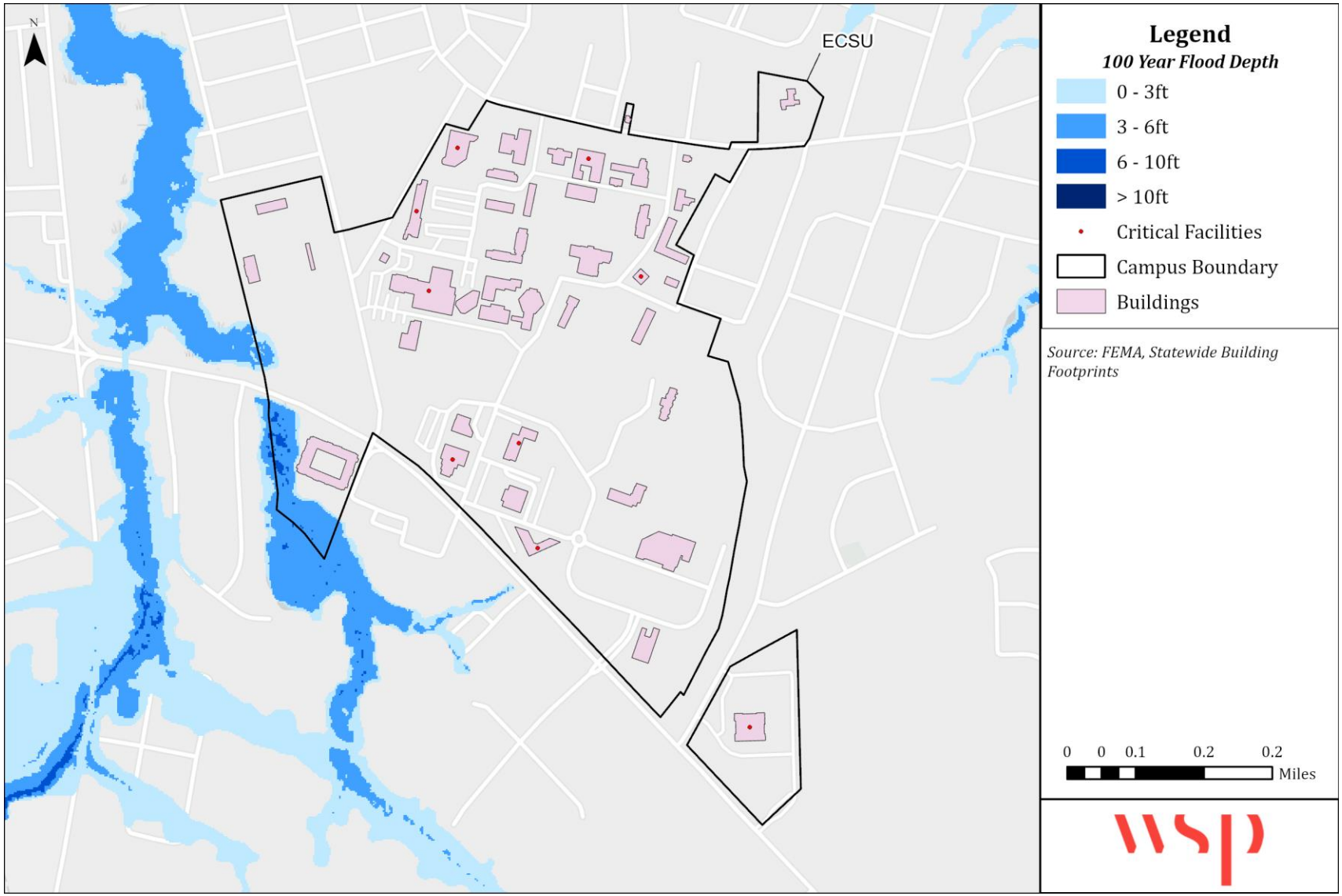
*Impact: 1 – Minor*

**Table B.18 – Flood Zone Acreage on ECSU Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 4.4 | 2.4% |
| 0.2% Annual Chance Flood Hazard | 8.5 | 4.6% |
| Unshaded X | 172.1 | 93.1% |
| **Total** | **184.9** | **--** |
| **SFHA Total** | **4.4** | **2.4%** |

Source: FEMA 2018 DFIRM

**Figure B.13 – Flood Depth, 1-Percent-Annual-Chance Flood, ECSU Campus**



## Historical Occurrences

Table B.19 details the historical occurrences of flooding for Elizabeth City and Pasquotank County identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 43 recorded flood-related events occurred on 32 separate days in Elizabeth City from 2000 to 2024 causing an estimated $5,000 in property damage, with no injuries, fatalities, or crop damage. Additional property damage has likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table B.19 – NCEI Records of Flooding, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| ELIZABETH CITY | 8/9/2005 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 8/30/2006 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 9/1/2006 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/6/2008 | 0/0 | $5,000 | $0 |
| ELIZABETH CITY | 9/6/2019* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 6/30/2024* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/18/2024* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 8/10/2024 | 0/0 | $0 | $0 |
| **Flood** | | | | |
| (ECG)ELIZABETH CITY | 8/27/2011 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/24/2018 | 0/0 | $0 | $0 |
| **Heavy Rain** | | | | |
| (ECG)ELIZABETH CITY | 10/24/2007 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 12/10/2008 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 11/11/2009 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 3/29/2010 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/11/2013 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 5/16/2014 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/16/2014 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 11/9/2015 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 9/19/2016 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 10/8/2016 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/28/2017 | 0/0 | $0 | $0 |
| ECG CST GRD AIR STN | 7/29/2017* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 8/13/2017 | 0/0 | $0 | $0 |
| (ECG)ELIZABETH CITY | 9/6/2019* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 10/20/2019* | 0/0 | $0 | $0 |
| ELIZABETH CITY | 8/15/2020 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 9/17/2020 | 0/0 | $0 | $0 |

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| ELIZABETH CITY | 11/11/2020 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 9/22/2023 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/18/2024 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 7/19/2024 | 0/0 | $0 | $0 |
| ELIZABETH CITY | 9/16/2024 | 0/0 | $0 | $0 |
| **Total** | | **0/0** | **$5,000** | **$0** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on Elizabeth City and Pasquotank County:

- **September 1, 2006** – Numerous roads closed countywide. National Guard was rescuing people from houses due to flooding.
- **July 6, 2008** – Heavy rains from thunderstorms produced flash flooding across portions of northeast North Carolina. Five to six inches of water from heavy rains covered business Route 17 north of Elizabeth City. Old Highway 17 from 3 miles north of Elizabeth City to 5 miles north of Elizabeth City was flooded. Numerous vehicles were pulled off the road in several feet of water.
- **August 27, 2011** – Heavy rains associated with Hurricane Irene produced widespread low-land flooding across much of the county, including roadways which were washed out or closed. Storm total rainfall generally ranged from four to ten inches. Burnt Mills reported 7.80 inches of rain. Elizabeth City reported 7.50 inches of rain.
- **October 8, 2016** – Numerous roads were impassable or closed, and some small creeks or streams were out of their banks due to heavy rain causing flash flooding across much of the county.
- **July 24, 2018** – Areas of moderate to heavy rain associated with a trough of low pressure caused flooding across portions of northeast North Carolina. Numerous roads were flooded and closed for several days across much of the county due to heavy rain.
- **September 6, 2019** – Flash flooding was reported on several campus streets at Elizabeth City State University. In addition, several buildings reported having water in interior entrances. Several streets were flooded and closed in the Elizabeth City area. Also, vehicles were stranded. Flora Street was impassable due to flash flooding.
- **September 17, 2020** – Post Tropical Cyclone Sally tracking northeast across the Southeast United States and off the Mid Atlantic Coast produced heavy rain across portions of northeast North Carolina. Rainfall totals were between one inch and three inches across the county. Rainfall total of 2.23 inches was reported at ECG. Rainfall total of 2.11 inches was reported at (5.1 SSE) Elizabeth City.
- **September 23, 2022** – Tropical Storm Ophelia tracked northward across east central North Carolina and up through central Virginia from early Saturday morning, September 23rd into early Sunday morning, September 24th. The storm produced bands of heavy rain across much of northeast North Carolina. Rainfall total of 4.83 inches was reported at (7.7 SSW)

Elizabeth City. Rainfall total of 4.20 inches was reported at Elizabeth City RAWS. Rainfall total of 3.16 inches was reported at ECG.

- **June 30, 2024** – Scattered thunderstorms in advance of a cold front produced heavy rain which caused flash flooding across portions of northeast North Carolina. Standing water was reported on the roadway at the intersection of North Hughes Boulevard and West Route 158. Flooded roads were reported at the intersection of Church Street and Route 17 North, intersection of Hughes Boulevard and Halstead Boulevard, Culpepper Street, and the Stockbridge neighborhood.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for hurricanes, tropical storms, and flood declared between 1954 and 2024. Pasquotank County has had six FEMA Major Disaster Declarations for Hurricanes in 1998, 1999, 2003, 2011, 2016, and 2019 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The ECSU campus has some area of land in FEMA-mapped flood hazard areas. This delineation is a useful way to identify the most at-risk areas, but the City of Elizabeth City and the ECSU campus are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Pasquotank County, and impacts from past flood events have been noted by NCEI. NCEI reports 43 flood-related events in the 24-year period from 2000-2019, which equates to an annual probability greater than 100% for Elizabeth City alone. Therefore, the overall probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

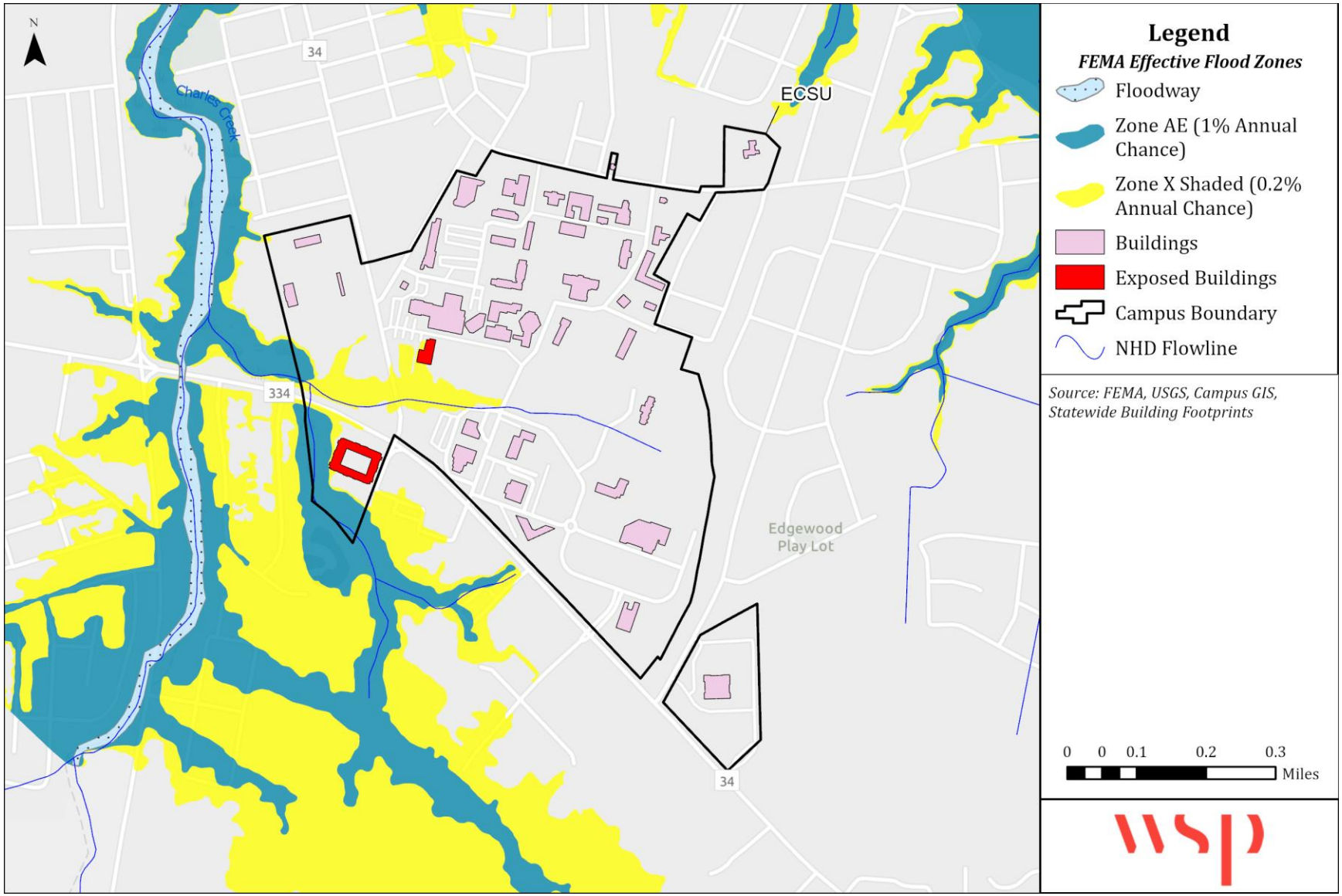
### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. In total, there are 44 buildings on ECSU's campus; of these, 2 buildings are located within the SFHA. These were the buildings evaluated as part of this analysis.

Flood damage is directly related to the depth of flooding by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a specific percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure B.13 depicts the depth of flooding that can be expected within ECSU's campus during the 1-percent-annual-chance flood event.

The two exposed buildings are shown in Figure B.14 on the following page. Each of these buildings has a first-floor elevation that is higher than the modeled 1% annual chance flood water surface elevation. Therefore, no estimated losses are expected from the 1% annual chance flood.

**Figure B.14 – Buildings Exposed to Flood Risk on ECSU Campus**



## People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.

- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths in Pasquotank County caused by flood events.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

The corner of a residence building intersects a very small portion of the SFHA. However, the first-floor elevation (FFE) of the structure that intersect the SFHA is higher than the flood elevation of the 1%-annual-chance flood zone, so no loss estimates were generated for these structures.

None of the critical facilities identified for ECSU are located within the 1%-annual-chance floodplain, therefore there is no estimated damage.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the ECSU Facilities Management works to

maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statements

- The 1%- annual-chance floodplain extends onto only 2.4 percent of the ECSU campus. There are no loss estimates for structures within the SFHA. Only two structures intersect the SFHA and these structures have a FFE higher than the flood elevation level for the 1%-annual-chance flood.
- There are no critical facilities in the SFHA.
- Flooding is not limited to the SFHA. Localized flooding can still impact facilities, roadways, and other locations on campus.
- In 2019, a flash flood was reported on several campus streets at Elizabeth City State University.

## B.5.4 Hurricane & Coastal Hazards

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |

### Location

Storm surges, or storm floods, are limited to the coastal counties of North Carolina. ECSU is located close to the coast and is therefore impacted by the storm surges of all five hurricane categories. Figure B.15 through Figure B.19 show the estimated worst case storm surge extents for hurricane categories 1-5 at ECSU. The entire campus could be completely inundated during Category 4 and Category 5 storm surge events. Additionally, hurricane winds can impact the entire campus, so the spatial extent was determined to be large.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table B.20), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table B.20 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Figure B.15 – Category 1 Storm Surge Inundation Areas, ECSU**

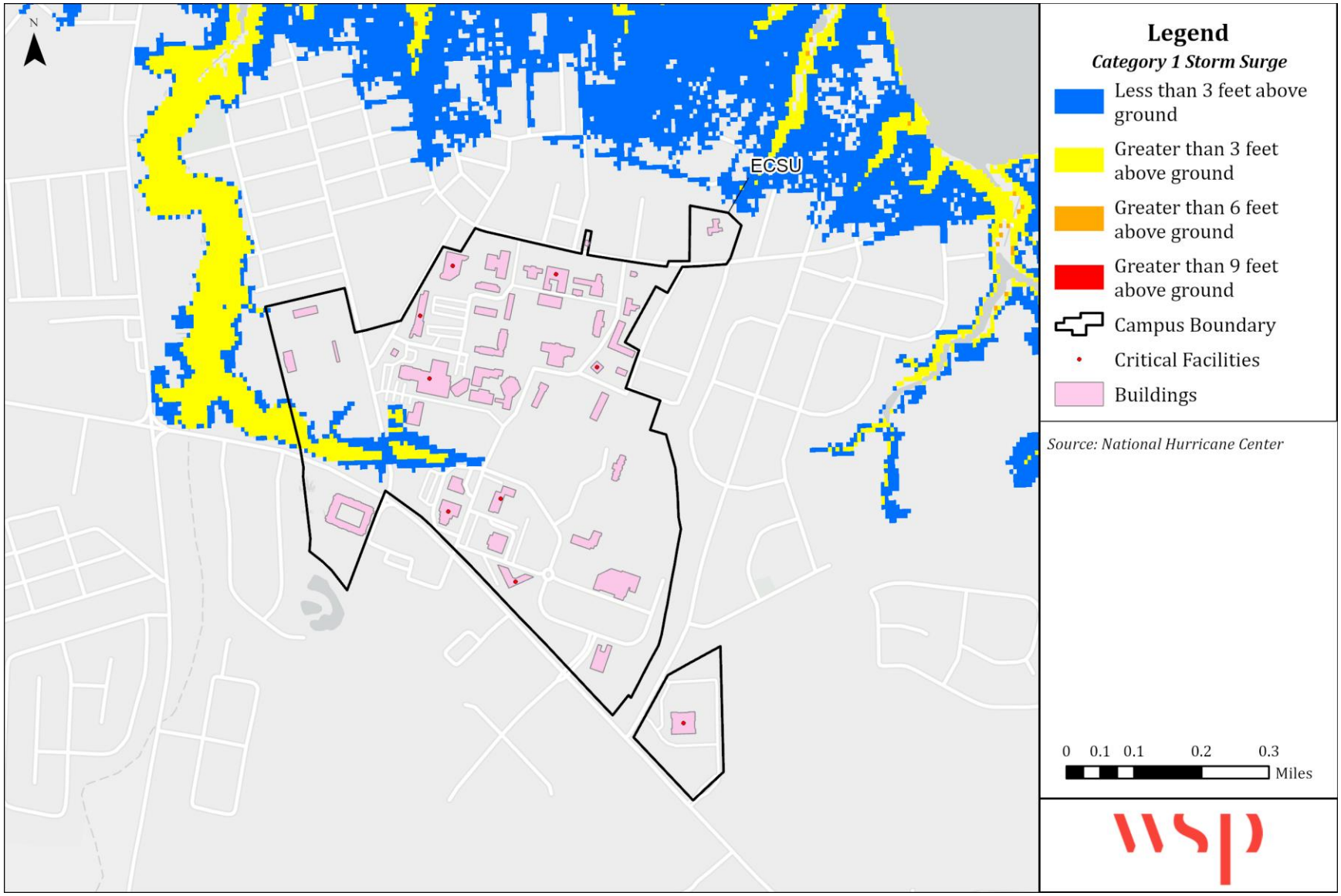


**Figure B.16 – Category 2 Storm Surge Inundation Areas, ECSU**

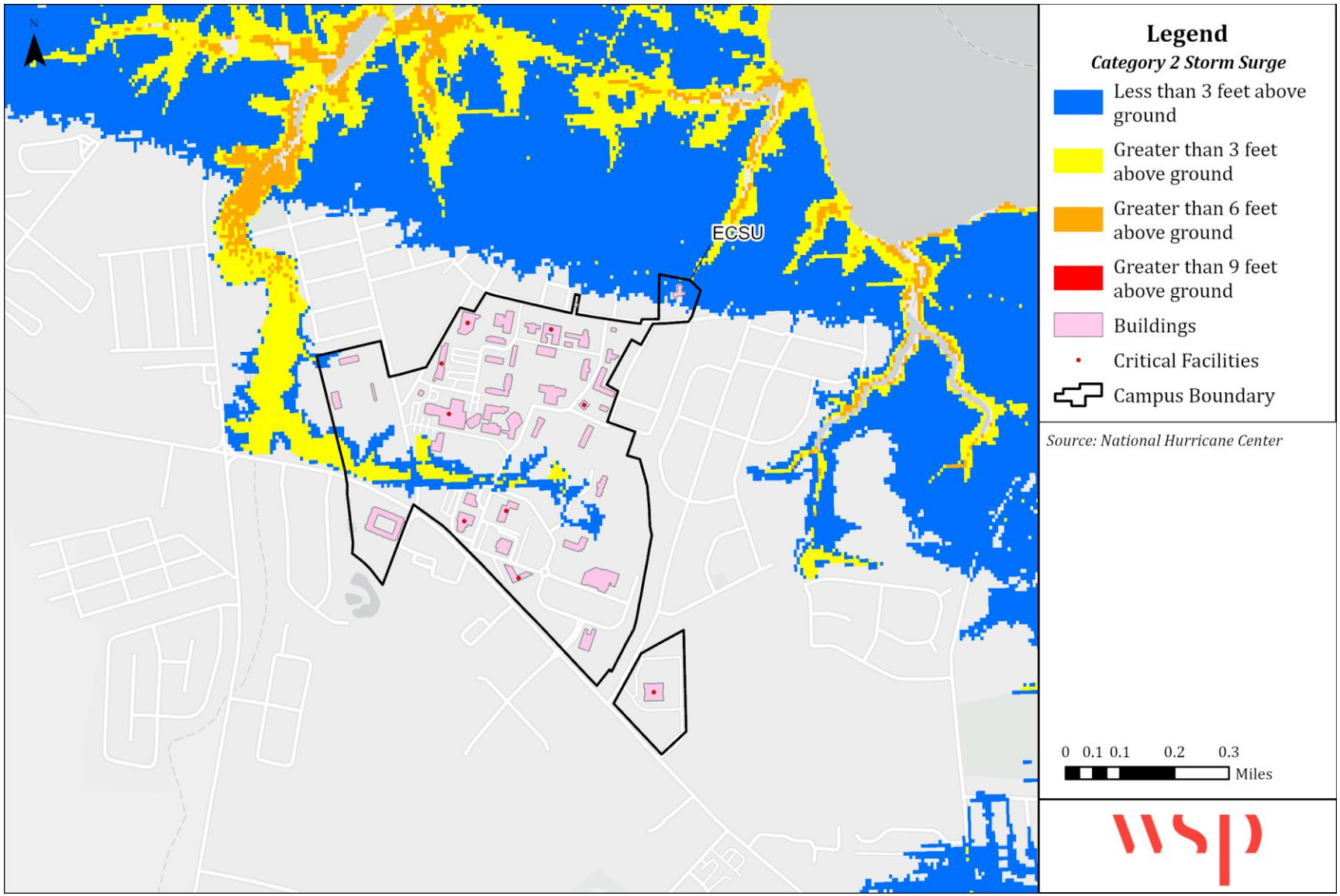


**Figure B.17 – Category 3 Storm Surge Inundation Areas, ECSU**

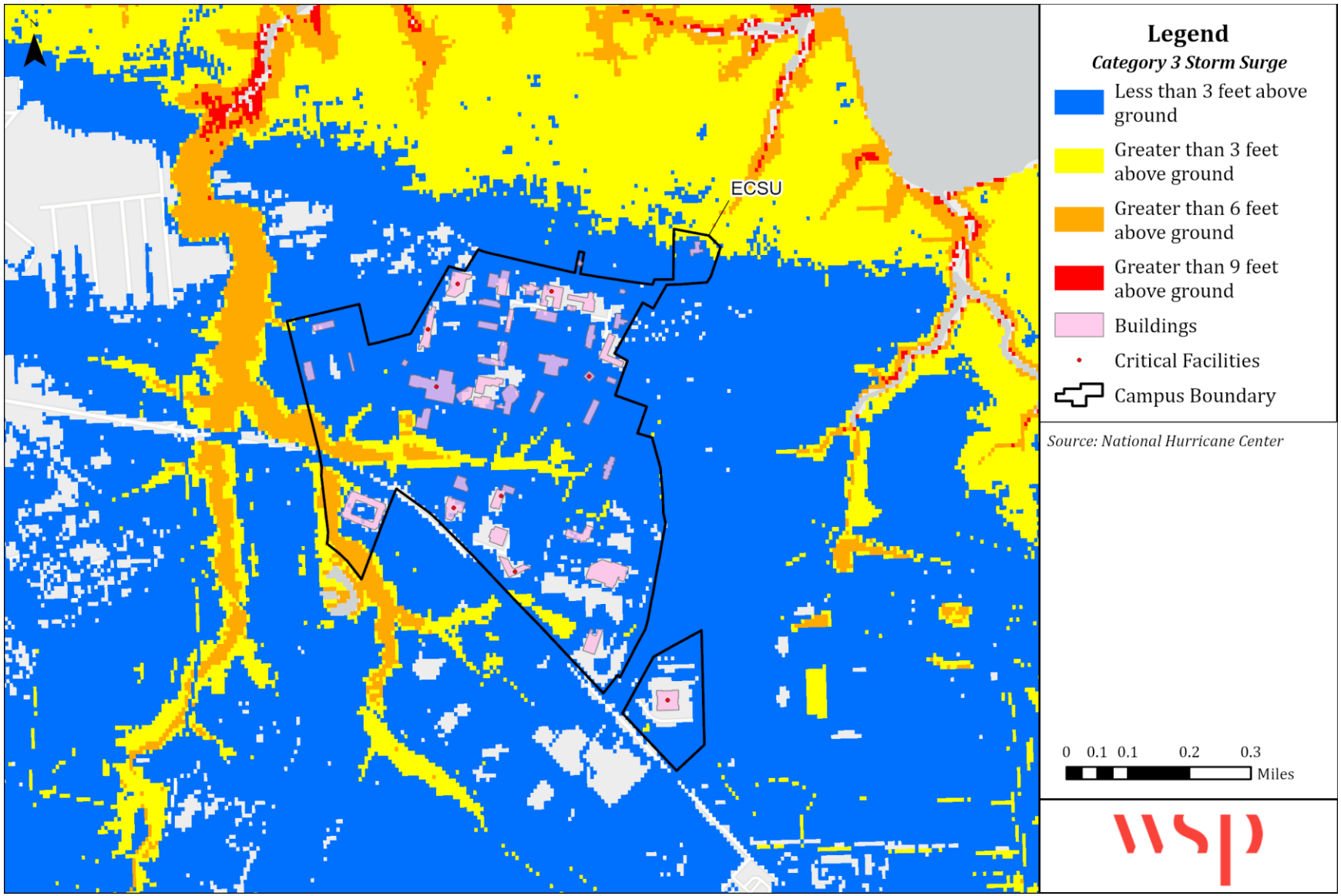


**Figure B.18 – Category 4 Storm Surge Inundation Areas, ECSU**

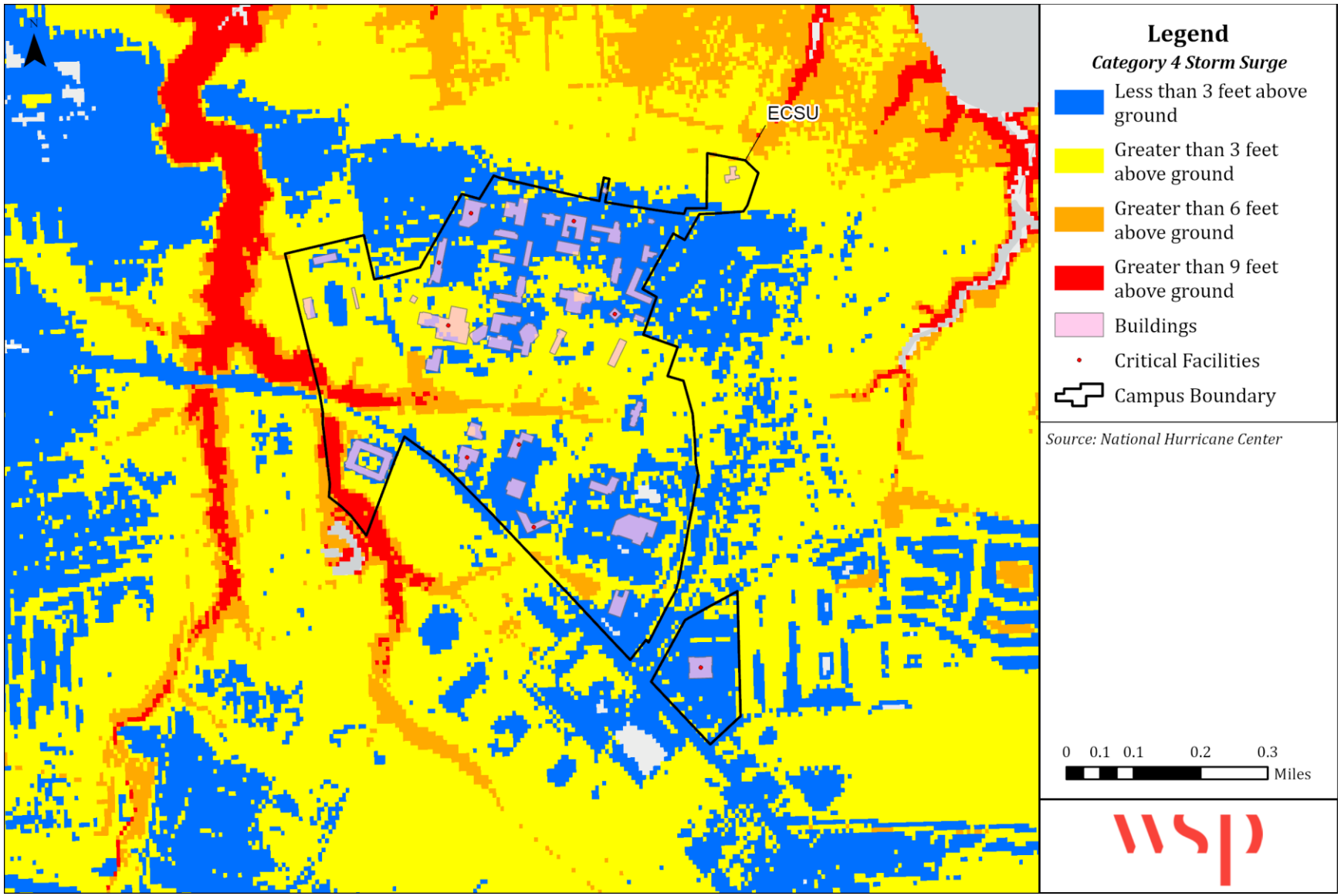
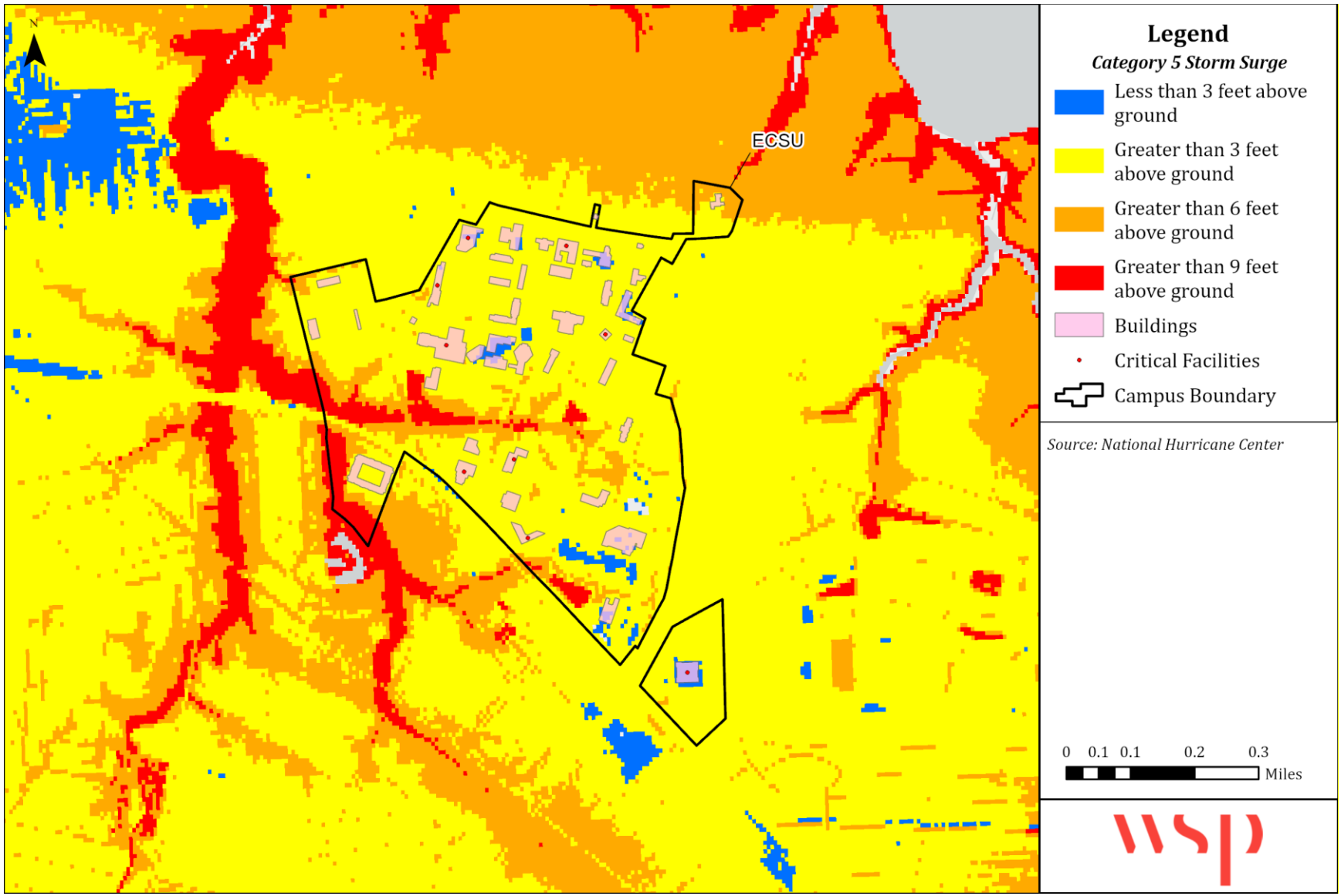


**Figure B.19 – Category 5 Storm Surge Inundation Areas, ECSU**



### Table B.20 – Saffir-Simpson Scale

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center (NCH)

**Table B.21 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Pasquotank County may experience any category of hurricane force winds. Hurricane Connie brought the most intense hurricane winds to pass within 25 miles of ECSU's campus as a Category 2 storm with wind speeds around 80 mph in 1955.

*Impact: 4 – Catastrophic*

## Historical Occurrences

The NCEI database reports 10 tropical storms, tropical depression, and hurricane events occurring in Pasquotank County over 10 separate days between 2000 and 2024. In total, these events caused approximately $5.5 million in property damage and $500,000 in crop damage, but no deaths or injuries. Damage from each of these events is summarized in Table B.22.

**Table B.22 – Recorded Hurricane and Tropical Storm Events for Pasquotank County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/18/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $4,500,000 | $0 |
| 8/14/2004 | Tropical Storm | N/A | 0/0 | $0 | $0 |

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/6/2008 | Tropical Storm | Tropical Storm Hanna | 0/0 | $5,000 | $0 |
| 8/27/2011 | Hurricane (Typhoon) | Hurricane Irene | 0/0 | $500,000 | $500,000 |
| 7/4/2014 | Tropical Storm | Hurricane Arthur | 0/0 | $0 | $0 |
| 9/2/2016 | Tropical Storm | Tropical Storm Hermine | 0/0 | $0 | $0 |
| 9/5/2019 | Tropical Storm | Hurricane Dorian | 0/0 | $25,000 | $0 |
| 8/4/2020 | Tropical Storm | Tropical Storm Isaias | 0/0 | $500,000 | $0 |
| 7/8/2021 | Tropical Storm | Tropical Storm Elsa | 0/0 | $20,000 | $0 |
| 9/22/2023 | Tropical Storm | Tropical Storm Ophelia | 0/0 | $0 | $0 |
| | | **Total** | **0/0** | **$5,550,000** | **$500,000** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Isabel (2003)** –Sustained tropical storm force winds with frequent gusts to hurricane force occurred over coastal northeast North Carolina. Isabel made landfall near Ocracoke Inlet in North Carolina, tracked northwest into central Virginia just west of Richmond, then continued northward into western Pennsylvania. The highest sustained wind speed recorded was 73 mph at Duck (DUCN7). Other sustained wind speed was 59 mph at Elizabeth City (ECG). The highest gusts recorded were 97 mph at Elizabeth City (from Clemson University observation site in Elizabeth City), 92 mph at Duck (DUCN7), and 74 mph at Elizabeth City (ECG). The unusually large wind field uprooted many thousands of trees, downed many power lines, damaged hundreds of houses, and snapped thousands of telephone poles and cross arms. Hundreds of roads, including major highways, were blocked by fallen trees. Local power companies reported many thousands of customers were without power. On the Albemarle Sound, storm surge values around 7 feet occurred at Edenton, with a surge around 5 feet observed on the Pasquotank River in Elizabeth City. Isabel will be remembered for the greatest wind and storm surge in the region since Hazel in 1954, and the 1933 Chesapeake-Potomac Hurricane. Also, Isabel will be remembered for the extensive power outages in northeast North Carolina, and permanent change to the landscape from all the fallen trees and storm surge. Rainfall amounts ranged from 2 to 5 inches across coastal northeast North Carolina. Inland flooding due to heavy rainfall occurred over parts of coastal northeast North Carolina.
- **Hurricane Irene (2011)** – Tropical storm force winds and Hurricane force wind gusts knocked down numerous trees and power lines, as well as caused some structural damage. In addition, heavy rains contributed to minor crop damage. The highest sustained wind of 43 knots (50 mph) with a peak gust of 64 knots (74 mph) was recorded at ECG (Elizabeth City). Storm total rainfall generally ranged from four to ten inches.
- **Hurricane Dorian (2019)** – Tropical storm winds downed and uprooted several trees and power lines, produced minor structural damage, and caused power outages across the county. Wind gust of 61 knots (70 mph) was measured at ECG.

- **Tropical Storm Elsa (2021)** - Tropical storm winds downed several trees and power lines, produced minor structural damage, and caused scattered power outages across the county. Wind gusts averaged between 35 and 45 knots. Wind gust of 38 knots (44 mph) was measured at ECG.

According to the NOAA Historical Hurricane Tracks dataset, 32 hurricanes or tropical storms, passed within 25 miles of ECSU since 1900. These events are listed in Table B.23, and storm tracks are mapped in Figure B.20.

**Table B.23 – Hurricane Tracks within 25 miles of ECSU, 1900-2024**

| Storm Name | Date | Storm Category |
|---|---|---|
| Unnamed | 6/30/1907 | Tropical Storm |
| Unnamed | 7/1/1907 | Tropical Storm |
| Unnamed | 10/1/1924 | Tropical Storm |
| Unnamed | 8/24/1933 | Category 1 |
| Unnamed | 9/26/1947 | Tropical Storm |
| Barbara | 8/15/1953 | Category 1 |
| Connie | 8/14/1955 | Category 1 |
| Ione | 9/20/1955 | Category 1 |
| Flossy | 9/28/1956 | Tropical Storm |
| Unnamed | 10/19/1956 | Tropical Storm |
| Unnamed | 9/15/1961 | Tropical Storm |
| Unnamed | 6/4/1963 | Tropical Storm |
| Unnamed | 7/25/1964 | Tropical Depression |
| Cleo | 9/2/1964 | Tropical Storm |
| Unnamed | 6/17/1965 | Tropical Storm |
| Unnamed | 6/20/1967 | Tropical Depression |
| Unnamed | 9/17/1967 | Tropical Storm |
| Doria | 8/28/1971 | Tropical Storm |
| Bob | 7/16/1979 | Tropical Depression |
| Charley | 8/18/1986 | Category 1 |
| Josephine | 10/9/1996 | Tropical Storm |
| Danny | 7/25/1997 | Tropical Storm |
| Earl | 9/5/1998 | Tropical Storm |
| Floyd | 9/17/1999 | Category 1 |
| Helene | 9/24/2000 | Tropical Storm |
| Allison | 6/16/2001 | Tropical Depression |
| Bonnie | 8/14/2004 | Tropical Depression |
| Charley | 8/15/2004 | Tropical Storm |
| Alberto | 6/15/2006 | Tropical Storm |
| Irene | 8/28/2011 | Category 1 |
| Claudette | 6/22/2021 | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

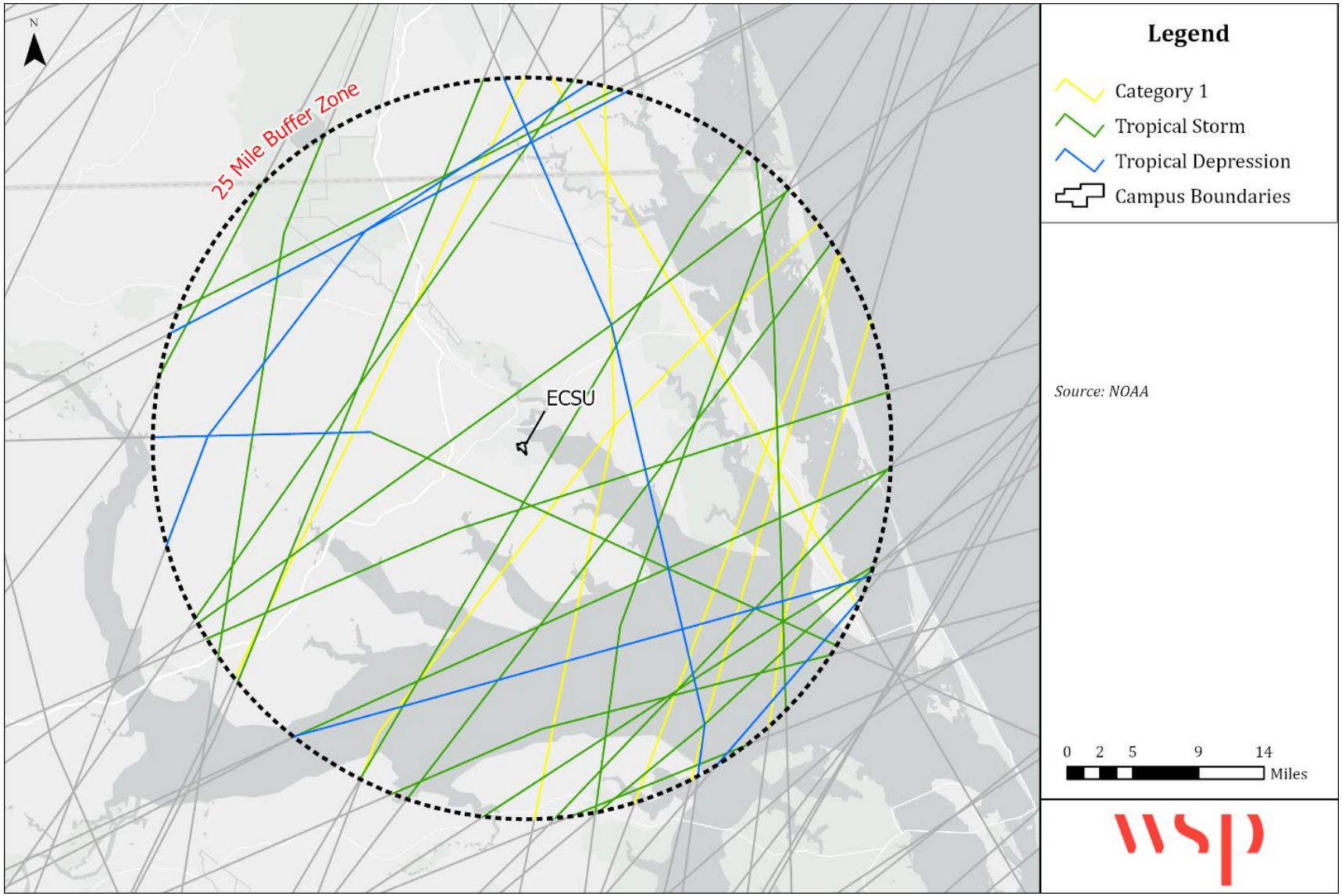
Pasquotank County has received 7 major disasters and 12 emergency declarations for Hurricane and Tropical Storm events summarized in Table B.24.

### Table B.24 – Hurricane-Related Disaster Declarations & Emergency Declarations

| Date | Disaster ID | Event Name |
|---|---|---|
| 8/27/1998 | DR-1240-NC | Hurricane Bonnie |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/10/2004 | DR-1546-NC | Tropical Storm Frances |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina |
| 9/14/2005 | EM-3254-NC | Hurricane Ophelia |
| 9/1/2010 | EM-3314-NC | Hurricane Earl |
| 8/31/2011 | EM-3327-NC & DR-4019-NC | Hurricane Irene |
| 10/10/2016 | EM-3380-NC & DR-4285-NC | Hurricane Matthew |
| 9/10/2018 | EM-3401-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC & DR-4465-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |
| 8/6/2024 | EM-3608-NC | Tropical Storm Debby |
| 9/26/2024 | EM-3617-NC | Hurricane Helene |

Source: OpenFEMA

**Figure B.20 – Historic Hurricane and Tropical Storm Tracks 1900-2024 within 25 miles of ECSU**



## Probability of Future Occurrence

In a 25-year period from 2000 through 2024, 10 hurricanes and tropical storms have impacted Pasquotank County, which equates to a 40% chance of a hurricane event occurring in a given year. Overall, the probability of a hurricane or tropical storm impacting the campus is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. The on-campus student population may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall, that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause over $892,000 of estimated total building damages to ECSU's campus.

Table B.25 details the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table B.25 – Estimated Building Damage by Hurricane Winds, ECSU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $13,948.73 | $539.70 | $14,488.43 |
| Educational | $509,781.87 | $248,611.65 | $758,393.52 |
| Housing | $86,999.74 | $32,708.97 | $119,708.71 |
| **Total** | **$610,730.34** | **$281,860.32** | **$892,590.66** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **300-Year Hurricane Wind Event** | | | |
| Administration | $88,243.48 | $10,044.45 | $98,287.93 |
| Educational | $4,898,758.96 | $3,299,029.40 | $8,197,788.36 |
| Housing | $775,001.34 | $433,285.48 | $1,208,286.82 |
| **Total** | **$5,762,003.78** | **$3,742,359.33** | **$9,504,363.11** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $180,513.42 | $33,455.21 | $213,968.63 |
| Educational | $9,455,501.94 | $7,086,157.43 | $16,541,659.37 |
| Housing | $1,489,609.98 | $941,851.31 | $2,431,461.29 |
| **Total** | **$11,125,625.34** | **$8,061,463.95** | **$19,187,089.29** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation and shelter planning for the event of a hurricane.

## Problem Statements

- Historical tracks of multiple hurricane events pass within 25 miles of the ECSU campus.
- For the 25-year period from 2000 through 2024, there have been 10 hurricane and tropical storm events causing over $5.5 million dollars in property damage and $500,000 in crop damage for Pasquotank County.

## B.5.5 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Pasquotank County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI), shown in Table B.26 for the Pasquotank County region, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. The county may experience any level on the RSI scale. Pasquotank County receives an average of 2 to 4 inches of snowfall per year. According to NCEI, the greatest snowfall amounts to impact Pasquotank County have been between 5-12 inches, with Elizabeth City reporting around 9 inches of snowfall. During the snowstorm of December 24 to December 26, 2010, from which 8-9.5 inches were reported near Elizabeth City, the county was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

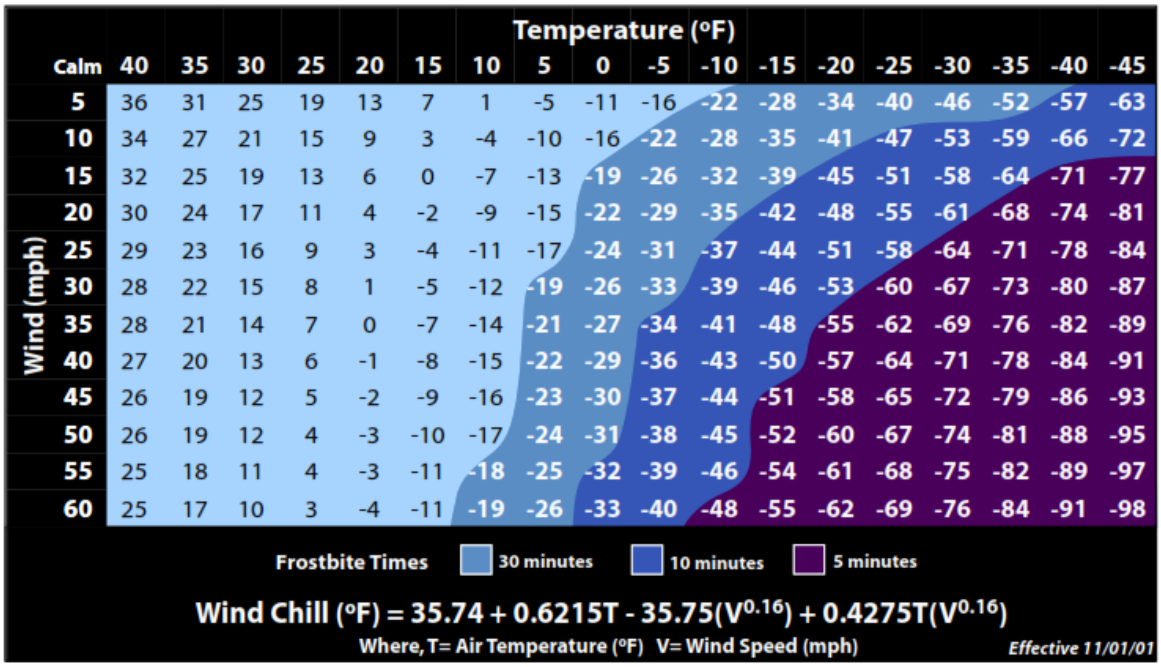
**Table B.26 – Regional Snowfall Index (RSI) Values**

| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure B.21, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure B.21 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Pasquotank County took place March 2nd, 1980, with a recorded depth of 15 inches of snow occurring in Elizabeth City.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of a severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24-hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one blizzard event, three frost/freeze events, and 31 combined winter storm/winter weather events in Pasquotank County during the 25-year period from 2000 through 2024. As reported in NCEI, severe winter weather did not cause any fatalities, injuries, property damage, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Pasquotank County by incident are recorded in Table B.27.

**Table B.27 – Recorded Severe Winter Weather Events in Pasquotank County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Blizzard | 1 | 0 | 0 | $0 | $0 |
| Frost/Freeze | 3 | 0 | 0 | $0 | $0 |

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Winter Storm | 19 | 0 | 0 | $0 | $0 |
| Winter Weather | 12 | 0 | 0 | $0 | $0 |
| **Total** | **35** | **0** | **0** | **0** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **December 26, 2010** – Snowfall amounts were generally between five and twelve inches across the county. Lynch's Corner reported 11.8 inches of snow. Elizabeth City reported between 8.0 inches and 9.5 inches of snow.
- **January 28, 2014** – Snow began during the afternoon of January 28th and continued into the early morning hours of January 29th. The snow mixed with sleet and freezing rain at times. Total snow accumulations were 3 to 6 inches across the county. Roads were icy for several days during and after the event.
- **April 5, 2016 –** Freezing temperatures between 25 and 28 degrees occurred. The average duration was around 10 hours. Widespread damage to fruit trees and bushes was noted across the county. Winter wheat, barley, and hay grasses were also damaged.
- **January 17, 2018** – Low pressure deepening off the North Carolina coast produced significant snowfall over most of eastern North Carolina during the late evening of January 17th through the early morning of January 18th. Snowfall over the region ranged from less than 1 inch over the southwest tier to 8 inches or more over the north coast. There was one weather related traffic fatality reported in Washington county on the morning of January 18th.
- **January 28, 2022** – Rapidly intensifying low pressure lifting northward just off the Mid Atlantic coast produced snowfall totals between one half inch and three inches across portions of northeast North Carolina. Snowfall totals generally ranged between one half inch and two inches across the county. Snowfall total of 1.5 inches was reported at (2.6 W) Elizabeth City.

Pasquotank County received two FEMA Major Disaster Declarations for a severe ice storm in 1968 and a blizzard in 1996.

## Probability of Future Occurrence

NCEI records 35 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $50,268, which assumes that 10% of the student population is impacted.

**Table B.28 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 2,357 | 236 | $50,268 |

### Property

No property damage was reported in association with any winter weather events recorded by the NCEI between 2000 and 2024 for Pasquotank County. Therefore, no annualized loss estimate could be calculated for this hazard.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is out driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. ECSU may wish to

consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statements

- Severe winter weather events are highly likely for Pasquotank County and the ECSU campus. The events have also resulted in two presidential disaster declarations for the County.

## B.5.6 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

### Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas. All of ECSU is exposed to tornadoes and thunderstorms. Overall, due to the small size of the planning area, any given event will likely impact most, if not all, of the planning area, so the spatial extent of a tornado or thunderstorm event is considered large.

*Spatial Extent: 4 – Large*

#### TORNADO

Tornados can occur anywhere on ECSU's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado is not increased in one area of the campus versus another.

#### THUNDERSTORM WINDS

The entirety of ECSU's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

#### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

#### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

### Extent

#### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28)

and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table B.29 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table B.29 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

Source: NWS Storm Prediction Center

The most intense tornado to pass through Elizabeth City in the past 75 years was an F3 (EF3) on November 23, 1992. NCEI reports this event causing around $2.5 million in property damage and 21 injuries.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, Thunderstorm Wind, Tornado and Hurricane. For this severe weather risk assessment, High Wind, Strong Wind and Thunderstorm Wind data was collected. Hurricane Wind and Tornadoes are addressed as individual hazards. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.

- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Elizabeth City occurred on January 14, 2006 with a measured gust of 69 mph. The event reportedly caused $10,000 in property damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table B.30, is a common parameter that is part of fire weather forecasts nationwide.

**Table B.30 – Lightning Activity Level Scale**

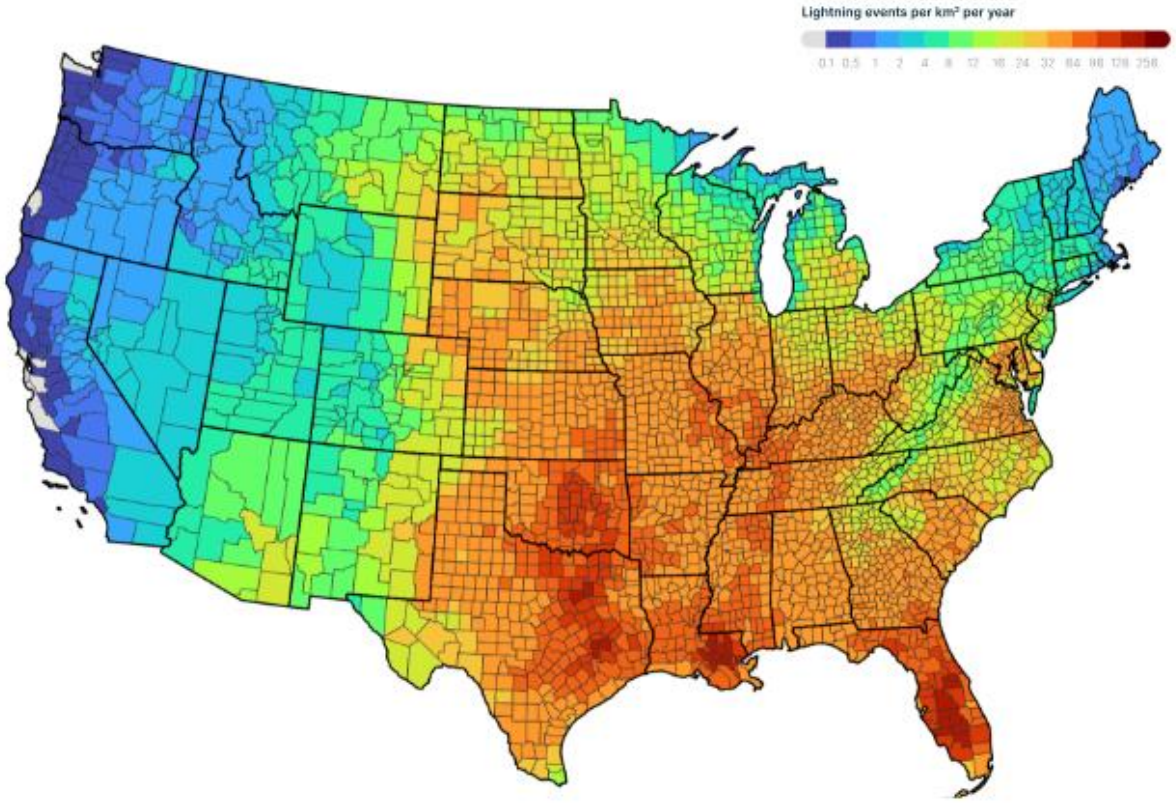
| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

According to the Vaisala flash density map, shown in Figure B.22, Pasquotank County experiences between 24 to 32 lightning flashes per kilometer per year. It should be noted that future lightning occurrences may exceed these figures.

**Figure B.22 – Lightning Density in the U.S. (2024)**




*Impact: 1 – Minor*

## HAIL

The NWS classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table B.31 indicates the hailstone measurements utilized by the NWS.

**Table B.31 – Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |

| Average Diameter | Corresponding Household Object |
|---|---|
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table B.32 describes typical intensity and damage impacts of the various sizes of hail.

**Table B.32 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls damaged |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Elizabeth City was a little over 1" in diameter; the largest hailstone recorded was 1.75", recorded on April 16, 2002 and July 17, 2009.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 to 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Pasquotank County experienced 20 tornado events, causing 30 injuries and $5.2 million in property damage.

Table B.33 documents historical tornadoes in Pasquotank County during this time, and Figure B.23 shows tornado paths within 10 miles of Greenville.

**Table B.33 – Recorded Tornadoes in Pasquotank County, 2000-2024**

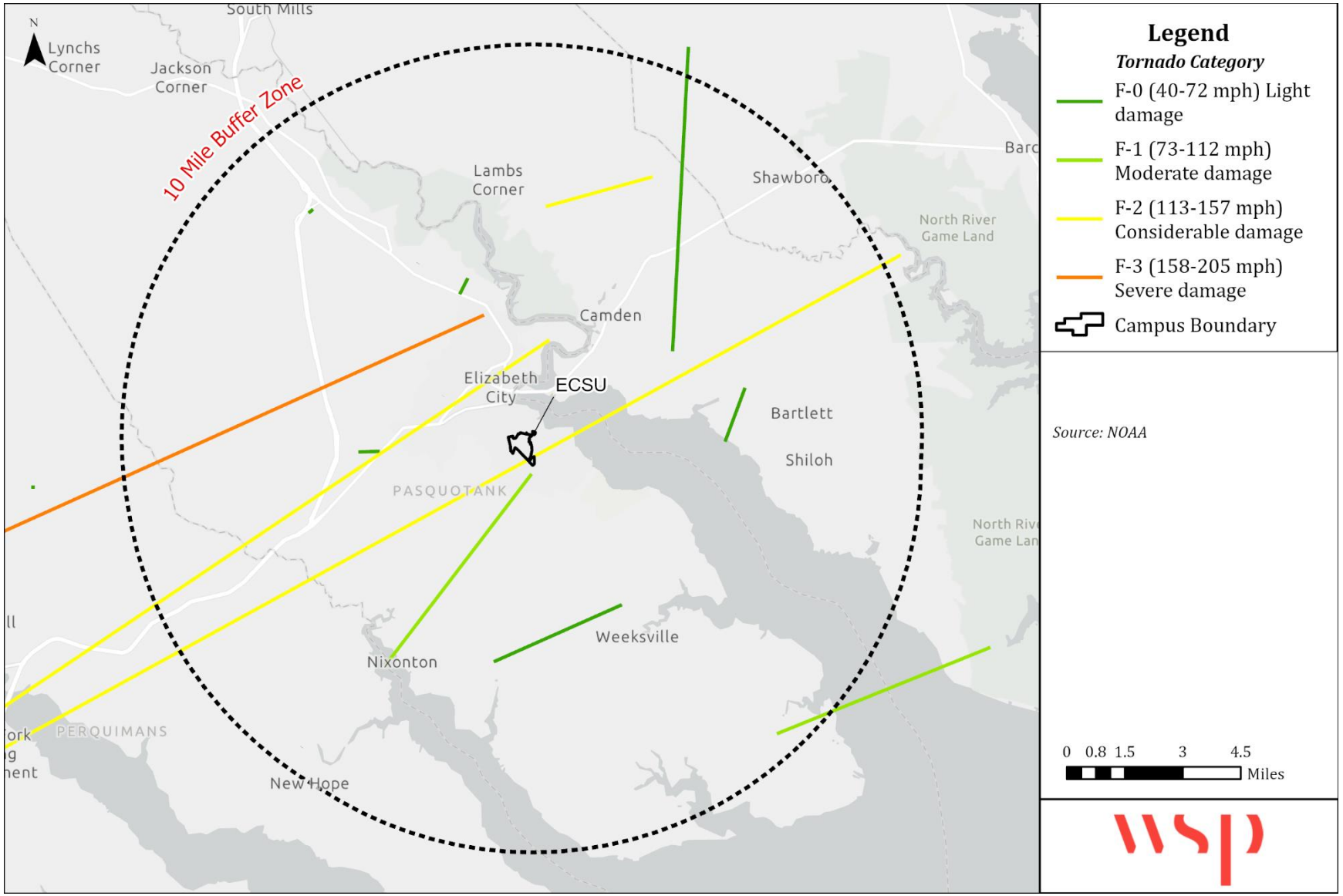
| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 4/5/1957 | 1530 | F1 | 0 | 0 | $25,000 |
| - | 7/10/1959 | 700 | F1 | 0 | 0 | $25,000 |
| - | 7/14/1963 | 1500 | F2 | 0 | 0 | $250,000 |
| - | 5/20/1973 | 915 | F2 | 0 | 2 | $250,000 |
| - | 5/16/1983 | 1500 | F2 | 0 | 3 | $25,000 |
| - | 11/5/1988 | 1115 | F2 | 0 | 1 | $250,000 |
| - | 7/12/1992 | 1530 | F0 | 0 | 0 | $2,500 |
| - | 7/18/1992 | 1545 | F0 | 0 | 0 | $2,500 |
| - | 11/23/1992 | 610 | F3 | 0 | 21 | $2,500,000 |
| Newland Area | 11/11/1995 | 2125 | F0 | 0 | 0 | $50,000 |
| Symonds Creek | 4/11/1999 | 1330 | F0 | 0 | 0 | $50,000 |
| Weeksville | 10/17/1999 | 1730 | F2 | 0 | 1 | $150,000 |
| Weeksville | 7/29/2005 | 1758 | F0 | 0 | 0 | $0 |
| Elizabeth City | 5/9/2008 | 832 | EF0 | 0 | 0 | $15,000 |
| Morgans Corners | 7/20/2010 | 1616 | EF0 | 0 | 0 | $0 |
| Elizabeth City Arpt | 6/1/2012 | 1620 | EF0 | 0 | 0 | $0 |
| Nixonton | 4/25/2014 | 1910 | EF1 | 0 | 0 | $100,000 |
| Okisko | 4/25/2014 | 1915 | EF2 | 0 | 2 | $1,000,000 |
| Nixonton | 4/25/2014 | 1915 | EF2 | 0 | 0 | $500,000 |
| Elizabeth City | 4/25/2014 | 1914 | EF0 | 0 | 0 | $0 |
| **Total** | | | | **0** | **30** | **$5,195,000** |

Source: NCEI

Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **November 23, 1992** – Tornado touched down at 7:20 in the morning. A school bus carrying students was hurled 75 yards injuring 32 students. Three homes were destroyed and another 42 damage.
- **May 9, 2008** – Tornado shifted a mobile home off its foundation. Trees were downed and one tree fell on a building near North Side Road. Tornado was observed by residents.
- **June 1, 2012** – State police reported a tornado touchdown in farmland just west of Highway 17 near Elizabeth City.
- **April 25, 2014** – A weak EF-0 tornado touched down north of Elizabeth City near the intersection of Highway 17 and North St. The tornado tracked northeast removing shingles from homes and snapping numerous trees.

**Figure B.23 – Tornado Paths within 10 Miles of Elizabeth City, 1950-2024**



### THUNDERSTORM WINDS

Between 2000 and 2024, the NCEI recorded wind speeds for 33 separate incidents of thunderstorm winds, occurring on 29 separate days, for Elizabeth City. These events caused $126,000 in recorded property damage and no injuries or fatalities. The recorded gusts averaged 59.2 miles per hour, with the highest gusts recorded at 69 mph on January 14, 2006. Of these events, 25 caused property damage. Wind gusts with property damage recorded averaged $5,040 in damage, with the highest reported damage being a total of $35,000 between two events on June 20, 2019. These incidents are aggregated by the date the events occurred and are recorded in Table B.34. These records specifically note thunderstorm wind impacts for Elizabeth City.

**Table B.34 – Recorded Thunderstorm Winds, Elizabeth City, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Elizabeth City Arpt | 8/16/2000 | 63 | 0 | 0 | $5,000 |
| Ecg Cst Grd Air Stn | 4/28/2002* | 58 | 0 | 0 | $10,000 |
| Ecg Cst Grd Air Stn | 5/2/2002 | 64 | 0 | 0 | $0 |
| (Ecg)Elizabeth City | 4/26/2003 | 62 | 0 | 0 | $0 |
| Elizabeth City | 7/7/2004 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 3/8/2005 | 58 | 0 | 0 | $5,000 |
| Elizabeth City | 4/23/2005 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 7/27/2005* | 59 | 0 | 0 | $5,000 |
| Elizabeth City | 1/14/2006 | 69 | 0 | 0 | $10,000 |
| Elizabeth City | 7/28/2006 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 2/18/2008 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 1/7/2009 | 58 | 0 | 0 | $1,000 |
| Elizabeth City | 7/27/2009 | 58 | 0 | 0 | $1,000 |
| Ecg Cst Grd Air Stn | 7/17/2010 | 58 | 0 | 0 | $3,000 |
| Elizabeth City | 6/1/2012 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 6/29/2012 | 58 | 0 | 0 | $2,000 |
| (Ecg)Elizabeth City | 6/13/2013 | 64 | 0 | 0 | $0 |
| (Ecg)Elizabeth City | 6/30/2016 | 62 | 0 | 0 | $1,000 |
| Elizabeth City | 5/5/2017 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 6/2/2019 | 58 | 0 | 0 | $2,000 |
| Elizabeth City | 6/20/2019* | 58 | 0 | 0 | $35,000 |
| Elizabeth City | 8/9/2019* | 63 | 0 | 0 | $4,000 |
| Elizabeth City | 4/13/2020 | 58 | 0 | 0 | $3,000 |
| Elizabeth City | 4/18/2020 | 58 | 0 | 0 | $1,000 |
| Elizabeth City ARPT | 7/30/2022 | 58 | 0 | 0 | $1,000 |
| Elizabeth City | 6/27/2023 | 58 | 0 | 0 | $20,000 |
| Elizabeth City | 1/9/2024 | 58 | 0 | 0 | $3,000 |
| Elizabeth City | 6/30/2024 | 58 | 0 | 0 | $2,000 |
| | | **Total** | **0** | **0** | **$126,000** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **July 7, 2004** – Numerous trees twisted or down in and around Edgewood section. Also, windows blown out of a house.
- **July 17, 2010** – The front of a building was blown off and power lines were downed.
- **June 20, 2019** – Extensive roof and interior damage was reported to the building that houses Flour Girls Bakery and several condominiums. Tractor trailer was blown over on Route 17 Bypass.
- **August 9, 2019** – Several power poles were downed in the Ehringhaus Street area causing power outages in Elizabeth City.

### LIGHTNING

According to NCEI data, there were 3 lightning strikes reported between 2000 and 2024. Of these, the event occurring on August 1, 2004 injured two people on a golf course; one was a critical injury. Two events led to property damage. The June 2014 event caused $5,000 due to lightning striking a vehicle. The July 2023 event led to $10,000 in damage due to lightning causing a house fire. Table B.35 details NCEI-recorded lightning strikes from 2000 through 2024 for Elizabeth City.

**Table B.35– Recorded Lightning Strikes in Elizabeth City, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Elizabeth City | 8/1/2004 | 1405 | 0 | 2 | $0 |
| Elizabeth City | 6/19/2014 | 2000 | 0 | 0 | $5,000 |
| Ecg Cst Grd Air Stn | 07/03/2023 | 1430 | 0 | 0 | $10,000 |
| | | **Total** | **0** | **2** | **$15,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Elizabeth City:

- **June 25, 2001** – Two golfers injured on the golf course by lightning strike. One was critical.
- **June 22, 2004** – Officials reported a vehicle was struck by lightning with the owner standing outside. No injuries were reported.
- **July 3, 2023** – Lightning strike caused a house fire off of Bayshore Drive.

### HAIL

NCEI records 13 days with hail incidents between 2000 and 2024 in Elizabeth City. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the city was 1.75 inches, which occurred on two occasions: April 16, 2002 and July 17, 2009. The average hail size of all events in the city was just over one inch in diameter. Table B.36 summarizes hail events for Elizabeth City. In some cases, hail was reported for multiple locations on the same day.

**Table B.36 – Summary of Hail Occurrences in Elizabeth City**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| Elizabeth City | 5/10/2000 | 0.75 |
| Elizabeth City | 8/16/2000 | 1 |
| Elizabeth City | 4/16/2002 | 1.75 |
| Elizabeth City | 4/25/2002 | 0.75 |
| Elizabeth City | 4/23/2005 | 0.75 |
| Elizabeth City | 7/2/2005 | 1 |
| Ecg Cst Grd Air Stn | 4/3/2006 | 1 |
| Elizabeth City | 4/22/2009 | 1 |
| Elizabeth City | 6/22/2009* | 1 |
| Elizabeth City | 7/17/2009 | 1.75 |
| Elizabeth City | 10/14/2010 | 1 |
| Elizabeth City | 3/31/2017* | 1.25 |
| Elizabeth City | 8/9/2019 | 1.5 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **April 22, 2009 –** Quarter size hail was reported on Church Street.
- **June 22, 2009 –** Quarter size hail was reported along Route 17.
- **March 31, 2017 –** Quarter size hail was reported. Half dollar size hail was reported at Elizabeth City State University

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Elizabeth City averages approximately 1.16 days with wind events per year. Over this same period, three lightning events were reported as having caused death, injury, or property damage, which equates to 0.12 damaging lightning strikes per year.

Over the 25-year period from 2000 through 2024, Elizabeth City experienced 23 days with reported hail incidents; this averages to nearly one day per year with reported hail incidents somewhere in the planning area.

In a 75-year period between 1950 and 2024, Pasquotank County experienced 20 tornado events. This correlates to a 26% annual probability that the County will experience a tornado somewhere in its boundaries.

Based on these historical occurrences, there is between 10% to 100% chance that Elizabeth City will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on ECSU's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water. Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes.

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Individuals who work outdoors may face increased risk during severe weather events. Residents living in mobile homes are also more vulnerable to severe weather events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $50,268, which assumes that 10% of the student population is impacted.

**Table B.37 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 2,357 | 236 | $50,268 |

Between 2000 and 2024, the NCEI recorded no fatalities or injuries caused by hail or wind. Lightning caused 2 injuries during this period. However, tornadoes occurring between 1950 to 2024 resulted in 30 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Elizabeth City, two events led to property damage of $15,000. Based on these records, the planning area experiences an annualized loss of $600 in property damage. The average impact from lightning per incident in Elizabeth City is $5,000.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Elizabeth City, NCEI did not report any property damage as a direct result of hail. It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damages in Elizabeth City, thus the NCEI is still used to form a baseline.

When strong enough, wind events can cause significant direct damage to buildings and infrastructure. Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $126,000 in property damage, which equates to an annualized loss of $5,040 across the planning area.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

During the 75-year span from 1950 to 2024, tornadoes caused approximately $5,195,000 in property damage. This equates to an annualized loss of $69,266. Per the iRISK analysis, an F2 tornado event could cause over $86 million of estimated total building damages on campus.

Table B.38 details the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table B.38 – Estimated Building Damage by Tornado Events, ECSU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $72,023.84 | $63,063.14 | $135,086.98 |
| Educational | $1,173,445.94 | $1,117,641.70 | $2,291,087.64 |
| Housing | $438,039.29 | $310,970.23 | $749,009.52 |
| **Total** | **$1,683,509.07** | **$1,491,675.07** | **$3,175,184.14** |
| **F1 Tornado Event** | | | |
| Administration | $579,835.85 | $507,696.76 | $1,087,532.61 |
| Educational | $9,431,019.10 | $8,992,683.51 | $18,423,702.61 |
| Housing | $3,526,483.74 | $2,503,500.23 | $6,029,983.97 |
| **Total** | **$13,537,338.69** | **$12,003,880.50** | **$25,541,219.19** |
| **F2 Tornado Event** | | | |
| Administration | $2,098,174.83 | $1,837,134.71 | $3,935,309.54 |
| Educational | $31,224,525.23 | $29,688,940.80 | $60,913,466.03 |
| Housing | $12,760,817.47 | $9,059,083.15 | $21,819,900.62 |
| **Total** | **$46,083,517.53** | **$40,585,158.66** | **$86,668,676.19** |
| **F3 Tornado Event** | | | |
| Administration | $3,337,380.26 | $2,922,166.94 | $6,259,547.20 |
| Educational | $48,555,717.34 | $46,095,281.31 | $94,650,998.65 |
| Housing | $20,297,498.38 | $14,409,478.53 | $34,706,976.91 |
| **Total** | **$72,190,595.98** | **$63,426,926.78** | **$135,617,522.76** |
| **F4 Tornado Event** | | | |
| Administration | $3,457,144.11 | $3,027,030.61 | $6,484,174.72 |
| Educational | $50,248,659.28 | $47,691,760.72 | $97,940,420.00 |
| Housing | $21,025,886.03 | $14,926,571.14 | $35,952,457.17 |
| **Total** | **$74,731,689.42** | **$65,645,362.47** | **$140,377,051.89** |

Source: NCEM iRISK Database

## Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statements

- The most intense tornado to pass through Elizabeth City in the past 75 years was an F3 tornado on November 23, 1992. This event caused $2.5 million in property damage and 21 injuries.
- The strongest recorded thunderstorm wind event for Elizabeth City occurred on January 14, 2006 with a measured gust of 69 mph. The event reportedly caused $10,000 in property damages.
- The average hailstone size recorded between 2000 and 2025 in Elizabeth City was a little over 1” in diameter; the largest hailstone recorded was 1.75”, recorded on April 16, 2002 and July 17, 2009.
- Thunderstorms are frequent hazard events in Pasquotank County and the ECSU campus. Reported damages for the 25-year period from 2000-2024 include $126,000 for thunderstorm winds and $15,000 for lightning strikes.
- Between 1950 and 2024, Pasquotank County reported $5.2 million in property damage due to tornadoes.

# B.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 18 percent of the ECSU campus is within the primary exposure category and 65 percent is within the secondary exposure category of the Functional WUI. Table B.39 details the Functional WUI acreage in the ECSU campus, and Figure B.24 below shows the Functional WUI areas. On a county level, the majority of Pasquotank County, particularly the western portion, is predominately classified as Wildfire Transmission Zone with very little to no housing density. Some areas along coastal

Pasquotank County have a higher concentration of areas classified as sources of ember load to buildings and secondary exposure.

The expansion of residential development from residential or developed centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to agricultural and forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

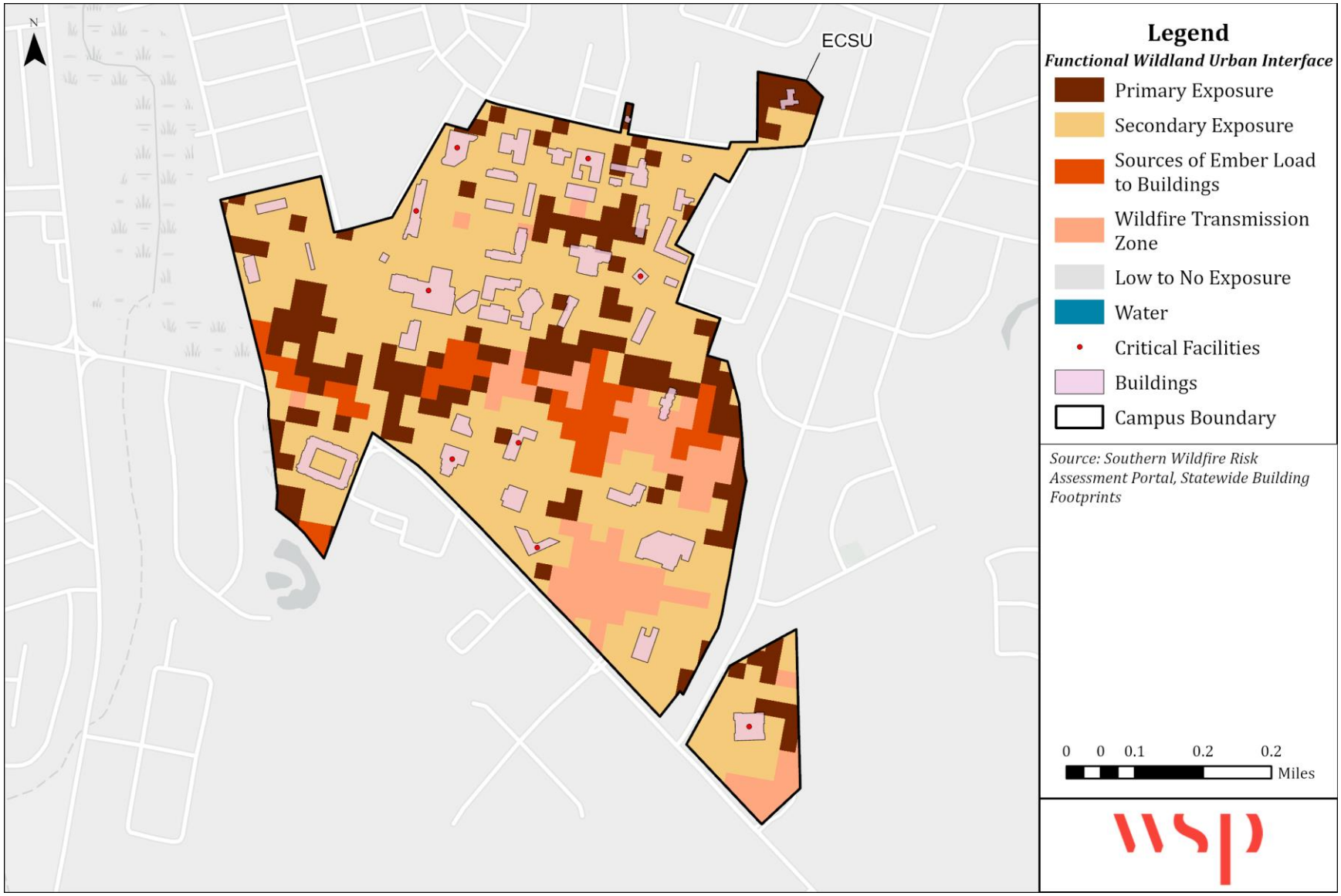
*Spatial Extent: 4 – Large*

**Table B.39 – Functional Wildland Urban Interface, ECSU Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 33 | 18% |
| | Secondary Exposure | 121 | 65% |
| | Sources of Ember Load to Buildings | 21 | 11% |
| | Wildfire Transmission Zone | 11 | 6% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **185** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure B.24 – Functional Wildland Urban Interface, ECSU Campus**



## Extent

Factors such as drought conditions or high levels of fuel on the forest floor may make wildfire more likely or intense in certain areas.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table B.40, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table B.41 and Figure B.25 detail the characteristic fire intensity scale across the ECSU campus.

### Table B.40 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

### Table B.41 – Characteristic Fire Intensity, ECSU Campus

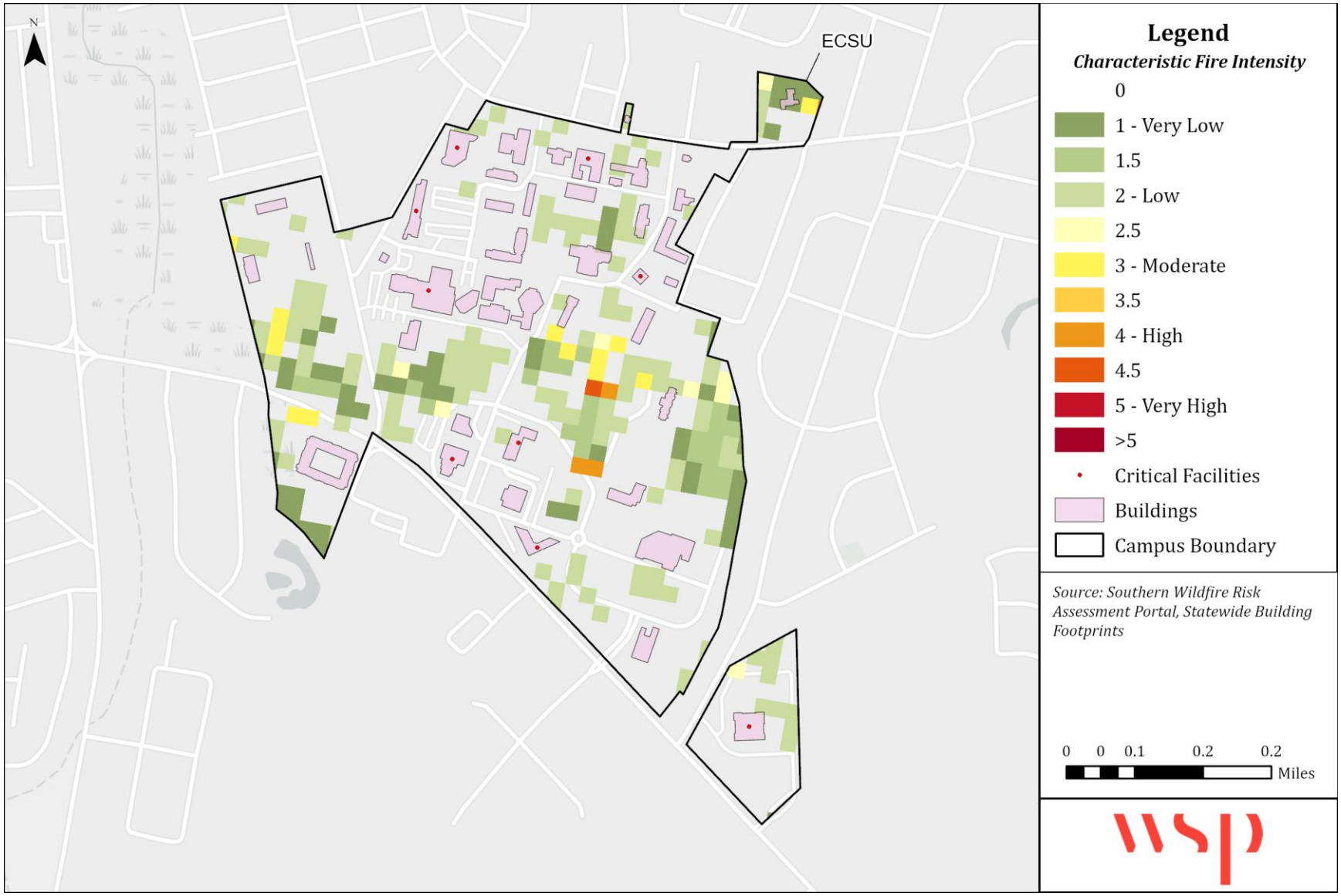
| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 137 | 74% |
| | 1 - Very Low | 11 | 6% |
| | 1.5 | 6 | 3% |
| | 2 - Low | 27 | 14% |
| | 2.5 | 2 | 1% |
| | 3 - Moderate | 3 | 1% |
| | 3.5 | 0 | 0% |
| | 4 - High | 1 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **185** | **100%** |

Source: Southern Wildfire Risk Assessment

Most of the campus (74%) is rated non-burnable on the characteristic fire Intensity scale. Class 4 fire intensity indicates high intensity and can result in significant harm or damage to life and property. Only one acre (0.5%) is characterized as a class 4, which is the highest classification that intersects the campus. The areas with greatest potential fire intensity are within the WUI. Around 1.6 percent of the campus may experience Class 3-3.5 fire intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the planning area (25%) would face a Class 1 to Class 2.5 fire intensity, which is easily suppressed.

*Impact: 2 – Limited*

**Figure B.25 – Characteristic Fire Intensity, ECSU**



## Historical Occurrences

According to the North Carolina Forest Service (NCFS), there were 382 noted wildfires within Pasquotank County between 2000 and 2024. The total acreage burned during this period was 909.7 acres. There were no additional data records regarding specific cities or school districts within Pasquotank County. The data is from NCFS records only and may not include data on fires burned within jurisdictional limits that did not require NCFS assistance to suppress. Actual number of fires and acreage burned may be higher than what is reported here.

On average, Pasquotank County experiences 15.3 fires and 36.4 acres burned annually from fires reported by the NCFS. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments. Based on these records, the average wildfire event can be calculated as 2.2 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments. The most known cause was noted as debris. Machine use, children and miscellaneous causes were the next leading causes following debris burning.

## Probability of Future Occurrence

The SWRA provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during on calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the ECSU campus is presented in Table B.42 and illustrated in Figure B.26.

### Table B.42 – Burn Probability, ECSU

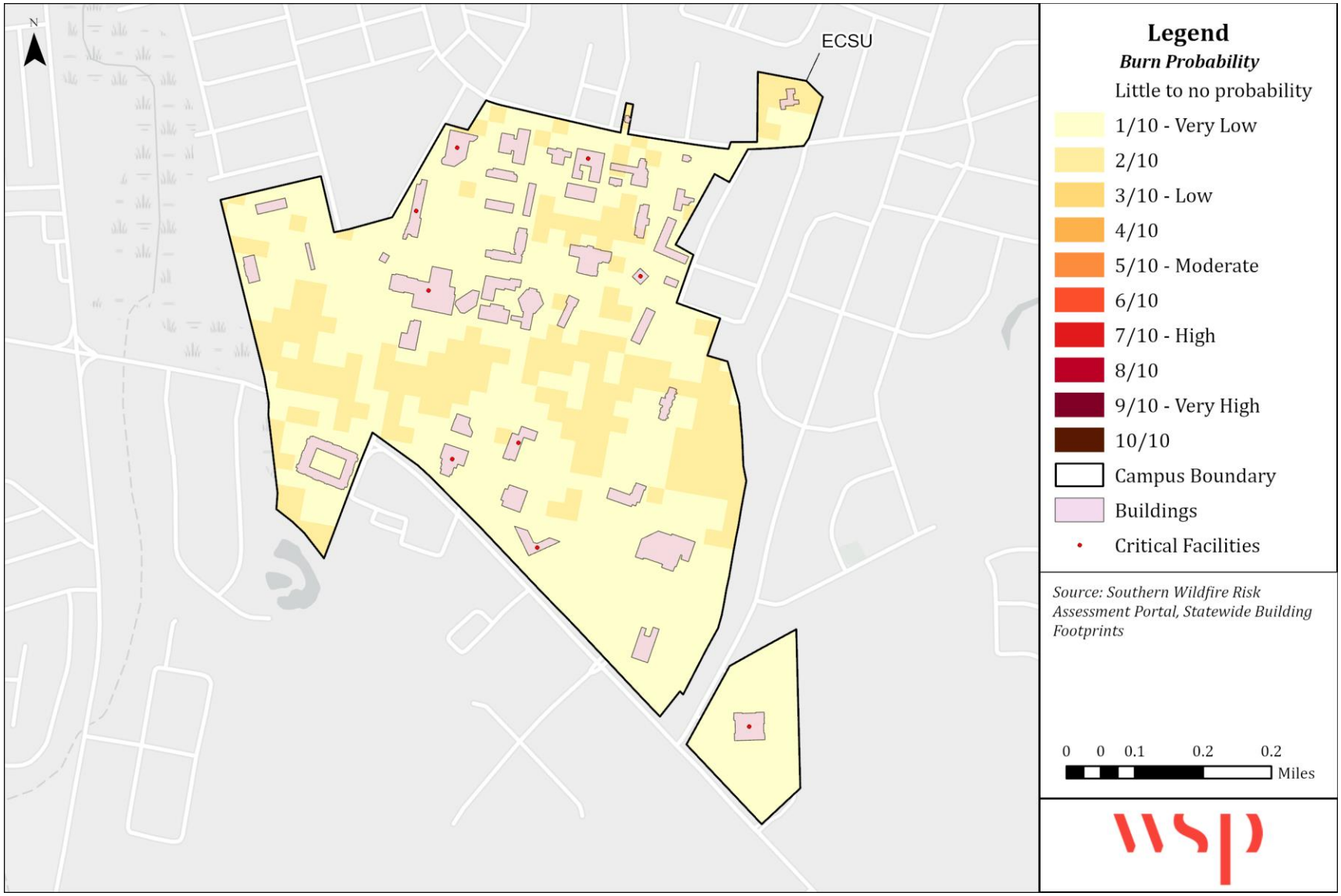
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 142 | 77% |
| | 2/10 | 0.0001000 - 0.0002154 | 43 | 23% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **185** | **100%** |

Source: Southern Wildfire Risk Assessment

The ECSU campus has very low to low burn probability. The majority of the campus, 77% has very low probability, and the remaining 23% of the campus has low probability of experiencing wildfire. Based on the SWRA results, the probability of wildfire across the campus is considered unlikely.

*Probability: 1 – Unlikely*

**Figure B.26 – Burn Probability, ECSU**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10, and so on.

All of the 44 structures assessed on the ECSU campus have a wildfire exposure score of 2/10 or relatively low vulnerability.

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the ECSU campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires.

## Problem Statements

- The Information Technology Center is within an area of campus with secondary exposure to wildfire. Sprinkler systems in the Information Technology Center could cause loss of campus servers in the event of a fire.

# B.5.8 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

## Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the ECSU campus, the Division of Information Technology (DIT) provides integrated technology support for administrative computing, client services, IT infrastructure systems, and IT security. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

## Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a distributed denial-of-service (DDoS) attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the ECSU campus could cause significant disruption and impact a large number of records.

*Impact: 3 – Critical*

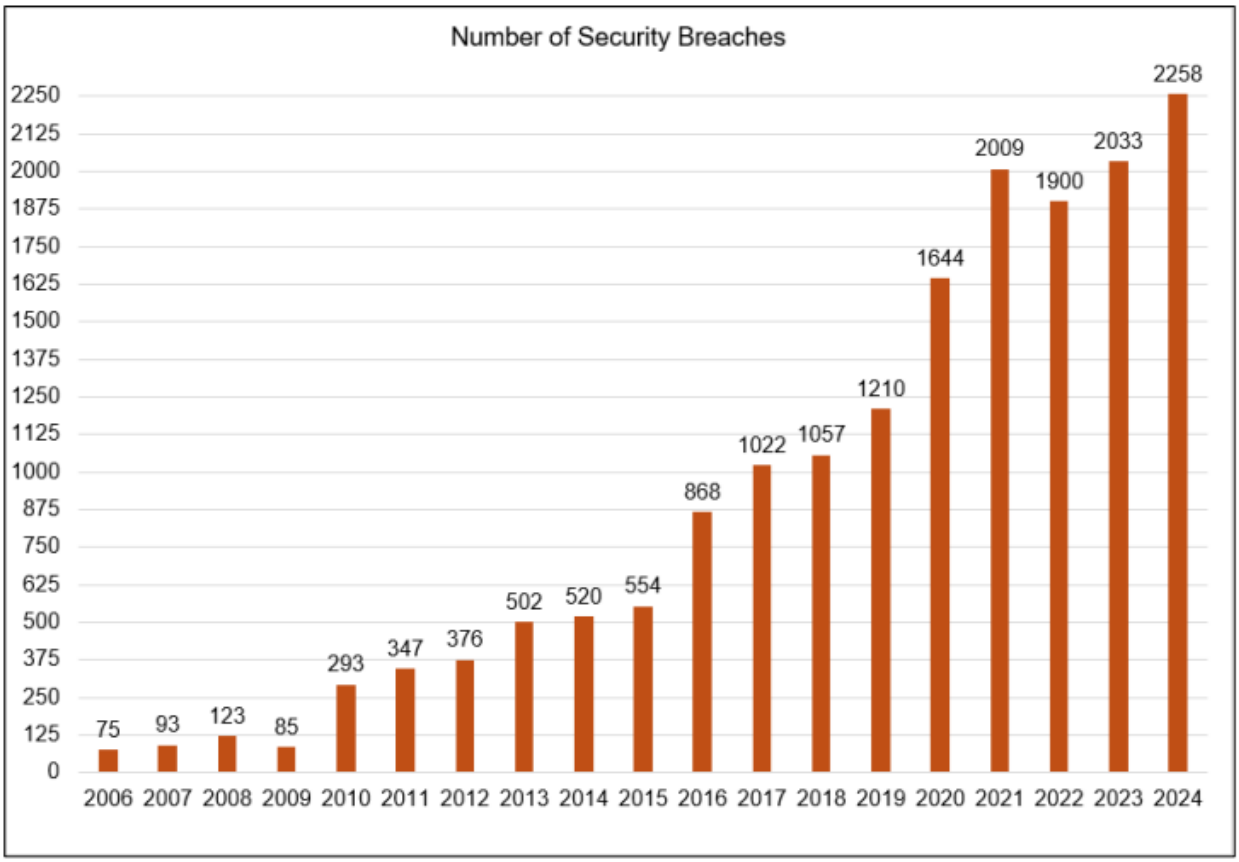
## Historical Occurrences

According to local news reports, the most recent cyberattack on ECSU campus occurred in September 2020 when the college's network system was attacked and shut down. The university immediately launched an investigation and put additional security measures in place

to protect the computer network and the private information of their students and faculty. This incident led to two days of academic instruction being cancelled and the ECSU learning management system being offline for 10 days.

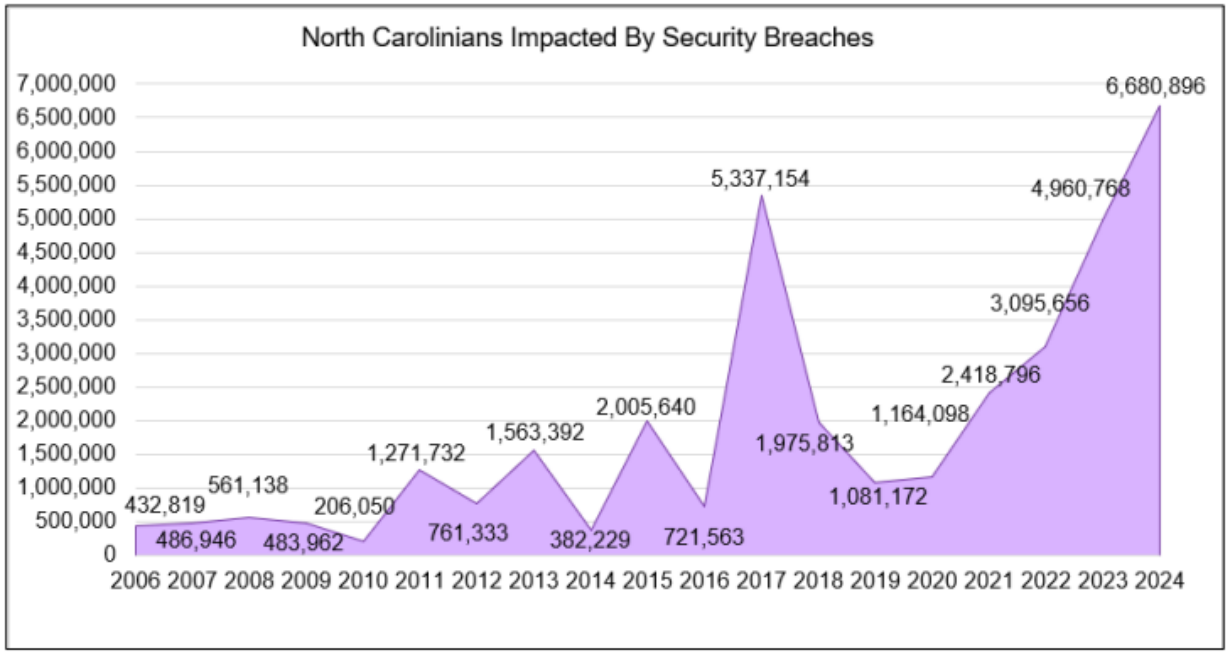
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure B.27 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure B.28 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been some notable disruption events within the Education target distribution and in the local area that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included. (https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/)

- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).
- May 2018, Cyber Attack shut down Pasquotank County website, compromising crucial files, (https://www.dailyadvance.com/news/local/cyberattack-shuts-down-pasquotank-website-files/article_fae0c688-0b7a-5475-92a6-266bfc38cdd8.html).

## Probability of Future Occurrence

Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of ECSU are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the University are less likely but cannot be ruled out.

*Probability: 2 – Possible*

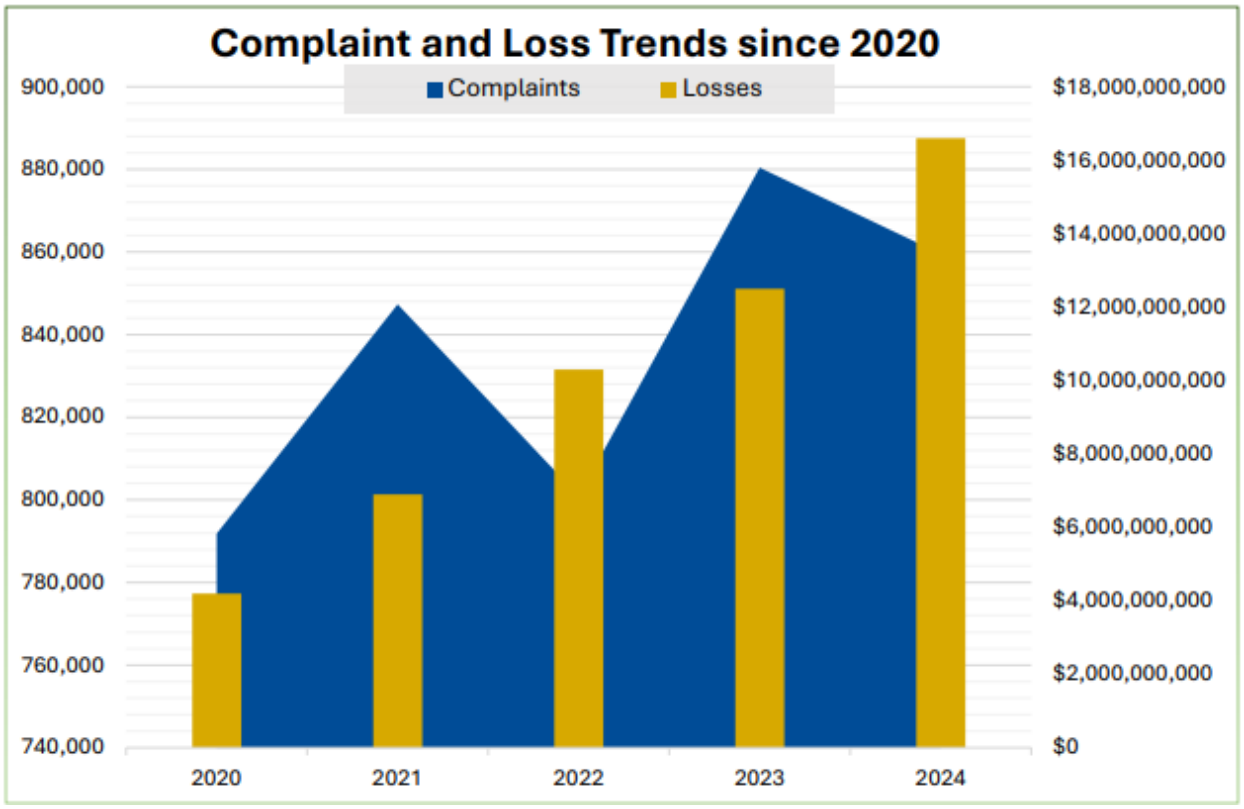
## Vulnerability Assessment

As discussed above, the impacts from a cyber-attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure B.29.

**Figure B.29 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers continued usage of online services, such as banking and shopping, increase vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

The vast majority of cyber incidents have little to no environmental impact. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment slowly increasing since the last plan, the number of users of campus networks and software has increased. Additionally, with more buildings located on campus, the number of network access points has increased.

For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statements

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Division of Information Technology (DIT) addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.

# B.5.9 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Substances | Possible | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 1.7 |

## Location

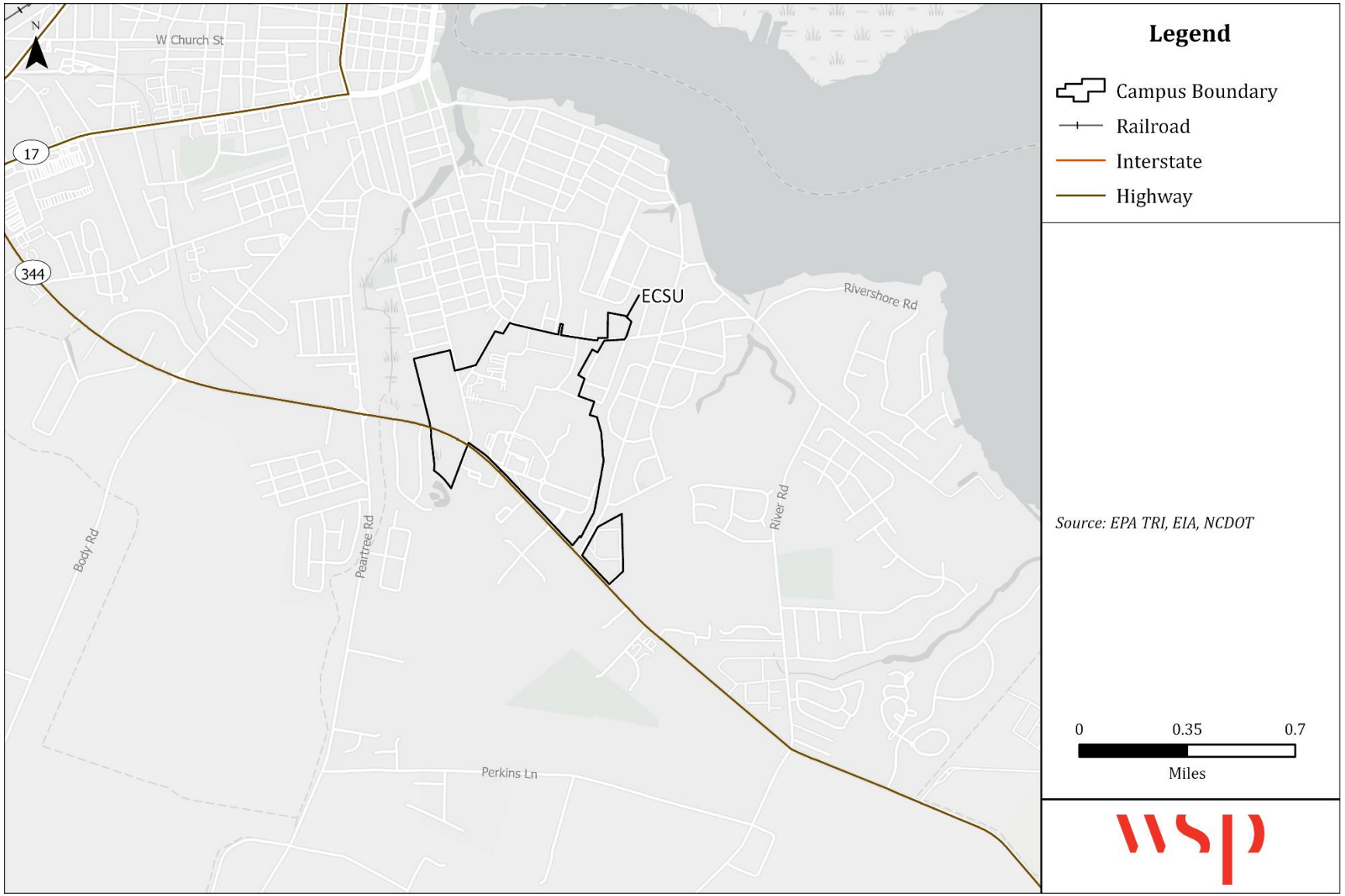
Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of ECSU campus.

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure B.30 shows the routes of transportation for hazardous materials adjacent to or through ECSU's campus. According to data collected by the UNC System, one pipeline intersects the critical facility, Steam Plant, on campus.

*Spatial Extent: 1 – Negligible*

**Figure B.30 – Major Transportation Routes, ECSU**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

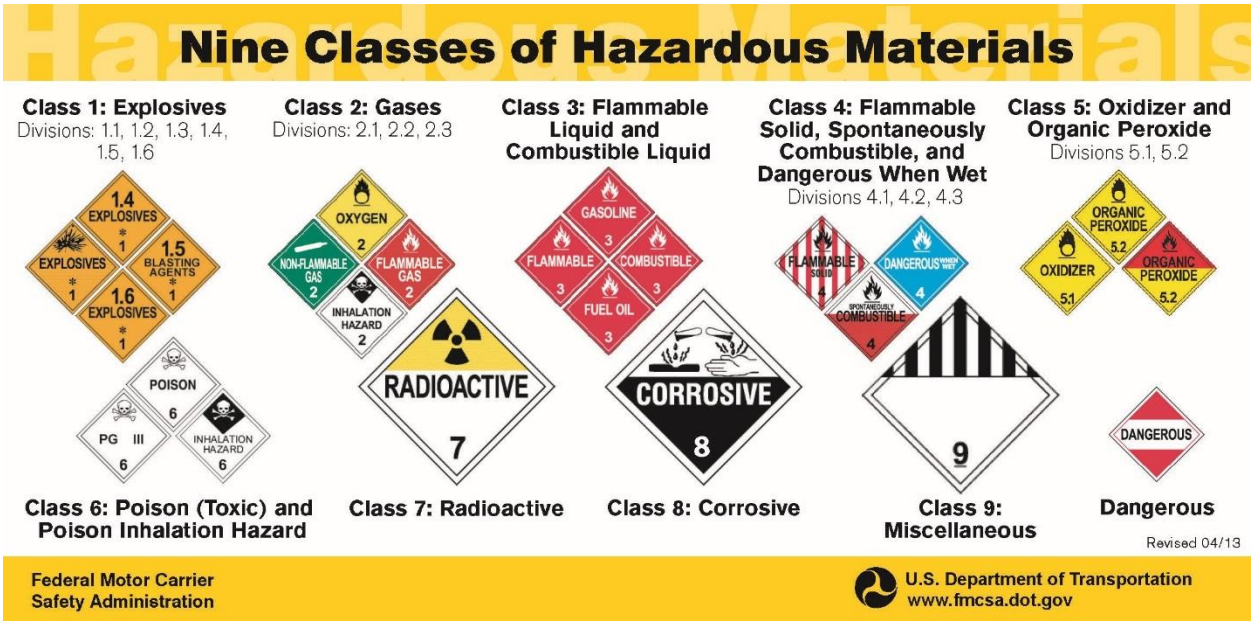
The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were only two recorded releases in Elizabeth City from 2000 through 2024. Neither of these events were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $3,288 in damage with all incidents occurring on highways and roads. Both events were Class 3 flammable liquids. Figure B.31 describes all nine hazard classes.

**Figure B.31 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been two incidents of hazardous materials release in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is an 8 percent annual probability of a hazardous materials incident occurring throughout Elizabeth City.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among people living near certain chemical facilities. However there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized

hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $3,288 in damage, which equates to an annualized loss of $28,703 across Elizabeth City.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statements

- Transportation routes for hazardous materials are located adjacent to the ECSU Campus.
- The number of reported incidents within Elizabeth City can be approximated to an 8 percent annual probability

# B.5.10 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table B.43, according to the World Health Organization.

**Table B.43 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

*Impact: 3 – Critical*

When an epidemic scales, diseases can lead to high infection rates in the population causing isolation, quarantine, and potential mass fatalities. An especially severe influenza or coronavirus pandemic or other major disease outbreak can lead to high levels of illness, death, social disruption, and economic loss. As was seen during the COVID-19 pandemic, impacts can range

from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines.

Another way to measure the extent of an infectious disease is by using the case-fatality rate. The case-fatality rate does not represent the overall spread of the disease but rather the proportion of people diagnosed with the disease who die from it. It should be noted that the case-fatality rate has limitations because it does not take into account unreported cases.

The John Hopkins Coronavirus Resource Center reports that between March 2020 and March 2023, COVID-19 had a case fatality rate of 1.1%. The COVID-19 pandemic disproportionately killed older people, so case-fatality rate does vary significantly amongst age groups.

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in

Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Pasquotank County experienced 10,697 cases of COVID-19 and 136 deaths. Per 100,000 people, Pasquotank County experienced 342 deaths, significantly higher than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Pasquotank County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 10 deaths to certain infectious and parasitic diseases, excluding COVID-19. Most of these deaths (7) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Enterovirus and other unspecified infectious diseases.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other

natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

Given the record of past events with known or possible impacts at ECSU or in Pasquotank County, the probability of future occurrences is considered possible (between 1 and 10 percent annual chance).

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

### Changes in Development

With enrollment increasing since the last plan, the number of students and employees on campus has grown. Fall 2024 enrollment included a 23% surge in first-time freshman. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statements

- Based on the recent COVID-19 pandemic, it is clear the ECSU campus population is susceptible to the infectious disease pandemic.
- ECSU has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# B.5.11 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section B.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table B.44 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table B.44 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Minor | Small | 6 to 12 hrs | Less than 1 week | 2.5 |
| Hurricane & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| Hazardous Substances | Possible | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 1.7 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table B.45:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.

**Table B.45 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Hurricane & Coastal Hazards<br>Tornadoes & Thunderstorms<br>Cyber Security<br>Excessive Heat<br>Severe Winter Weather |
| **Moderate Risk (2.0 – 2.9)** | Infectious Disease<br>Flooding<br>Wildfire<br>Hazardous Substances |
| **Low Risk (< 2.0)** | Earthquake |

# B.6 Capability Assessment

This section discusses ECSU's mitigation capabilities, including plans, programs, policies and land management tools, staff resources, and funding that are typically used to implement hazard mitigation activities. It consists of the following subsections:

- B.6.1 Overview of Capability Assessment
- B.6.2 Planning and Regulatory Capability
- B.6.3 Administrative and Technical Capability
- B.6.4 Fiscal Capability

## B.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## B.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table B.46 lists these local resources currently in place at ECSU.

**Table B.46 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | ECSU Strategic Plan 2025-2030 |
| Campus Master Plan | Y | ECSU 2022 Campus Master Plan |
| Capital Improvements Plan | Y | ECSU Budget Office |
| Local Emergency Operations Plan | Y | ECSU Emergency Operations Plan 2014, update underway |

More details on relevant tools are provided below:

- **Strategic Master Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and includes policies to plan, direct and accommodate anticipated growth. ECSU developed its first campus Strategic Plan in 1995 and has gone through multiple updates, most recently with the completion of the 2025-2030 Strategic Plan.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable.
- **Capital Improvements Plan** is a planning document that typically provides an outlook for anticipated capital projects designed to facilitate decision making in the replacement of capital assets. Capital improvements planning on campus is led by the ECSU Budget Office. Each UNC System campus creates and maintains its own 6-year CIP, which helps inform the UNC System's overall CIP.
- **Emergency Operations Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster. ECSU has an Emergency Operations Plan, developed in 2014. According to the HMPC, the campus is currently working towards updating their EOP.

## B.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table B.47 provides a summary of the administrative and technical capabilities for ECSU.

**Table B.47 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Elizabeth City |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Office of Design & Construction |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Emergency Management Department and Emergency Management Degree Program, Faculty and Students |
| Personnel skilled in GIS | Yes | Office of Design & Construction |
| Emergency Manager | Yes | ECSU Emergency Management Coordinator, Pasquotank-Camden-Elizabeth City Emergency Management Agency |
| Grant Writer | Yes | Office of Sponsored Programs, Contracts and Grants |
| Public Information Officer | Yes | Communications & Marketing |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | Public Safety/Campus Police |

Additional resources and departments that may support administrative capabilities include the following:

- **Bachelor of Science in Emergency Management Degree Program** regularly takes on local service projects in and around the surrounding campus. In the past, Elizabeth City has been used for a risk analysis project where flooding was found to be a concern for smaller rain events.
- **Design and Construction** tracks all facility deficiencies and manages schedules and budgets for facility improvements. Integration with the Budget Office to plan for capital improvements and inclusion of hazard vulnerabilities in facility deficiency tracking could support improvement mitigation capability on campus.
- **The Facilities Management Department** is responsible for building maintenance and upgrades.
- **Division of Student Affairs** coordinates with the Emergency Management Department to disseminate hazard information on all student social media platforms, E4U, Student List Moderator, and via the Vikings Engage app. When students are impacted on campus due to hazard event, SA takes immediate action on residence hall departure and shelter-in place plans.
- ECSU maintains two **emergency shelter** sites on campus in conjunction with the American Red Cross (ARC). One shelter site is maintained for the students that are unable to evacuate during a disaster. The second shelter site is on campus but is designated for use by area residents and is run by the ARC though ECSU employees.

## B.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table B.48 provides a summary of the fiscal resources at ECSU.

**Table B.48 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y |

# B.7 Mitigation Strategy

## B.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table B.49 summarizes the status of mitigation actions from the 2021 plan. Table B.50 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section B.7.2. in the Mitigation Action Plan.

**Table B.49 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| ECSU | 15 | 2 | 10 |

**Table B.50 – Completed and Deleted Actions from the 2021 Plan**

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| ECSU1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, transformers and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Central Utility Plant; E.V. Wilkins Academic Computing Center; Jimmy R. Jenkins Science Complex; K.E. White Graduate and Continuing Education Center; Marion D. Thorpe Administration Building; Moore Hall; Robert L. Vaughn Center; Thomas Jenkins Building; and Williams Hall. | Completed | All systems anchored to foundations |
| ECSU5 | E.V. Wilkins Academic Computing Center - Roof drainage relies exclusively on two drains which if clogged could lead to significant ponding. When the roof is replaced, consider installing one or more scuppers as emergency overflow to prevent roof ponding (which would be significant given the existing parapets). | Completed | Roof replaced |
| ECSU7 | Information Technology Center - There are a number of mechanical and electrical systems serving critical functions that are not bolted to their foundations including transformers, the chiller, the boiler, air handling units, and UPS systems. All mechanical and electrical systems serving critical facilities should be bolted to their foundations in compliance with the building code. | Completed | Will be addressed upon replacement of HVAC system |
| ECSU9 | Jimmy R. Jenkins Science Complex - Several of the guy wires securing rooftop exhaust stacks have become slack. Guy wires for rooftop exhaust vents should be properly tensioned to prevent roof damage during high wind events. | Completed | Secured wires. Replaced roof and issue resolved |
| ECSU10 | Jimmy R. Jenkins Science Complex - The roof of the planetarium ponds water and this reportedly leads to above normal humidity inside the planetarium. The roof over the planetarium should be replaced with a roof that has been properly sloped toward drains and provides increased resistance to wind and driving rain. | Completed | Roof replaced |
| ECSU11 | Jimmy R. Jenkins Science Complex - In certain laboratories there appears to be expensive analytical equipment near windows which in an intense storm could break and allow rain to damage instruments. Locate expensive analytical equipment away from windows or install shatter resistant film over select windows. | Completed | Will verify |
| ECSU12 | K.E. White Graduate and Continuing Education Center - There are two locations at the rear of the facility where the new masonry is cracking around window openings. The cause of masonry damage should be investigated and remedied before further damage occurs. | Completed | Will identify and address |
| ECSU14 | K.E. White Graduate and Continuing Education Center - The guy wires supporting the boiler exhaust are slack. Guy wires supporting the rooftop exhaust stack should be taut to prevent wind related damage. | Completed | Roof has been replaced |

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| ECSU15 | Marion D. Thorpe Administration Building - There are several large pine trees near one corner of the building which could fall and damage the structure during high winds. The large pines adjacent to the facility should be routinely inspected by an arborist to ensure that the trees are healthy. If the tree is in poor health, it should be cut down to prevent damage to the structure as a result of high winds. | Completed | Trees have been cleared to make way for new parking lot |
| ECSU16 | Marion D. Thorpe Administration Building - At the time of the site visit the center of the roof membrane was debonded from the deck and billowing upward in the wind. There were also a number of pine needles on the roof beginning to clog roof drains. The roof of the building should be replaced with one that provides increased resistance to wind and driving rain. | Completed | Roof has been replaced |
| ECSU17 | Marion D. Thorpe Administration Building - The network core switch located in the auditor's office on the first floor lacks proper HVAC. During normal conditions the switch operates above ideal temperatures. During a power outage the switch would eventually overheat cutting off telephone service to the EOC. The network core switch on the first floor should have an independent HVAC unit installed that is powered by the generator. | Completed | Thermostat issue has been addressed. |
| ECSU18 | Moore Hall - The steam lines located in the adjacent street should either be relocated or have better barriers installed to prevent accidental impacts. Place barriers in the vicinity of the steam lines to prevent impacts. | Completed | Backflow diverter replaced and enclosed |
| ECSU20 | Robert L. Vaughn Center - There is widespread and serious damage to the brick façade around embedded steel columns. The cause of masonry damage should be investigated and remedied before further damage occurs. | Delete | Waiting on funding |
| ECSU21 | Robert L. Vaughn Center - There is minor cracking and spalling of reinforced concrete columns on the exterior of the swimming pool. Concrete damage should be repaired to prevent further deterioration. | Delete | Waiting on funding |
| ECSU24 | Thomas Jenkins Building - The roof is reported to leak in the vicinity of the 911/dispatch area. The roof should be repaired with one that provides increased resistance to wind and driving rain. | Completed | New roof |
| ECSU26 | Williams Hall - One of the three sets of guy wires for the radio tower is surrounded by tall pines that could cause serious or catastrophic damage if they were to fall as a result of high winds. Large trees adjacent to the antennae guy wires should be cut down. Severe damage to the guy wires could result in catastrophic failure. | Completed | System removed completely |
| ECSU27 | Williams Hall - Facility personnel report scattered leaks in the roof in the area of the gymnasium. The cause of roof leaks should be identified and repaired to prevent further damage to the building. | Completed | New Roof |

## B.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for ECSU. Each mitigation action recommended for implementation is listed in these tables along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources and estimated cost for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table B.51 – Mitigation Action Plan, ECSU**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ECSU1 | Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational when normal power supply is not available. | All Hazards | 3.2 | H | Property Protection | Facilities Dept. | To be determined | State/Federal grants | 2026-2030 | Carry Forward | Two generators were set for the campus generator plant in March, two more generators and the switchgear will be set in June, and Campus wide generator plant will be operational by August 2026. Action language updated to apply to additional campus facilities |
| ECSU2 | Central Utility Plant - Out on the plant floor there is a large bank of electrical gear with numerous water lines running nearby overhead. During future system modifications relocate or attempt to route water lines further from the electrical switchgear. | All Hazards | 1.1 | M | Property Protection | Facilities Dept. | $25,000-$100,000 | General funds | 2026-2030 | Carry Forward | Implementation of pans above-described area in the near future-2026 fund code. |
| ECSU3 | E.V. Wilkins Academic Computing Center - There are a number of unreinforced IGU windows that could be broken by wind borne debris near sensitive electrical equipment. The windows in the server and UPS area should be reinforced with shatter resistant film to prevent water intrusion in the event of glass breakage. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.1 | M | Property Protection | Facilities Dept. | $5,000-$25,000 | General funds | 2026-2030 | Carry Forward | Computers moved from site |
| ECSU4 | Information Technology Center - There is no redundant HVAC for either the upstairs or downstairs data center and there is insufficient emergency cooling available if the chiller or the downstairs supplemental system fail. The data centers should each have a primary and a backup cooling system capable of cooling the computers if they would be operationally necessary in an emergency. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.2 | M | Property Protection | Facilities Dept. | >$100,000 | General funds | 2026-2030 | Carry Forward | Consolidation of all units in the upstairs while awaiting generator project upgrade |
| ECSU5 | Information Technology Center - There is an unreinforced window in the network switching/call manager closet. Wind borne debris could break the window and driving rain could damage the equipment located there. The window located in the network/call manager room should be reinforced or protected against wind borne debris impacts. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.1 | L | Property Protection | Facilities Dept. | <$5,000 | General funds | 2026-2030 | Carry Forward | Relocation upstairs to area without windows |
| ECSU6 | K.E. White Graduate and Continuing Education Center - There is a clogged roof drain and standing water over the boiler room. Roof drains should be regularly inspected and cleaned. Trees adjacent to the facility should be pruned to prevent them from dropping leaves onto the roof deck. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.1 | M | Prevention | Facilities Dept. | <$5,000 | General funds | 2026-2030 | Carry Forward | Project remains priority for campus. Have not secured funding |
| ECSU7 | Robert L. Vaughn Center - There is no pedestrian sidewalk in the relatively high traffic area between the building and the tennis courts at the rear, exposing pedestrian to vehicle strike. Install a non-skid, ice-resistance pedestrian sidewalk between the rear of the facility and the tennis courts to protect pedestrians during snow/ice events. | Severe Winter Weather | 1.1 | M | Prevention | Facilities Dept. | $5,000-$25,000 | General funds | 2026-2030 | Carry Forward | Leadership discussion pending |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ECSU8 | Robert L. Vaughn Center - Hollowell Drive adjacent to the facility floods so severely during intense rain storms that the University must be temporarily closed for safety. This also significantly limits emergency vehicle access. The University should enhance their existing stormwater capture and detention system to prevent road flooding and University closure. | Flooding | 1.1 | H | Structural Projects | Facilities Dept. | >$100,000 | State/Federal grants | 2026-2030 | Carry Forward | Preventative maintenance |
| ECSU9 | Thomas Jenkins Building - There are unreinforced windows in the 911/dispatch area that could break as a result of wind borne debris. Replace or reinforce the windows in the 911/dispatch center with shatter resistant film to protect equipment and personnel in the event of a wind borne debris strike. | Tornadoes & Thunderstorms, Hurricanes & Coastal Hazards | 1.1 | M | Property Protection | Facilities Dept. | $5,000-$25,000 | General funds | 2026-2030 | Carry Forward | Pending funding application of shatter resistant film |
| ECSU10 | Williams Hall - There is an unreinforced window in the room housing the radio station's electronic equipment. The window could be broken by wind borne debris, allowing rain to damage sensitive electronics. The window in the room with sensitive radio station electronics should be reinforced or covered with a protective Plexiglas shield to prevent water damage in the event that wind borne debris breaks the window. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms, Flooding | 1.1 | L | Property Protection | Facilities Dept. | <$5,000 | General funds | 2026-2030 | Carry Forward | Pending leadership decision |
| ECSU11 | Improve hazard monitoring and warning systems to enable earlier response actions. | All Hazards | 2.2 | M | Emergency Services | Facilities Dept. | To be determined | General funds | 2026-2030 | New | |
| ECSU12 | Improve drainage conditions through the identification and implementation of capital improvements projects. | Flooding, Hurricanes & Coastal Hazards | 1.1 | M | Structural Projects | Facilities Dept. | To be determined | State/Federal grants | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM




# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

## Annex C: Fayetteville State University

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# Annex C. Fayetteville State University

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to Fayetteville State University (FSU). This section contains the following subsections:

- C.1 Planning Process Details
- C.2 Campus Profile
- C.3 Asset Inventory
- C.4 Hazard Identification
- C.5 Hazard Profiles, Analysis, and Vulnerability
- C.6 Capability Assessment
- C.7 Mitigation Strategy

## C.1 Planning Process Details

The table below lists the HMPC members who represented FSU during the planning process.

**Table C.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Abiodun Awoyemi | Director Emergency Management; Police and Public Safety |
| Alpha Clowney | Chief of Police/Asso VC Public Safety; Police and Public Safety |
| Nicole Lucas | Sr Vice Chancellor (VC); Academic Affairs |
| Gregory Moyd | Assistant VC; Student Affairs |
| Gretchen Cobb | Director of Business Services; Business and Finance |
| Conroy Campbell | Database Administrator; Information Technology |
| Harold Miller | Director Planning & Construction; Facilities Management |
| Carl Dean | Associate VC; Human Resources |
| Benita Angel Powell | Assistant General Counsel; Legal Office |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table C.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| FSU Campus Master Plan | The FSU Campus Master Plan was developed in 2013 and has since been updated in 2023. It was referenced for the Campus Profile in Section C.2 as well as the Capability Assessment in Section C.6 |

| Resource Referenced | Use in this Plan |
|---|---|
| Cumberland County and Incorporated Areas Flood Insurance Study (FIS), Revised 6/20/2018 | The FIS report was referenced in the preparation of flood hazard profile in Section C.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section C.5. The plan was additionally used to track implementation progress (Section 2) and develop the mitigation plan (Section 7). |
| Cumberland-Hoke Regional Hazard Mitigation Plan, 2020 | The Cumberland-Hoke Regional Hazard Mitigation Plan, which includes Fayetteville, was referenced in compiling the Hazard Identification and Risk Assessment in Section C.5. FSU is also part of the Cumberland-Hoke County Hazard Mitigation Plan update for 2025-2030. |

# C.2 Campus Profile

This section provides a general overview of the Fayetteville State University (FSU) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

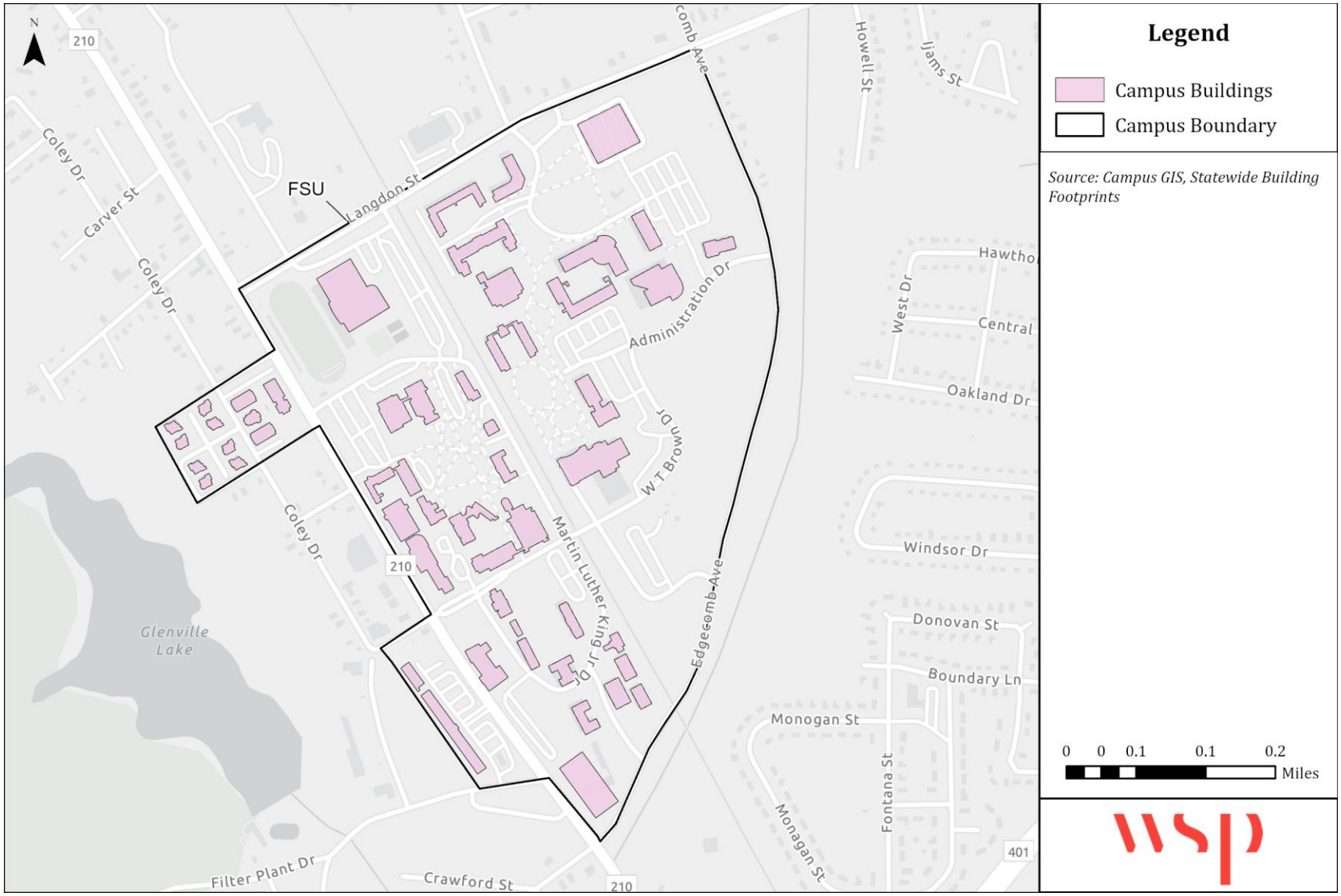
## C.2.1 Location and Setting

Located just outside of downtown Fayetteville, Fayetteville State University offers students the opportunity to receive an excellent education while enjoying a wide variety of recreational and cultural amenities. Favored by a mild climate and proximity to Glenville Lake and Mazarick Park, FSU has features that help make student living and learning both exciting and fulfilling. In addition, the university is rich with an array of exciting co-curricular experiences including over 100 different clubs and student organizations, intramural sports, social activities, speakers and cultural events.

United States Highways 210, 24, and 401 make the city and the university easily accessible by automobile. FSU offers the free Bronco Shuttle, Zipcars, and Lime Bikes as campus transportation, and Fast Bus services are available city wide. Hotels and motels are available to accommodate overnight visitors. The university is situated on 156 acres and consists of 38 buildings, 4 of which were built in the last 10 years.

Figure C.1 provides a base map of the FSU main campus. For more details on on-campus buildings and critical facilities, see Section C.3.

## Figure C.1 – FSU Campus Base Map



## C.2.2 Geography and Climate

Fayetteville is in the Sandhills of North Carolina, which are between the coastal plain to the southeast and the Piedmont to the northwest. The land in Fayetteville sits approximately 102 feet above sea level. The city is built on the Cape Fear River, which empties into the Atlantic Ocean. Fayetteville has a mild climate with max temperatures dropping to 53 degrees Fahrenheit on average in January and climbing to 90 degrees Fahrenheit in July on average. The annual precipitation for the city is approximately 47 inches per year.

**Figure C.2 – Average Annual Temperature, Cumberland County**

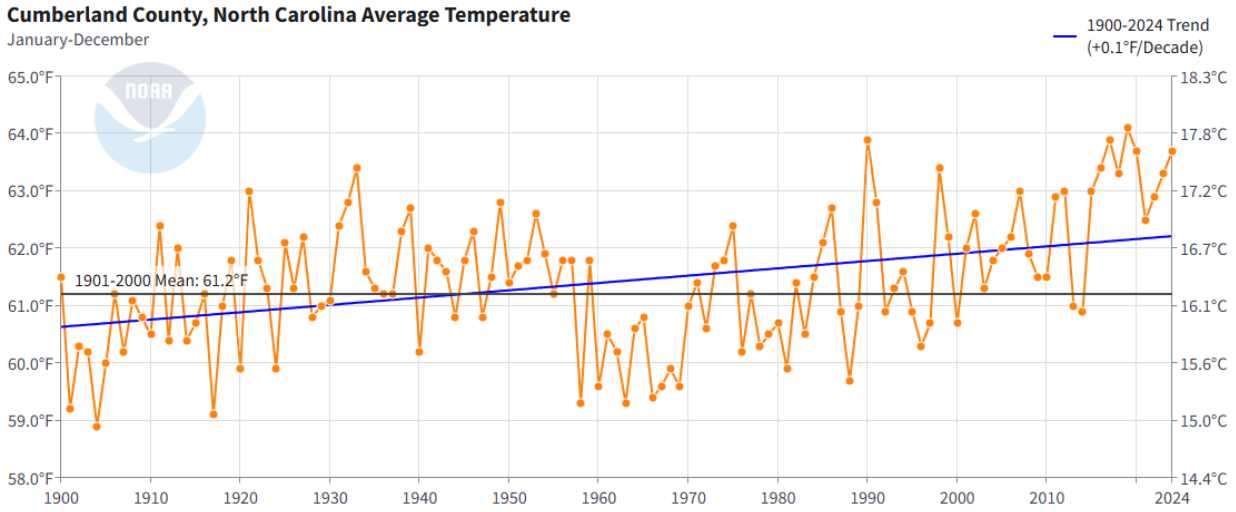
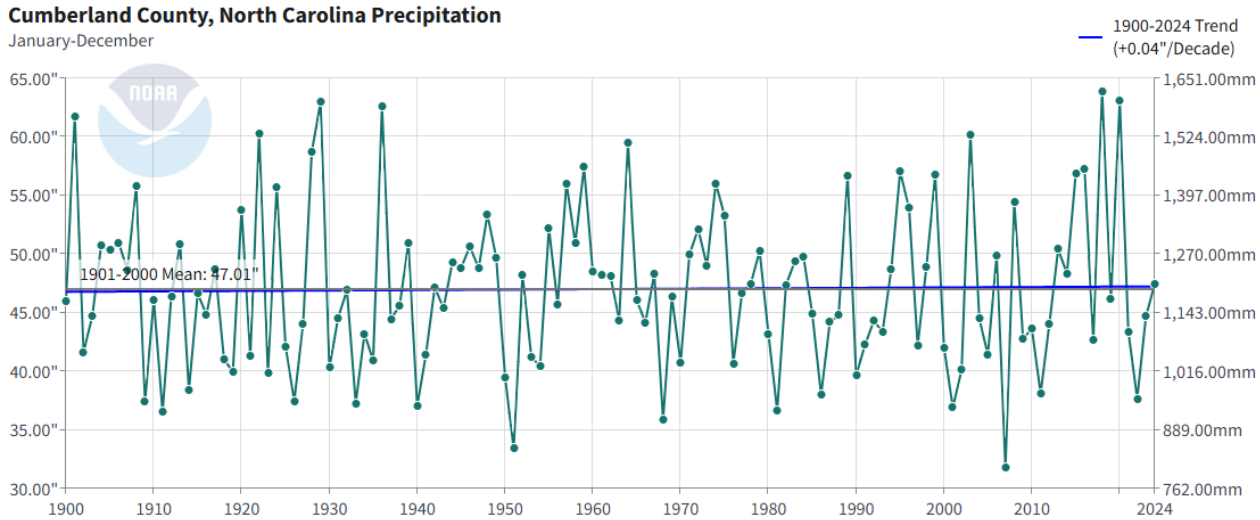



**Figure C.3 – Average Annual Precipitation, Cumberland County**



## C.2.3 Population and Demographics

Table C.3 provides population counts for Fayetteville State University from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to FSU's website, as of fall 2025 the campus has a student to faculty ratio of 17 to 1.

**Table C.3 – Population Counts for Fayetteville State University, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **7,607** |
| *Undergraduate Students* | 6,542 |
| *Graduate Students* | 1,065 |
| *Full-Time Students* | 6,705 |
| *In-State Residency* | 6,546 |
| *Out-of-State Residency* | 1,061 |

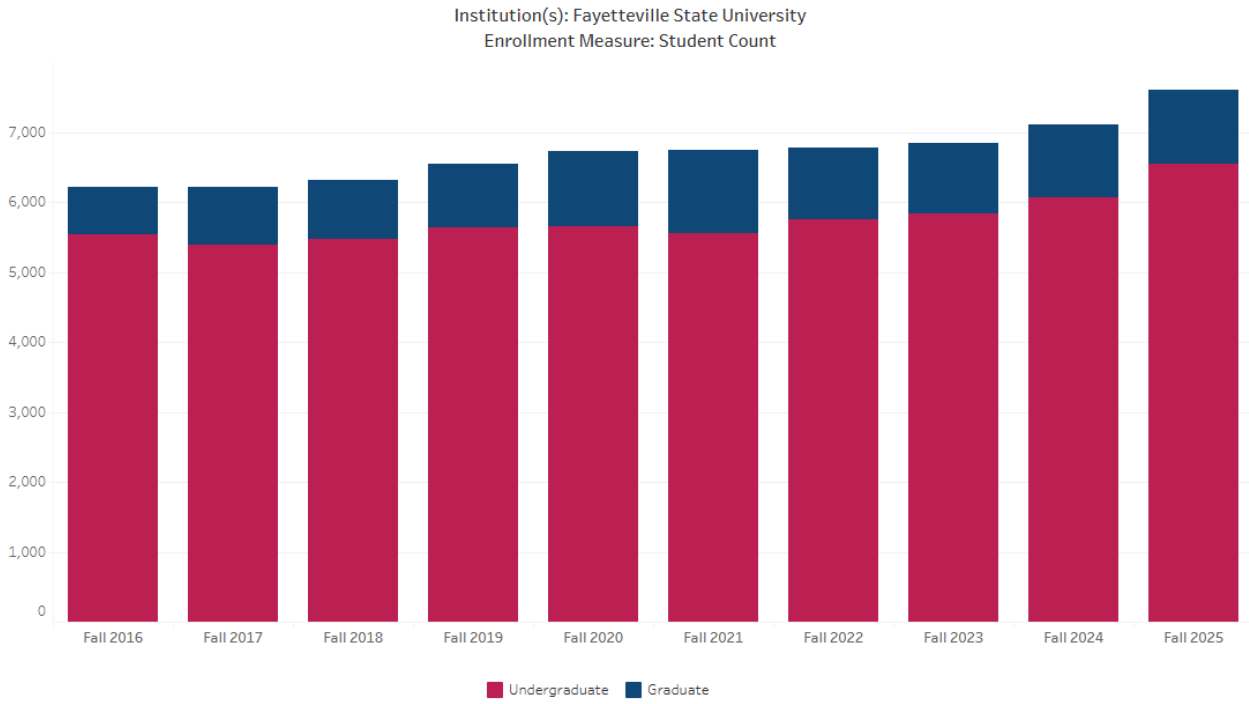
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Cumberland, Wake, and Harnett Counties as well as other counties located in the central and southern regions of North Carolina. Approximately 44% of all enrolled students come from Cumberland County.

Among the FSU student population, the most popular majors for undergraduates were Health Professions and Related Programs, Psychology, and Homeland Security, Law Enforcement, Firefighting, and Related Support Services. The top graduate majors were Business Management, Education, and Psychology.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure C.4. Enrollment has increased slightly over the last five years.

**Figure C.4 – FSU Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 5,540 | 5,393 | 5,473 | 5,644 | 5,661 | 5,557 | 5,748 | 5,845 | 6,074 | 6,542 |
| Graduate | 683 | 833 | 845 | 907 | 1,065 | 1,191 | 1,039 | 1,002 | 1,033 | 1,065 |
| Total | 6,223 | 6,226 | 6,318 | 6,551 | 6,726 | 6,748 | 6,787 | 6,847 | 7,107 | 7,607 |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table C.4.

**Table C.4 – FSU Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 94 | 1.2% |
| Black or African American | 4,844 | 63.7% |
| Hispanic or Latino | 753 | 9.9% |
| Two or More Races | 424 | 5.6% |
| Asian | 126 | 1.7% |
| Native Hawaiian or Other Pacific Islander | 10 | 0.1% |
| White | 1,022 | 13.4% |
| Race/Ethnicity Unknown | 193 | 2.5% |
| U.S. Nonresident | 141 | 1.9% |

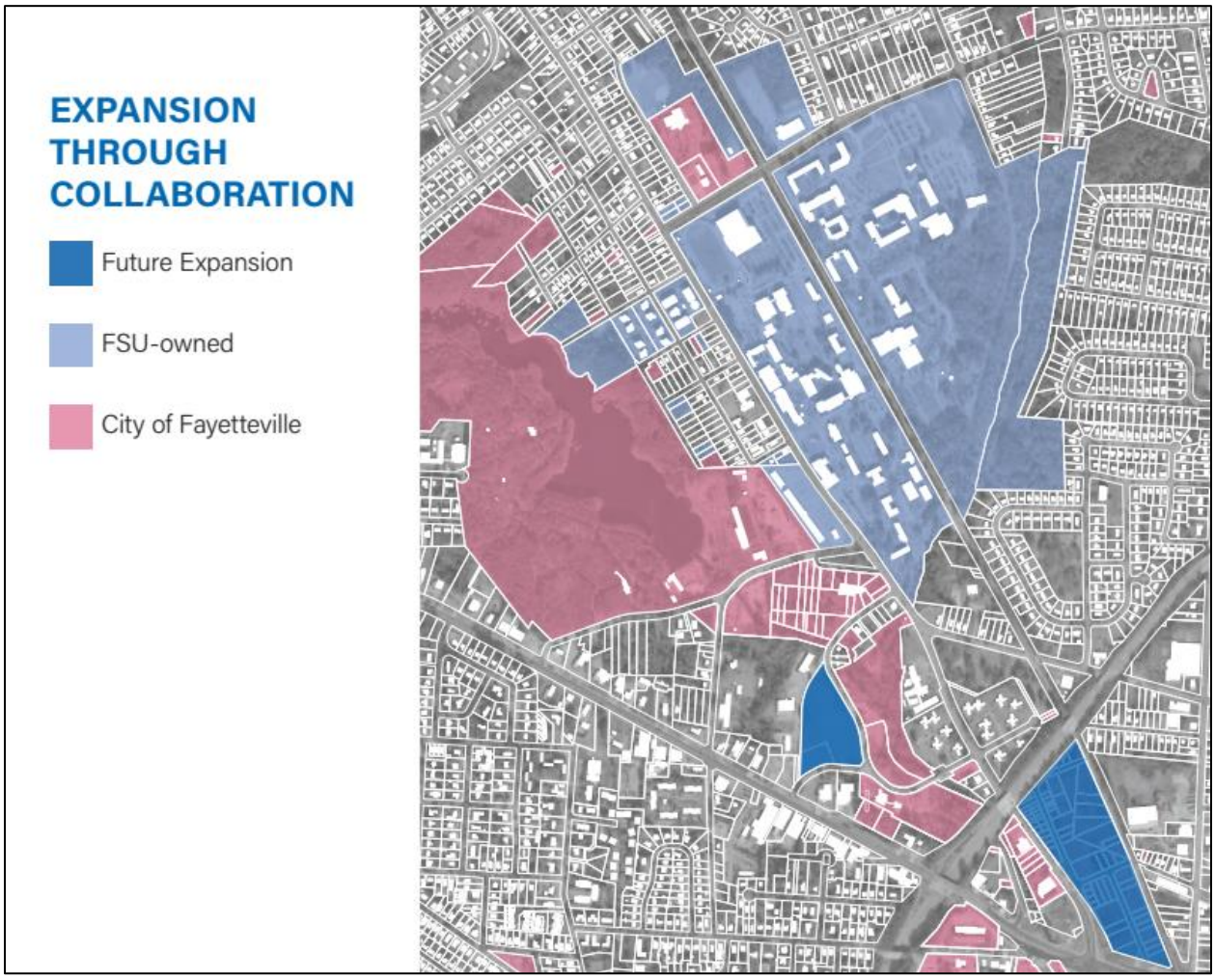
Source: UNC System Interactive Data Dashboards

## C.2.4 Growth and Development Trends

According to the FSU 10-Year Campus Master Plan, FSU is looking to expand and collaborate with the City of Fayetteville to develop mixed-use spaces as shown in Figure C.5. This plan mentions several new buildings such as the College of Education, the Health and Wellness

Center, new residence halls, new campus restaurants, and additional parking decks. Several building and renovation updates are occurring as well at the G.L. Butler Building, the Helen T. Chick Building, A.B. Rosenthal Building, and the H.L. Cook Building.

**Figure C.5 – Areas of Future Expansion at FSU**




Source: FSU 10-Year Master Campus Plan

# C.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the FSU campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## C.3.1 Building Exposure

Table C.5 provides total building exposure for the campus, which was estimated by summarizing building footprints and building replacement values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table C.5 – FSU Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Building Replacement Value |
|---|---|---|
| Administration | 7 | $8,974,664.68 |
| Educational/Extracurricular | 22 | $115,593,933.10 |
| Housing | 21 | $64,104,552.36 |
| **Total** | **50** | **$188,673,150.10** |

Source: NCEM iRisk database

## C.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by FSU's HMPC representatives. After reviewing the following criteria designed to identify and evaluate all critical buildings in the UNC System Hazard Mitigation Plan, the FSU HMPC maintained the list of critical facilities from the previous plan. Some revisions were made due to changes to the campus building inventory. Factors considered for critical building evaluation included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

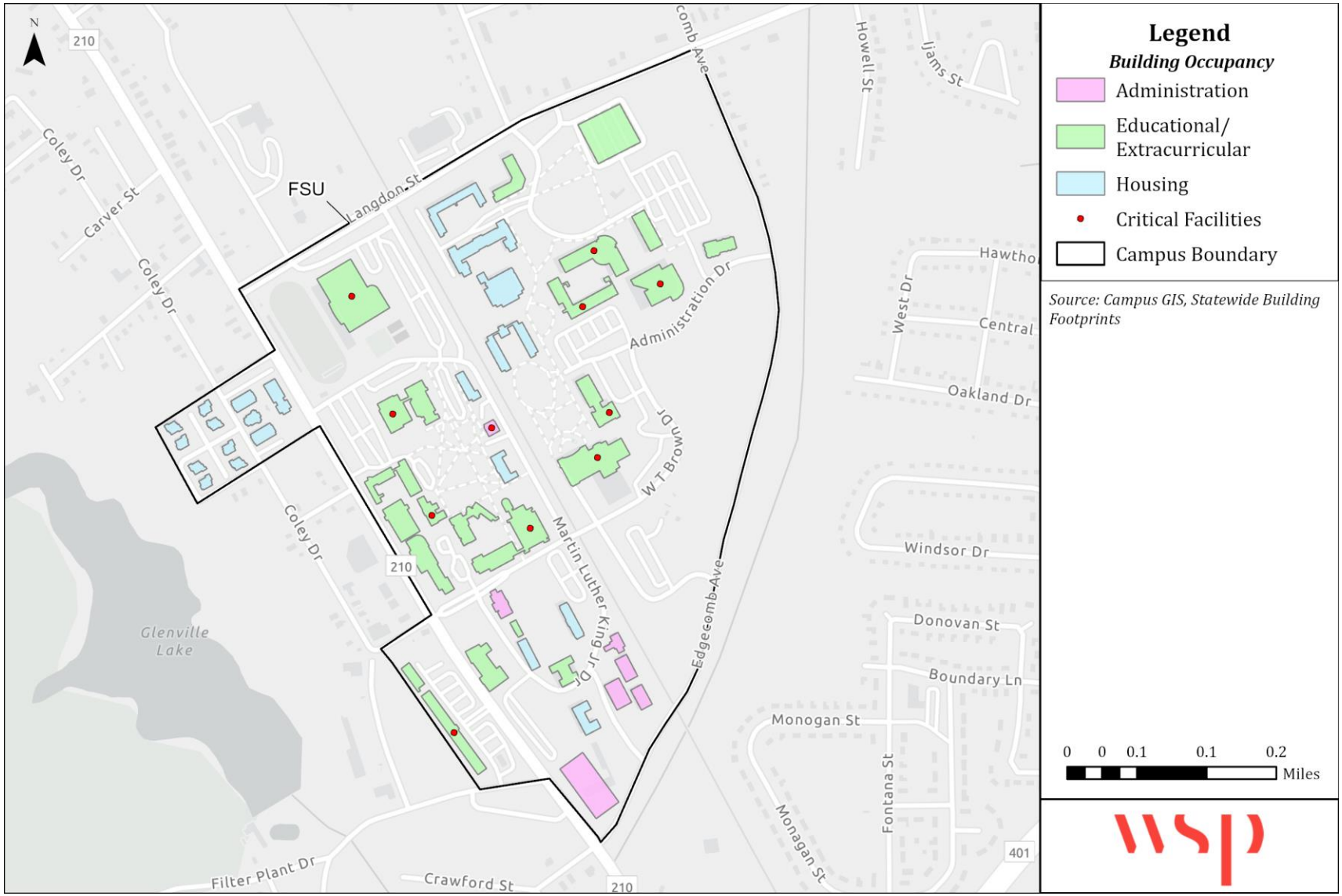
The identified critical facilities for FSU are listed below

- Barber Building
- Bronco Mid-Town
- Butler Building

- Capel Arena
- Chestnutt Library
- Collins Building
- Lily Gymnasium
- Lyons Science Annex
- Lyons Science Building
- Mitchell Building
- Rudolph Jones Student Center
- SBE Building
- Telecommunications Building

Campus building classifications and critical facilities are shown in Figure C.6.

**Figure C.6 – FSU Map of Critical Facilities**



# C.4 Hazard Identification & Risk Assessment

## C.4.1 Hazard Identification

To identify a full range of hazards relevant to FSU, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the FSU Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table C.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table C.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP FSU Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Excessive Heat | Yes | No |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | No |
| Drought | Yes | Yes |
| Tornadoes & Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | No |
| Infectious Disease | Yes | No |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | No |

FSU's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State HMP and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Cumberland County was used to approximate past events that may have affected the FSU campus. The NCEI database contains 454 records of storm events that occurred in Cumberland County in the 25-year period from 2000 through 2024. Table C.7 summarizes these events.

**Table C.7 – NCEI Severe Weather Data for Cumberland County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Flash Flood | 71 | $3,353,000 | $0 | 0 | 0 |
| Flood | 3 | $97,410,000 | $50,000,000 | 2 | 0 |
| Hail | 88 | $1,025,000 | $0 | 0 | 0 |
| Heat | 1 | $0 | $0 | 1 | 0 |
| Heavy Rain | 6 | $1,500,000 | $0 | 0 | 0 |
| High Wind | 5 | $1,176,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 1 | $28,000 | $0 | 0 | 0 |
| Lightning | 16 | $1,836,000 | $0 | 0 | 22 |
| Strong Wind | 11 | $1,628,000 | $7,000 | 0 | 1 |
| Thunderstorm Wind | 204 | $1,516,500 | $0 | 0 | 4 |
| Tornado | 6 | $100,525,000 | $0 | 1 | 89 |
| Tropical Storm | 7 | $4,110,000 | $0 | 0 | 0 |
| Winter Storm | 22 | $0 | $0 | 0 | 0 |
| Winter Weather | 13 | $10,000 | $0 | 1 | 0 |
| **Total** | **454** | **$214,117,500** | **$50,007,000** | **5** | **116** |

Source: National Center for Environmental Information Events Database, retrieved October 2025

Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Cumberland County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.

- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Cumberland County has been designated in 17 major disaster declarations, as detailed in Table C.8, and 13 emergency declarations, as detailed in Table C.9.

**Table C.8 – FEMA Major Disaster Declarations, Cumberland County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 1-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-699-NC | 30-Mar-84 | Tornado | Severe Storms & Tornadoes | N/A | N/A | N/A |
| DR-1134-NC | 6-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1240-NC | 27-Aug-98 | Hurricane | Hurricane Bonnie | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7790 | $21,289,504 | $18,285,917 |
| DR-1546-NC | 10-Sep-04 | Hurricane | Tropical Storm Frances | 25950 | $45,380,867 | $70,854,432 |
| DR-1969-NC | 20-Apr-11 | Severe Storm(s) | Severe Storms, Tornadoes, And Flooding | 1778 | $5,391,278 | N/A |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28971 | $98,842,213 | $291,092,954 |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34713 | $133,948,455 | $632,937,402 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance; IAH = Individuals and Households; PA = Public Assistance

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table C.9 – FEMA Emergency Declarations, Cumberland County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 5-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3254-NC | 15-Sep-05 | Hurricane | Hurricane Ophelia |
| EM-3380-NC | 7-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 4-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 2-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 5-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3586-NC | 01-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 06-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table C.10 summarizes the determination made for each hazard.

### Table C.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in 2021 FSU Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in 2021 FSU Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 FSU Annex<br>▪ Modeled building damages in iRisk database enable vulnerability assessment |
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 FSU Annex<br>▪ Cumberland County has had three disaster declarations for flooding and 11 disaster declarations for hurricanes or tropical storms which may have involved flooding |
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Included in 2021 FSU Annex but no landslide risk found |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Hurricane & Coastal Hazards | Yes | ▪ Included in 2021 FSU Annex<br>▪ Cumberland County has had 11 disaster declarations related to hurricanes.<br>▪ Coastal hazards not relevant due to campus's inland location |
| Severe Winter Weather | Yes | ▪ Included in 2021 FSU Annex |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 FSU Annex<br>▪ Cumberland County has had six disaster declarations for tornadoes and/or severe storms |
| Wildfire | Yes | ▪ Included in 2021 FSU Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | No | ▪ Not included in 2021 FSU Annex but HMPC expressed interest in evaluating this hazard<br>▪ Transportation routes with hazardous materials are present in and around the campus |
| Infectious Disease | No | ▪ Not included in 2021 FSU Annex but HMPC expressed interest in evaluating this hazard<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | No | ▪ Not included in 2021 FSU Annex but HMPC expressed interest in evaluating this hazard<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |
| Terrorism | No | ▪ Not included in 2021 FSU Annex<br>▪ HMPC did not express interest in evaluating this hazard; best addressed by State and federal planning and emergency response |

# C.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and

- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on FSU's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Cumberland County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses

specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2020 Cumberland-Hoke Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Cumberland County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table C.11 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Earthquake** | USGS, NCEI | County | iRisk | Campus |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricanes & Coastal Hazards** | NHC | County | iRisk | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the FSU planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table C.12.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile. The results of the risk assessment and overall PRI scoring are provided in Section C.5.11 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table C.12 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF | **1** | **30%** |
| | **LIMITED** | MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 | **3** | |
| | **CATASTROPHIC** | HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

## C.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

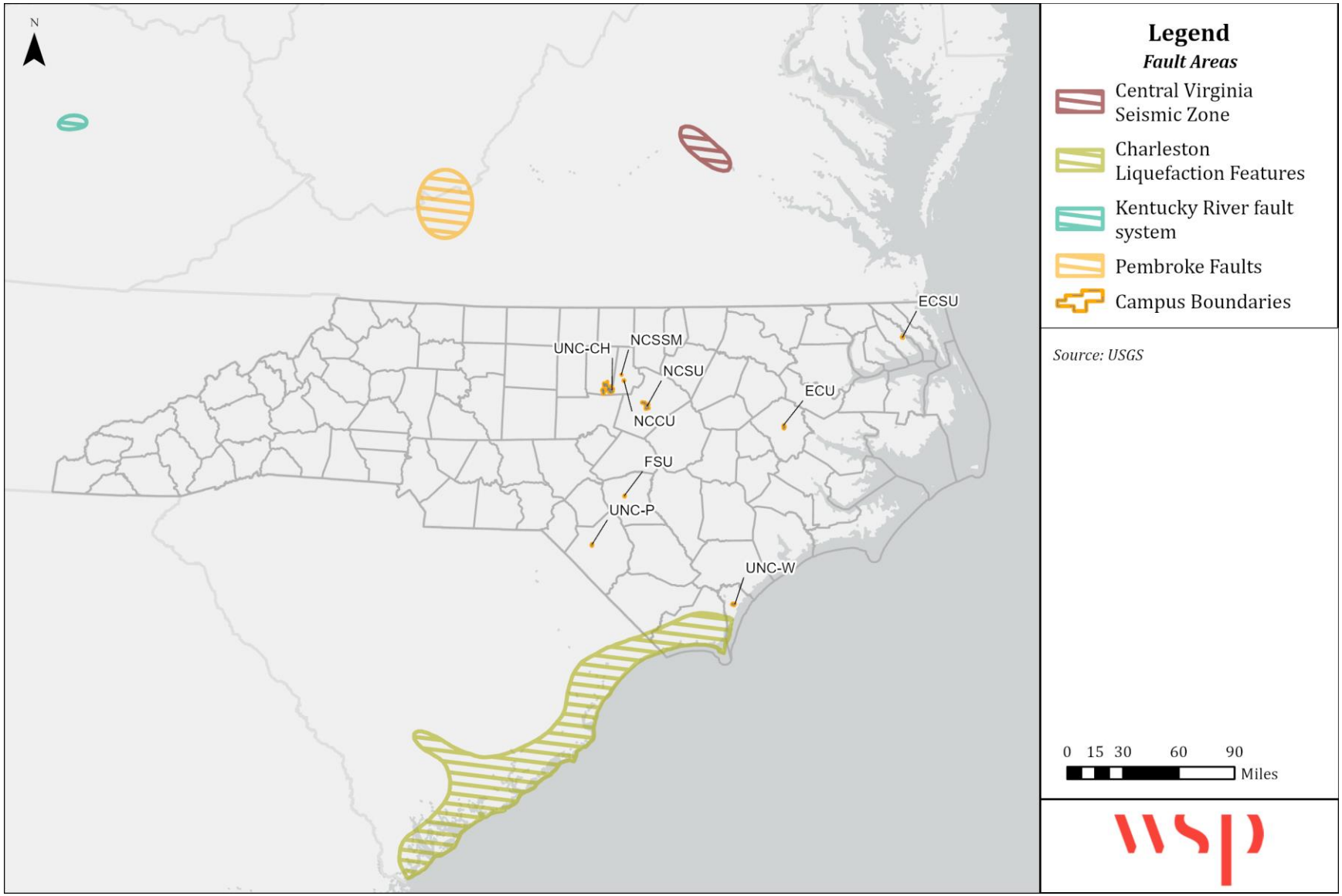
Figure C.7 reflects the quaternary faults that present an earthquake hazard for the FSU planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. No active faults were noted in Cumberland County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Cumberland County is likely to be felt across the entire campus.

*Spatial Extent: 4 – Large*

**Figure C.7 – U.S. Quaternary Faults**



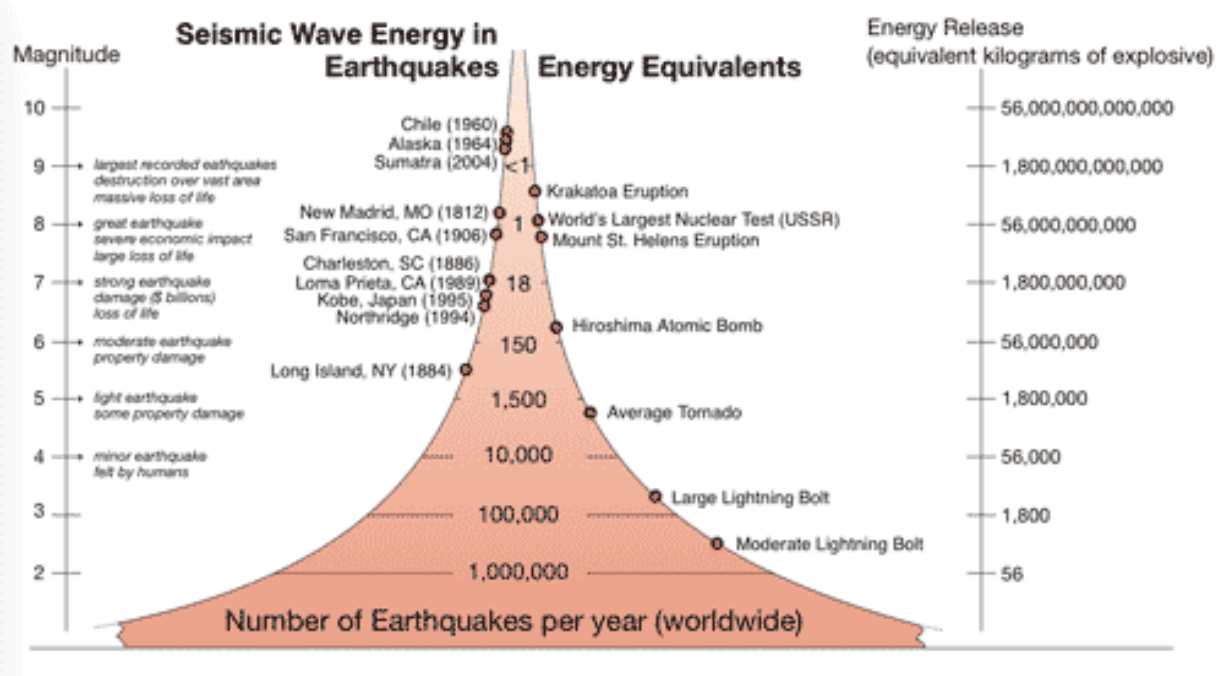
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure C.8.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table  shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure C.8 – Earthquake Magnitude and Energy Release**




Source:  USGS Earthquake Hazards Program

**Table C.13 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater. Earthquake events that occurred within 100 miles of the FSU campus are presented in Table C.14 and Figure C.9.

**Table C.14 – Historical Earthquakes within 100 Miles of FSU, 1900-2024**

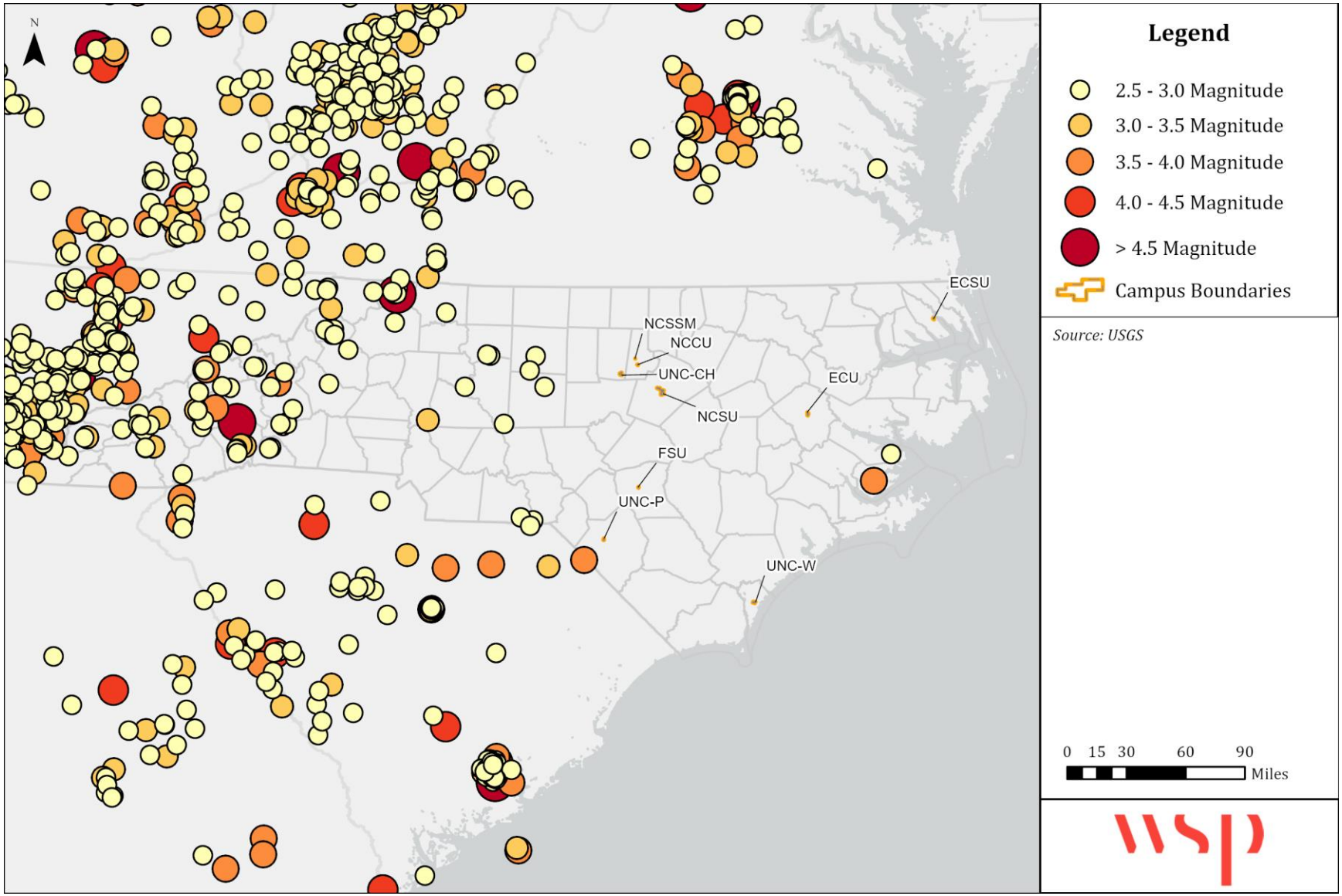
| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 10/27/1959 | 3.9 | 6 km NE of McBee, South Carolina |
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 1/29/1994 | 2.9 | 12 km NNE of Alcolu, South Carolina |
| 8/6/1994 | 3.6 | 4 km SSW of Bayboro, North Carolina |
| 4/13/1998 | 3.9 | 9 km S of Kershaw, South Carolina |
| 6/5/1998 | 3.2 | 4 km SSE of Mooresville, North Carolina |
| 9/22/2006 | 3.4 | 4 km WSW of Blenheim, South Carolina |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 11/3/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |

Source: USGS

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there was one earthquake felt in and around Fayetteville: on September 1, 1886 with an epicenter approximately 260 miles from Fayetteville.

**Figure C.9 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

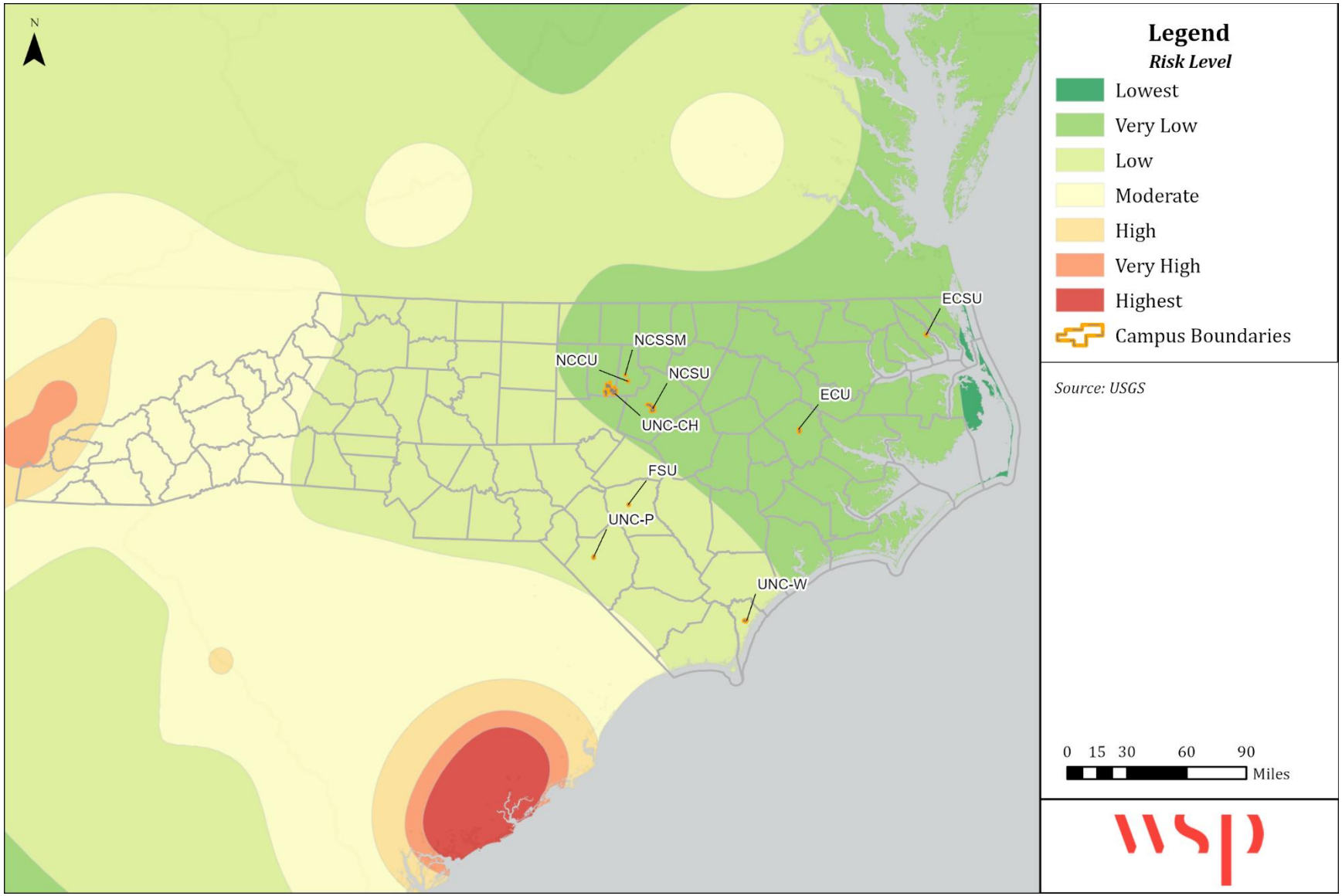
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure C.10 on the following page reflects the seismic hazard for Cumberland County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Cumberland County is located within the light green zone which represents "low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting FSU is unlikely.

*Probability: 1 – Unlikely*

**Figure C.10 – Seismic Hazard Information for Cumberland County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on FSU's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also damage infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause $439,436 of estimated total building damages.

Cumberland County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structures. Table C.15 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table C.15 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $704.22 | $1,201.43 | $1,905.65 |
| Educational | $7,155.49 | $12,133.16 | $19,288.65 |
| Housing | $2,251.81 | $3,094.15 | $5,345.96 |
| **Total** | **$10,111.52** | **$16,428.74** | **$26,540.26** |
| **500-Year Earthquake Event** | | | |
| Administration | $10,076.32 | $20,190.31 | $30,266.63 |
| Educational | $104,754.51 | $209,968.38 | $314,722.89 |
| Housing | $35,616.04 | $53,612.30 | $89,228.34 |
| **Total** | **$150,446.87** | **$283,770.99** | **$434,217.86** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **1,000-Year Earthquake Event** | | | |
| Administration | $56,978.15 | $81,691.53 | $138,669.68 |
| Educational | $493,233.36 | $754,255.33 | $1,247,488.69 |
| Housing | $171,119.61 | $195,568.55 | $366,688.16 |
| **Total** | **$721,331.12** | **$1,031,515.41** | **$1,752,846.53** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Cumberland County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on USGS seismic probabilities and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the FSU campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at FSU have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statement

- While earthquakes are an unlikely hazard event for the FSU campus, an estimated $439,436 of total building damage could occur in the case of a 500-year earthquake event.

## C.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures at or above 100°F. Table C.16 provides counts of heat index values by threshold recorded from 2000-2024 at the Fayetteville Regional Airport in Cumberland County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Cumberland County experiences an average of 84 hours per year with heat index values at or above 100°F.

*Impact: 2 – Limited*

**Table C.16 – Historical Heat Index, Fayetteville Regional Airport, Cumberland County, NC, 2000-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2000 | 25 | 8 | 0 | 0 | 33 |
| 2001 | 28 | 10 | 0 | 0 | 38 |
| 2002 | 64 | 1 | 0 | 0 | 65 |
| 2003 | 51 | 4 | 0 | 0 | 55 |
| 2004 | 16 | 0 | 0 | 0 | 16 |
| 2005 | 74 | 21 | 0 | 0 | 95 |
| 2006 | 55 | 17 | 0 | 0 | 72 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2007 | 51 | 13 | 9 | 0 | 73 |
| 2008 | 60 | 0 | 0 | 0 | 60 |
| 2009 | 27 | 1 | 0 | 0 | 28 |
| 2010 | 117 | 30 | 2 | 0 | 149 |
| 2011 | 86 | 28 | 2 | 0 | 116 |
| 2012 | 62 | 24 | 3 | 2 | 91 |
| 2013 | 32 | 1 | 0 | 0 | 33 |
| 2014 | 29 | 0 | 0 | 0 | 29 |
| 2015 | 103 | 6 | 0 | 0 | 109 |
| 2016 | 147 | 21 | 0 | 0 | 168 |
| 2017 | 112 | 41 | 14 | 2 | 169 |
| 2018 | 26 | 1 | 0 | 0 | 27 |
| 2019 | 148 | 30 | 0 | 0 | 178 |
| 2020 | 76 | 12 | 0 | 0 | 88 |
| 2021 | 59 | 2 | 0 | 0 | 61 |
| 2022 | 88 | 15 | 0 | 0 | 103 |
| 2023 | 105 | 14 | 6 | 3 | 128 |
| 2024 | 98 | 21 | 3 | 0 | 122 |
| **Sum** | **1,739** | **321** | **39** | **7** | **2,106** |
| **Average** | **70** | **13** | **2** | **0** | **84** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

Cumberland County experienced one heat-related incident according to NCEI between 2000 and 2024, which is summarized below. The incident resulted in one fatality.

- **August 10, 2007** – Central North Carolina experienced several days of extreme heat with afternoon highs in the upper 90s to lower 100s. A 43-year-old male collapsed while pumping gas and was found by a highway patrol officer. The man died from heat stroke. The victim's core body temperature was 106 degrees.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Fayetteville Regional Airport in Cumberland County, NC. Based on 52 years of data (1973-2024), the Fayetteville station averaged 22.6 days per year with a heat index at or above 100 degrees.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat. In 2007, one person in Robeson County died from heat stroke.

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized "heat islands." Information is not available concerning the extent to which impervious surface coverage has changed on campus since the adoption of the previous hazard mitigation plan.

## Problem Statement

- FSU is located in Cumberland County, which currently averages 84 hours per year with heat index values above 100°F and there is a 100% annual chance of heat index values meeting or exceeding 100°F in any given year.

## C.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Minor | Small | 6 to 12 hrs | Less than 1 week | 2.5 |

### Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the FSU campus using the FIRM dated January 5, 2007. Figure C.11 reflects the 2007 mapped flood insurance zones. Table C.17 summarizes one of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table C.17 intersect the FSU campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Fayetteville and the FSU campus. Flood risk is not limited to the 1%-annual-chance floodplain.

Although this assessment focuses on riverine flooding, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. Data was not available to evaluate the location or extent of stormwater flooding on campus.

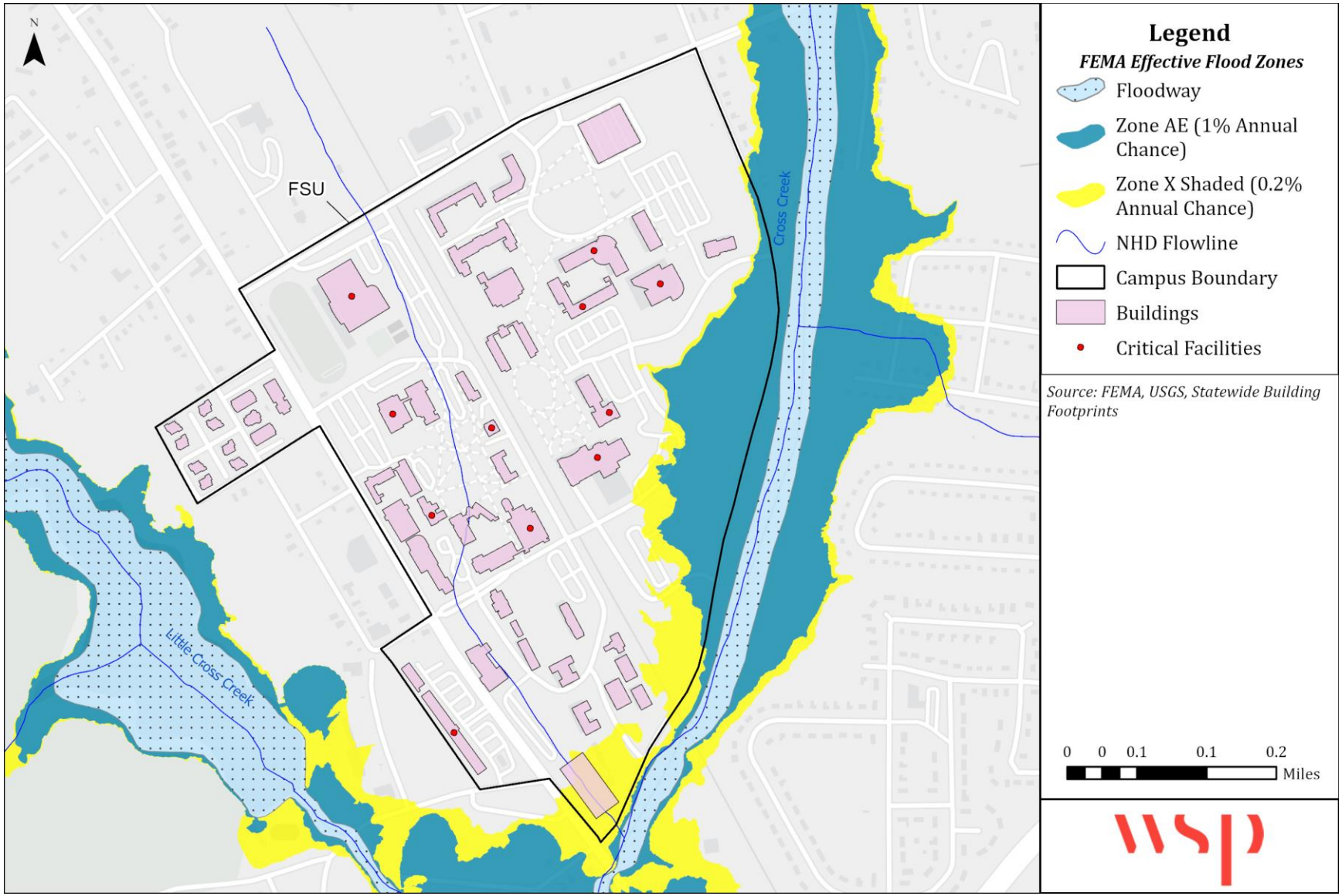
*Spatial Extent: 2 – Small*

**Table C.17 – Mapped Flood Insurance Zones**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 |

| Zone | Description |
|---|---|
| | and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure C.11 – FEMA Flood Hazard Areas in FSU's Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain, detailed above, and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Approximately 8.6 percent of the FSU Campus falls within the SFHA. The majority of the campus, 85 percent, is outside of the floodplain. Table C.18 provides a summary of the FSU campus' total area by flood zone on the 2007 effective DFIRM. Figure C.12 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

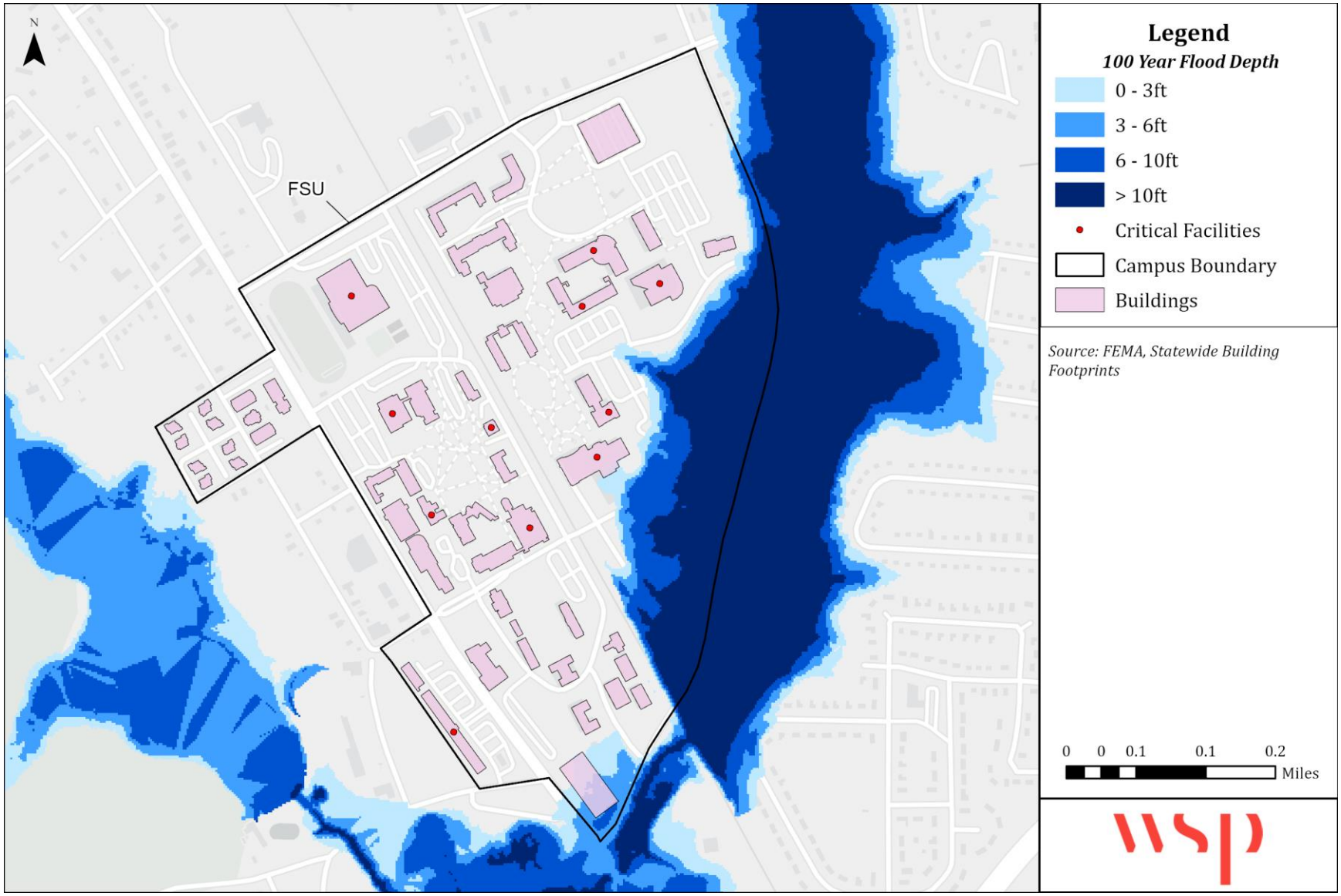
*Impact: 1 – Minor*

**Table C.18 – Flood Zone Acreage on FSU Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 12.6 | 8.6% |
| 0.2% Annual Chance Flood Hazard | 8.3 | 5.7% |
| Unshaded X | 125.2 | 85.7% |
| **Total** | **146.1** | **--** |
| **SFHA Total** | **12.6** | **8.6%** |

Source: FEMA 2007 DFIRM

**Figure C.12 – Flood Depth, 1-Percent-Annual-Chance Flood, FSU Campus**



## Historical Occurrences

Table C.19 details the historical occurrences of flooding for Fayetteville and Cumberland County identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 36 recorded flood-related events occurred on 29 separate days in Fayetteville and Cumberland County from 2000 to 2024 causing $98,941,000 in property damage, $50,000,000 in crop damage, two fatalities, and no injuries. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table C.19 – NCEI Records of Flooding Events in Fayetteville, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Fayetteville | 6/16/2001 | 0/0 | $0 | $0 |
| Fayetteville | 8/28/2002 | 0/0 | $0 | $0 |
| Fayetteville | 9/18/2002 | 0/0 | $0 | $0 |
| Fayetteville | 5/25/2003 | 0/0 | $0 | $0 |
| Fayetteville | 7/19/2003 | 0/0 | $0 | $0 |
| Fayetteville | 7/29/2003 | 0/0 | $0 | $0 |
| Fayetteville | 6/8/2005 | 0/0 | $0 | $0 |
| Fayetteville | 7/20/2006 | 0/0 | $0 | $0 |
| Fayetteville | 8/22/2006 | 0/0 | $0 | $0 |
| Fayetteville | 6/15/2008 | 0/0 | $0 | $0 |
| (Fay)Grannis Fld Fay | 7/8/2008* | 0/0 | $0 | $0 |
| Fayetteville | 9/6/2008 | 0/0 | $0 | $0 |
| (Fay)Grannis Fld Fay | 6/25/2010 | 0/0 | $10,000 | $0 |
| Fayetteville | 6/21/2011 | 0/0 | $0 | $0 |
| Cumberland County | 6/22/2011 | 0/0 | $0 | $0 |
| Fayetteville | 9/2/2014 | 0/0 | $2,000 | $0 |
| (Fbg)Ft Bragg | 10/8/2016 | 0/0 | $0 | $0 |
| Fayetteville | 6/8/2019 | 0/0 | $0 | $0 |
| (Fay)Grannis Fld Fay | 2/6/2020* | 0/0 | $0 | $0 |
| Cumberland County | 7/7/2022 | 0/0 | $0 | $0 |
| Fayetteville | 7/9/2022 | 0/0 | $0 | $0 |
| Fayetteville | 6/26/2023* | 0/0 | $15,000 | $0 |
| (Fay)Grannis Fld Fay | 8/8/2024 | 0/0 | $2,000 | $0 |
| Fayetteville | 9/16/2024 | 0/0 | $2,000 | $0 |
| Fayetteville | 9/27/2024 | 0/0 | $0 | $0 |
| **Flood** | | | | |
| (Fbg)Ft Bragg | 10/9/2016 | 2/0 | $62,100,000 | $20,000,000 |
| (Fbg)Ft Bragg | 9/17/2018 | 0/0 | $35,310,000 | $30,000,000 |

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Heavy Rain** | | | | |
| Fayetteville | 12/11/2008 | 0/0 | $1,500,000 | $0 |
| (Fay)Grannis Fld Fay | 7/7/2022 | 0/0 | $0 | $0 |
| **Total** | | **2/0** | **$98,941,000** | **$50,000,000** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **05/25/2003** - Numerous roads were flooded, stranding cars, and some people had to be rescued. Water entered houses on Butterwood Circle and Smith Street. A small dam broke on Dundle Road, flooding the road.
- **June 8, 2005** – About six inches of water covered the floors of businesses on Franklin Street after water backed out of a storm drainage system, covering the street, flooding buildings and the parking lot for the Police Department. Cross Creek overflowed its banks and left mud on streets, sidewalks, and parking lots. Twenty streets were closed due to flooding.
- **July 20, 2006** – Numerous streets flooded within the city limits of Fayetteville. Many motorists were forced to abandon stalled vehicles as water rose to 2 to 3 ft. on some of the streets.
- **December 11, 2008** – A powerful upper-level disturbance with associated cold front pushed across the region the afternoon and evening of December 11. Over 2 inches of rain fell in many locations with several reports of minor urban flooding. A car ran off the road and into a ditch which was full of water. The vehicle was carried downstream and the driver had to be rescued.
- **August 2, 2012** – With a broad area of troughing persisting across the East Coast, a strong vorticity center aloft and weak surface convergence combined with a moist and moderately unstable air mass and resulted in scattered showers and thunderstorms, mainly across the Coastal Plain. Multiple reports of flash flooding were received just west of downtown Fayetteville. Flooding was reported on Yadkin Road, on Santa Fe Road, on Strickland Bridge Road near the intersection of Graham Road and on Hope Mills Road, with several reports of stranded cars. Hybarts Branch Creek came out of its banks and flooded several yards. Several roads also flooded near the Cross Creek Mall, with some water getting into portions of the mall and cars in the parking lot had water over the tires.
- **10/8/2016** - Torrential rainfall of 12 to 15 inches caused widespread flash flooding across the county. The heavy rains caused at least 8 dams to breach in Cumberland County. Numerous roads were closed due to flooding, including portions of Interstate 95. Numerous homes and businesses were flooded as well, with numerous water rescues from people trapped in homes and vehicles.
- **10/9/2016** - Torrential rainfall of 12 to 15 inches caused widespread flash flooding across the county. The heavy rains caused at least 8 dams to breach in Cumberland County.

Additional rainfall upstream resulted in major flooding at both the Little River at Manchester and Cape Fear at Fayetteville. Flooding damaged approximately 4,050 structures throughout the county, resulting in $62.1 million in property damage and at least $20 million in crop damage. There was more than 700 swift water rescues in Cumberland County alone. The flooding resulted in 2 direct fatalities. A 81 year old female was found dead inside her vehicle in the 100 block of Rhodes Pond Road. After flood waters receded, a 53-year-old male was found less than 100 yards away from his vehicle near the Clinton Road exit on the southbound side of I-95. There were also 2 indirect fatality. A 63-year-old man died several days later from a pre-existing health condition after he was unable to refill his prescription medication due to flooded and impassable roadways. The second indirect fatality occurred several weeks later when a construction equipment operator died while repairing an earthen dam damaged by Hurricane Matthew. The victim was operating a Bobcat when the equipment overturned, trapping him underwater at McFayden Lake.

- **9/17/2018** – Torrential rainfall of 15 to 20 inches caused widespread flooding across the county. Additional rainfall upstream resulted in all-time record major flooding along the Little River at Manchester and major flooding along the Cape Fear River at Fayetteville. Flooding damaged approximately 1,052 structures throughout the county, resulting in $35.3 million in property damage and at least $30 million in crop damage. The Star Lite Motel along the Little River was partially washed away into the river. The Cape Fear River reached the base of both the Person Street and Grove Street bridges at its crest. Numerous roads were closed due to flooding and much of East Fayetteville was evacuated based on forecast river flooding.
- **June 26, 2023** – A cold front interacted with a moist and unstable air mass to result in numerous showers and storms across central North Carolina. A few discrete cells first developed during the evening in the northwest Piedmont, resulting in reports of one to two inch hail there. Once the storms consolidated into a line farther south and east, they transitioned into more of a damaging wind event in the late evening and early overnight hours, with numerous reports of trees and power lines down in parts of the northeast Piedmont, Sandhills, and Coastal Plain. There were also many reports of flash flooding in Cumberland County, including Fayetteville. What rescues and street closures were reported on the following streets: Martin Luther King Jr freeway, Bragg Blvd, Russell St, Ramsey St, and Telegraph Cir.
- **September 16, 2024** – A subtropical area of low pressure off the coast of the Carolinas moved inland, tracking west-northwest towards Charlotte and western North Carolina into the morning of the 17th of September. Rainfall amounts across central North Carolina ranged from 1 to 4 inches, which led to isolated flash flooding in Cumberland and Wake Counties. Ramsey St near Highway 401 was closed due to flooding.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954-2024 which have also included damages associated with flooding.

Additionally, Cumberland County has received one Major Disaster Declaration for a severe storm that included elements of flooding in 2011. The County also received seven Major Disaster Declarations for Hurricanes and Tropical Storms in 1996, 1998, 1999, 2003, 2004, 2016, and 2018 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The FSU campus has some area of land in FEMA-mapped flood hazard areas. This delineation is a useful way to identify the most at-risk areas, but the City of Fayetteville and the FSU campus are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Cumberland County, and impacts from past flood events have been noted by NCEI. NCEI reports 36 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability of over 100% for Fayetteville. Therefore, the overall probability of flooding is considered highly likely.

*Probability: 3 – Highly Likely*

## Vulnerability Assessment

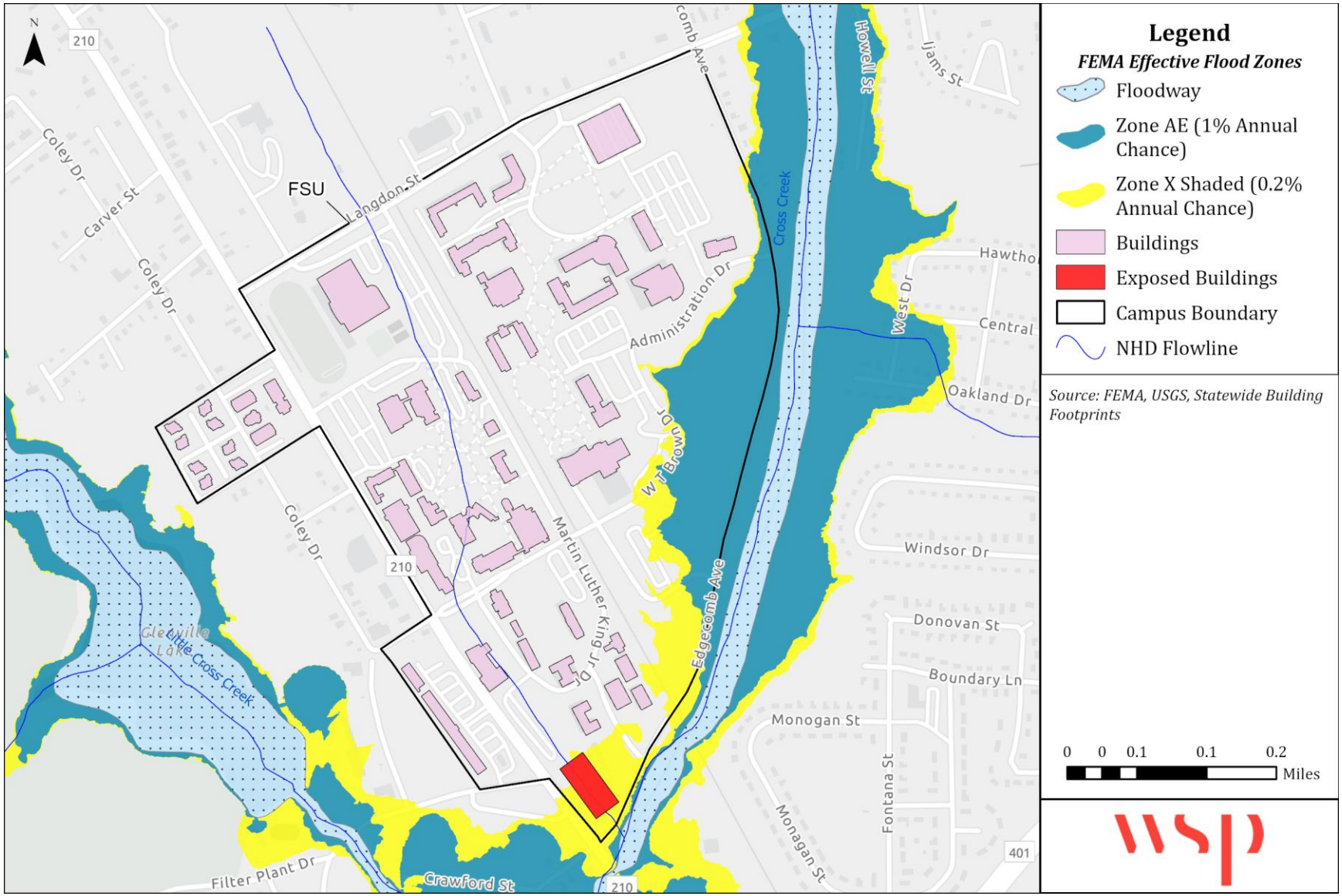
### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. In total, there are 50 buildings on FSU's campus; of these, 1 is located within the SFHA. This was the building evaluated as part of this analysis.

Flood damage is directly related to the depth of flooding by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a specific percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure C.12 depict the depth of flooding that can be expected within the FSU campus during the 1-percent-annual-chance flood event.

The one exposed building is shown in Figure C.13 on the following page. This building has a first-floor elevation that is higher than the modeled 1% annual chance flood water surface elevation. Therefore, no estimated losses are expected from the 1% annual chance flood.

**Figure C.13 – Buildings Exposed to Flood Risk on FSU Campus**



## People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.

- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. NCEI does not contain records of deaths caused by flood events in Fayetteville.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

None of the critical facilities identified for FSU are located within the 1%-annual-chance floodplain, therefore there is no estimated damage. However, the Bronco Student Plaza and the planned location of the new Health and Wellness Center are located within the 0.2%-annual-chance-floodplain.

### Environment

During a flood event, chemicals and other hazardous substances may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the FSU Facilities Management works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statement

- The 1% annual chance floodplain does not impact any structures on the FSU campus. However, the 0.2% annual chance floodplain (or 500-year floodplain) does extend onto the FSU campus and could potentially impact the Bronco Student Plaza, Health and Wellness Center, and adjacent roadways during these flood events.
- Cumberland County has received one Major Disaster Declaration for a severe storm that included elements of flooding in 2011. The County also received seven Major Disaster Declarations for Hurricanes and Tropical Storms in 1996, 1998, 1999, 2003, 2004, 2016, and 2018 which also may have included damages associated with flooding.

## C.5.4 Hurricane

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. Hurricanes and tropical storms can occur anywhere within Cumberland County. Storm surges, or storm floods, are limited to the coastal counties of North Carolina. FSU is not located on the coast and is therefore not impacted by storm surges. However, hurricane winds can impact the entire campus, so the spatial extent was determined to be large.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table C.20), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

**Table C.20 – Saffir-Simpson Scale**

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table C.21 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table C.21 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Tropical cyclones weaken relatively quickly after making landfall; therefore, Cumberland County will not typically experience major hurricane force winds, though these occurrences are possible. A storm on record that impacted FSU was an unnamed tropical depression whose path moved through the campus in 1965 with maximum wind speeds of around 40 mph. However, Hurricane Fran passed within 25 miles of FSU's campus as a Category 2 storm with maximum wind speeds around 84 mph in 1996.

*Impact: 3 – Critical*

## Historical Occurrences

According to NCEI, eight recorded hurricane-related events affected Cumberland County from 2000 to 2024 causing an estimated $4,138,000 in property damage. There were no injuries or fatalities recorded for any of these events.

**Table C.22 – Recorded Hurricane and Tropical Storm Events for Cumberland County, 2000-2024**

| Date | Type | Storm | Deaths/Injuries | Property Damage |
|---|---|---|---|---|
| 9/18/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $28,000 |
| 9/1/2006 | Tropical Storm | Tropical Storm Ernesto | 0/0 | $0 |
| 9/2/2016 | Tropical Storm | Tropical Storm Hermine | 0/0 | $10,000 |
| 9/13/2018 | Tropical Storm | Hurricane Florence | 0/0 | $1,500,000 |
| 10/11/2018 | Tropical Storm | Tropical Storm Michael | 0/0 | $100,000 |
| 9/5/2019 | Tropical Storm | Hurricane Dorian | 0/0 | $1,000,000 |
| 8/3/2020 | Tropical Storm | Hurricane Isaias | 0/0 | $500,000 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $1,000,000 |
| **Total** | | | **0/0** | **$4,138,000** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Florence (2018)** – Frequent wind gusts of 50 to 70 mph resulted in numerous trees down across Cumberland County, including on homes, cars, power lines and damage to structures. Numerous customers lost power in Cumberland County because of the tropical storm force winds from Hurricane Florence. A husband and wife died (indirect) in a house fire. The couple was using candles and lanterns, due to a loss of power. A ridge of high pressure over eastern North America stalled Florence's forward motion a few miles off the southeast North Carolina coast on September 13th. Hurricane Florence made landfall near Wrightsville Beach early on Saturday, September 15, and weakened further as it moved slowly inland. Despite making landfall as a weakened. Category 1 hurricane, Florence still produced 40 to 70 mph wind gusts, enough wind speed to uproot trees and cause widespread power outages throughout the Carolinas. As the storm moved inland,

from September 15 to 17, heavy rain of 10 to 25 inches caused widespread inland flooding, inundating cities such as Fayetteville, Smithfield, Goldsboro, Durham, and Chapel Hill, and causing major river flooding on main-stem rivers such as the Neuse, Cape Fear, and Little River. Most major roads and highways in the area experienced some flooding, with large stretches of I-40 and I-95 remaining impassable for days after the storm had passed. The storm also spawned tornadoes in several places along its path. There were 3 direct and 6 indirect deaths attributed to the storm with in the WFO RAH CWA.

- **Hurricane Dorian (2019)** – Frequent wind gusts of 35 to 55 mph resulted in scattered to numerous trees and power lines down across Cumberland County, including some on homes. Numerous customers lost power in Cumberland County because of the tropical storm force winds from Hurricane Dorian.
- **Hurricane Ian (2022)** - Frequent wind gusts of 40 to 60 mph resulted in scattered to numerous trees and power lines down across Cumberland County, including some on homes. Numerous customers lost power in Cumberland County as a result of the tropical storm force wind gusts.

According to the NOAA Historical Hurricane Tracks dataset, 24 hurricanes or tropical storms, passed within 25 miles of FSU since 1900. These events are listed in Table C.23, and storm tracks are mapped in Figure C.14.

**Table C.23 – Hurricane Tracks within 25-Miles of FSU, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 9/15/1904 | Unnamed | Tropical Storm |
| 6/15/1912 | Unnamed | Tropical Storm |
| 9/4/1913 | Unnamed | Tropical Storm |
| 9/24/1920 | Unnamed | Tropical Storm |
| 9/7/1935 | Unnamed | Tropical Storm |
| 10/21/1944 | Unnamed | Tropical Storm |
| 9/14/1949 | Unnamed | Tropical Depression |
| 7/11/1959 | Cindy | Tropical Depression |
| 7/24/1964 | Unnamed | Tropical Depression |
| 6/17/1965 | Unnamed | Tropical Storm |
| 6/11/1968 | Abby | Tropical Depression |
| 9/16/1976 | Unnamed | Tropical Depression |
| 9/17/1976 | Unnamed | Tropical Depression |
| 9/9/1987 | Unnamed | Tropical Depression |
| 9/7/1996 | Fran | Category 1 |
| 7/25/1997 | Danny | Tropical Depression |
| 9/5/1998 | Earl | Tropical Storm |
| 9/20/2000 | Gordon | Tropical Depression |
| 9/24/2000 | Helene | Tropical Depression |
| 8/31/2004 | Gaston | Tropical Depression |
| 6/15/2006 | Alberto | Tropical Storm |

| Date | Storm Name | Storm Category |
|---|---|---|
| 6/8/2013 | Andrea | Tropical Storm |
| 10/21/2019 | Nestor | Tropical Storm |
| 6/22/2021 | Claudette | Tropical Storm |

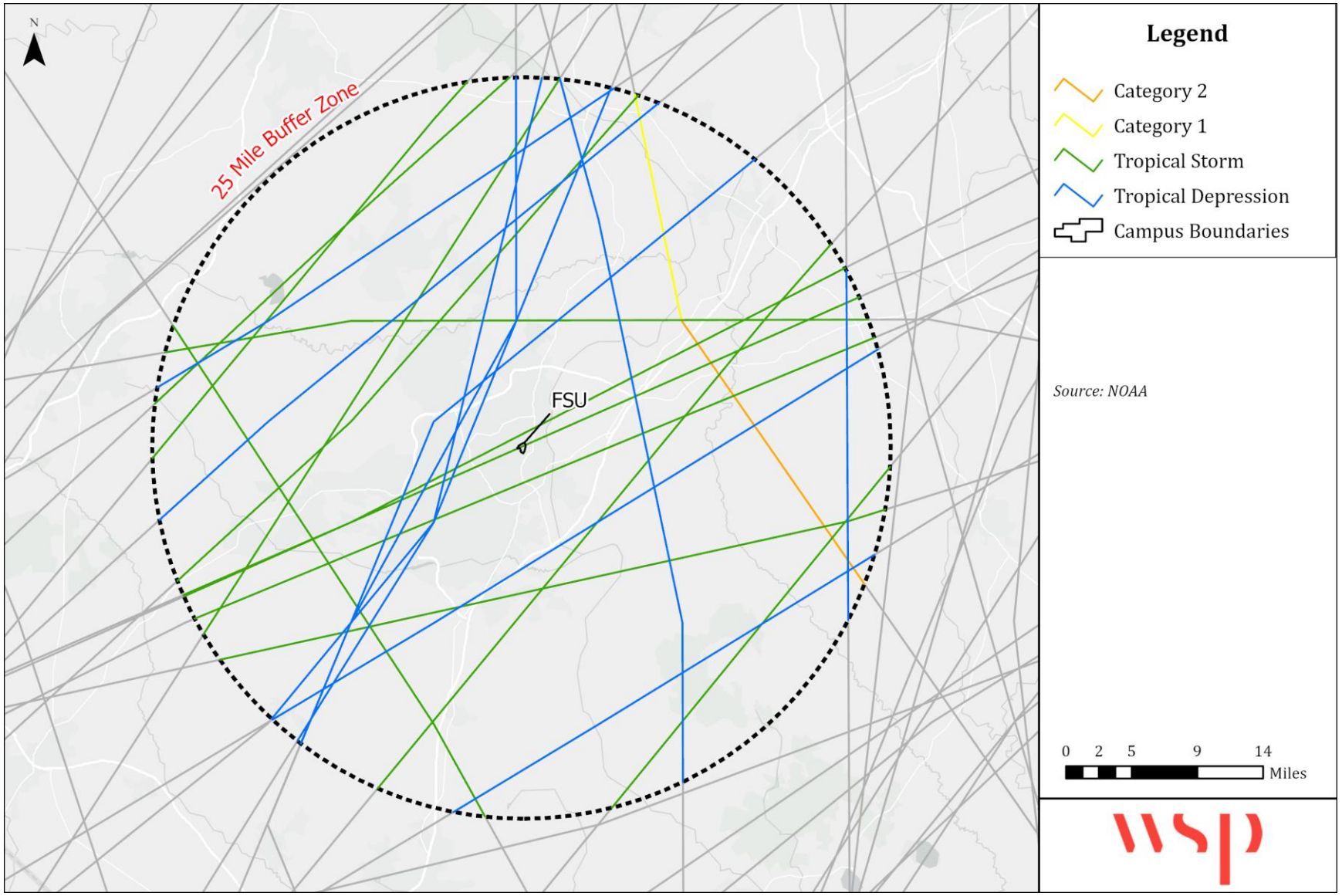
Source: NOAA

Cumberland County has received 7 major disasters and 8 emergency declarations for Hurricane and Tropical Storm events summarized in Table C.24.

**Table C.24 – Hurricane-Related Disaster Declarations & Emergency Declarations**

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 8/27/1998 | DR-1240-NC | Hurricane Bonnie |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/10/2004 | DR-1546-NC | Tropical Storm Frances |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina |
| 9/14/2005 | EM-3254-NC | Hurricane Ophelia |
| 10/10/2016 | EM-3380-NC & DR-4285-NC | Hurricane Matthew |
| 9/10/2018 | EM-3401-NC & DR-4393-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

**Figure C.14 – Historic Hurricane and Tropical Storm Tracks within 25 miles of FSU, 1900-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, eight hurricanes and tropical storms have impacted Cumberland County, which equates to a 32 percent annual probability of hurricanes or tropical storms impacting the county. Overall, the probability of a hurricane or tropical storm impacting the county is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. On-campus students may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause over $1 million of estimated total building damage to FSU's campus.

Table C.25 detail the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table C.25 – Estimated Building Damage by Hurricane Winds, FSU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $37,325.69 | $9,706.52 | $47,032.21 |
| Educational | $523,266.60 | $126,769.54 | $650,036.14 |
| Housing | $249,157.92 | $60,515.41 | $309,673.33 |
| **Total** | **$809,750.21** | **$196,991.47** | **$1,006,741.68** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $331,233.47 | $204,524.68 | $535,758.15 |
| Educational | $3,358,266.58 | $1,809,514.55 | $5,167,781.13 |
| Housing | $1,317,332.81 | $522,046.35 | $1,839,379.16 |
| **Total** | **$5,006,832.86** | **$2,536,085.58** | **$7,542,918.44** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $783,859.79 | $626,168.78 | $1,410,028.57 |
| Educational | $7,525,098.26 | $5,679,819.36 | $13,204,917.62 |
| Housing | $2,889,284.97 | $1,659,315.00 | $4,548,599.97 |
| **Total** | **$11,198,243.02** | **$7,965,303.14** | **$19,163,546.16** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statement

- Historical tracks of multiple hurricane events pass within 25-miles of the FSU Campus.
- For the 25-year period from 2000 through 2024, there have been 8 hurricane wind events causing over $4.1 million dollars in damage for Cumberland County.

## C.5.5 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Cumberland County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI), shown in Table C.26 for the Cumberland County region, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. The county may experience any level on the RSI scale. Cumberland County receives an average of 2 to 4 inches of snowfall per year in the northern region of the County, while the southern half averages 1 to 2 inches. According to NCEI, the greatest snowfall amounts to impact Cumberland County have been between 7-9 inches, with Fayetteville reporting around 7-9 inches of snowfall as well. During the snowstorm of December 24 to December 26, 2010, from which 7-9 inches were reported near Fayetteville, the county was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

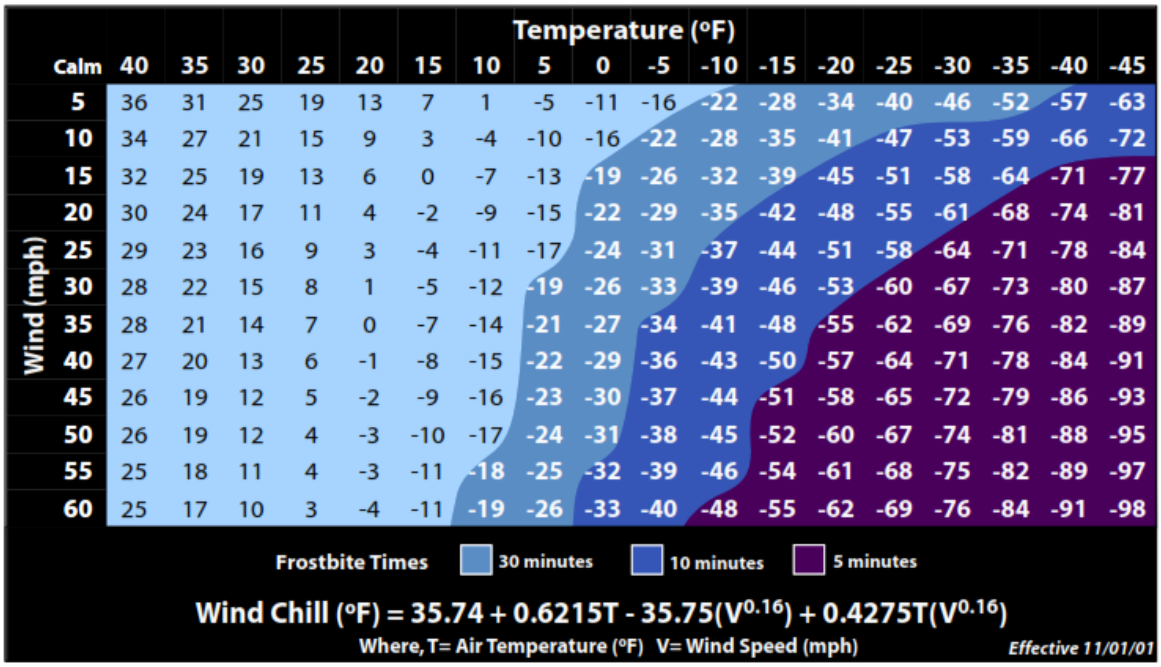
**Table C.26 – Regional Snowfall Index (RSI) Values**

| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure C.15, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure C.15 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Cumberland County took place March 2nd, 1927, with a recorded depth of 24 inches of snow occurring in the City of Fayetteville.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of a severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24-hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there were 35 combined winter storm/winter weather events in Cumberland County during the 25-year period from 2000 through 2024. As reported in NCEI, severe winter weather directly caused one fatality and $10,000 in property damage. Events in Cumberland County are summarized by incident type in Table C.27.

**Table C.27 – Recorded Severe Winter Weather Events in Cumberland County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Winter Storm | 22 | 0 | 0 | $0 | $0 |
| Winter Weather | 13 | 1 | 0 | $10,000 | $0 |
| **Total** | **35** | **1** | **0** | **$10,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

**March 2, 2010** – Around 1 to 2 inches of snow fell across the county. Around 8000 customers were without power in the region.

**December 16, 2010** – A prolonged period of light snow and freezing rain in the morning resulted in a half inch of snow with a tenth of an inch of freezing rain. This combination created hazardous driving conditions during the morning commute. A 50-year-old man was killed in Fayetteville when a truck in the opposite lane slid on the ice striking a car in the oncoming traffic.

**December 25, 2010** – Seven to nine inches of snow fell countywide including in Fayetteville. Many roads were impassible due to the heavy snow, however, other than a few minor accidents no other problems were reported due to the holiday.

**January 10, 2011 –** Three to five inches of snow fell across the area during the morning and afternoon hours. Snow changed over to freezing rain during the afternoon resulting in nearly a quarter inch of ice in some locations on top of the snow. All area roads were covered in snow resulting in the closure of schools and businesses.

**January 7, 2017 –** A low pressure system tracking north along the Carolina coast and interacting with an |arctic airmass moving into the area from the central CONUS produced wintry precipitation |across central North Carolina during the late evening hours on the 6th and continuing until the early afternoon hours on the 7th. A swath of heavy to moderate snow of 6 to 11 inches fell across the western and central Piedmont of North Carolina, with a mixture of 1 to 2 inches of snow and 0.15 inches of ice across the Sandhills and Coastal Plain.

**January 21, 2022 –** Light snow developed over central North Carolina during the afternoon of January 21, peaked in the late evening and early overnight hours, and ended the morning of January 22. The highest totals occurred over the Coastal Plain and Sandhills where up to 5 inches fell, while locations across the Piedmont received around 1 to 4 inches of snow. The snow caused numerous accidents and scattered power outages, especially across the eastern and southern half of the area, where snowfall totals were the greatest.

Cumberland County has never received any FEMA Major Disaster Declarations for severe winter weather.

## Probability of Future Occurrence

NCEI records 35 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $162,306, which assumes that 10% of the student population is impacted.

**Table C.28 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 7,623 | 762 | $162,306 |

### Property

A winter storm may cause damage to buildings and vehicles when severe. Frozen or snow-covered trees and branches could fall on homes or vehicles. Additionally, building and household pipes are at risk of freezing and cracking which could eventually cause water damage. Approximately, $10,000 of property damage was reported in association with any winter weather events recorded by the NCEI between 2000 and 2024 for Cumberland County. This equates to an annualized loss of $400 per year.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. FSU may wish to consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statement

- Severe winter weather events are highly likely for Cumberland County and the FSU campus.

# C.5.6 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas. All of FSU is exposed to tornadoes and thunderstorms. Overall, due to the small size of the planning area, any given event will likely impact most, if not all, of the planning area, so the spatial extent of a tornado or thunderstorm event is considered large.

*Spatial Extent: 4 – Large*

### TORNADO

Tornados can occur anywhere on FSU's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado is not increased in one area of the campus versus another.

### THUNDERSTORM WINDS

The entirety of FSU's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28)

and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table C.29 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table C.29 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

Source: NWS Storm Prediction Center

The most intense tornado to pass near Fayetteville in the past 75 years was an F4 (EF4) on April 8, 1957. NCEI reports this event causing around $250,000 in property damage and resulting in 8 injuries.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, Thunderstorm Wind, Tornado and Hurricane. For this severe weather risk assessment, High Wind, Strong Wind and Thunderstorm Wind data was collected. Hurricane Wind and Tornadoes are addressed as individual hazards. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.

- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Fayetteville occurred on July 8, 2015 with a measured gust of 74 mph. The event reportedly resulted in no fatalities, injuries, property or crop damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table C.30 is a common parameter that is part of fire weather forecasts nationwide.

**Table C.30– Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

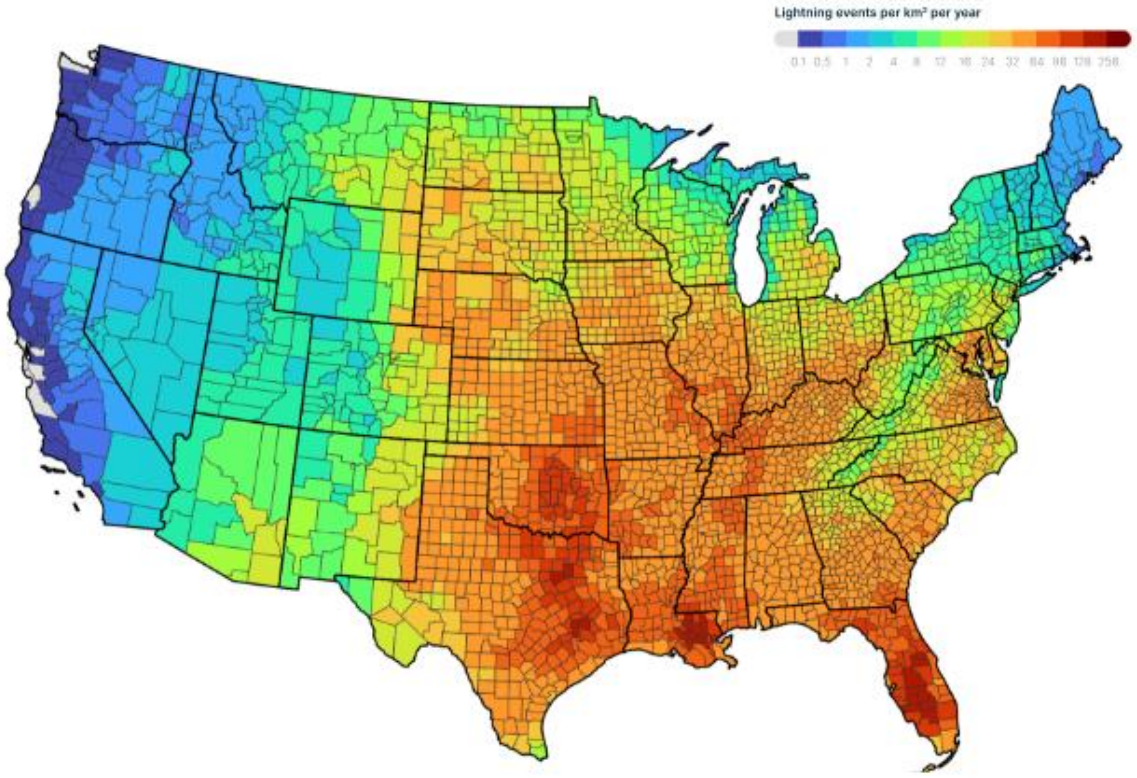
Source: National Weather Service

With the right conditions in place, the entire campus is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

*Impact: 1 – Minor*

According to the Vaisala flash density map, shown in Table C.11, Cumberland County experiences between 24 to 37 lightning flashes per kilometer per year. It should be noted that future lightning occurrences may exceed these figures.

**Figure C.16 – Lightning Density in the U.S. (2024)**




## HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table C.31 indicates the hailstone measurements utilized by the National Weather Service.

**Table C.31– Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table C.32 describes typical intensity and damage impacts of the various sizes of hail.

**Table C.32 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls damaged |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 Fayetteville was a little over 1" in diameter; the largest hailstone recorded was 2.5", recorded on July 1, 2012.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Cumberland County experienced 5 deaths, 169 injuries, and $134.1 million in property damage. Table C.33 shows historical tornadoes in Cumberland County from 1950 to 2024, and Figure C.17 shows tornado paths within 10 miles of Fayetteville. Table C.33

**Table C.33 – Recorded Tornadoes in Cumberland County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 4/8/1957 | 1930 | F4 | 0 | 8 | $250,000 |
| - | 6/2/1959 | 1300 | F0 | 0 | 0 | $25,000 |
| - | 10/4/1960 | 545 | F1 | 0 | 0 | $25,000 |
| - | 9/29/1963 | 230 | F2 | 0 | 0 | $250,000 |
| - | 12/26/1964 | 830 | F1 | 0 | 1 | $2,500 |
| - | 2/22/1971 | 1630 | F3 | 2 | 60 | $4,500,000 |
| - | 3/15/1971 | 1430 | F1 | 0 | 0 | $250,000 |
| - | 5/29/1973 | 400 | F1 | 0 | 0 | $25,000 |
| - | 8/2/1974 | 1100 | F0 | 0 | 0 | $25,000 |
| - | 2/11/1981 | 232 | F2 | 0 | 0 | $250,000 |
| - | 3/28/1984 | 1850 | F3 | 2 | 11 | $25,000,000 |
| - | 3/28/1984 | 1930 | F4 | 0 | 0 | $2,500,000 |
| - | 5/19/1986 | 1535 | F2 | 0 | 0 | $250,000 |
| - | 8/28/1988 | 1505 | F1 | 0 | 0 | $250,000 |
| - | 11/4/1992 | 1515 | F0 | 0 | 0 | $0 |
| - | 11/4/1992 | 1638 | F0 | 0 | 0 | $0 |
| - | 11/4/1992 | 1749 | F0 | 0 | 0 | $0 |
| Hope Mills | 5/28/2000 | 1206 | F0 | 0 | 0 | $0 |
| Pope Afb | 12/17/2000 | N/A | F0 | 0 | 0 | $0 |
| Hope Mills | 3/27/2009 | 1613 | EF1 | 0 | 0 | $225,000 |
| Fenix | 4/16/2011 | 1437 | EF3 | 1 | 85 | $100,000,000 |
| Cedar Creek | 4/16/2011 | 1527 | EF2 | 0 | 4 | $250,000 |
| Stedman | 4/29/2014 | 1452 | EF1 | 0 | 0 | $50,000 |
| **Total** | | | | **5** | **169** | **$134,127,500** |

Source: NCEI

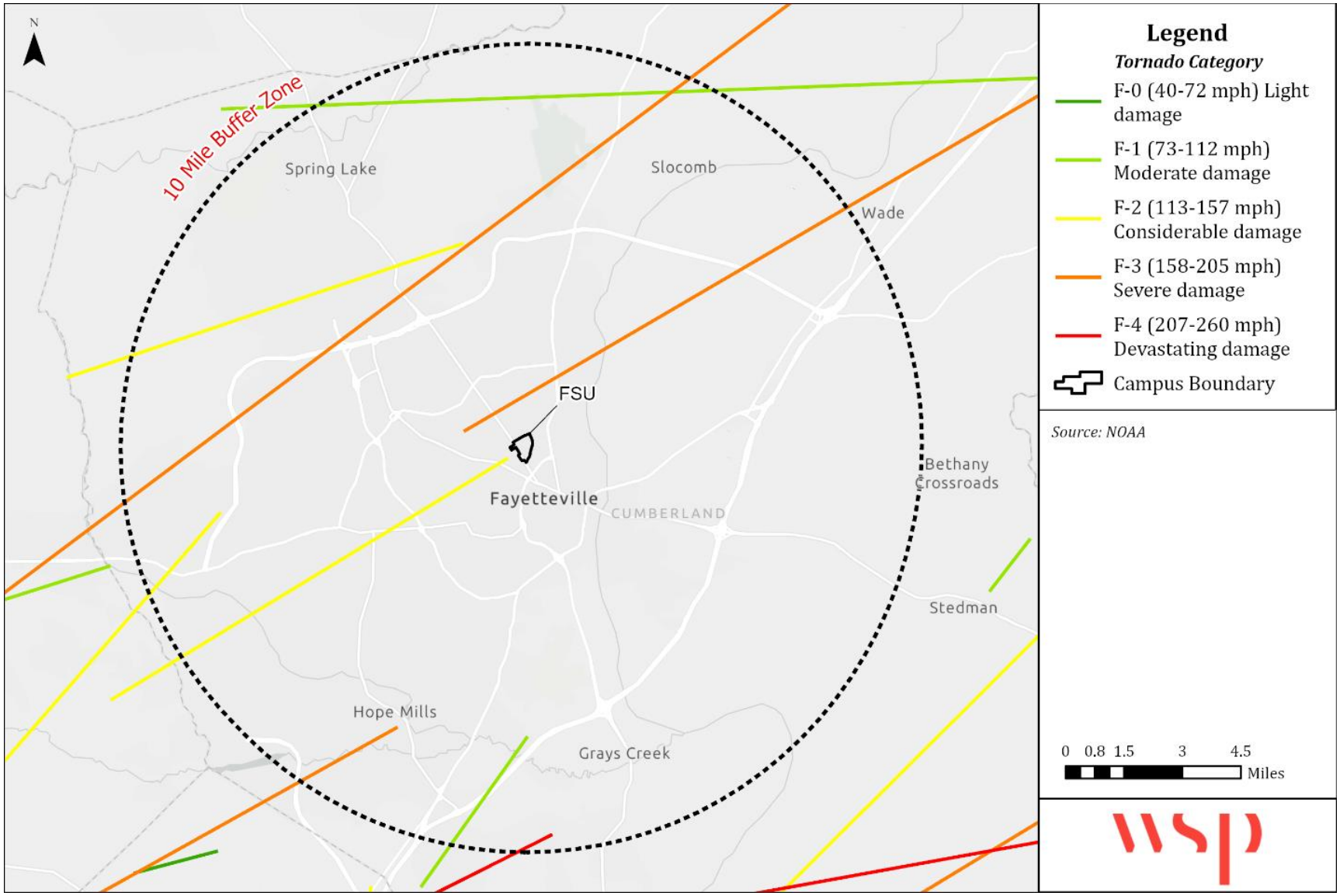
Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **February 22, 1971** – Just after 4 pm on February 22, an F1 tornado touched down southeast of Columbia, South Carolina. Along its nearly 12-mile path, the tornado tore the roofs off of a factory and two homes, but no injuries were reported. A tornado developed on the northwest side of Fayetteville around 5:30 pm. Newspaper reports suggest it first touched down north of Bragg Boulevard near Margaret Willis Elementary School before hitting the Veterans Administration Hospital — where damages exceeded $500,000. In Fayetteville, where the tornado peaked at F3 intensity with winds exceeding 158 mph. Reports suggest that 68 homes in Fayetteville were destroyed and more than 400 homes in Cumberland County were damaged, with costs estimated at $4.5 million in 1971 dollars.
- **March 28, 1984** – The tornado struck the community of Beaver Dam in Cumberland County where two lives were lost, and vast sections pine forest were leveled.
- **March 27, 2009** – An EF-1 tornado touched southeast of Hope Mills in the Roslin community. The tornado damage track was about 50 yards wide and stretched northeast for approximately 5 miles. On Roslin Farm Road, a brick home lost more than eighty percent of

its roof structure. Several sheds and outbuildings in the area were also destroyed. A neighboring house also suffered minor structural damage to the garage. The tornado then tracked northeast over bare fields, before reaching Braxton Road. At Braxton Road the tornado continued with EF-1 intensity winds causing significant damage to a recently built two-story home. The home was condemned when it experienced around twenty percent roof loss with major damage to the upstairs structure. Numerous sheds and fences were also blown over in the area. The tornado continued northeast crossing Chicken Foot Road and Corporation Drive, along which several trees were snapped. The tornado crossed Interstate 95 where numerous trees were blown down and snapped near Tim Starling Road. It was just north of this intersection where a tractor trailer was overturned by the high winds. Just west of Interstate 95 near the intersection of Tim Starling Road and Research Drive, a large industrial building suffered significant roof damage. The wind of the tornado caused the roof to buckle enough for the Fire Marshall to order an evacuation of the building. Rocks on the roof of the building were blown into the parking lot shattering the windows of numerous vehicles. A house currently under construction on Tim Starling Drive also sustained significant damage. The tornado continued tracking northeast along Research Road while weakening to an EF-0 as it approached Claude Lee Road. Numerous trees were blown down and sheds were destroyed along Catherine Drive and Arlie Drive. Several homes in the area lost shingles and suffered minor damage to trim and siding. The tornado then lifted off the ground just as it approached the Fayetteville Regional Airport.

- **April 16, 2011** – The tornado crossed into Cumberland County, just north of NC Highway 401. EF0 damage continued near the Clifdale community, where the damage was more sporadic across Bones Creek and Stewarts Creek. Strong tornado damage then occurred in and near the Beaver Creek community along Reilly Road and Yadkin Road west of Fayetteville. Damage was mostly EF1 and EF2, but was briefly EF3 damage, with wind speeds near 140 mph, causing major damage to a business and some dwellings along Yadkin Road. EF0 and EF1 damage was then observed across Simmons Army Airfield, along Andrews Road and across from the Pine Forest High School. The Goodyear Plant on NC Highway 401 sustained minor damage as well. The tornado continued northeast through the Carlos and Slocomb communities, with mainly EF0 tree damage. Just south of the Linden community, a small area of EF2 damage occurred near McBryde Road where several homes were heavily damaged, including a mobile home that was destroyed. One fatality occurred when the tornado hit a double-wide mobile home. The victim suffered massive head injuries. Two other occupants of the mobile home survived and were taken to Betsy Johnson Hospital. In total, approximately 1,000 homes were damaged, of which 310 homes suffered major damage, with 287 homes being destroyed. There were also 40 businesses that experienced damage as well. The tornado exited Bladen County and moved into Cumberland County just west of NC Highway 242. The tornado moved northeast, crossing NC Highway 210 near Smith Road and Peters Creek road. In this area, a few homes were damaged with one home sustaining heavy damage rated EF2. There were four injuries sustained by some of the occupants. Hundreds of trees were also downed in this vicinity. Damage was also observed along Broadwater Bridge Road, east of Smith Road.

**Figure C.17 – Tornado Paths within 10 Miles of Fayetteville, 1950-2024**



### THUNDERSTORM WINDS

Between 2000 to 2024, the NCEI recorded wind speeds for 62 separate incidents of thunderstorm winds, occurring on 46 separate days, for Fayetteville. These events caused $1,190,500 in recorded property damage, three injuries, and no fatalities. The recorded gusts averaged 60.5 miles per hour, with the highest gusts recorded at 74 mph on July 8, 2015. Of these events, four caused property damage. Wind gusts with property damage recorded averaged $119,050 in damage, with the highest reported damage being a total of $1,000,000 on March 8, 2005. These incidents are aggregated by the date the events occurred and are recorded in Table C.34. These records specifically note thunderstorm wind impacts for Fayetteville.

**Table C.34 – Recorded Thunderstorm Winds, Fayetteville, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| FAYETTEVILLE ARPT | 5/28/2000 | 67 | 0 | 0 | $0 |
| FAYETTEVILLE | 9/25/2000 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE ARPT | 4/1/2001 | 67 | 0 | 3 | $0 |
| FAYETTEVILLE | 5/28/2001 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/22/2001 | 69 | 0 | 0 | $0 |
| FAYETTEVILLE | 5/25/2003 | 69 | 0 | 0 | $0 |
| FAYETTEVILLE & FT BRAGG | 3/8/2005* | 66 | 0 | 0 | $1,000,000 |
| FAYETTEVILLE | 7/28/2005 | 63 | 0 | 0 | $0 |
| FAYETTEVILLE | 4/17/2006* | 64 | 0 | 0 | $0 |
| FAYETTEVILLE | 7/20/2006 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 7/28/2006* | 58 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 3/2/2007 | 63 | 0 | 0 | $0 |
| (POB)POPE AFB FAYETT | 6/29/2007 | 60 | 0 | 0 | $0 |
| FAYETTEVILLE | 8/21/2007 | 58 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 3/4/2008 | 59 | 0 | 0 | $0 |
| (POB)POPE AFB FAYETT | 6/20/2008 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 8/7/2008* | 59 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/26/2009 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 7/1/2009 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/18/2011 | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/21/2011 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 8/7/2011 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 6/23/2012* | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 7/24/2012* | 58 | 0 | 0 | $105,000 |
| (POB)POPE AFB FAYETT | 8/2/2012 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 2/21/2014 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 6/19/2014* | 50 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 6/19/2015* | 58 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/30/2015 | 58 | 0 | 0 | $0 |
| (FBG) FT BRAGG | 7/8/2015 | 74 | 0 | 0 | $0 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| (FAY)GRANNIS FLD FAY | 6/5/2016* | 58 | 0 | 0 | $30,000 |
| (FBG)FT BRAGG | 7/4/2016* | 60 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 7/7/2016 | 58 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 7/15/2016 | 61 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 4/15/2018 | 60 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 4/19/2019* | 64 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 5/30/2019 | 60 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 8/19/2019 | 58 | 0 | 0 | $0 |
| (FBG) FT BRAGG | 5/4/2021 | 58 | 0 | 0 | $5,000 |
| EAST FAYETTEVILLE | 5/6/2022 | 58 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 6/11/2022 | 67 | 0 | 0 | $25,000 |
| (FAY)GRANNIS FLD FAY | 1/4/2023 | 62 | 0 | 0 | $0 |
| FAYETTEVILLE | 6/26/2023* | 58 | 0 | 0 | $2,500 |
| (FAY)GRANNIS FLD FAY | 7/6/2023 | 58 | 0 | 0 | $5,000 |
| (FAY)GRANNIS FLD FAY | 8/7/2023 | 58 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 1/9/2024 | 62 | 0 | 0 | $0 |
| (FAY)GRANNIS FLD FAY | 4/12/2024* | 59 | 0 | 0 | $1,000 |
| (FAY)GRANNIS FLD FAY | 5/8/2024 | 58 | 0 | 0 | $0 |
| (FBG)FT BRAGG | 5/10/2024* | 66 | 0 | 0 | $7,000 |
| (FBG)FT BRAGG | 7/15/2024 | 71 | 0 | 0 | $0 |
| FAYETTEVILLE | 8/12/2024 | 58 | 0 | 0 | $10,000 |
| | | **Total** | **0** | **3** | **$1,190,500** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **April 1, 2001** – Two girls were injured and taken to a hospital when a tree fell through a house off Ramsey St. Another child was injured when a swing set blew over. Two banks on Bragg Blvd. sustained damage, and numerous large trees and powerlines were blown down.
- **March 8, 2005 –** KFBG METAR reported 66 mph wind gust. Several homes on Ft. Bragg property sustained roof damage. Simmons Army Airfield sustained a significant amount of damage to four helicopter hangars, government vehicles, and outdoor structures.
- **July 24, 2012 –** Moderate to severe damage was reported to 5 structures in the city of Fayetteville, North Carolina. At least one home was uninhabitable.
- **June 5, 2016** – Homes were reported damaged along Goshawk Drive and Screech Owl Drive.

### LIGHTNING

According to NCEI data, there were three lightning strikes reported in Fayetteville between 2000 and 2024. These events reportedly caused $255,000 in property damage and one direct injury. No crop damage or fatalities were recorded by these strikes. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional

lightning incidents have occurred. Table C.35 details NCEI-recorded lightning strikes from 2000 through 2024 for Fayetteville.

**Table C.35 – Recorded Lightning Strikes in Fayetteville, 2000-2024**

| Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|
| 7/22/2002 | 1640 | 0 | 0 | $180,000 |
| 8/19/2002 | 1330 | 0 | 0 | $75,000 |
| 7/27/2006 | 1715 | 0 | 1 | $0 |
| | **Total** | **0** | **1** | **$255,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Fayetteville:

- **July 22, 2002** – Lightning set fire to a home.
- **August 19, 2002** – Lightning started a fire in a house.
- **July 27, 2006** – Nine-year-old girl struck by lightning while inside her home paying a video game.

### HAIL

NCEI records 13 days with hail incidents between 2000 and 2024 in Fayetteville. Two of these events were reported to have caused a total of $1,025,000 in property damage, with the highest reported damage being $1,000,000 on July 1, 2012. There were no reports of any injuries, deaths, or crop damage during these events. The largest diameter hail recorded in the City was 2.5 inches, which occurred on July 1, 2012. The average hail size of all events in the City was around 1.3 inches in diameter. Table C.36 summarizes hail events for Fayetteville. In some cases, hail was reported for multiple locations on the same day.

**Table C.36– Summary of Hail Occurrences in Fayetteville**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| Fayetteville | 3/31/2002 | 1.75 |
| Fayetteville | 4/26/2003 | 0.75 |
| Fayetteville | 4/3/2006 | 1.5 |
| (Fay)Grannis Fld Fay | 5/20/2008 | 0.75 |
| (Fay)Grannis Fld Fay | 6/20/2008 | 0.75 |
| (Fbg)Ft Bragg | 8/7/2008 | 1.75 |
| Fayetteville | 6/21/2011 | 1 |
| Fayetteville | 7/1/2012* | 2.5 |
| (Fbg)Ft Bragg | 4/25/2014 | 1 |
| (Fay)Grannis Fld Fay | 4/9/2015 | 1 |
| (Pob)Pope Afb Fayett | 6/26/2015 | 1 |
| (Fay)Grannis Fld Fay | 6/5/2016 | 1.75 |
| Fayetteville | 6/25/2018 | 1.5 |

Source: NCEI;

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **July 1, 2012 –** Large hail up to the size of tennis balls fell at Stewart Nissan, causing damage to nearly all 300 cars parked at the dealership. Some rear and front windows were shattered along with lots of dented cars. Half dollar size hail was covering the ground at Fort Bragg Road and Oakridge Avenue.
- **June 25, 2018 –** Ping Pong size hail was reported in Downtown Fayetteville.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Fayetteville averages 1.8 days with wind events per year. Over this same period, 3 lightning events were reported as having caused death, injury, or property damage, which equates to an average of 0.12 damaging lightning strikes per year.

The average hail storm in Fayetteville occurs in the late afternoon and has a hail stone with a diameter of 1.3 inches. Over the 25-year period from 2000 through 2024, Fayetteville experienced 13 days with reported hail incidents; this averages to 0.52 days per year with reported incidents somewhere in the planning area.

In a 75-year period between 1950 and 2024, Cumberland County experienced 23 tornadoes. This correlates to a 30.6% annual probability that the County will experience a tornado somewhere in its boundaries.

Based on historical occurrences, there is between a 10% to 100% chance that Fayetteville will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on FSU's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water. Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes. Since 2000, NCEI records report one injury attributed to lightning strikes in Fayetteville.

The availability of sheltered locations such as basements, buildings constructed using hail and/or tornado resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to wind, tornado, and hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage. Individuals who work outdoors may also face increased risk.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $162,306, which assumes that 10% of the student population is impacted.

**Table C.37 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 7,623 | 762 | $162,306 |

Between 2000 and 2024, the NCEI recorded no fatalities or injuries due to hail, and 3 injuries attributable to thunderstorm winds. Tornadoes occurring between 1950 to 2024 resulted in 5 deaths and 169 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Fayetteville, two events with recorded property damage were due to fires caused by lightning strikes.

NCEI records lightning impacts over 25 years (2000-2024), with $255,000 in property damage recorded between two events, both occurring in 2002. Based on these records, the planning area experiences an annualized loss of $10,200 in property damage. The average impact from lightning per incident in Fayetteville is $85,000.

Hail damage to property is direct, including destroyed windows, dented cars and buildings, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 20-year span between 2000 and 2024 in Fayetteville, NCEI reported $1,025,000 in property damage as a direct result of hail. This damage was caused by only two storms.

It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are

notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damages in Fayetteville, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $1,190,500 in property damage, which equates to an annualized loss of $47,620 across the planning area. It should be noted that one wind event at Fort Bragg accounts for $1,000,000 in property damage.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damage and losses attributed to secondary hazards spawned by the tornado, or due to the damage caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

From 1950 to 2024, damaging tornadoes in the County were directly responsible for $134,127,500 worth of damage to property according to NCEI data. This equates to an annualized loss of $1,788,366. Per the iRisk analysis, an F2 tornado event could cause over $171 million of estimated total building damage on campus.

Table C.38 details estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado.

**Table C.38 – Estimated Building Damage by Tornado Events, FSU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $168,431.12 | $252,646.67 | $421,077.79 |
| Educational | $1,732,591.89 | $2,552,798.51 | $4,285,390.40 |
| Housing | $654,076.43 | $744,898.47 | $1,398,974.90 |
| **Total** | **$2,555,099.44** | **$3,550,343.65** | **$6,105,443.09** |
| **F1 Tornado Event** | | | |
| Administration | $1,355,973.42 | $2,033,959.97 | $3,389,933.39 |
| Educational | $13,661,874.21 | $20,273,462.04 | $33,935,336.25 |
| Housing | $4,784,950.02 | $5,757,061.55 | $10,542,011.57 |
| **Total** | **$19,802,797.65** | **$28,064,483.56** | **$47,867,281.21** |
| **F2 Tornado Event** | | | |
| Administration | $4,906,680.59 | $7,360,020.32 | $12,266,700.91 |
| Educational | $49,273,424.86 | $73,202,646.96 | $122,476,071.82 |
| Housing | $16,170,196.79 | $20,260,229.34 | $36,430,426.13 |
| **Total** | **$70,350,302.24** | **$100,822,896.62** | **$171,173,198.86** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F3 Tornado Event** | | | |
| Administration | $7,804,620.80 | $11,706,930.28 | $19,511,551.08 |
| Educational | $78,202,290.36 | $116,269,398.97 | $194,471,689.33 |
| Housing | $27,297,539.83 | $33,014,799.37 | $60,312,339.20 |
| **Total** | **$113,304,450.99** | **$160,991,128.62** | **$274,295,579.61** |
| **F4 Tornado Event** | | | |
| Administration | $8,084,694.20 | $12,127,040.36 | $20,211,734.56 |
| Educational | $81,128,597.51 | $120,558,273.64 | $201,686,871.15 |
| Housing | $28,758,949.58 | $34,440,366.72 | $63,199,316.30 |
| **Total** | **$117,972,241.29** | **$167,125,680.72** | **$285,097,922.01** |

Source: NCEM iRISK Database

### Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorm hazards and tornadoes at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statement

- The strongest recorded thunderstorm wind event for Fayetteville from 2000-2024 occurred on July 8, 2015 with a measured gust of 74 mph.
- The average hailstone size recorded from 2000-2024 in Fayetteville was a little over 1" in diameter; the largest hailstone recorded was 2.5", recorded on July 1, 2012.
- The most intense tornado to pass near Fayetteville in the past 75 years was an F4 on April 8, 1957. NCEI reports this event caused 8 injuries and $250,000 in property damage.
- Thunderstorms are frequent hazard events in Cumberland County and the FSU campus. Reported damages for the 25-year period from 2000-2024 include $1,190,500 and for thunderstorm winds and $255,000 for lightning strikes. Between 1950-2024, Cumberland County experienced $100,525,000 in property damage due to two tornado events.

# C.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- **Primary Exposure:** The Primary Exposure zone identifies where structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- **Secondary Exposure:** The Secondary Exposure zone identifies land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- **Sources of Ember Load to Buildings:** The areas of burnable land cover that produces embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- **Wildfire Transmission Zone:** The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- **Low-to-no Exposure:** The Low-to-No Exposure zone identifies where structures beyond 1500m from a large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- **Water:** Classified as Non-burnable Water (NB8) in the Surface Fuel Map.

Southern Wildfire Risk Assessment (SWRA) estimates that 7% of the FSU campus is within the primary exposure category and 78% is within the secondary exposure category of the Functional WUI. Structures in the secondary exposure zone could be impacted by embers even though they are not immediately located with vegetation types classified as burnable. Table C.39 details the Functional WUI acreage in the FSU campus, and Figure C.18 below shows the Functional WUI areas. On a county level, a large portion of Cumberland County, particularly the

western portion that includes Fayetteville and Fort Brag, is predominately classified as secondary exposure with a mix of primary exposure. Areas with less development and housing density consist of Sources of Ember Load to Buildings and Wildfire Transmission Zone.

The expansion of residential development from residential or developed centers out into less dense or rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to agricultural and forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

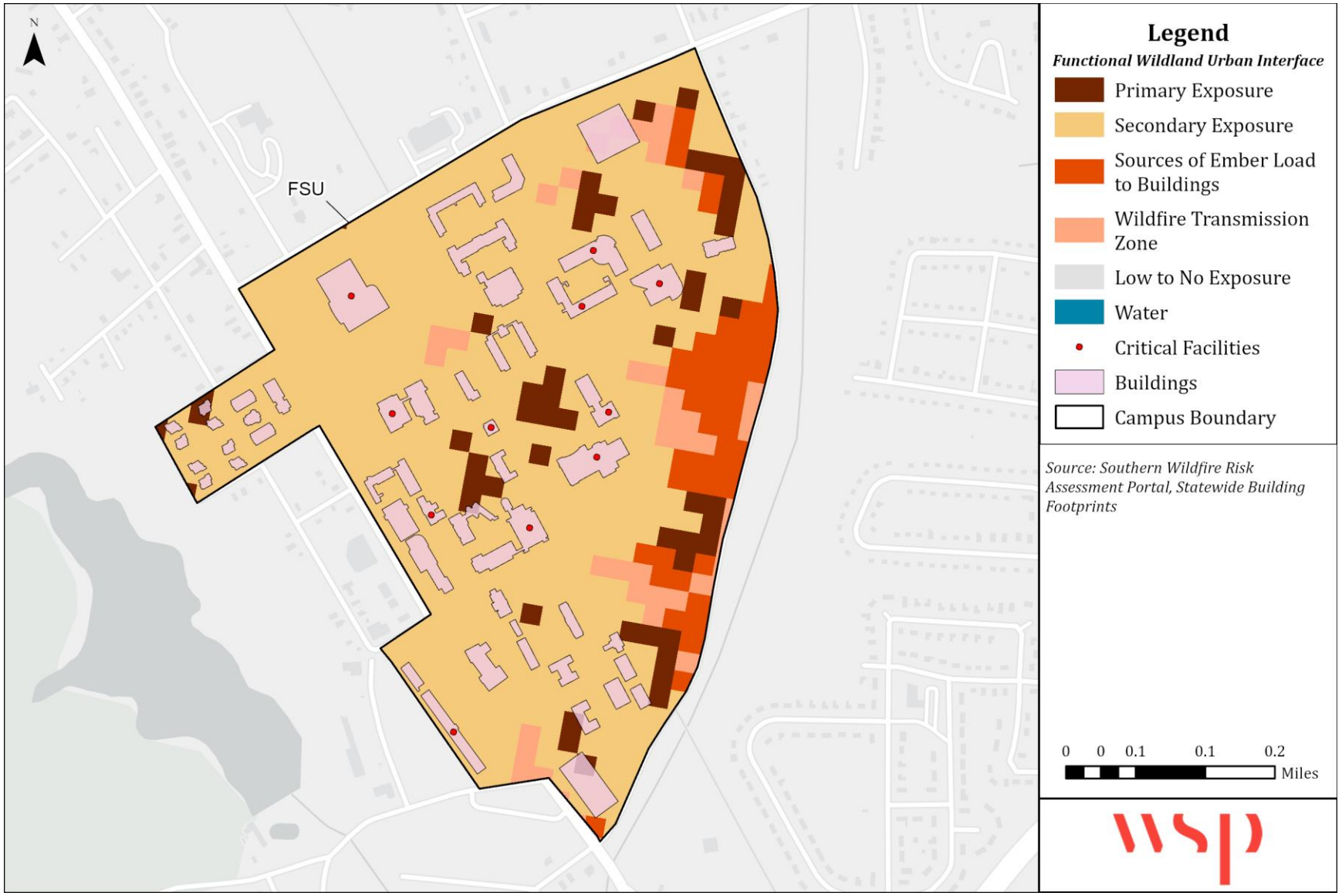
**Table C.39 – Functional Wildland Urban Interface, FSU Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 11 | 7% |
| | Secondary Exposure | 114 | 78% |
| | Sources of Ember Load to Buildings | 9 | 6% |
| | Wildfire Transmission Zone | 12 | 8% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **146** | **100%** |

Source: Southern Wildfire Risk Assessment

*Spatial Extent: 4 – Large*

**Figure C.18 – Wildland Urban Interface Areas, FSU Campus**



## Extent

The entire state is at risk to a wildfire occurrence. 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.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table C.40, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table C.41 and Figure C.19 show the potential fire intensity within the WUI across FSU.

### Table C.40 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

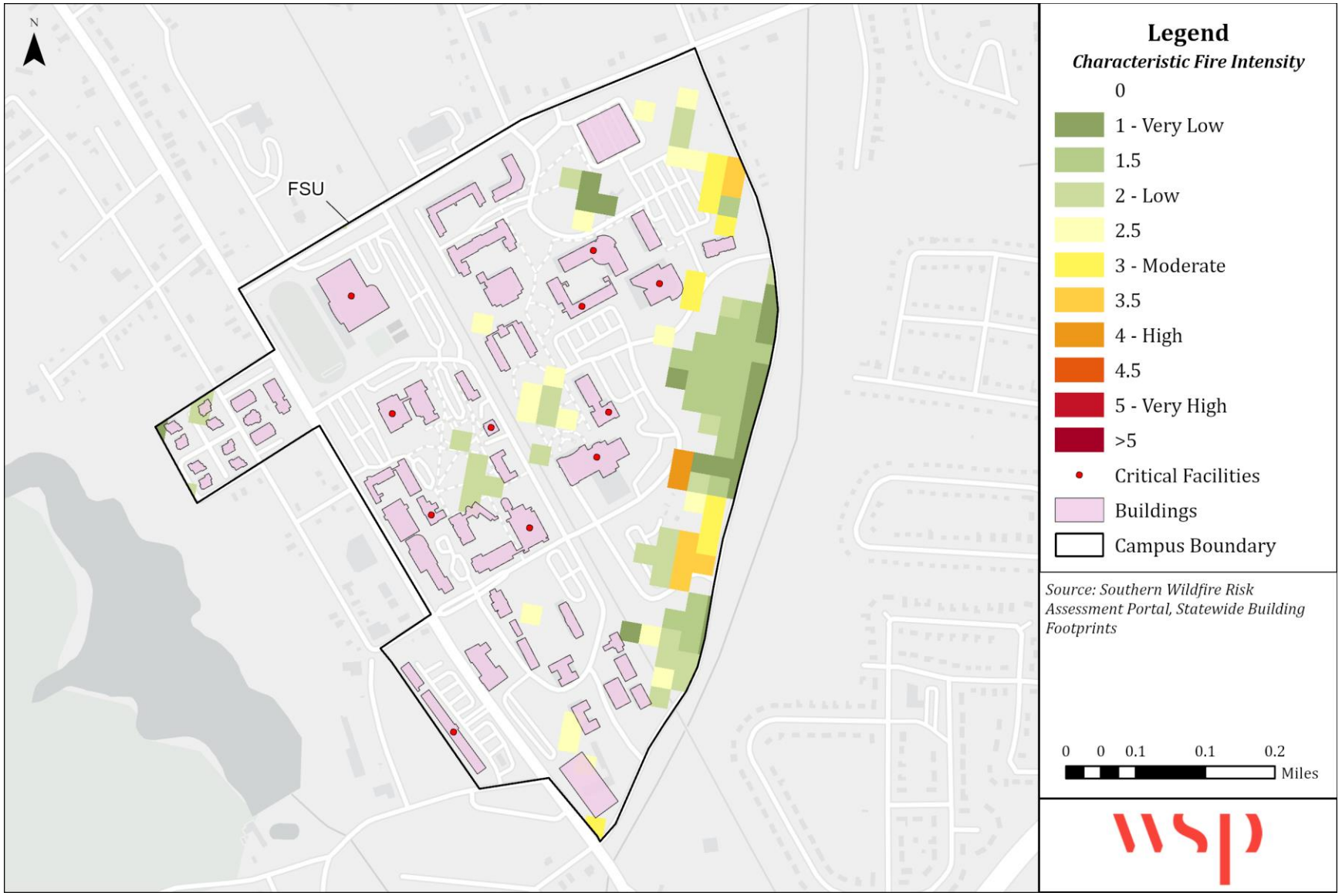
### Table C.41 – Characteristic Fire Intensity, FSU Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 122 | 84% |
| | 1 - Very Low | 4 | 3% |
| | 1.5 | 6 | 4% |
| | 2 - Low | 6 | 4% |
| | 2.5 | 4 | 3% |
| | 3 - Moderate | 2 | 2% |
| | 3.5 | 1 | 1% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **146** | **100%** |

Most of the campus (84%) is rated non-burnable on the Potential Fire Intensity scale. The highest fire intensity category to impact the campus is 3.5 which is classified as moderate-high intensity on the scale and only encompasses 1 percent of the campus. The remaining portion of the campus, around 16 percent has very low to low characteristic fire intensity. The areas with greatest potential fire intensity are within the WUI. Around 1.6 percent of the campus may experience Class 3-3.5 fire intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the planning area (25%) would face a Class 1 to Class 2.5 fire intensity, which is easily suppressed.

*Impact: 2 – Limited*

**Figure C.19 – Characteristic Fire Intensity, FSU**



## Historical Occurrences

According to the North Carolina Forest Service (NCFS), there were 457 noted wildfires within Pitt County between 2000 and 2024. The total acreage burned during this period was 1484.9 acres. There were no additional data records regarding specific cities or school districts within Pitt County. The data is from NCFS records only and may not include data on fires burned within jurisdictional limits that did not require NCFS assistance to suppress. Actual number of fires and acreage burned may be higher than what is reported here.

On average, Pitt County experiences 18.3 fires and 59.4 acres burned annually from fires reported by the NCFS. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments. Based on these records, the average wildfire event can be calculated as 2.9 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments. The most known cause was noted as debris. Machine use, children and miscellaneous causes were the next leading causes following debris burning.

## Probability of Future Occurrence

The Southern Wildfire Risk Assessment provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the FSU campus is presented in Table C.42 and illustrated in Figure C.20

**Table C.42 – Burn Probability, FSU Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 0 | 0% |
| | 2/10 | 0.0001000 - 0.0002154 | 1 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 122 | 83% |
| | 4/10 | 0.0004642 - 0.0010000 | 15 | 10% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 9 | 6% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |

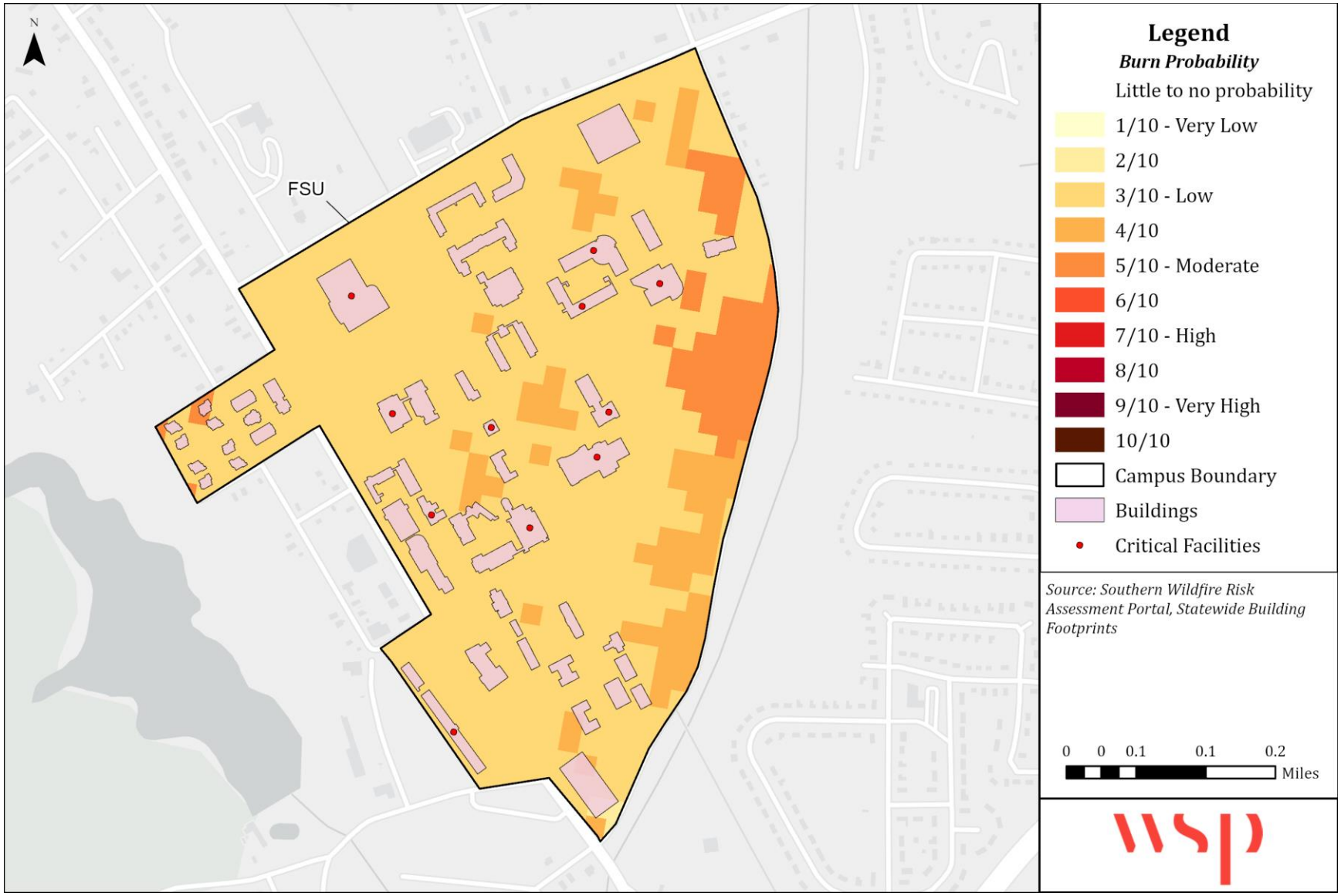
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **146** | **100%** |

Source: Southern Wildfire Risk Assessment

Nearly 94% of FSU has a burn probability between 3 and 4 indicating low burn probability. The remaining 6% has a burn probability of 5 indicating which is moderate. Areas with higher burn probability (4 or 5), are located along the eastern border of the campus. The probability of wildfire across the campus is therefore considered possible.

*Probability: 2 – Possible*

**Figure C.20 – Burn Probability, FSU**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10, and so on.

All of the 49 structures assessed on the FSU campus have a wildfire exposure score of either 3/10 or 4/10 which equates to relatively low vulnerability. Table C.43 shows the number and value of campus buildings by occupancy type that fall within Wildfire Exposure Scores 3 and 4.

**Table C.43 – Building Counts and Values within the Wildfire Exposure Score**

| Occupancy | Wildfire Exposure Score 3 | | Wildfire Exposure Score 4 | |
|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 7 | $11,340,629 | 0 | $0 |
| Extracurricular/Educational | 21 | $115,593,933 | 0 | $0 |
| Housing | 13 | $57,697,632 | 8 | $6,406,921 |
| **Total*** | **41** | **$184,632,194** | **8** | **$6,406,921** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

Note* There are a total of 50 buildings on FSU Campus; one of these buildings is newly constructed and not yet available in the iRISK inventory.

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the FSU campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. Currently, there are no community wildfire protection plans and no wildfire mitigation review requirements or regulations for development in the wildland-urban interface in Cumberland County.

## Problem Statement

- The entirety of the FSU campus falls within the Functional WUI; 41 buildings were given a Wildfire Exposure Score of 3 and 8 buildings were given a Wildfire Exposure Score of 4.

# C.5.8 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

## Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the FSU campus, the Information Security Office provides centralized campuswide computing and information and communication technology services in support of the university's academic and administrative goals. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

## Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the FSU campus could cause significant disruption and impact a large number of records.

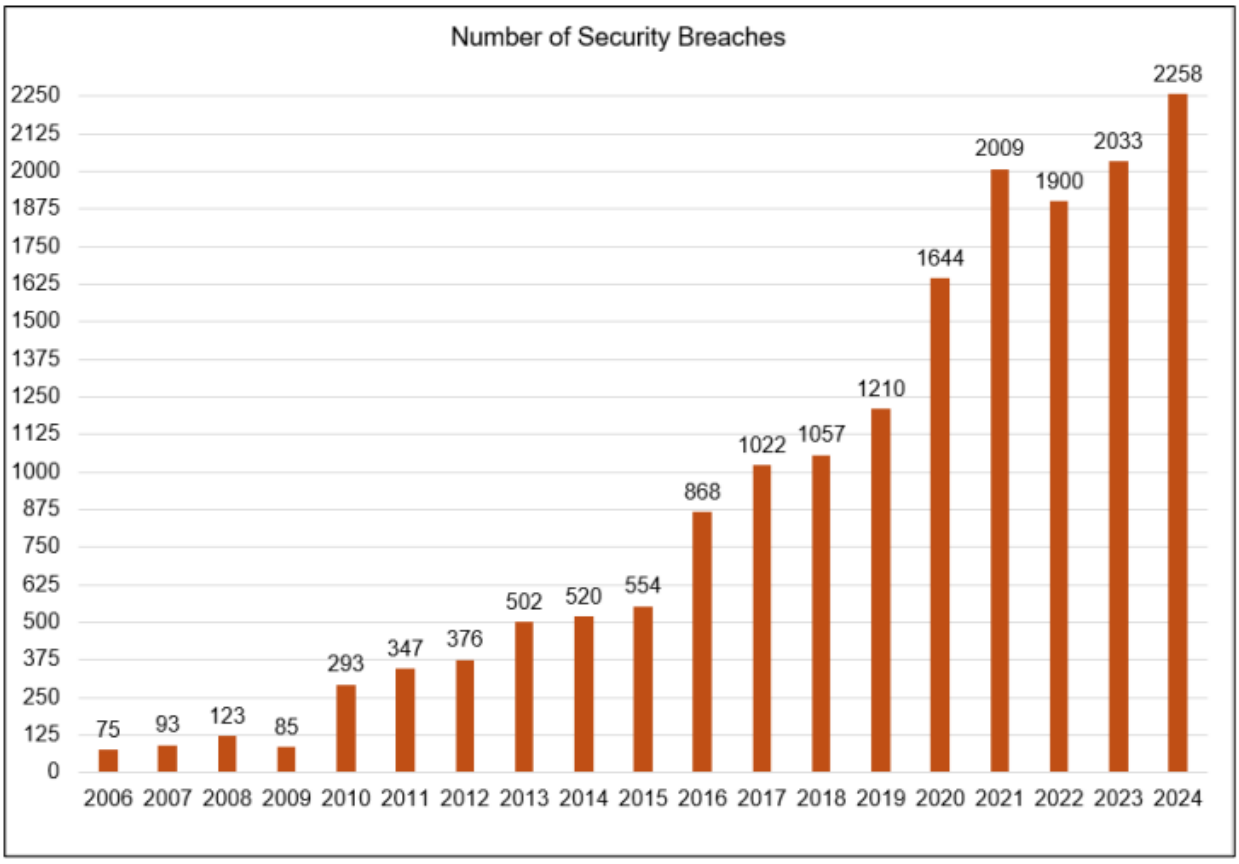
*Impact: 3 – Critical*

## Historical Occurrences

According to local news reports, FSU campus hasn't experienced a major cyber threat in recent years. The FSU Cybersecurity Resources web page notes that phishing attacks through E-mail is the most common way student and faculty accounts are compromised at the University.

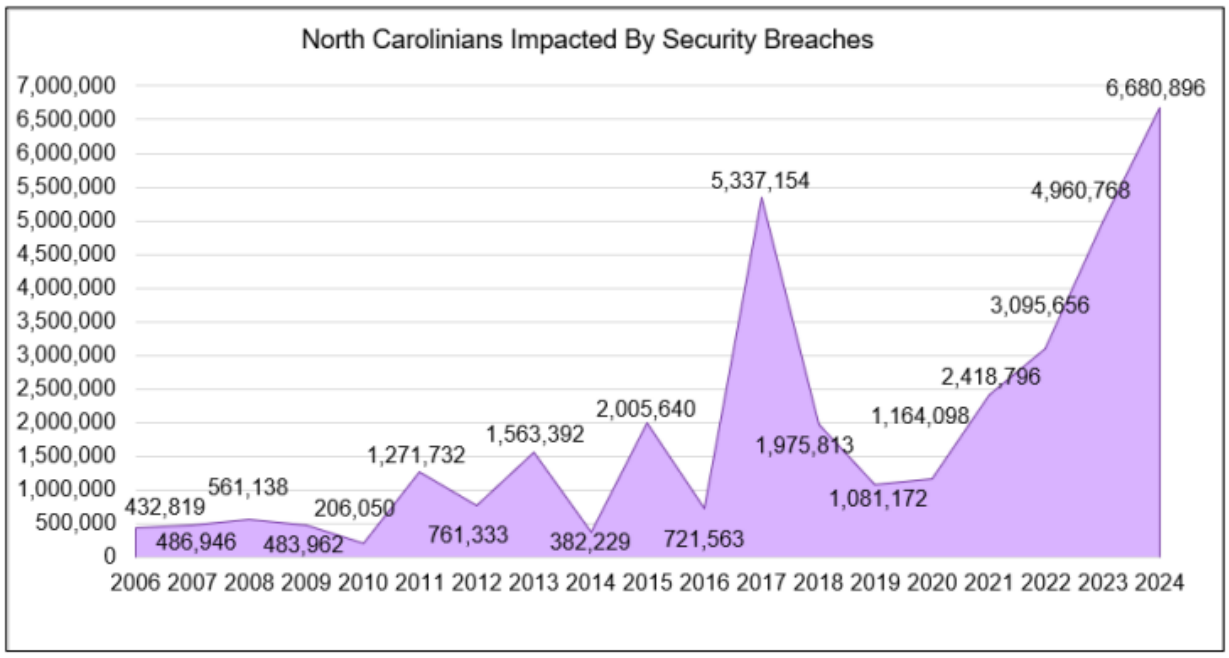
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure C.21 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure C.22 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included. (https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/)

- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).

## Probability of Future Occurrence

Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of FSU are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the university are less likely but cannot be ruled out.

*Probability: 2 – Possible*

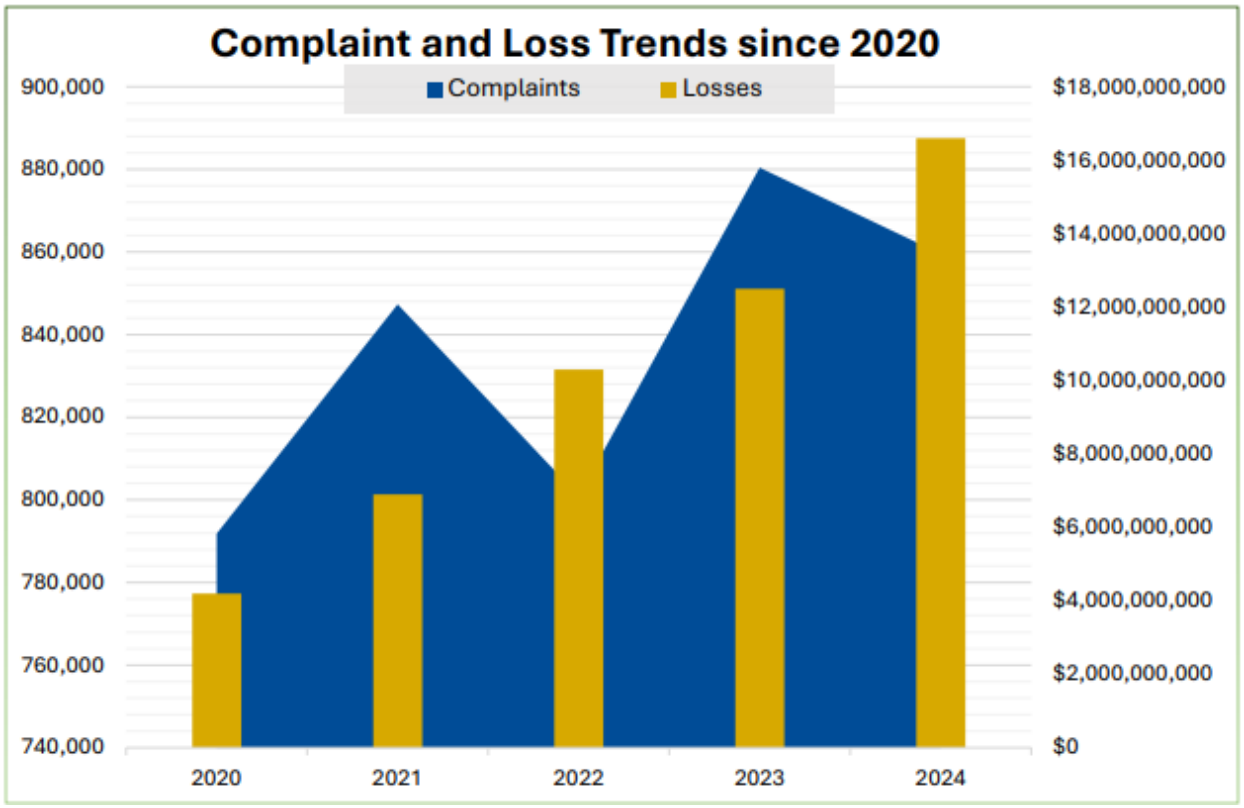
## Vulnerability Assessment

As discussed above, the impacts from a cyber-attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure C.23.

**Figure C.23 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers' continued usage of online services, such as banking and shopping, increases vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment increasing since the last plan, the number of users of campus networks and software has increased. For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statement

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Information Security Office performs cyber-defense operations, internal compliance audits, and risk assessments to protect university information and network assets.

# C.5.9 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Materials Incident | Highly Likely | Limited | Small | Less than 6 hrs | Less than 24 hrs | 2.8 |

## Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of FSU's campus.

On campus, the primary locations associated with storage of hazardous materials are located in science and research facilities such as the Lyons Science Building. Storage quantities were not reported for this mitigation planning effort.

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure C.24 shows the modes of transportation for hazardous materials adjacent to or through FSU's campus.

The campus is divided by a CSX Transportation freight route that runs through the middle of campus which exposes the campus to risks associated with rail transport of hazardous materials.

*Spatial Extent: 2 – Small*

**Figure C.24 – Major Transportation Routes, FSU**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 2 – Limited*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 99 recorded releases in Fayetteville from 2000 through 2024. Of these events, only ten were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $803,374 in damage with 81 percent of all incidents occurring on highways and roads, 8 percent on rail roads, and 11 percent occurring by airplane. The most common materials spilled in the city were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure C.25 describes all nine hazard classes.

**Figure C.25 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 99 incidents of hazardous materials released in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Fayetteville.

However, the number of serious incidents is significantly lower: only 10 in 25 years or an average of 0.4 serious incidents per year. This means that based on historical data, there is a 40 percent annual chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However, there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $803,374 in damage, which equates to an annualized loss of $32,134 across the City of Fayetteville.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statement

- Highway and freight train routes for hazardous materials are located both on and adjacent to the FSU campus.
- The number of reported incidents within Fayetteville can be approximated to over 100-percent annual probability

# C.5.10 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table C.44, according to the World Health Organization.

*Impact: 3 – Critical*

**Table C.44 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period,

rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.

- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Cumberland County experienced 117,076 cases of COVID-19 and

749 deaths. Per 100,000 people, Cumberland County experienced 239 deaths, slightly lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Cumberland County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 46 deaths to certain infectious and parasitic diseases, excluding COVID-19. 47% of these deaths (*22*) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included intestinal infectious disease, Staphylococcal infection, Viral Hepatitis, Human Immunodeficiency Virus (HIV) disease, Mycoses, and other unspecified viral diseases.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously

affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

Over the past ten years enrollment has steadily risen on FSU's campus. FSU's enrollment was the highest in its history in fall of 2025. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statement

- Based on the recent COVID-19 pandemic, it is clear the FSU campus population is susceptible to the infectious disease pandemic.
- FSU has a Pandemic Plan in place to provide a guide for the University's response in the event of a pandemic in North Carolina.

# C.5.11 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section C.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below. Table C.45 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table C.45 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Minor | Small | 6 to 12 hrs | Less than 1 week | 2.5 |
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| Hazardous Substances | Highly Likely | Limited | Small | Less than 6 hrs | Less than 24 hrs | 2.8 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table C.46:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.

**Table C.46 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Severe Winter Weather<br>Tornadoes & Thunderstorms<br>Cyber Security |
| **Moderate Risk (2.0 – 2.9)** | Hurricane<br>Flooding<br>Wildfire<br>Hazardous Substances<br>Infectious Disease |
| **Low Risk (< 2.0)** | Earthquake |

# C.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- C.6.1 Overview of Capability Assessment
- C.6.2 Planning and Regulatory Capability
- C.6.3 Administrative and Technical Capability
- C.6.4 Fiscal Capability

## C.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## C.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table C.47 lists these local resources currently in place at FSU.

**Table C.47 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | FSU Strategic Plan 2022-2027 |
| Campus master plan | Y | FSU Campus Master Plan 2023-2033 |
| Capital improvements plan | Y | FSU Division of Business and Finance |
| Local emergency operations plan | Y | FSU Emergency Operations Plan |
| Cyber Incidents Assessment Plan | Y | FSU Cyber Incidents Assessment Plan |

More details on several relevant tools are provided below:

- **Strategic Master Plan** identifies a future vision, values, principles and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth. FSU's 2022-2027 Strategic Plan establishes goals and priorities for FSU.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The 2023-2033 Campus Master Plan is a building program that includes renovation and renewal.
- **Capital Improvement Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC System Campus creates and maintains its own 6-year CIP, which helps inform the UNC System's overall CIP.
- **Emergency Operations Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster. FSU has an Emergency Warning and Communications Plan as well as a Safety Manual.
- **Cyber Incidents Assessment Plan** provides emergency response process for cyber security incidents.

## C.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table C.48 provides a summary of the administrative and technical capabilities for FSU.

**Table C.48 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Facilities Management |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Facilities Services |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Office of Emergency Management |
| Personnel skilled in GIS | Yes | Planning and Construction, Office of Emergency Management |
| Emergency Manager | Yes | Office of Emergency Management |
| Grant Writer | No | |
| Public Information Officer | Yes | Office of Emergency Management Communications |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | Office of Emergency Management Campus Safety |

The following support services and resources may provide administrative capability to implement mitigation:

- **The Office of Environmental Health and Safety** provide services in cases of emergency situations, emergency response, hurricane instructions, winter weather, and railroad safety.
- **The Division of Facilities Management** oversees designing, constructing, maintaining, and operating the physical facilities of FSU. This group could be tasked with tracking mitigation needs of individual facilities in order to improve property protection against hazards on campus.

## C.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table C.49 provides a summary of the fiscal resources at FSU.

**Table C.49 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y |

# C.7 Mitigation Strategy

## C.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is also documented in this plan update. Table C.50 summarizes the status of mitigation actions from the 2021 plan. Table C.51 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section C.7.2 in the Mitigation Action Plan.

**Table C.50 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| FSU | 5 | 9 | 3 |

## Table C.51 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| FSU1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, transformers and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Bronco Hall; C.J. Barber Administration Building; G.L. Butler Building; Lilly Gym; Lyons Science Building; Mitchell Building; Rudolph Jones Student Center; School of Business and Economics (SBE); and William R. Collins Administration Building. | Delete | This is a maintenance activity. |
| FSU4 | Bronco Hall - Several member-to-member connections in the steel-framed penthouse do not appear to be constructed in accordance with standard practice. Certain welds do not appear to have sufficient penetration and/or length. Welds in the penthouse should be inspected by a Certified Weld Inspector and repairs made in accordance with his recommendations. | Delete | This is a maintenance activity. |
| FSU5 | Bronco Hall - Some of the large trees on site are near the potable water back-flow preventer off Langdon St. Consideration should be given to removing trees near the potable water backflow preventer. If trees are to remain, they should be periodically evaluated and pruned by an arborist. | Completed | Trees were removed |
| FSU6 | Capel Arena - The campus' lone connection to power comes via overhead lines and runs to a switchgear that is exposed to vehicle impacts and train derailment. Redundant connection(s) should be made to the PWC power grid, preferably underground. The switchgear and poles should be better protected from vehicle impacts (possibly a guardrail). | Completed | The switchgear is currently protected with installed concrete bollards to help prevent potential vehicle impacts. |
| FSU7 | Chesnutt Library - The archives/rare books collection has no means of providing environmental control in the event of a power outage. Personnel reported trouble maintaining environmental control under normal conditions. Mold and fungal growth will occur if environmental conditions are not properly and constantly maintained. The existing emergency generator is too small to power HVAC equipment. A stand-alone cooling system, on back-up power, should be installed in the archives/rare books collection, providing HVAC redundancy in the event the main system or power goes down. | Delete | No longer a priority. |
| FSU8 | Chesnutt Library - The seals around windows and skylights in the rare books collection are frequently reported to leak. This could lead to water damage and mold/fungal growth. The skylights also permit UV rays to deteriorate exposed artifacts. The skylights in the rare books area should be removed and properly sealed. The seals around windows should be repaired and a film to provide UV protection should be added to windows. | Delete | This is a maintenance activity. |

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| FSU9 | G.L. Butler Building - The server room lacks under-floor water detection. The server room should have under-floor water detection equipment. There should also be proper signage warning occupants of the suffocation risk in the event the FM-200 is released. | Completed | The flooring has been updated. The IT rack system has an independent cooling system in place. FM-200 signage is installed. The smart room includes humidity control and a self-monitoring control system. |
| FSU10 | Lyons Science Annex - There was a significant amount of debris left on the roof which could become airborne during a high wind event and damage surrounding facilities or harm people outside. All debris should be cleared off the roof to prevent debris from becoming airborne during a high wind event. | Delete | This is a maintenance activity. |
| FSU11 | Mitchell Building - If the fiber connection to Lyons is severed, Mitchell will be isolated from the campus in terms of data and communications. An additional fiber path should be laid to another telecom switch to add redundancy to the fiber network Mitchell depends on for telephone and data services. | Completed | The Mitchell Building was renovated in 2006, and all recommended measures are already in place. |
| FSU12 | Mitchell Building - Exterior windows are unreinforced, while many interior windows are bullet-resistant. The exterior window in the dispatch center (and possibly other offices) should retrofitted with impact resistant film to mitigate potential damage from windborne debris. | Completed | Police & Public Safety is no longer located in the Mitchell Building. The department has moved to University Advancement, and all exterior windows are shatter-resistant |
| FSU13 | Rudolph Jones Student Center - A concrete arch on the roof is experiencing rebar corrosion and deterioration. The arch on the roof sits over skylights and should be repaired immediately. | Delete | This is a maintenance activity. |
| FSU14 | William R. Collins Administration Building - The single ply roof is in poor condition and has several patches that are becoming debonded. Collins should be re-roofed to provide increased resistance to wind and driving rain. | Delete | Roof replacement was completed in Fall 2025. |
| FSU15 | William R. Collins Administration Building - Roof drain covers were coated with a layer of debris, indicating a lack of an adequate roof drain inspection/maintenance schedule. A campus-wide roof/roof drain inspection schedule should be implemented to ensure proper function and maintenance of roof and roof drains. | Delete | Roof replacement was completed in Fall 2025. |
| FSU16 | Bryant Hall is in a floodplain and borders Murchison Road and Edgecombe Avenue Extension. The building should be closed or flood protection should be put in place. | Delete | Building condemned |

## C.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for FSU. Each mitigation action recommended for implementation is listed in these tables along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table C.52 – Mitigation Action Plan, FSU**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FSU1 | Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational where normal power supply is not available. | All Hazards | 3.2 | H | Property Protection | Facilities Department | $5,000-$100,000 per site | Operating Budget, State/Federal Grants | 2026-2030 | Carry Forward | Action revised to account for all campus structures. Generator needs will be taken into consideration for future projects. |
| FSU2 | Campus-Wide – Upgrade fire suppression systems at campus facilities including: C.J. Barber Administration Building; Chesnutt Library; G.L. Butler Building; Lyons Science Building; and William R. Collins Administration Building. | Wildfire | 1.1 | M | Property Protection | Facilities Department | $25,000-$100,000 per site | Operating Budget, State/Federal Grants | 2026-2030 | Carry Forward | Lyons Science System Upgraded<br>Butler Building System Upgraded<br>Chessnut Building System Upgraded |
| FSU3 | Flood warning signs should be posted in Cross Creek tributary, which is in the floodplain at Fayetteville State University, the retention pools near Mary Eldridge Drive and Edgecombe Extension, as well as behind the University Place Apartments on Coley Drive. | Flooding | 2.1 | H | Public Education & Awareness | Emergency Management | <$5,000 | Operating Budget | 2026-2030 | Carry Forward | 2026 plan |
| FSU4 | Improve drainage conditions through the identification and implementation of capital improvements projects. | Flooding, Hurricane & Coastal Hazards | 1.1 | M | Structural Projects | Facilities Department | To be determined | Operating Budget, State/Federal Grants | 2026-2030 | New | |
| FSU5 | Update Emergency Notification System | All Hazards | 2.2 | H | Emergency Services | Emergency Management | <$5,000 | Operating Budget | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM



UNC System Eastern Campuses

# Regional Hazard Mitigation Plan

## Annex D: North Carolina Central University

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# Annex D. North Carolina Central University

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to North Carolina Central University (NCCU). This section contains the following subsections:

- D.1 Planning Process Details
- D.2 Campus Profile
- D.3 Asset Inventory
- D.4 Hazard Identification
- D.5 Hazard Profiles, Analysis, and Vulnerability
- D.6 Capability Assessment
- D.7 Mitigation Strategy

## D.1 Planning Process Details

Table D.1 lists the HMPC members who represented NCCU during the planning process.

**Table D.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Steven Alas | Emergency Management Coordinator; Environmental and Occupational Health and Safety |
| Joel Faison | Director of Infrastructure & Information Security; Information Technology Services |
| Ayana Hernandez | Associate Vice Chancellor; Office of Communications and Marketing |
| Dr. Undi Hoffler | Director of Research Compliance and Technology Transfer; Division of Research & Sponsored Programs |
| Ondin Mihalcescu | Director of Design, Planning, and Construction; Capital Projects Management |
| Timothy Williams | Architectural Project Manager; Capital Projects Management |
| Jerry Guerrier | Director of Facilities Services; Facilities Operations |
| Damon Williams | Chief of Police; NCCU Campus Police |
| Christopher Russell | Director of Environmental Health and Safety; Environmental Health and Safety |
| Tyra Slade | General Counsel; Legal Affairs |
| Rondall Rice | Associate Vice Chancellor for Administration; Office of the Chancellor |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

Table D.2 lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table D.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| NCCU Campus Master Plan | The NCCU Campus Master Plan, developed in 2007 and updated in 2020, was referenced for the Campus Profile in Section D.2 as well as the Capability Assessment in Section D.6 |
| Durham County and Incorporated Areas Flood Insurance Study (FIS), Revised 7/19/2022 | The FIS report was referenced in the preparation of flood hazard profile in Section D.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section D.5. The plan was additionally used to track implementation progress and develop the mitigation plan (Section D.7). |
| Eno-Haw Regional Hazard Mitigation Plan, 2025 | The Eno-Haw Regional Hazard Mitigation Plan, which includes Durham, was referenced in compiling the Hazard Identification and Risk Assessment in Section D.5. |

# D.2 Campus Profile

This section provides a general overview of the North Carolina Central University (NCCU) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## D.2.1 Location and Setting

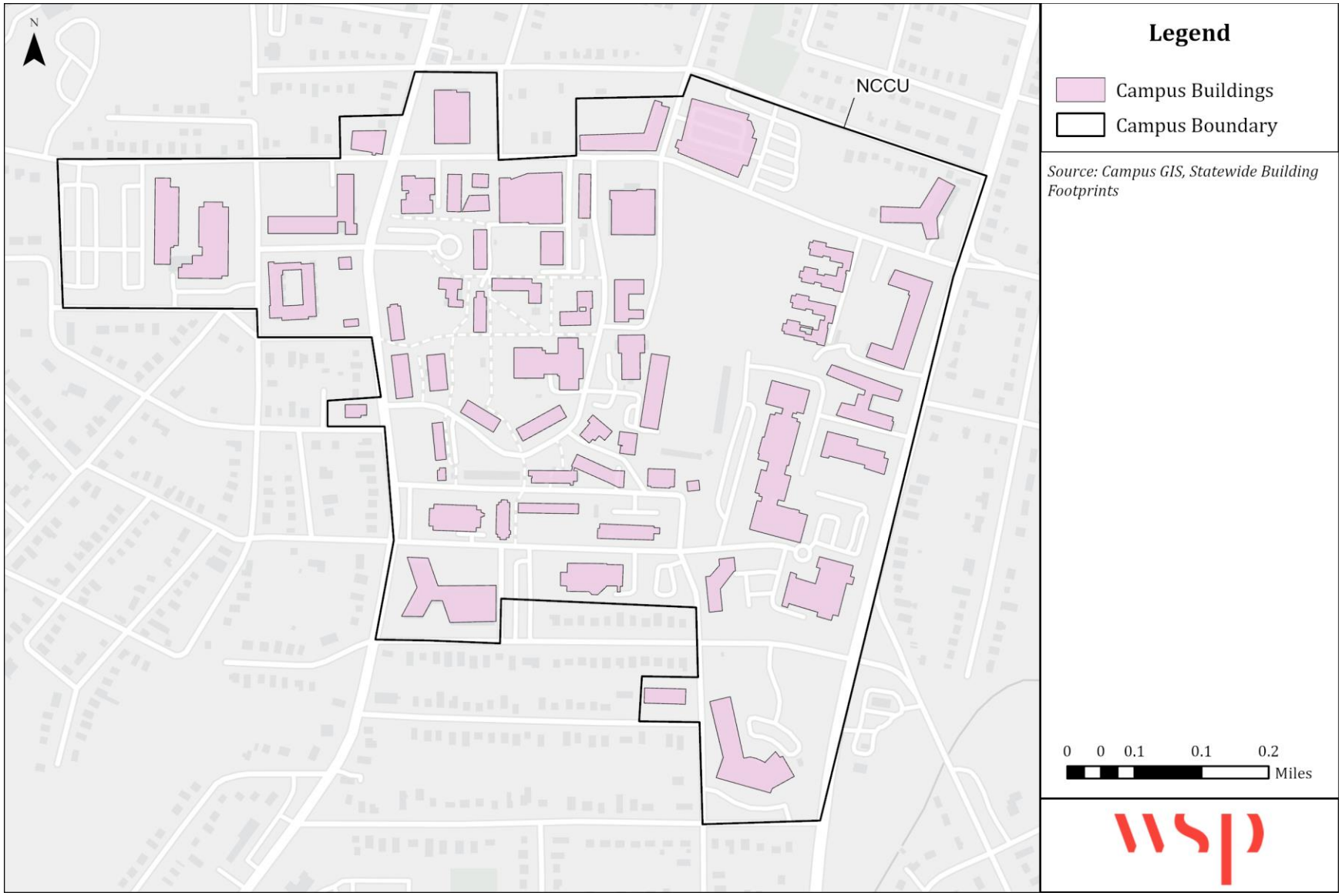
NCCU is located south of downtown Durham near the Hayti District. The University is situated on 136 acres and consists of 62 buildings. A wide variety of cultural and educational resources are accessible to NCCU students, and over 100 Student Clubs are available on campus. Musical organizations and activities in the area include blues, jazz, and gospel festivals, community bands, symphony orchestras and choral societies. Museums dedicated to art, the sciences, history and other topics are in the region, as are theaters performing both classical and contemporary drama. Located in the Research Triangle, the University advances research in the biotechnological, biomedical, informational, computational, behavioral, social, and health sciences.

Durham is the primary beneficiary of North Carolina Central University's innovative Community Services Program, which ensures that NCCU students have experience with voluntary public service. NCCU students serve as tutors in local schools, help build Habitat for Humanity housing, assist with a variety of youth programs, promote the causes of nonprofit service agencies, and volunteer in a variety of other endeavors as they meet the university's standard of 15 hours of community service per semester.

United States Highways 501, 147, and 55 make the University easily accessible by automobile. The City of Durham is on two Interstate highways, I-40 and I-85, and is served by Raleigh-Durham International Airport. Durham is also home to Duke University.

Figure D.1 provides a base map of the NCCU campus. For more details on campus buildings and critical facilities, see Section 0

**Figure D.1 – NCCU Campus Base Map**



## D.2.2 Geography and Climate

NCCU is in Durham, in the eastern part of North Carolina's Piedmont region. NCCU's campus is largely flat with a few rolling hills, which reflects the topography of the Piedmont region. In addition, the central location of Durham provides driving access to both the coastal region in the east and to the mountains in the west. Durham has a mild climate with max temperatures dropping 50 degrees Fahrenheit on average in January and climbing to 89 degrees Fahrenheit in July on average. The annual precipitation for the city is approximately 44 inches per year.

**Figure D.2 – Average Annual Temperature, Durham County**

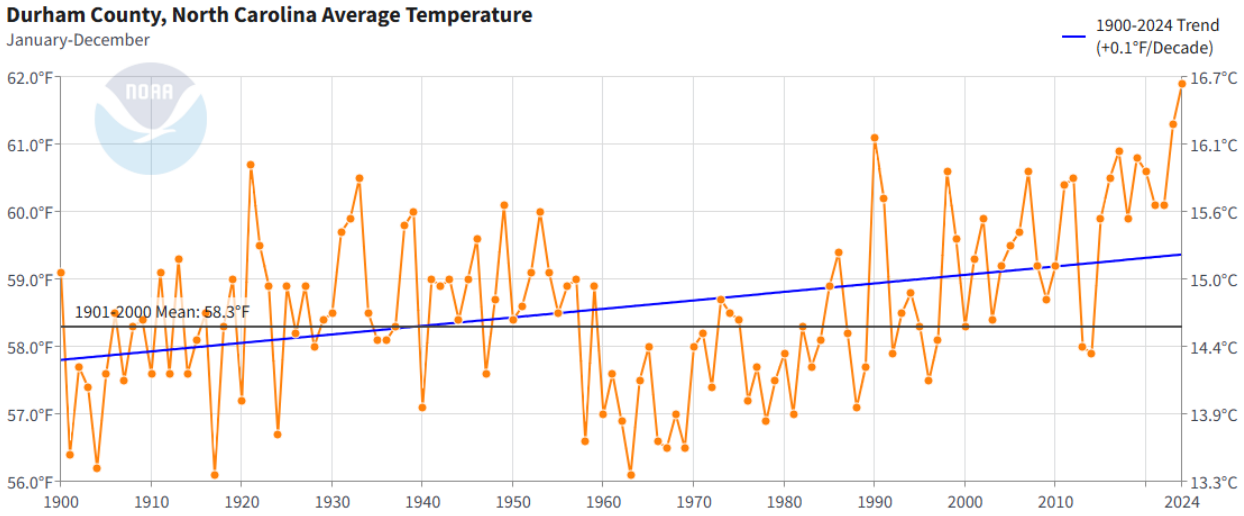
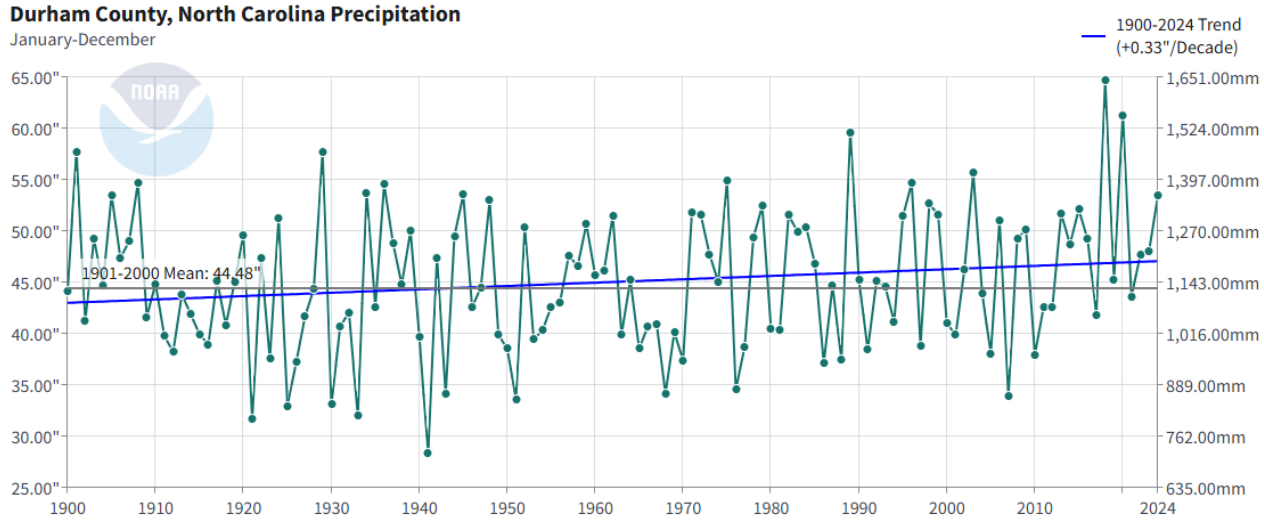



**Figure D.3 – Average Annual Precipitation, Durham County**



## D.2.3 Population and Demographics

Table D.3 provides population counts for North Carolina Central University from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to NCCU's website, as of fall 2025 the campus has a student to faculty ratio of 16 to 1.

**Table D.3 – Population Counts for North Carolina Central University, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **9,281** |
| *Undergraduate Students* | 7,325 |
| *Graduate Students* | 1,956 |
| *Full-Time Students* | 8,627 |
| *In-State Residency* | 7,263 |
| *Out-of-State Residency* | 2,018 |

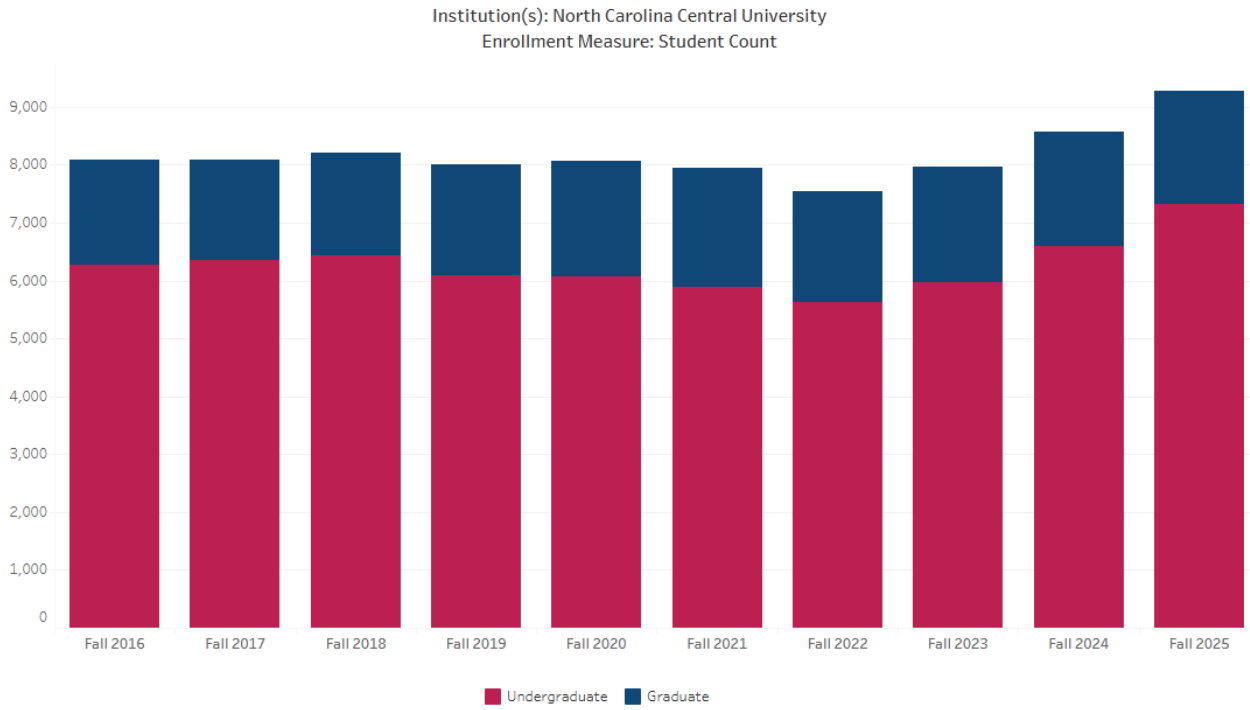
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Durham, Wake, and Mecklenburg Counties as well as other counties located in central North Carolina. Approximately 17.7% of all enrolled students come from Durham County.

Among the NCCU student population, the most popular majors for undergraduates were Business Management and Marketing, Biological and Biomedical Sciences, and Psychology. The top graduate majors were Health Professions and Related Programs, Education, and Public Administration and Social Service Professions.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure D.4. Enrollment has increased slightly over the last four years.

**Figure D.4 – NCCU Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 6,283 | 6,355 | 6,434 | 6,101 | 6,067 | 5,892 | 5,634 | 5,973 | 6,595 | 7,325 |
| Graduate | 1,811 | 1,742 | 1,773 | 1,910 | 2,011 | 2,061 | 1,919 | 1,992 | 1,984 | 1,956 |
| **Total** | **8,094** | **8,097** | **8,207** | **8,011** | **8,078** | **7,953** | **7,553** | **7,965** | **8,579** | **9,281** |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table D.4.

**Table D.4 – NCCU Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 64 | 0.7% |
| Black or African American | 7,093 | 76.4% |
| Hispanic or Latino | 568 | 6.1% |
| Two or More Races | 512 | 5.5% |
| Asian | 138 | 1.5% |
| Native Hawaiian or Other Pacific Islander | 3 | 0.0% |
| White | 673 | 7.3% |
| Race/Ethnicity Unknown | 164 | 1.8% |
| U.S. Nonresident | 66 | 0.7% |

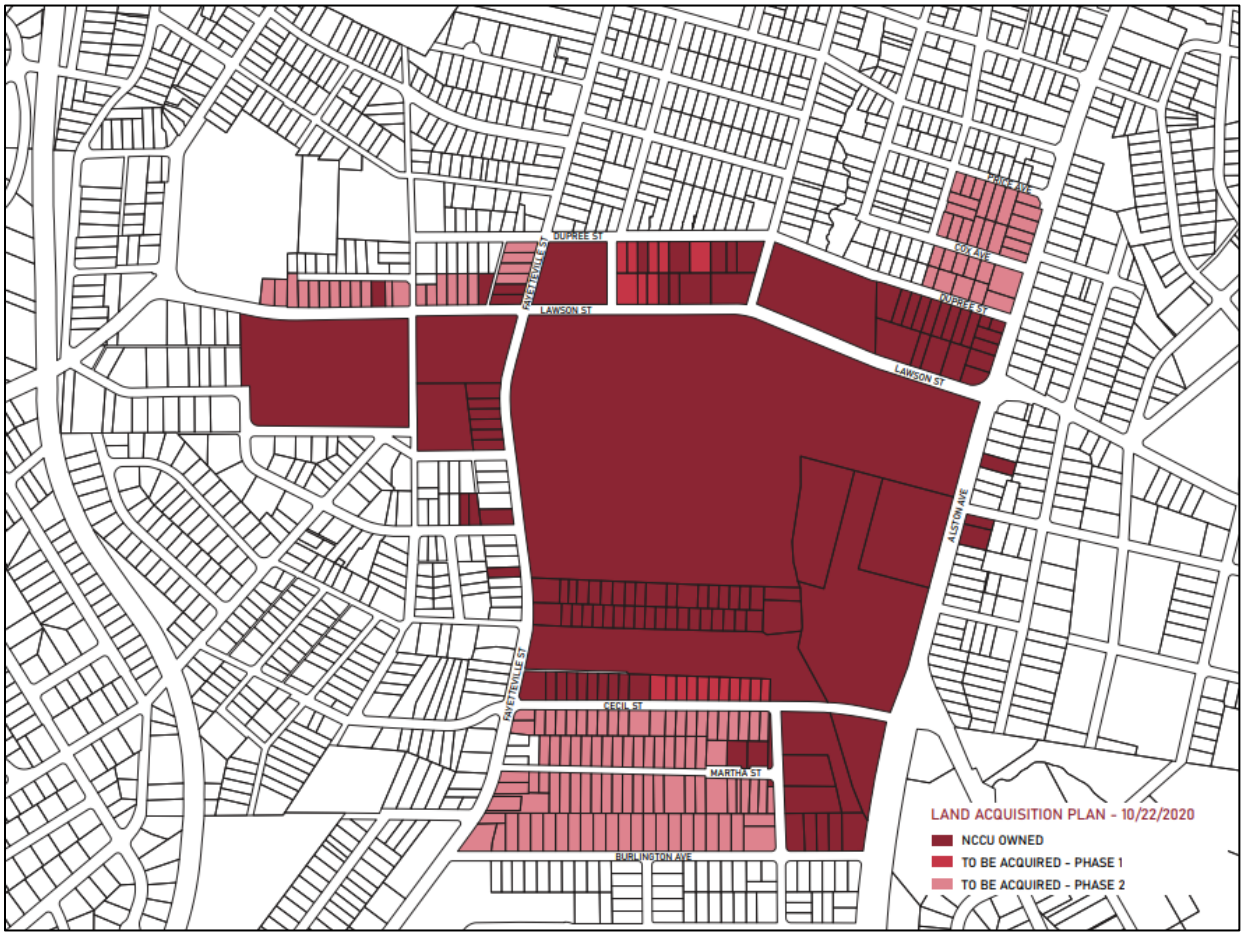
Source: UNC System Interactive Data Dashboards

## D.2.4 Growth and Development Trends

According to the 2020 NCCU Campus Master Plan Update, the campus approved and completed multiple construction projects in the last several years which include a new School of

Business, new parking decks, Community and Student Recreation Centers or athletic fields, new Chidley Dining and Retail Services Center, and new residence halls. The Campus Master Plan also notes the proposed future projects that would support the development of a Convocation Center, Fine Arts Performance Center, Stem Research Complex, Health and Human Performance Center, Student & Community Integrated Health Center, a new library, a Student Recreation Complex, and other projects. NCCU campus is currently bound by four primary city streets: Lawson Street, Fayetteville Street, Cecil Street, and Alston Avenue. Future university property acquisitions will aim to expand beyond these streets as shown in Figure D.5.

**Figure D.5 – NCCU Future Land Acquisition**




Source: 2020 NCCU Campus Master Plan Update

# D.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the NCCU campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## D.3.1 Building Exposure

Table D.5 provides total building exposure for the NCCU campus, which was estimated by summarizing building footprints and building replacement values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table D.5 – NCCU Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 7 | $12,766,103.29 |
| Educational/Extracurricular | 37 | $207,298,709.71 |
| Housing | 13 | $35,547,438.20 |
| **Total** | **57** | **$255,612,251.20** |

Source: NCEM iRisk Database

## D.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt campus continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by NCCU's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the NCCU HMPC maintained most critical facilities from the previous plan and made some revisions to account for changes to the building inventory. Factors considered for this ranking included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The NCCU HMPC used these criteria to rank the most critical facilities on campus in two tiers. The identified critical facilities for NCCU, as shown in Figure D.6, include the following:

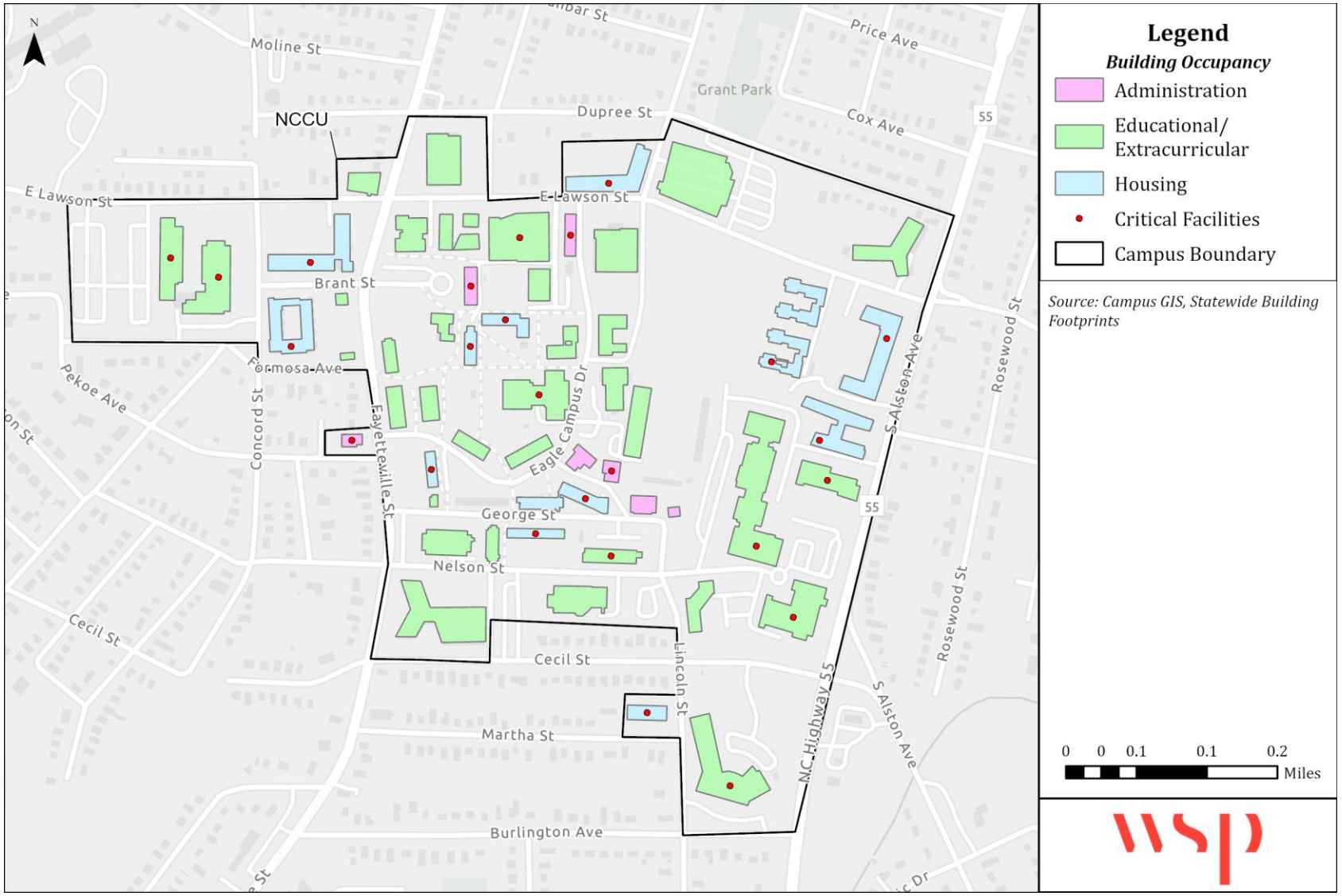
**Admin/Academic – Tier 1**

- Police Headquarters
- Police Communications Center
- H.M. Michaux School of Education
- James Shepard Library
- New Nursing Building
- Shepard Administration Building
- Julius Chambers BBRI
- BRITE
- Mary Townes Science Complex
- Heating Plant
- Pearson Cafeteria
- School of Law
- Walker Complex

**Residential – Tier 2**

- Benjamin S. Ruffin
- Eagle Landing
- Annie Day Shepard
- Rush
- Deborah Saunders-White Residence Hall
- Eagleson
- George St. Residential Complex
- Martha St. Apartments
- New Residence II
- Chidley North
- Alston Ave. Apartments
- Lawson St. Residential Complex

## Figure D.6 – NCCU Map of Buildings and Critical Facilities



# D.4 Hazard Identification & Risk Assessment

## D.4.1 Hazard Identification

To identify a full range of hazards relevant to NCCU, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the NCCU Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table D.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table D.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP NCCU Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Extreme Heat | Yes | No |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | No |
| Drought | Yes | No |
| Tornadoes/Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | Yes |

NCCU's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Durham County was used to approximate past events that may have affected the NCCU campus. The NCEI database contains 436 records of storm events that occurred in Durham County in the 25-year period from 2000 through 2024. Table D.7 summarizes these events.

**Table D.7 – NCEI Severe Weather Data for Durham County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Flash Flood | 72 | $479,000 | $0 | 0 | 0 |
| Flood | 4 | $11,050,000 | $5,000,000 | 0 | 0 |
| Funnel Cloud | 3 | $0 | $0 | 0 | 0 |
| Hail | 73 | $15,000 | $0 | 0 | 0 |
| Heavy Rain | 5 | $0 | $0 | 0 | 0 |
| Heavy Snow | 1 | $0 | $0 | 0 | 0 |
| High Wind | 2 | $1,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 1 | $205,000 | $0 | 0 | 0 |
| Ice Storm | 1 | $400,000 | $0 | 0 | 0 |
| Lightning | 8 | $163,000 | $0 | 1 | 4 |
| Strong Wind | 19 | $1,498,450 | $6,000 | 1 | 1 |
| Thunderstorm Wind | 179 | $1,263,750 | $0 | 1 | 1 |
| Tornado | 6 | $630,000 | $0 | 0 | 0 |
| Tropical Storm | 3 | $1,200,000 | $25,000 | 0 | 0 |
| Winter Storm | 26 | $1,000,000 | $0 | 0 | 0 |
| Winter Weather | 33 | $30,000 | $0 | 0 | 0 |
| **Total** | **436** | **$17,935,200** | **$5,031,000** | **3** | **6** |

Source: National Center for Environmental Information Events Database, retrieved November 2025

Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Durham County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Durham County has been designated in 18 major disaster declarations, as detailed in Table D.8, and 13 emergency declarations, as detailed in Table D.9.

**Table D.8 – FEMA Major Disaster Declarations, Durham County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-827-NC | 17-May-89 | Tornado | Tornadoes | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard Of 96 | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1211-NC | 22-Mar-98 | Severe Storm(s) | Severe Storms Tornadoes, & Flooding | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1312-NC | 31-Jan-00 | Severe Storm(s) | Severe Winter Storm | N/A | N/A | $27,368,108 |
| DR-1448-NC | 12-Dec-02 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | $86,565,180 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7,790 | $21,289,504 | $18,285,917 |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34,713 | $133,948,455 | $632,937,402 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-4889-NC | 9-Sep-2025 | Tropical Depression | Tropical Depression Chantal | N/A | N/A | N/A |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance, IAH = Individuals and Households, PA = Public Assistance

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table D.9 – FEMA Emergency Declarations, Durham County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3033-NC | 02-Mar-77 | Snow | Drought & Freezing |
| EM-3049-NC | 11-Aug-77 | Drought | Drought |
| EM-3110-NC | 17-Mar-93 | Snow | Severe Snowfall & Winter Storm |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 1-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 6-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table D.10 summaries the determination made for each hazard.

### Table D.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in 2021 NCCU Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in 2021 NCCU Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 NCCU Annex<br>▪ Modeled building damages in iRisk database enable vulnerability assessment |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 NCCU Annex<br>▪ Durham County has had two disaster declarations for flooding and nine disaster declarations for hurricanes or tropical storms which may have involved flooding |
| Geological Hazards (Sinkhole & Landslide) | Yes | ▪ Included in 2021 NCCU Annex<br>▪ HMPC noted risk of sinkholes on campus due to local water table and soil conditions |
| Hurricane & Coastal Hazards | Yes | ▪ Included in 2021 NCCU Annex<br>▪ Durham County has had 8 disaster declarations related to hurricanes<br>▪ Coastal hazards not relevant due to campus's inland location |
| Severe Winter Weather | Yes | ▪ Included in 2021 NCCU Annex |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 NCCU Annex<br>▪ Durham County has had three disaster declarations for tornadoes and/or severe storms |
| Wildfire | Yes | ▪ Included in 2021 NCCU Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in the 2021 NCCU Annex<br>▪ There are fixed facility sites and transportation routes with hazardous materials in/near the campus |
| Infectious Disease | Yes | ▪ Included in the 2021 NCCU Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in the 2021 NCCU Annex<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |
| Terrorism | No | ▪ Not included in the 2021 NCCU Annex<br>▪ HMPC did not express interest in evaluating this hazard; best addressed by State and federal planning and emergency response |

# D.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on NCCU's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Durham County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Eno Haw Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Durham County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table D.11 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Earthquake** | USGS, NCEI | County | iRisk | Census Tract |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Geological – Sinkhole** | USGS | County | Qualitative Analysis | Campus |
| **Hurricane** | NHC | County | iRisk | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

## Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

## Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

# Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the NCCU planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table D.12 on the following page.

PRI ratings are provided by category throughout each hazard profile for the planning area as a whole. Ratings specific to each jurisdiction are provided at the end of each hazard profile. The results of the risk assessment and overall PRI scoring are provided in Section D.5.12 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table D.12 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

## D.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

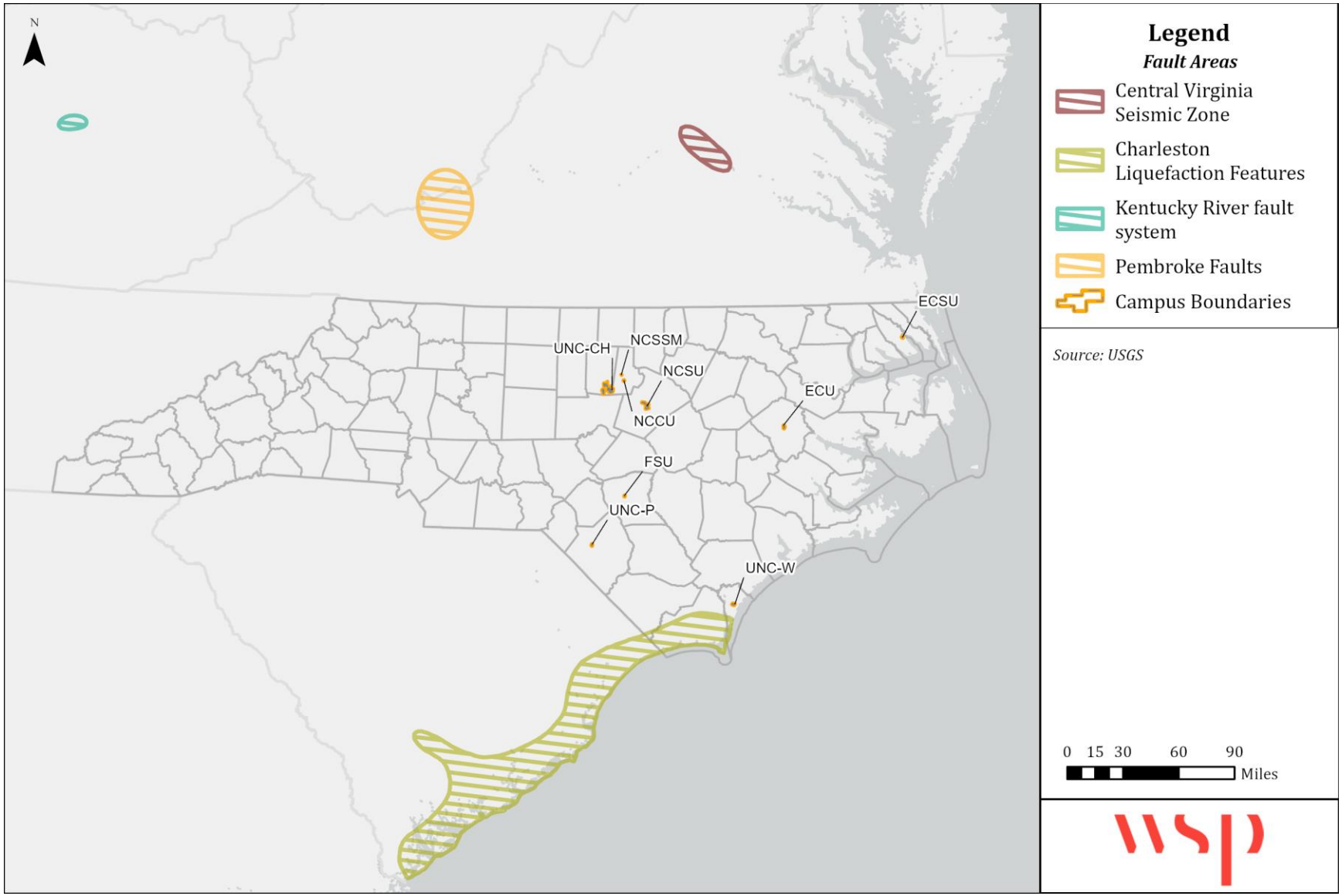
Figure D.7 reflects the quaternary faults that present an earthquake hazard for the NCCU planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. There are no active faults in Durham County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Durham County is likely to be felt across the NCCU campus.

*Spatial Extent: 4 – Large*

**Figure D.7 – U.S. Quaternary Faults**



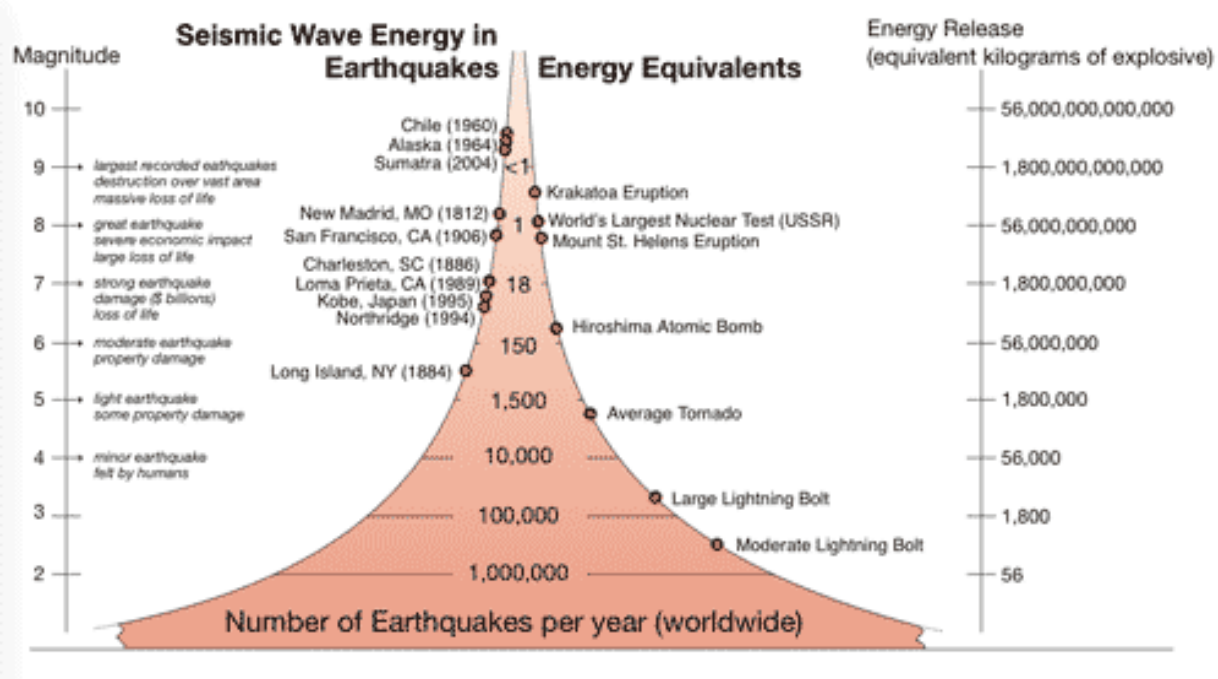
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure D.8.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table D.13 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure D.8 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table D.13 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |

| MMI | Shaking | Description/Damage |
|---|---|---|
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater. Earthquake events that occurred within 100 miles of the NCCU campus are presented in Table D.14 and Figure D.9 shows the epicenter of these events.

**Table D.14 – Historical Earthquakes within 100 Miles of NCCU, 1900-2024**

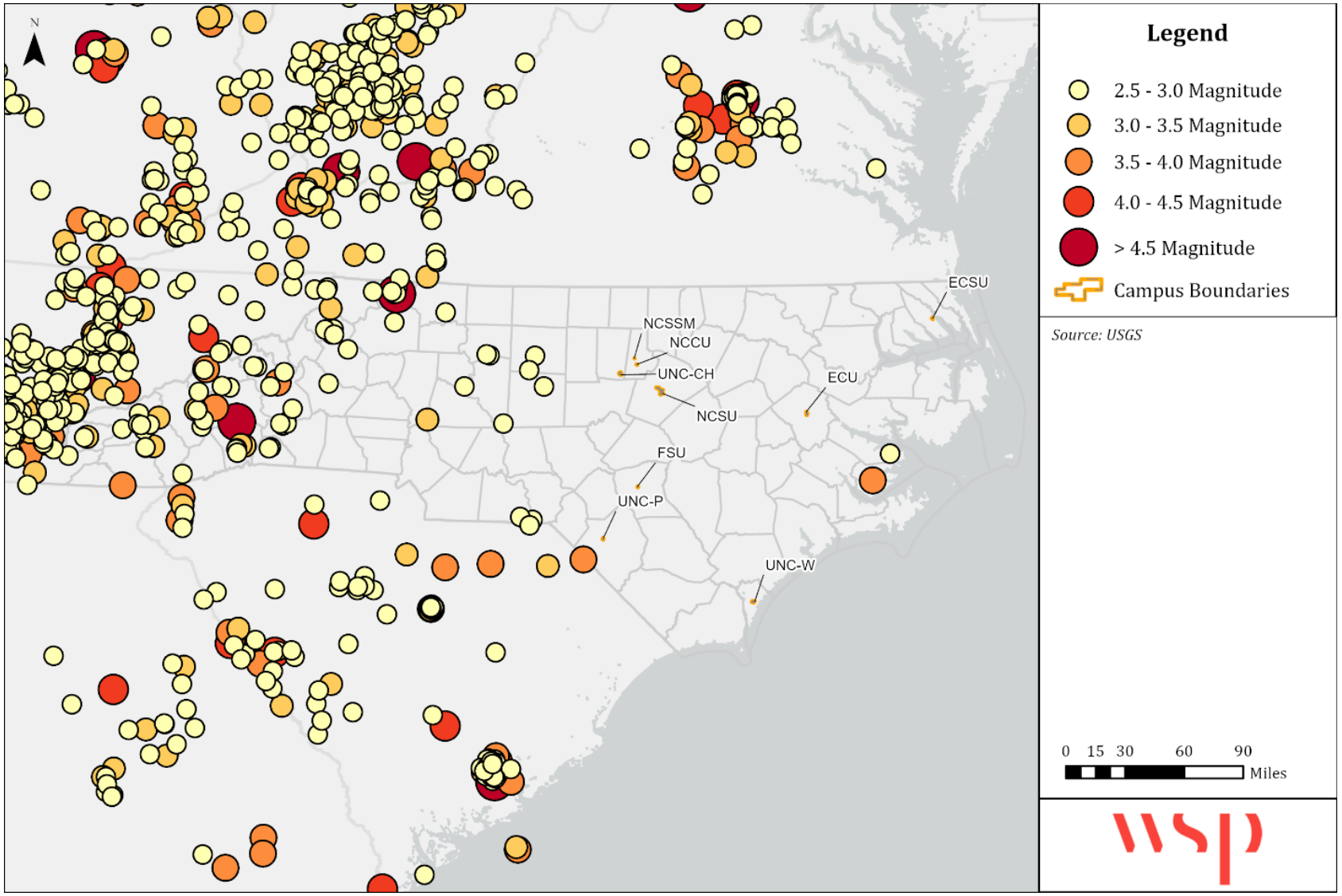
| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 4/22/1980 | 2.8 | 9 km SE of Dobson, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 6/4/1989 | 2.8 | 9 km WNW of Burkeville, Virginia |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 10/21/1998 | 3.8 | 13 km S of Dillwyn, Virginia |
| 8/18/2000 | 2.7 | 2 km SSE of Narrows, Virginia |
| 9/3/2001 | 2.5 | Virginia |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |
| 11/3/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 5/16/2009 | 3.0 | 2 km NNE of Cave Spring, Virginia |
| 11/25/2009 | 2.7 | 14 km S of Arrington, Virginia |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |
| 5/22/2014 | 3.1 | 15 km ENE of Cumberland, Virginia |

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 11/4/2015 | 2.67 | 3 km NE of Dillwyn, Virginia |
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |
| 9/27/2021 | 2.56 | 4 km N of Lafayette, Virginia |
| 5/6/2025 | 2.96 | 8 km S of Dillwyn, Virginia |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there were two earthquakes felt in and around Durham: on September 1, 1886 with an epicenter approximately 365 miles from Durham; and on November 20, 1969 a 4.3 magnitude with an epicenter approximately 242 miles from Durham.

**Figure D.9 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

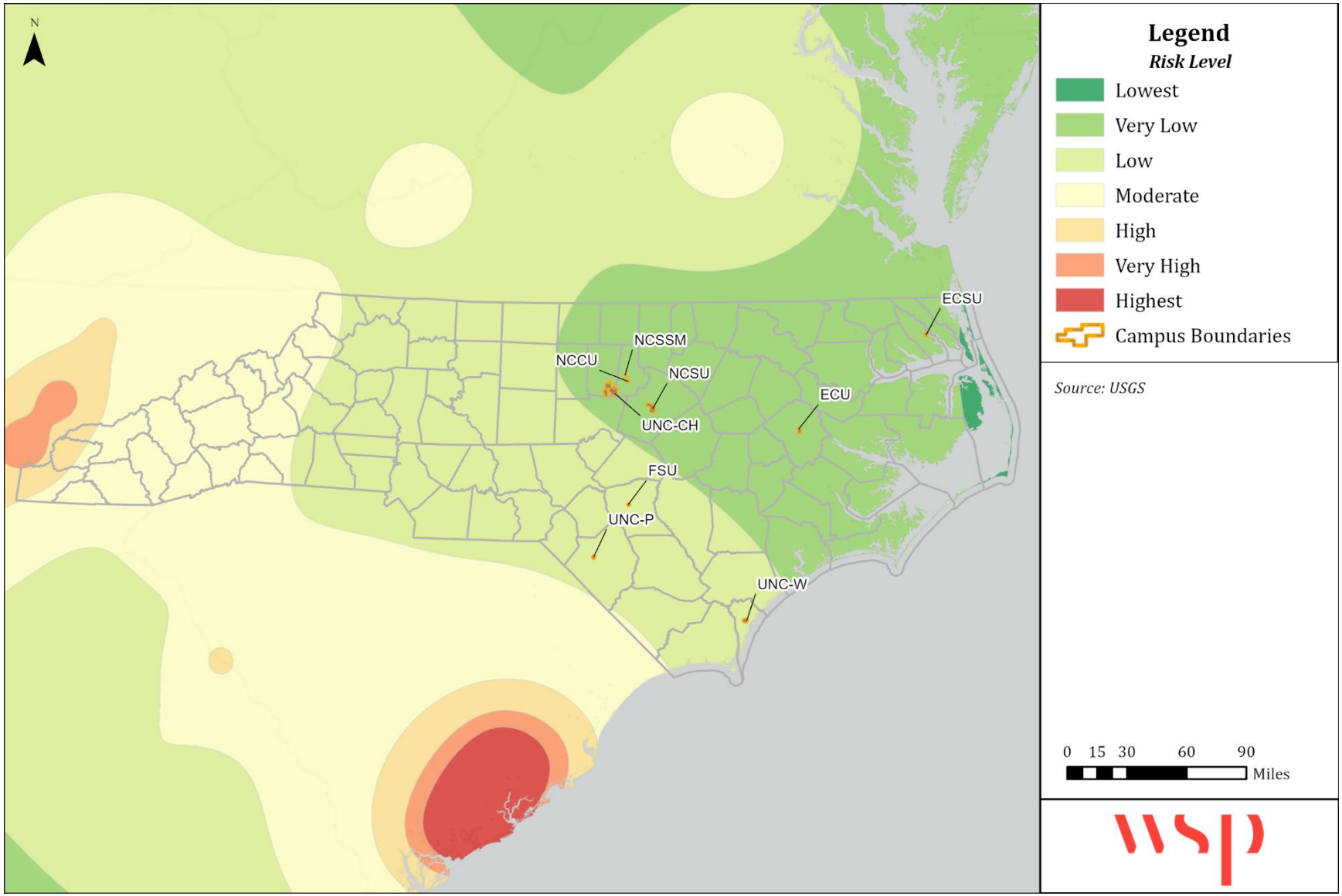
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure D.10 on the following page reflects the seismic hazard for Durham County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Durham County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting NCCU is unlikely.

*Probability: 1 – Unlikely*

**Figure D.10 – Seismic Hazard Information for Durham County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on NCCU's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damage to infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause $313,107 of estimated total building damages.

Durham County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structures. Table D.15 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table D.15 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $476.89 | $919.05 | $1,395.94 |
| Educational | $7,531.60 | $10,952.89 | $18,484.49 |
| Housing | $1,642.15 | $2,648.48 | $4,290.63 |
| **Total** | **$9,650.64** | **$14,520.42** | **$24,171.06** |
| **500-Year Earthquake Event** | | | |
| Administration | $4,052.93 | $8,568.06 | $12,620.99 |
| Educational | $80,146.05 | $167,772.80 | $247,918.85 |
| Housing | $15,877.35 | $36,689.90 | $52,567.25 |
| **Total** | **$100,076.33** | **$213,030.76** | **$313,107.09** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **1,000-Year Earthquake Event** | | | |
| Administration | $16,925.92 | $25,185.99 | $42,111.91 |
| Educational | $339,337.25 | $636,563.12 | $975,900.37 |
| Housing | $65,460.45 | $135,769.93 | $201,230.38 |
| **Total** | **$421,723.62** | **$797,519.04** | **$1,219,242.66** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Durham County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on USGS seismic probability data and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the NCCU campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at NCCU have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statements

- While earthquakes are an unlikely hazard event for the NCCU campus, an estimated $313,107 of total building damages to main campus could occur in the case of a 500-year earthquake event.

## D.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. Table D.16 provides counts of heat index values by threshold recorded from 2009-2024 at the North Durham Water Reclamation Facility in Durham County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Durham County experiences an average of 77 hours per year with heat index values at or above 100°F.

*Impact: 2 – Limited*

**Table D.16 – Historical Heat Index, North Durham Water Reclamation Facility, Durham, NC, 2009-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2009 | 8 | 0 | 0 | 0 | 8 |
| 2010 | 98 | 24 | 0 | 0 | 122 |
| 2011 | 70 | 16 | 0 | 0 | 86 |
| 2012 | 58 | 22 | 1 | 0 | 81 |
| 2013 | 59 | 17 | 0 | 0 | 76 |
| 2014 | 14 | 0 | 0 | 0 | 14 |
| 2015 | 26 | 1 | 0 | 0 | 27 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2016 | 76 | 6 | 0 | 0 | 82 |
| 2017 | 36 | 0 | 0 | 0 | 36 |
| 2018 | 44 | 2 | 0 | 0 | 46 |
| 2019 | 119 | 13 | 0 | 0 | 132 |
| 2020 | 74 | 16 | 0 | 0 | 90 |
| 2021 | 60 | 16 | 0 | 0 | 76 |
| 2022 | 83 | 15 | 0 | 0 | 98 |
| 2023 | 69 | 17 | 0 | 0 | 86 |
| 2024 | 77 | 30 | 7 | 61 | 175 |
| **Sum** | **971** | **195** | **8** | **61** | **1,235** |
| **Average** | **61** | **12** | **1** | **4** | **77** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

NCEI records did not include a heat-related incident between 2000 and 2024 in Durham County. The most recent heat-related incident on record occurred in 1998 and is summarized below. It should be noted that heat-related incidents did occur in Durham County during this time period, as indicated in Table D.16, but they were not captured by NCEI.

- **July 22, 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.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the North Durham Water Reclamation Facility in Durham County, NC. Based on 16 years of data (2009-2024), the Durham station averaged 19 days per year with a heat index of 100 degrees or higher.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

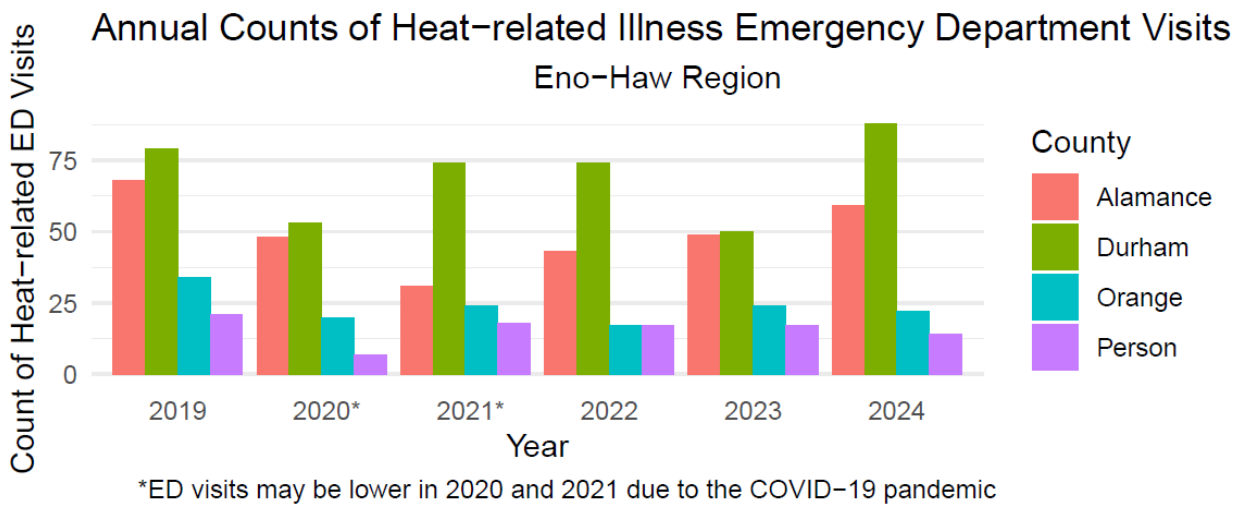
### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease

or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

Emergency department visits for heat related illnesses notably increase when heat index temperatures exceed 100°F. The 2025 Eno-Haw Regional Hazard Mitigation Plan utilized public health syndromic surveillance system data from NC DETECT to show heat related illness emergency department visits by county. Figure D.11 shows the annual count of emergency department visits for heat-related illness in Durham County, which ranged from 50 in 2023 to 88 in 2024.

**Figure D.11 – Annual Heat-Related Illness Emergency Department Visits by County**




Source: North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT)

## Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

## Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized “heat islands.” Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statements

- NCCU is located in Durham County, which currently averages 77 hours per year with heat at or above 100°F and there is a 100% annual chance of heat index values meeting or exceeding 100°F in any given year.

# D.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Critical | Moderate | 6 to 12 hrs | Less than 6 hours | 3.1 |

## Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the NCCU campus using the FIRM dated October 19, 2018. Figure D.12 reflects the 2018 mapped flood insurance zones. Table D.17 summarizes some of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table D.17 intersect the NCCU campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Durham and the NCCU campus. Flood risk is not limited to the 1%-annual-chance floodplain. Although no detailed study was completed by FEMA, it should be noted that a tributary of Third Fork Creek runs through campus and could be a source of flooding.

Although this assessment focuses on riverine flooding, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. The HMPC identified the following buildings and locations as areas that have experienced flooding during heavy rain events:

- The mechanical room in the Administration Building
- Rush Residence Hall, flooding around the side door
- Annie Day Shepard Residence Hall, flooding around the side door
- BRITE Building drain located in the rear parking lot
- The drain on the sidewalk behind Residence Hall 1 & 2
- The drain beside the gazebo heading into the Greek Bowl

The HMPC indicated that flooding and ponding are widespread issues across campus.

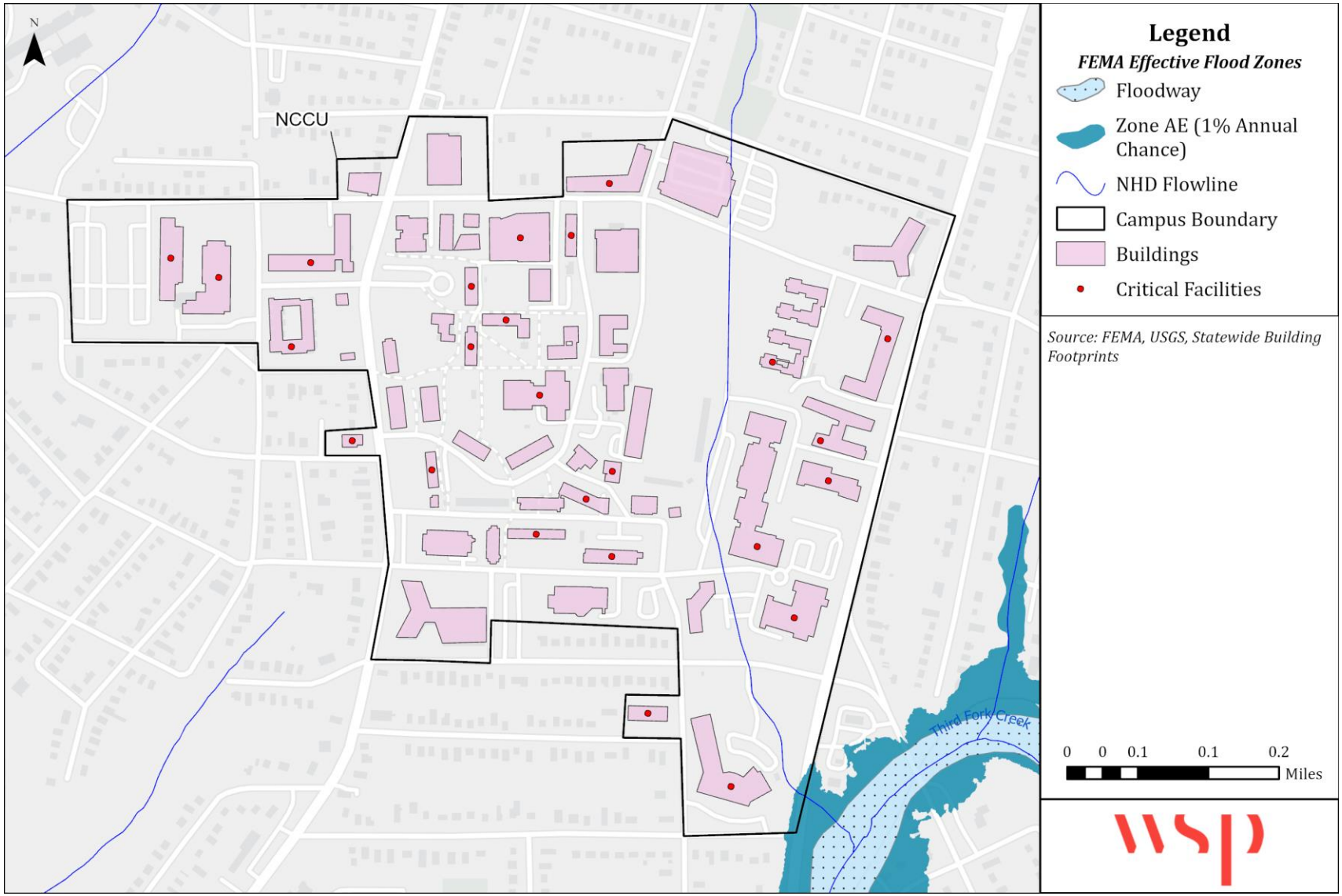
*Spatial Extent: 3 – Moderate*

### Table D.17 – Mapped Flood Insurance Zones

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because |

| Zone | Description |
|---|---|
| | detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **VE** | Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure D.12 – FEMA Flood Hazard Areas in NCCU's Campus Boundary**



## Extent

Flood extent can often be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Approximately 0.2% percent of the NCCU campus falls within the SFHA; the remaining area is outside of the floodplain. Table D.18 provides a summary of the NCCU campus' total area by flood zone on the 2018 effective DFIRM. Figure D.13 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

**Table D.18 – Flood Zone Acreage on NCCU Campus**

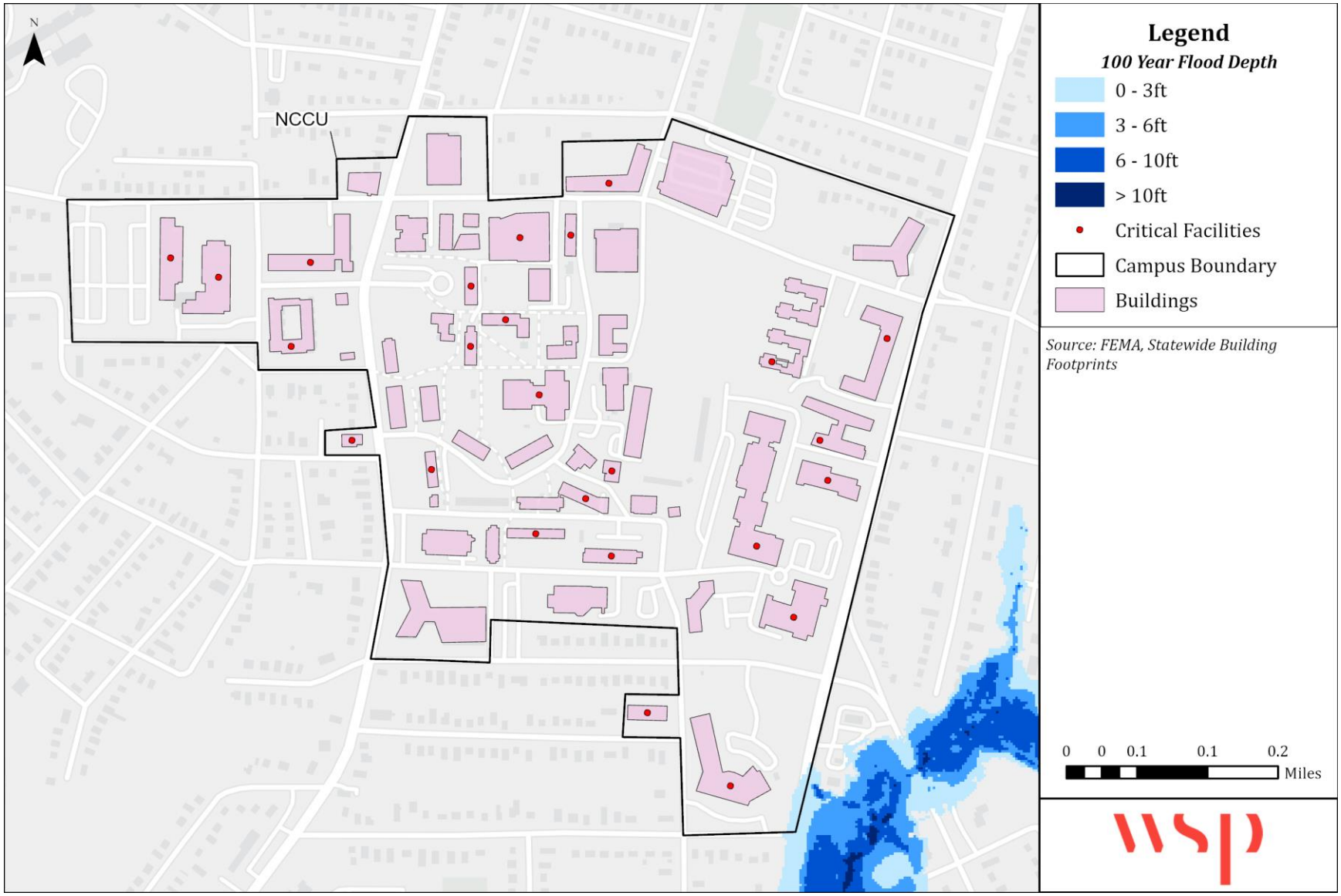
| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 0.2 | 0.2% |
| Unshaded X | 126.9 | 99.8% |
| **Total** | **127.1** | **--** |
| **SFHA Total** | **0.2** | **0.2%** |

Source: FEMA 2018 DFIRM

Although the 1% annual chance flood as studied by FEMA does not present any risks to campus, the HMPC noted that stormwater flooding is an ongoing issue and many buildings and areas of campus experience nuisance flooding. The HMPC indicated that the impact of flooding should be considered critical.

*Impact: 3 – Critical*

**Figure D.13 – Flood Depth, 1-Percent-Annual-Chance Flood, NCCU Campus**



## Historical Occurrences

Table D.19 details the historical occurrences of flooding for the City of Durham and Duram County identified from 2000 through 2024 by NCEI Storm Events database. The table below summarizes NCEI events that occurred countywide or started or ended in the City of Durham. According to NCEI, 21 recorded flood-related events occurred on 19 separate days in Durham and Durham County from 2000 to 2024 causing $55,000 in property damage, and no injuries, fatalities, or crop damage. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table D.19 – NCEI Records of Flooding for the City of Durham, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Durham | 7/23/2000 | 0/0 | $0 | $0 |
| Durham | 8/4/2000 | 0/0 | $0 | $0 |
| Durham | 6/22/2001 | 0/0 | $0 | $0 |
| Durham | 10/11/2002* | 0/0 | $0 | $0 |
| County-Wide | 8/9/2003 | 0/0 | $0 | $0 |
| Durham | 5/23/2004 | 0/0 | $0 | $0 |
| Durham | 8/12/2004 | 0/0 | $0 | $0 |
| Durham | 7/13/2006 | 0/0 | $0 | $0 |
| Durham | 11/16/2006 | 0/0 | $0 | $0 |
| East Durham | 9/6/2011 | 0/0 | $0 | $0 |
| Durham | 6/11/2014 | 0/0 | $0 | $0 |
| Durham | 12/30/2015 | 0/0 | $10,000 | $0 |
| West Durham | 4/15/2018 | 0/0 | $0 | $0 |
| Durham | 4/12/2019 | 0/0 | $30,000 | $0 |
| Durham | 7/9/2022 | 0/0 | $0 | $0 |
| West Durham | 6/30/2023 | 0/0 | $0 | $0 |
| West Durham | 9/27/2024* | 0/0 | $15,000 | $0 |
| **Heavy Rain** | | | | |
| Durham | 11/22/2006 | 0/0 | $0 | $0 |
| West Durham | 8/4/2020 | 0/0 | $0 | $0 |
| **Total** | | **0/0** | **$55,000** | **$0** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the City and county:

- **August 4, 2000** - Flooding on Hwy 147, 6 to 8 inches of water covered roads in the South Square area.
- **September 6, 2011** – As the remnants of Tropical Storm Lee tracked along a frontal zone that extended from the southern Appalachians into central Virginia, heavy rain and severe storms spread into central North Carolina. The initial severe weather threat, during the early morning hours, was tornadoes, due to the highly sheared environment associated with the former tropical cyclone. As the day progressed, and the remnant low of Lee continued to weaken, the severe weather threat transitioned to straight line winds, as instability increased with the heating of the day. Multiple street closings due to high water were reported by law enforcement in Durham. The intersection of Berkely Street and Englewood Avenue was impassable due to flooding. The intersection of Morrene Road and Tremont Drive was flooded. Indian Trail in Durham was closed due to rising water. High water also forced the closure of the intersection of North Alston Avenue and Juniper Street.
- **December 30, 2015** - Flooding caused minor damage to the Hillandale Road VA Clinic in Durham, where 1-2 inches of water got inside the building. In addition, high water signs were deployed across Durham.
- **April 12, 2019** - Flash flooding was reported on several campus streets at North Carolina Central University. In addition, several buildings reported having water in interior entrances. Several streets were flooded and closed in the Durham area. Also, vehicles were stranded. Flora Street was impassable due to flash flooding.
- **July 9, 2022** – A warm and humid air mass produced widespread showers and storms. Very high moisture, deeply warm low levels, and slow storm motion produced high rainfall rates and flash flooding, ranging from nuisance flooding in most places to road closures in Chapel Hill, Durham, and Wake County. Flooded was reported near the intersection of NC Highway 147 (Durham Freeway) and Fulton St.
- **June 27, 2024** – Isolated to scattered showers and storms developed in the western Piedmont, tracking east and south over the central Piedmont and Sandhills. A few of the storms became severe in Chatham and Orange Counties, along with flash flooding over Durham. The city of Durham reported high water and numerous vehicles stranded.
- **September 27, 2024** – Hurricane Helene weakened to a strong tropical storm. Widespread rainfall totals of 2-4 inches of rain fell over central North Carolina, along with wind gusts of 25-45 mph. Additionally, four tornadoes occurred, with the strongest an EF3, touching down over Rocky Mount in Nash County. A vehicle was trapped in floodwaters on Lakewood Avenue near South Street and additional flooding was reported in the Durham Central Park area.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which have also included damages associated with flooding. Durham County has received one Major Disaster Declaration for a severe storm including elements of flooding in 1998. Additionally, five Major Disaster Declarations for hurricanes and tropical storms in 1996, 1999, 2003, 2018, and 2025 which also may have included damage associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The NCCU campus has minimal area of land in FEMA-mapped flood hazard areas. However, while this delineation is a useful way to identify the most at-risk areas, it does not capture risk to flooding of other magnitudes and probabilities. The City of Durham and the NCCU campus are at risk of stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Durham and impacts from past flood events have been recorded in NCEI. NCEI reports 21 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability of 88% for Durham. The HMPC emphasized that flooding is an ongoing issue on NCCU's campus and smaller scale flooding and ponding occurs even more regularly. Therefore, the probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. For the NCCU campus, there are no structures located within the SFHA.

### People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing

agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.

- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.
- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths caused by flood events in Durham.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

No structures or critical facilities identified for NCCU campus are located within the 1%-annual-chance floodplain, therefore there is no estimated damage.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the NCCU Facilities Management works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statements

- Only 0.2% of the campus falls within the 1%- annual-chance floodplain, however flooding is not limited to the SFHA. Localized flooding can still impact facilities, roadways, and other locations on campus.
- Buildings and drains that experience impacts from localized flooding include the Administration Building, Rush Residence Hall, Annie Day Shepard Residence Hall, the BRITE Building, and drains near the Greek Bowl.
- In 2019, a flash flood event was reported on several campus streets at NCCU.

## D.5.4 Geological – Sinkhole

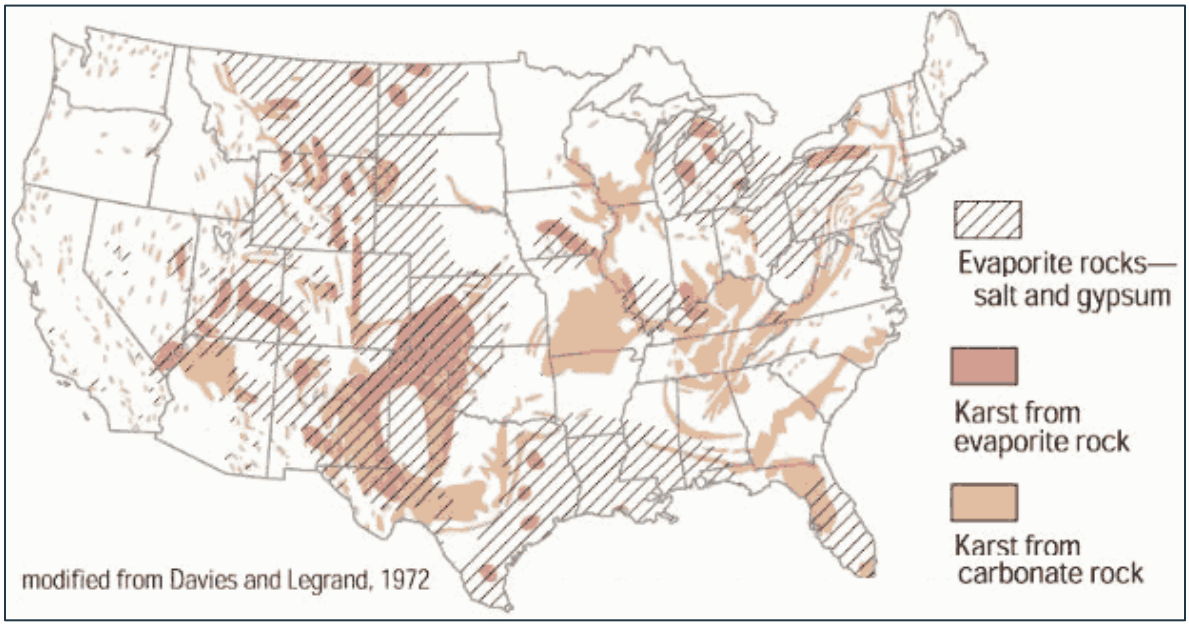
| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Sinkhole | Possible | Limited | Small | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

Durham County is located within the Piedmont physiographic province of North Carolina, which lies between the Coastal Plain and the Blue Ridge Mountains and encompasses approximately 45 percent of the area of the state. The Piedmont province is characterized by gently rolling, well-rounded hills and long low ridges with a few hundred feet of elevation difference between the hills and valleys. According to the North Carolina Department of Environmental Quality (NC DEQ), in North Carolina sinkholes mainly occur in the coastal plain. Figure D.14 shows the locations of rock formation susceptible to the formation of sinkholes.

*Spatial Extent: 1 – Negligible*

**Figure D.14 – Rock Formations in the United States**




### Extent

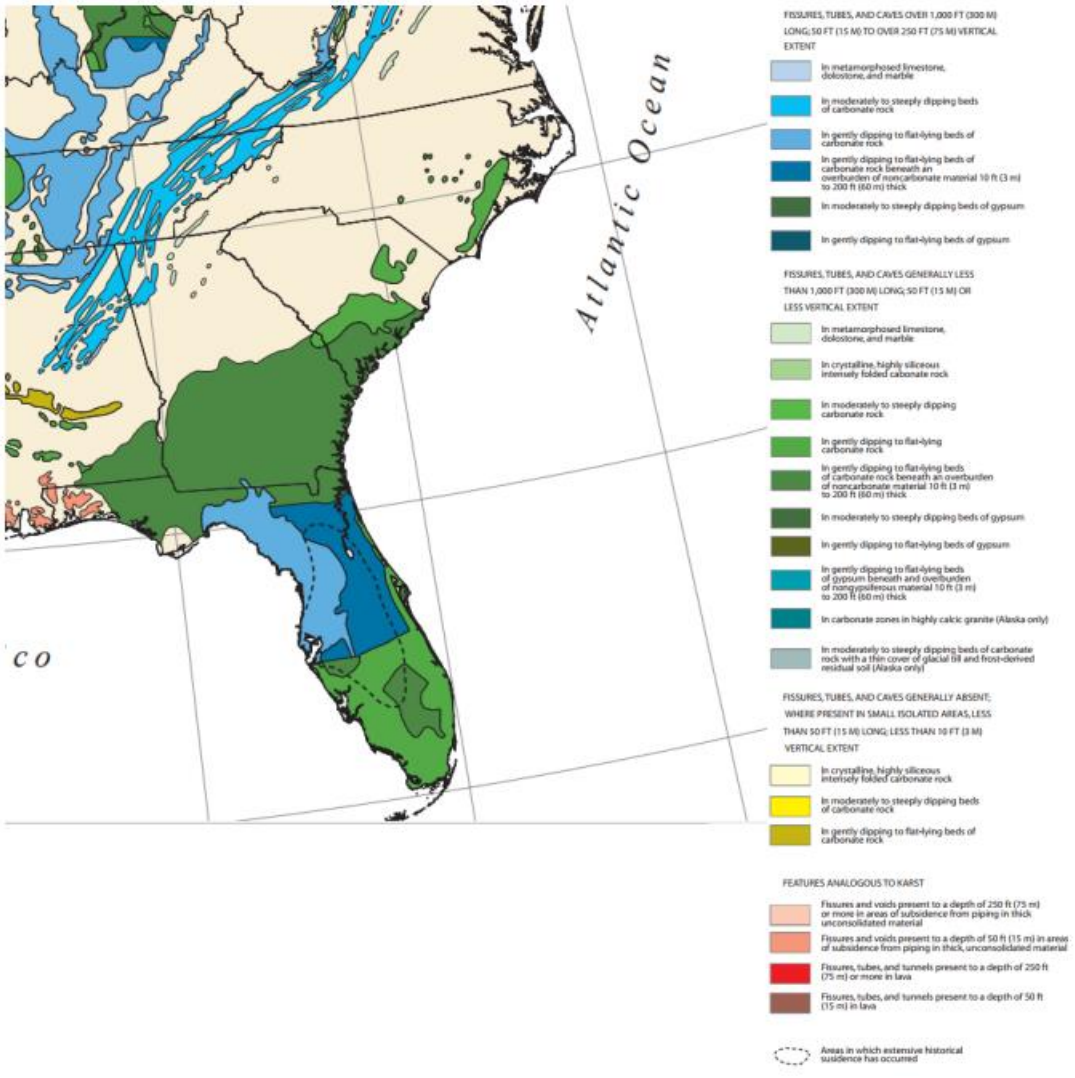
Sinkholes are relatively unpredictable. They can range dramatically in size, from a few feet wide to hundreds of acres wide and from less than 1 foot to more than 100 feet deep. Sinkholes can also vary in shape. Some are shaped like shallow bowls or saucers while others have vertical walls. In North Carolina, sinkholes sometimes hold water and form natural ponds. There is no formal scale for measuring the extent of sinkholes.

Sinkholes can have dramatic effects if they occur in urban settings, particularly when infrastructure, such as roads, or buildings are on top of the cavity, causing catastrophic damage. They can also contaminate water resources and have been known to swallow up vehicles, swimming pools, parts of roadways, and even buildings.

Figure D.15 shows more recent mapping of karst soil types that have been documented by the USGS. This map indicates that significant sinkhole activity in Durham County is extremely unlikely, and sinkholes would likely exhibit limited depth and surface coverage.

*Impact: 2 – Limited*

**Figure D.15 – United States Geological Survey of Karst Soils from Davies, et al, 1984**




Source: 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

## Historical Occurrences

Sinkhole incidents in Durham are typically caused by failing stormwater infrastructure and occur after heavy rain. These are not “natural” sinkhole events, and media uses the term sinkhole simply to refer to any sort of significant hole. Durham’s sinkhole events are not linked to karst topography/underground cavities and instead are a result of man-made infrastructure. Recent sinkhole events noted by local news outlets are detailed below:

- Cornwallis Road (2025) – 9 sinkholes have been reported, with the largest nearly the size of a football field.
- North Roxboro Street (2025) – Sinkhole formed on North Roxboro Street following heavy rain causing traffic delays.
- West Foster Street (2023) – A 3-ft deep sinkhole swallowed part of a school bus. No children were on board at the time, and the driver was able to safely exit.
- Bonnie Hills Subdivision (2022) – A large sinkhole formed several years prior and started expanding and now takes up more than half of Kingston Avenue.
- Redwood Road & Falls Lake (2016) – A sinkhole formed after heavy rain from Hurricane Matthew in October 2016. Despite warning fencing and cones, a man fell in. He did not sustain any injuries.
- Glenn Road (2016) – A man drove into a weather-related sinkhole on Glenn Road between Club Boulevard and Bundy Avenue. 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.

Additionally, the 2025 NCCU HMPC noted concern about a stream under campus that could cause sinkholes.

## Probability of Future Occurrence

While sinkholes have occurred in recent years across Durham County, these sinkholes are due to man-made infrastructure failures, not karst topography. Therefore, technical – rather than geological – sinkholes may occur in Durham County

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

A person’s vulnerability to sinkhole is directly related to the speed in which the sinkhole opens and the person being above the sinkhole. Deaths and injuries may occur if a sinkhole opens directly beneath an occupied building or may result from motor vehicle incidents if drivers cannot avoid driving into the sinkhole before protective barriers were in place. However, there were no records found of such severe events on or near the NCCU campus.

## Property

Similar to people, property's vulnerability to a sinkhole is dependent on a variety of factors including the speed at which the sinkhole develops. Property above a large sinkhole that suddenly collapses can suffer catastrophic damage ranging from cracked foundations to damaged roadways and totaled vehicles.

## Environment

Sinkholes are unlikely to cause substantial impacts to the natural environment. Natural areas that are damaged will recover quickly.

## Changes in Development

Increases in development could potentially be a contributing factor in causing sinkholes. Development increases water usage, alters drainage pathways, overloads the ground surface, and redistributes soil. Sinkholes may occur if infrastructure is not graded correctly, or if poorly planned alteration of drainage patterns is implemented.

## Problem Statements

- Sinkhole risks at NCCU campus are likely to be associated with infrastructure and drainage issues. Such events are typically minor, therefore NCCU is unlikely to experience a severe sinkhole event.

## D.5.5 Hurricane

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. Hurricanes and tropical storms can occur anywhere within Durham County. Storm surge is limited to the coastal counties of North Carolina, therefore NCCU is not exposed to storm surge. However, hurricane winds can impact the entire campus, so the spatial extent was determined to be large.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table D.20), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

**Table D.20 – Saffir-Simpson Scale**

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and |

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| | | power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table D.21 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table D.21 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Tropical cyclones weaken relatively quickly after making landfall; therefore, Durham County will not typically experience major hurricane force winds, though these occurrences are possible.

For example, Hurricane Fran passed directly through NCCU's campus as a Category 1 storm with wind speeds around 65 mph in 1996.

*Impact: 3 – Critical*

## Historical Occurrences

According to NCEI, four recorded hurricane-related events affected Durham County from 2000 to 2024 causing an estimated $1,405,000 in property damage and $25,000 in crop damage. There were no injuries or fatalities recorded for any of these events.

**Table D.22 – Recorded Hurricane and Tropical Storm Events for Durham County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/18/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $205,000 | $0 |
| 9/14/2018 | Tropical Storm | Hurricane Florence | 0/0 | $0 | $25,000 |
| 10/11/2018 | Tropical Storm | Tropical Storm Michael | 0/0 | $200,000 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $1,000,000 | $0 |
| **Total** | | | **0/0** | **$1,405,000** | **$25,000** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Florence (2018)** – Large tree reported down on a home along Piperwood Court.
- **Tropical Storm Michael (2018)** – Tropical storm wind gusts downed numerous trees, caused widespread power outages, and produced a variety of damage to homes and structures across the county. At the peak of the storm, the total peak outages were around 20,000 customers.
- **Hurricane Ian (2022)** - Frequent wind gusts of 40 to 60 mph resulted in scattered to numerous trees and power lines down across Durham County, including some on homes. Numerous customers lost power in Durham County as a result of the tropical storm force wind gusts.

According to the NOAA Historical Hurricane Tracks dataset, 16 hurricanes or tropical storms, passed within 25 miles of NCCU since 1900.These events are listed in Table D.23, and storm tracks are mapped in Figure D.16.

**Table D.23 – Hurricane Tracks within 25 miles of NCCU, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 6/17/1902 | Unnamed | Tropical Storm |
| 10/3/1929 | Unnamed | Tropical Storm |
| 10/21/1944 | Unnamed | Tropical Storm |
| 9/19/1945 | Unnamed | Tropical Storm |
| 8/18/1955 | Diane | Tropical Storm |

| Date | Storm Name | Storm Category |
|---|---|---|
| 9/1/1964 | Cleo | Tropical Depression |
| 6/11/1968 | Abby | Tropical Depression |
| 5/27/1970 | Alma | Tropical Storm |
| 9/17/1976 | Unnamed | Tropical Depression |
| 9/9/1987 | Unnamed | Tropical Depression |
| 9/7/1996 | Fran | Category 1 |
| 9/6/1999 | Dennis | Tropical Depression |
| 9/20/2000 | Gordon | Tropical Depression |
| 8/31/2004 | Gaston | Tropical Depression |
| 10/12/2018 | Michael | Tropical Storm |
| 7/9/2021 | Elsa | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

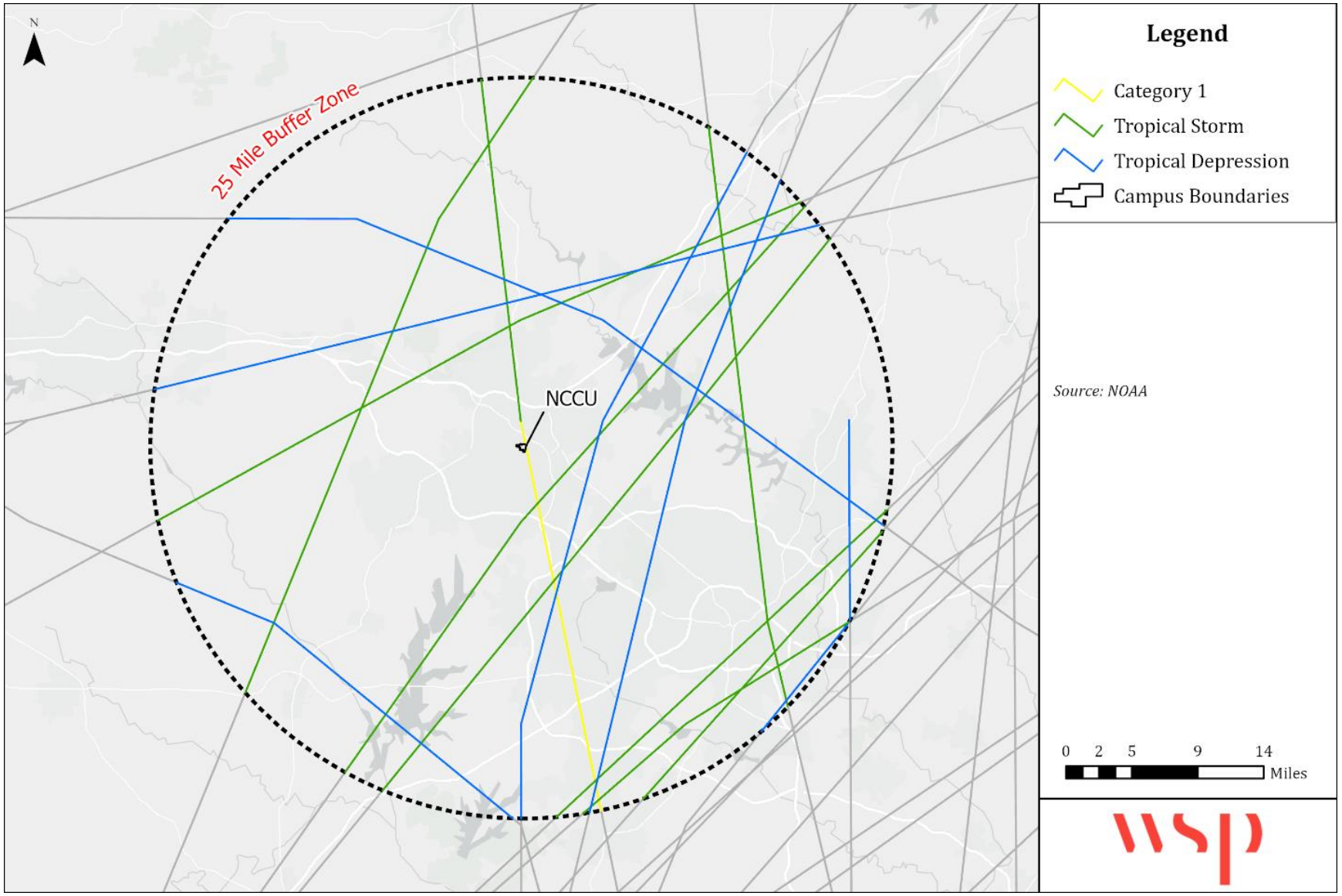
Durham County has received 4 major disasters and 7 emergency declarations for Hurricane and Tropical Storm events summarized in Table D.24.

### Table D.24 – Hurricane-Related Disaster Declarations & Emergency Declarations

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 9/15/1999 | DR-1292-NC & EM-3146-NC | Hurricane Floyd & Hurricane Floyd Emergency Declarations |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 10/7/2016 | EM-3380-NC | Hurricane Matthew |
| 9/14/2018 | DR-4393-NC & EM-3401-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

Source: OpenFEMA, 2025

**Figure D.16 – Historic Hurricane and Tropical Storm Tracks within 25 miles of NCCU, 1900-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, four hurricanes and tropical storms have impacted Durham County, which equates to a 16 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting the County is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. On-campus students may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause over $453,000 of estimated total building damage to NCCU's campus.

Table D.25 details the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table D.25 – Estimated Building Damage by Hurricane Winds, NCCU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $6,287.81 | $701.60 | $6,989.41 |
| Educational | $304,217.69 | $40,318.74 | $344,536.43 |
| Housing | $89,385.67 | $12,298.43 | $101,684.10 |
| **Total** | **$399,891.17** | **$53,318.77** | **$453,209.94** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $21,673.51 | $4,955.26 | $26,628.77 |
| Educational | $1,040,681.78 | $299,139.42 | $1,339,821.20 |
| Housing | $286,060.59 | $83,223.41 | $369,284.00 |
| **Total** | **$1,348,415.88** | **$387,318.09** | **$1,735,733.97** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $69,985.26 | $25,531.29 | $95,516.55 |
| Educational | $3,166,638.44 | $1,542,294.73 | $4,708,933.17 |
| Housing | $793,554.71 | $385,470.22 | $1,179,024.93 |
| **Total** | **$4,030,178.41** | **$1,953,296.24** | **$5,983,474.65** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages.

## Problem Statements

- Historical tracks of multiple hurricane events pass within 25 miles of the NCCU campus.
- For the 25-year period from 2000 through 2024, Durham County experienced four hurricane wind events causing over $1,430,000.

## D.5.6 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Durham County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI), shown in Table D.26 for the Durham County region, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. The county may experience any level on the RSI scale. Durham County receives an average of 4 to 6 inches of snowfall per year. According to NCEI, the greatest snowfall amounts to impact Durham County have been between 7-12 inches, with Durham reporting around 9 inches of snowfall. During the snowstorm of January 17, 2018, the county was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

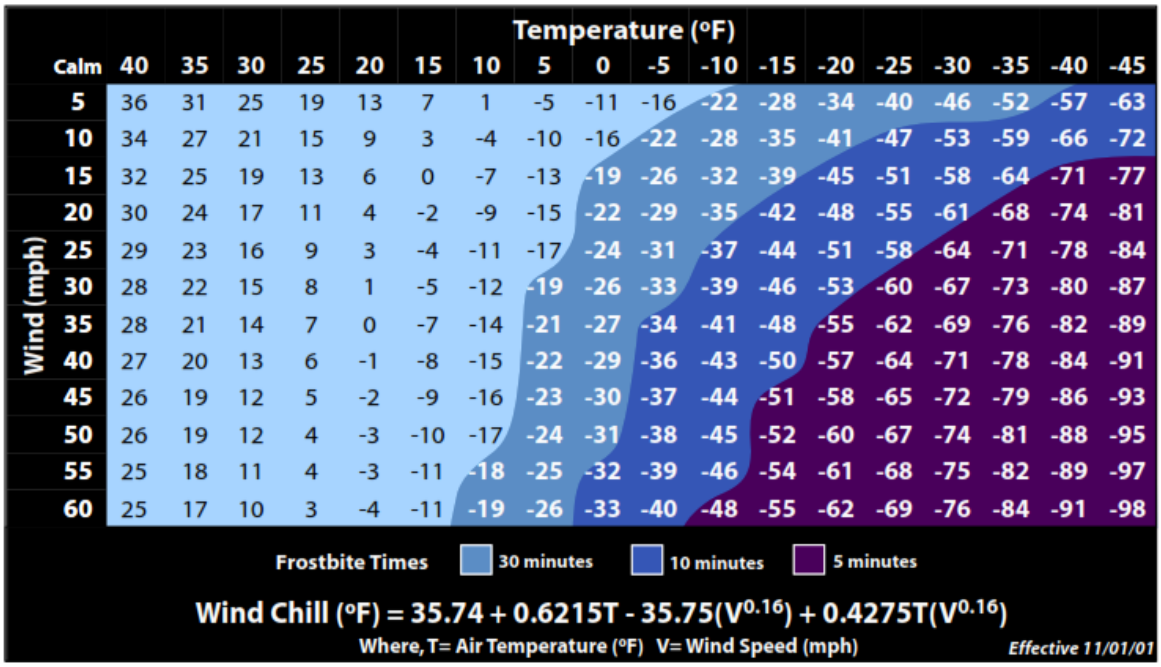
**Table D.26 – Regional Snowfall Index (RSI) Values**

| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure D.17, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure D.17 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Durham County took place December 18th, 1930, with a recorded depth of 18.5 inches of snow occurring within Rougemont, an unincorporated area of the County.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of a severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24 hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one heavy snow event, one ice storm, and 59 combined winter storm/winter weather events in Durham County during the 25-year period from 2000 through 2024. As reported in NCEI, severe winter weather caused $1,430,000 in property damage, but they did not cause any fatalities, injuries, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Durham County by incident are recorded in Table D.27.

**Table D.27 – Recorded Severe Winter Weather Events in Durham County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Heavy Snow | 1 | 0 | 0 | $0 | $0 |
| Ice Storm | 1 | 0 | 0 | $400,000 | $0 |

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Winter Storm | 26 | 0 | 0 | $1,000,000 | $0 |
| Winter Weather | 33 | 0 | 0 | $30,000 | $0 |
| **Total** | **61** | **0** | **0** | **$1,430,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **January 29, 2010** – Between 5 to 7 inches of snow fell across the county. Over 600 automobile accidents were reported in the county. Due to the cold temperatures icy road conditions persisted for several days resulting in the closure of schools and businesses.
- **March 6, 2014** – One quarter of an inch of ice from freezing rain resulted in widespread downed trees and power-lines. A strong surface low deepening off the Carolina coast brought a wintry mix of snow, sleet, and freezing rain to the northern-northwestern Piedmont counties. Snowfall amounts of 4 to 7 inches fell Forsyth, Person and Guilford counties. Just to the south and east of this area, a corridor of mainly sleet mixed with freezing rain produced significant icing of a quarter to half inch. This icing produced widespread downed trees and power outages over the northwest Piedmont. At the peak of the storm, over a 400,000 customers were without power. A natural disaster was declared in 7 counties across the Raleigh CWA that were impacted by this storm.
- **February 25, 2015 –** Snowfall/sleet amounts of 6 to 8 inches fell across the county. The heavy wet snow caused widespread power outages from falling trees and power lines. At the peak of the storm, over 40,000 customers were without power in the county.
- **January 17, 2018** – Total snowfall amounts ranged from 7 to 12 inches across the county.
- **January 29, 2022 –** An upper low and associated arctic cold front brought precipitation to central North Carolina on the 28th and 29th. Precipitation began as rain on the afternoon of the 28th with a gradual mix and changeover to snow as the front moved through the area. Precipitation wrapped up early on the morning of the 29th. Most locations saw less than 1 inch of snowfall with this event, although there were some locations from Guilford to Randolph Co's that saw over 3 inches of snow.

Durham County has received four FEMA Major Disaster Declarations for a snowstorm in 1977, blizzard in 1996, and severe winter storms in 2000 and 2002.

## Probability of Future Occurrence

NCEI records 61 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $195,108, which assumes that 10% of the on-campus population is impacted.

**Table D.28 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 9,160 | 916 | $195,108 |

### Property

The NCEI reported $1,430,000 of property damage in association with any winter weather events between 2000 and 2024 for Durham County. Based on these records, the County experiences an estimated annualized loss of $57,200 in property damage. The average impact from winter weather events per incident in Durham is $23,442.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is out driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. NCCU may wish to

consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statements

- Severe winter weather events are highly likely for Durham County and the NCCU campus. These events have also resulted in three presidential disaster declarations for the County.

## D.5.7 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

### Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally confined to the footprint of its associated thunderstorm. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas.

*Spatial Extent: 4 – Large*

#### TORNADO

Tornados can occur anywhere on NCCU's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado damage isn't increased in one area of the campus versus another. All of NCCU is exposed to this hazard.

#### THUNDERSTORM WINDS

The entirety of NCCU's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area, approximately 50% to 100% of the planning area could be impacted by one event.

#### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of NCCU is exposed to lightning.

#### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

### Extent

#### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates

(not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table D.29 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table D.29 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

The most intense tornadoes to pass through Durham County in the past 75 years were 3 F2s occurring in 1984, 1989, and 1998. Combined these incidents resulted in 5 injuries and caused $28.1 million in property damage.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.

- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Durham occurred on August 15, 2023 with the highest gusts recorded at 73 mph on August 15, 2023. The event did not result in fatalities or injuries but did cause $26,500 in property damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table D.30, is a common parameter that is part of fire weather forecasts nationwide.

**Table D.30 – Lightning Activity Level Scale**

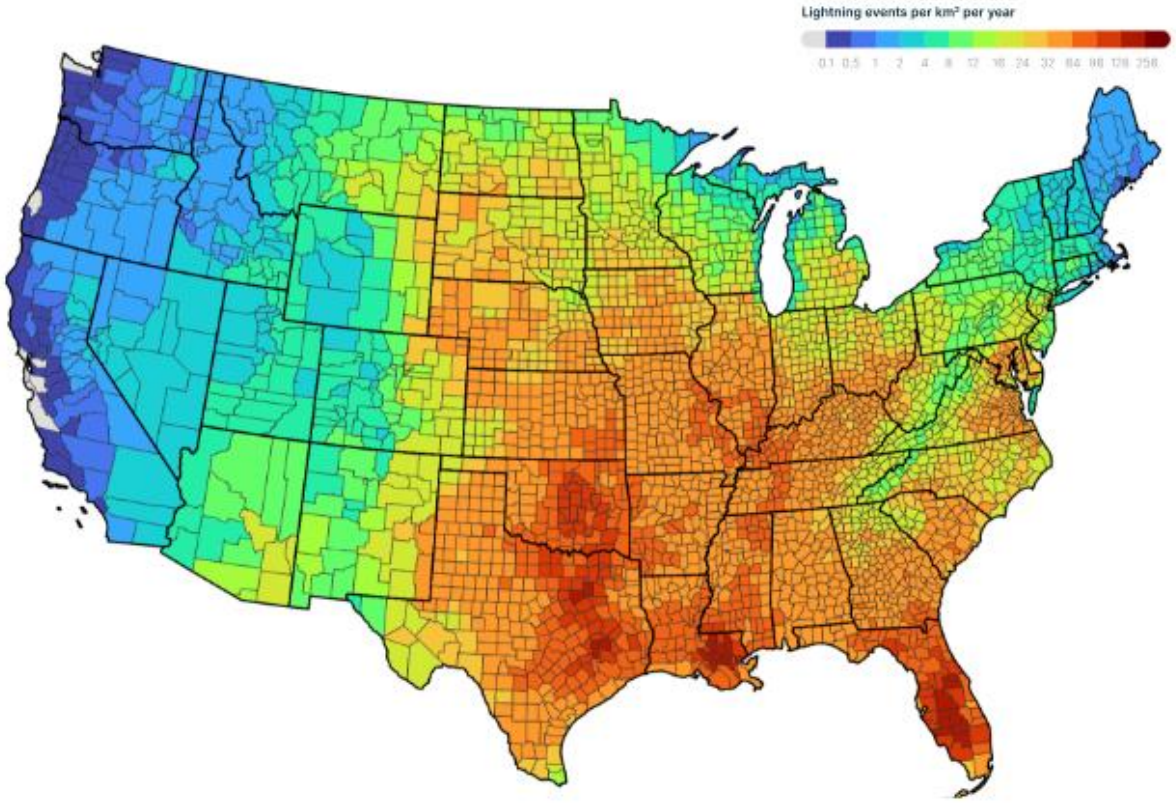
| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

According to the Vaisala flash density map, shown in Figure D.18, Durham County experiences between 16 and 24 lightning flashes per km per year.

**Figure D.18 – Lightning Density in the U.S. (2024)**




*Impact: 1 – Minor*

## HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table D.31 indicates the hailstone measurements utilized by the National Weather Service.

**Table D.31 – Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |

| Average Diameter | Corresponding Household Object |
|---|---|
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table D.32 describes typical intensity and damage impacts of the various sizes of hail.

**Table D.32 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls Durhamed |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2019 in Durham was a little over 1" in diameter; the largest hailstone recorded was 1.75", recorded on April 17, 2000, July 28, 2005, May 14, 2006 and March 14, 2016.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2025 to assess whether recent trends varied from the longer historical record. According to NCEI, Durham County experienced 5

injuries and $28.8 million dollars in property damage. Table D.33 shows historical tornadoes in Durham County from 1950 to 2024, and

Figure D.19 shows tornado paths within 10 miles of NCCU.

**Table D.33 – Recorded Tornadoes in Durham County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 12/31/1975 | 1615 | F0 | 0 | 0 | $250 |
| - | 4/4/1984 | 1800 | F2 | 0 | 4 | $2,500,000 |
| - | 5/5/1989 | 1720 | F2 | 0 | 0 | $25,000,000 |
| - | 7/16/1989 | 835 | F1 | 0 | 0 | $25,000 |
| Bahama | 3/20/1998 | 1830 | F2 | 0 | 1 | $600,000 |
| Gorman | 5/14/2006 | 1710 | F0 | 0 | 0 | $0 |
| Hope Vly | 5/15/2014 | 1710 | EF1 | 0 | 0 | $250,000 |
| Huckleberry Spg | 2/24/2016 | 1600 | EF1 | 0 | 0 | $100,000 |
| Clegg | 3/31/2022 | 1449 | EF1 | 0 | 0 | $100,000 |
| Weaver | 5/23/2022 | 1507 | EF0 | 0 | 0 | $150,000 |
| Mangum Store | 9/27/2024 | 1713 | EF1 | 0 | 0 | $30,000 |
| **Total** | | | | **0** | **5** | **$28,755,250** |

Source: NCEI

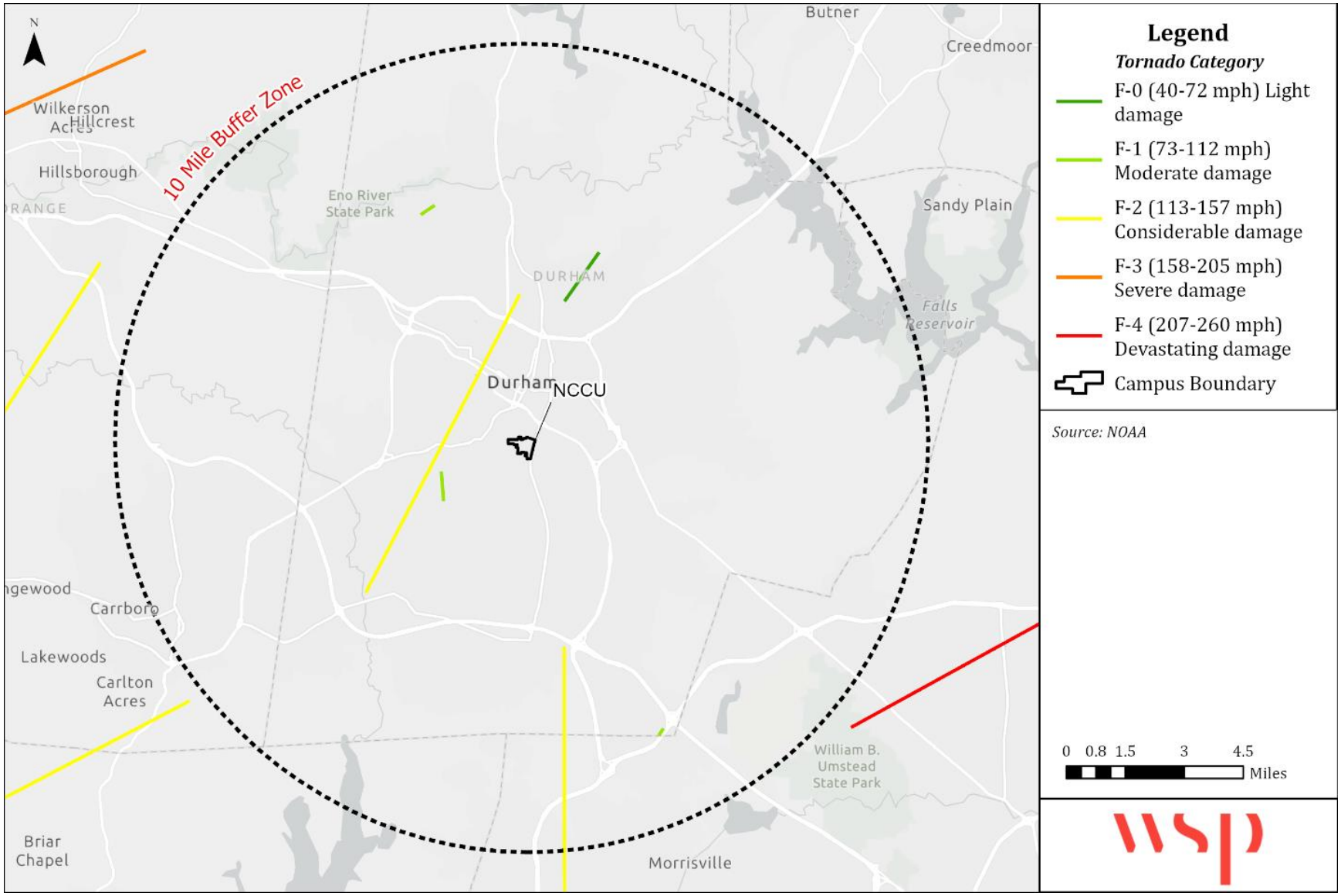
Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **April 4, 1984** – The tornado substantially damaged Northgate Mall and adjacent areas. Several cars in the parking lot were overturned. Parts of the mall roof were torn off, several houses were unroofed and four people were injured by flying glass. The tornado moved north-east to Quarry Park. Tree and roof damage occurred along its path.
- **May 5, 1989** – The tornado touched down 1.5 miles southwest of the intersection of Interstate 40 and State Highway 54. The tornado moved northeast and took a slightly “S” shaped path 8.75 miles long through the south and east part of the City of Durham. The storm reached its greatest intensity (F2) and with (100 yards) as it crossed State Highway 55 and Riddle Road. A convenience store was nearly demolished at this point. The tornado destroyed 16 homes and 2 businesses. It damaged 46 homes, 5 businesses, and an elementary school. In spite of the severe damage there were no deaths or serious injuries.
- **March 20, 1998** – A tornado first touched down in rural northeast Durham county off Bahama Road. The tornado moved northeast and took the roof off a manufactured home on a brick foundation. One minor injury occurred in the home. Down the road a half mile on Range Road, the tornado damaged farm sheds and sent sheets of tin flying in all directions. The tornado then hit a frame house with only minor roof damage. A large oak tree, without leaves, was snapped off at the base. Just 100 yards away, the tornado hit a manufactured home and reduced it to just splinters and rubble. The tornado picked up the home, turned it 90 degrees, and slammed it into the ground. The entire structure was then sheared off at the base and spread into the adjacent field and woods. Thankfully, no one was home at the time. This tornado reached its maximum intensity (F2) at this point. Minor damage occurred down the road to some businesses and houses and the storm lifted before reaching the

Person county line. Home damage was estimated by Emergency Management to be nearly $450K and damage to businesses was nearly $150K.

- **May 15, 2014** – A storm survey confirmed an EF-1 tornado near Durham. Damage consisted of dozens of snapped and uprooted trees and approximately 40 homes that experienced roof or other structural damage. Most of the damage to the homes was caused by falling trees and other debris. However, there were at least a half a dozen homes that experienced minor roof damage solely from the wind. In one case, a large oak tree was uprooted and fell onto a home, slicing through the roof and an exterior wall.
- **February 24, 2016** – The National Weather Service in Raleigh, NC has confirmed a brief tornado touchdown 5 miles northwest of downtown Durham in Durham County North Carolina. The touchdown occurred in a dense forest area near the intersection of Hillandale Road and Rose of Sharon Road. In this area, tree damage was extensive, mainly consisting of snapped trees.

**Figure D.19 – Tornado Paths within 10 Miles of NCCU, 1950-2024**



### THUNDERSTORM WINDS

Between 2000 and 2024, the NCEI recorded wind speeds for 63 separate incidents of thunderstorm winds, occurring on 48 separate days, for Durham. These events caused $361,250 in recorded property damage and no injuries or fatalities. The recorded gusts averaged 58.3 miles per hour, with the highest gusts recorded at 73 mph on August 15, 2023. Wind gusts with property damage recorded averaged $14,450 in damage, with the highest reported damage being a total of $100,000 between multiple events on May 11, 2017. These incidents are aggregated by the date the events occurred and are recorded in Table D.34. These records specifically note thunderstorm wind impacts for Durham.

**Table D.34 – Recorded Thunderstorm Winds, Durham, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| DURHAM | 4/8/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 5/20/2000* | 58 | 0 | 0 | $0 |
| DURHAM | 5/25/2000 | 69 | 0 | 0 | $0 |
| DURHAM | 8/10/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 12/17/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 8/27/2001 | 58 | 0 | 0 | $0 |
| DURHAM | 5/13/2002 | 58 | 0 | 0 | $0 |
| DURHAM | 9/15/2002 | 58 | 0 | 0 | $0 |
| DURHAM | 2/22/2003 | 58 | 0 | 0 | $0 |
| DURHAM | 6/11/2004 | 58 | 0 | 0 | $0 |
| DURHAM | 9/28/2004 | 69 | 0 | 0 | $0 |
| DURHAM | 1/14/2005 | 58 | 0 | 0 | $0 |
| DURHAM | 7/28/2005 | 58 | 0 | 0 | $0 |
| DURHAM | 4/3/2006 | 58 | 0 | 0 | $0 |
| DURHAM | 7/19/2006 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 6/9/2007* | 58 | 0 | 0 | $0 |
| WEST DURHAM | 7/4/2008 | 58 | 0 | 0 | $0 |
| WEST DURHAM | 7/9/2008 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 5/9/2009 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 5/28/2010* | 58 | 0 | 0 | $0 |
| DURHAM | 6/23/2010 | 58 | 0 | 0 | $15,000 |
| WEST DURHAM | 8/5/2010 | 58 | 0 | 0 | $0 |
| DURHAM | 4/5/2011 | 58 | 0 | 0 | $25,000 |
| DURHAM | 2/24/2012 | 58 | 0 | 0 | $0 |
| WEST DURHAM | 6/29/2012 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 9/8/2012 | 58 | 0 | 0 | $750 |
| DURHAM | 6/11/2014 | 58 | 0 | 0 | $25,000 |
| WEST DURHAM | 6/19/2014* | 58 | 0 | 0 | $8,000 |
| EAST DURHAM | 6/29/2016* | 58 | 0 | 0 | $0 |
| WEST DURHAM | 5/11/2017* | 58 | 0 | 0 | $100,000 |
| WEST DURHAM | 6/10/2018 | 58 | 0 | 0 | $1,000 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| DURHAM | 7/22/2018 | 58 | 0 | 0 | $5,000 |
| WEST DURHAM | 4/19/2019* | 58 | 0 | 0 | $16,000 |
| WEST DURHAM | 6/20/2019 | 58 | 0 | 0 | $5,000 |
| DURHAM | 7/4/2019 | 58 | 0 | 0 | $20,000 |
| WEST DURHAM | 6/11/2020 | 58 | 0 | 0 | $2,500 |
| EAST DURHAM | 7/5/2020 | 58 | 0 | 0 | $40,000 |
| EAST DURHAM | 5/19/2022 | 58 | 0 | 0 | $0 |
| NORTH DURHAM | 5/23/2022 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 6/17/2022 | 63 | 0 | 0 | $0 |
| DURHAM | 1/12/2023 | 58 | 0 | 0 | $25,000 |
| WEST DURHAM | 6/19/2023* | 58 | 0 | 0 | $5,000 |
| WEST DURHAM | 8/7/2023 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 8/15/2023* | 73 | 0 | 0 | $26,500 |
| DURHAM | 9/8/2023 | 58 | 0 | 0 | $1,500 |
| EAST DURHAM | 1/9/2024 | 58 | 0 | 0 | $5,000 |
| WEST DURHAM | 7/23/2024 | 59 | 0 | 0 | $0 |
| WEST DURHAM | 8/30/2024 | 58 | 0 | 0 | $5,000 |
| **Total** | | | **0** | **0** | **$344,750** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **April 8, 2000** – Strong wind gusts knocked down a tree that crashed into a mobile home and ripped a roof off a building.
- **April 3, 2006** – Tin roofs torn off a carport and barn and blown 1000 to 1500 feet downwind. Well house knocked down and shingles torn off a home on Shaw Road.
- **June 11, 2014** – Multiple trees were blown down within the city of Durham. In addition, 2 trees fell onto cars and 1 tree fell on a house. Monetary damage was unknown and were estimated.
- **July 4, 2019** – One tree was blown down onto a residence along Dacian Avenue in Durham. A lightning strike also resulted in a house fire near the 100 block of Presidents Drive.

### LIGHTNING

According to NCEI data, there were 2 lightning strikes reported between 2000 and 2024. The lightning strike event in 2007 recorded an estimated $10,000 worth of property damage. No crop damage, injuries, or fatalities were recorded for this strike. However, three people were injured in a lightning strike on September 8, 2021. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table D.35 details NCEI-recorded lightning strikes from 2000 through 2024 for Durham.

**Table D.35 – Recorded Lightning Strikes in Durham, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| DURHAM | 3/27/2007 | 2200 | 0 | 0 | $10,000 |
| DURHAM | 9/8/2021 | 1040 | 0 | 3 | $0 |
| | | **Total** | **0** | **3** | **$10,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Durham:

- **March 27, 2007** – Lightning struck an apartment complex and sparked a fire. There was no immediate information on the extent of the damage.
- **September 8, 2021** – Lightning struck an apartment complex along Broad Street and injured 3 men.

### HAIL

NCEI records 22 days with hail incidents between 2000 and 2024 in Durham. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the city was 1.75 inches, which occurred on four different occasions in 2000, 2005, 2006, and 2016. The average hail size of all events in the city was just over one inch in diameter. Table D.36 summarizes hail events for Durham. In some cases, hail was reported for multiple locations on the same day.

**Table D.36 – Summary of Hail Occurrences in Durham 2000-2024**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| DURHAM | 4/17/2000 | 1.75 |
| DURHAM | 4/29/2000 | 1 |
| DURHAM | 8/13/2000 | 0.75 |
| DURHAM | 8/27/2001 | 0.88 |
| DURHAM | 4/26/2003 | 0.75 |
| EAST DURHAM | 8/22/2003 | 0.75 |
| DURHAM | 10/3/2004 | 0.88 |
| DURHAM | 6/7/2005 | 0.75 |
| DURHAM | 7/28/2005 | 1.75 |
| DURHAM | 4/8/2006 | 0.75 |
| DURHAM | 5/14/2006 | 1.75 |
| DURHAM | 8/7/2006 | 0.75 |
| DURHAM | 7/27/2007 | 0.88 |
| WEST DURHAM | 3/4/2008 | 0.75 |
| NORTH DURHAM | 5/31/2008 | 1.25 |
| NORTH DURHAM | 6/2/2009 | 0.88 |
| WEST DURHAM | 5/27/2011 | 1 |
| WEST DURHAM | 3/24/2012 | 1.25 |
| DURHAM SKYPARK ARPT | 5/22/2012 | 1 |
| NORTH DURHAM | 3/14/2016 | 1.75 |

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| EAST DURHAM | 6/29/2016 | 1 |
| WEST DURHAM | 10/17/2022 | 0.75 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **July 28, 2005 –** Golf ball size hail was reported in Research Triangle Park.
- **May 22, 2012 –** Quarter sized hail was reported covering the ground along Interstate 85 near mile marker 184.
- **March 14, 2016 –** Hail up to the size of golf balls was reported along a swath from Duke Homestead Boulevard near Highway 157 to approximately 5 miles west-northwest of Gorman.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Durham averages 1.92 days with wind events per year. Over this same period, two lightning events were reported as having caused property damage or injuries, which equates to an average of 0.08 damaging lightning strikes per year.

The average hailstorm in Durham occurs in the evening and has a hail stone with a diameter of just over one inch. Over the 25-year period from 2000 through 2024, Durham experienced 22 days with reported hail incidents; this averages to .88 days per year with reported incidents somewhere in the city.

In a 75-year period between 1950 and 2024, Durham County experienced 11 tornado events. This correlates to 14.6% annual probability that the County will experience a tornado somewhere in its boundaries.

Based on these historical occurrences, there is between a 10% to 100% chance that Durham will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on NCCU's campus.

## People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes. In 2021, a lightning event injured three people.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $195,108, which assumes that 10% of the on-campus population is impacted.

**Table D.37 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 9,160 | 916 | $195,108 |

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population.

## Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Durham, the only event with recorded property damage was due to lightning striking a vehicle.

NCEI records lightning impacts over 25 years (2000-2024), with $10,000 in property damage recorded during one event in 2007. Based on these records, the planning area experiences an annualized loss of $400 in property damage. The average impact from lightning per incident in Durham is $5,000.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Durham, NCEI did not report any property damage as a direct result of hail.

It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damage in Durham, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $361,250 in property damage, which equates to an annualized loss of $14,450 across the City.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in Durham County are directly responsible for $28,755,250 worth of damage to property according to NCEI data. This equates to an annualized loss of $383,403. It should be noted that just one tornado event in 1989 accounts for $25 million of property damage. Per the iRISK analysis, an F2 tornado event could cause over $390 million of estimated total building damages on campus.

Table D.38 details the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table D.38 – Estimated Building Damage by Tornado Events, NCCU Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $104,030.43 | $148,622.95 | $252,653.38 |
| Educational | $2,695,458.34 | $3,769,710.65 | $6,465,168.99 |
| Housing | $615,299.40 | $890,490.73 | $1,505,790.13 |
| **Total** | **$3,414,788.17** | **$4,808,824.33** | **$8,223,612.50** |
| **F1 Tornado Event** | | | |
| Administration | $832,574.94 | $1,194,038.78 | $2,026,613.72 |
| Educational | $21,645,270.00 | $30,300,618.36 | $51,945,888.36 |
| Housing | $4,805,628.44 | $7,025,931.31 | $11,831,559.75 |
| **Total** | **$27,283,473.38** | **$38,520,588.45** | **$65,804,061.83** |
| **F2 Tornado Event** | | | |
| Administration | $4,758,758.46 | $7,016,550.90 | $11,775,309.36 |
| Educational | $128,603,074.55 | $180,411,463.45 | $309,014,538.00 |
| Housing | $28,059,362.40 | $41,499,019.62 | $69,558,382.02 |
| **Total** | **$161,421,195.41** | **$228,927,033.97** | **$390,348,229.38** |
| **F3 Tornado Event** | | | |
| Administration | $4,758,758.46 | $7,016,550.90 | $11,775,309.36 |
| Educational | $128,654,121.52 | $180,436,238.67 | $309,090,360.19 |
| Housing | $28,059,362.40 | $41,499,019.62 | $69,558,382.02 |
| **Total** | **$161,472,242.38** | **$228,951,809.19** | **$390,424,051.57** |
| **F4 Tornado Event** | | | |
| Administration | $4,758,758.46 | $7,016,550.90 | $11,775,309.36 |
| Educational | $128,654,121.52 | $180,436,238.67 | $309,090,360.19 |
| Housing | $28,059,362.40 | $41,499,019.62 | $69,558,382.02 |
| **Total** | **$161,472,242.38** | **$228,951,809.19** | **$390,424,051.57** |

Source: NCEM iRISK Database

## Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statements

- The most intense tornadoes to pass through Durham County in the past 75 years were 3 F2s (EF2) occurring in 1984, 1989, and 1998. Combined, these incidents resulted in 5 injuries and caused $28.1 million in property damage.
- The strongest recorded thunderstorm wind event for Durham between 2000 and 2024 occurred on August 15, 2023 with a measured gust of 73 mph. This event reportedly resulted in no property damage.
- The average hailstone recorded between 2000 and 2024 was a little over one inch. The largest hailstone recorded was 1.75”, which occurred on four different occasions in 2000, 2005, 2006, and 2016.
- Tornadoes and thunderstorms are frequent hazard events in Durham County and the NCCU campus. Reported damages for the 25-year period from 2000-2024 include $361,250 for thunderstorm winds and $10,000 for lightning strikes. Between 1950-2024, Durham County experienced $28.7 million in property damage due to tornadoes.

# D.5.8 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 5 percent of the NCCU campus is within the primary exposure category and 95 percent is within the secondary exposure category of the Functional WUI. Table D.39 details the Functional WUI acreage in the NCCU campus, and Figure D.20 below shows the Functional WUI areas. On a county level, Durham County is mix of secondary exposure (buildings within closer proximity to burnable land cover) and wildfire transmission zone. The City of Durham has low to no exposure, the neighborhoods

surrounding the city are primarily secondary exposure. Some of the less developed areas around the borders of the county are wildfire transmission zone.

The expansion of residential development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

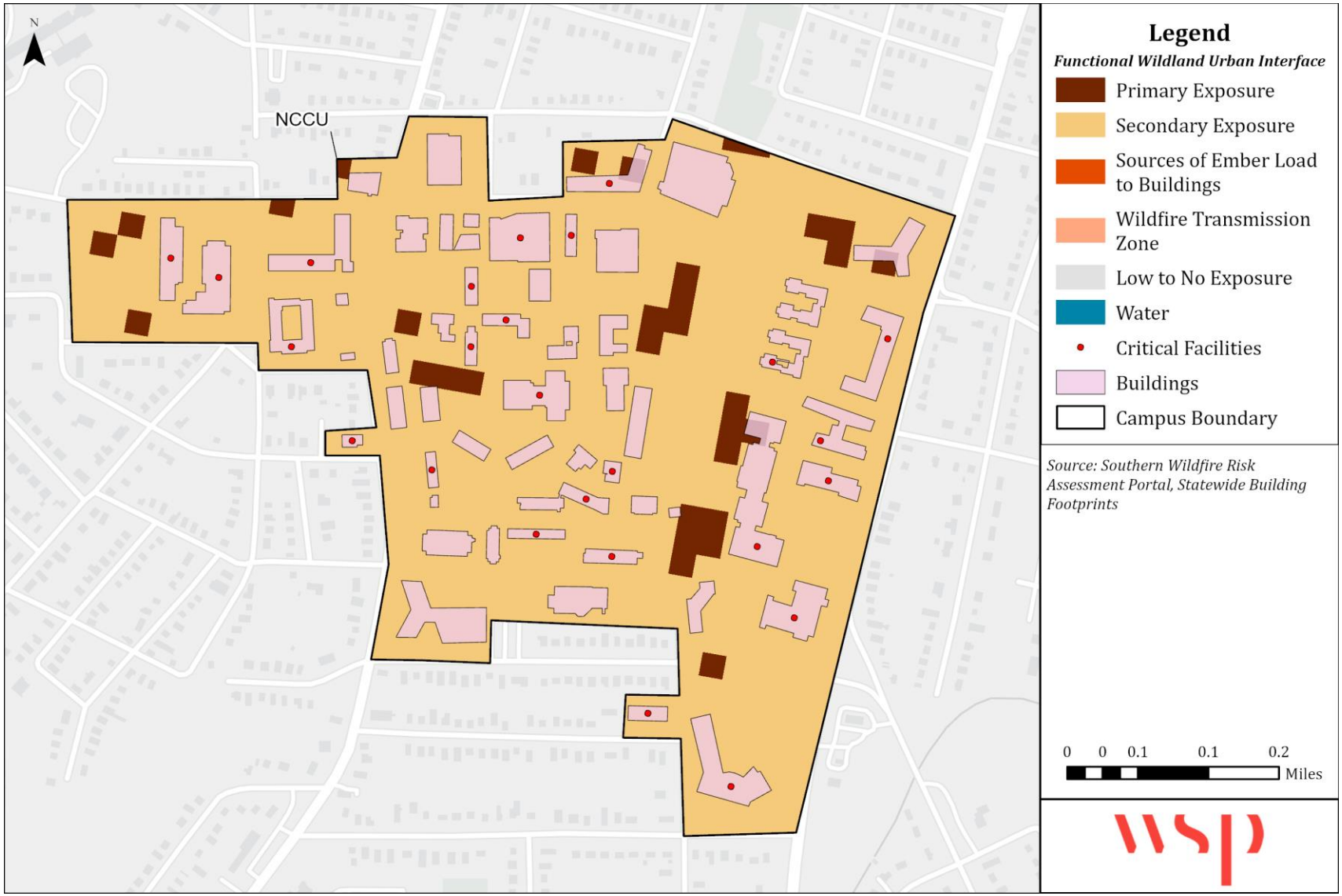
*Spatial Extent: 4 – Large*

**Table D.39 – Wildland Urban Interface, NCCU Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 6 | 5% |
| | Secondary Exposure | 121 | 95% |
| | Sources of Ember Load to Buildings | 0 | 0% |
| | Wildfire Transmission Zone | 0 | 0% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **127** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure D.20 – Wildland Urban Interface Areas, NCCU Campus**



## Extent

The entire state is at risk to a wildfire occurrence. 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.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table D.40, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table D.41 and Figure D.21 detail the characteristic fire intensity scale across the NCCU campus.

**Table D.40 – Fire Intensity Scale**

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

**Table D.41 – Characteristic Fire Intensity, NCCU Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 121 | 95% |
| | 1 - Very Low | 1 | 1% |
| | 1.5 | 0 | 0% |
| | 2 - Low | 5 | 4% |
| | 2.5 | 0 | 0% |
| | 3 - Moderate | 0 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |

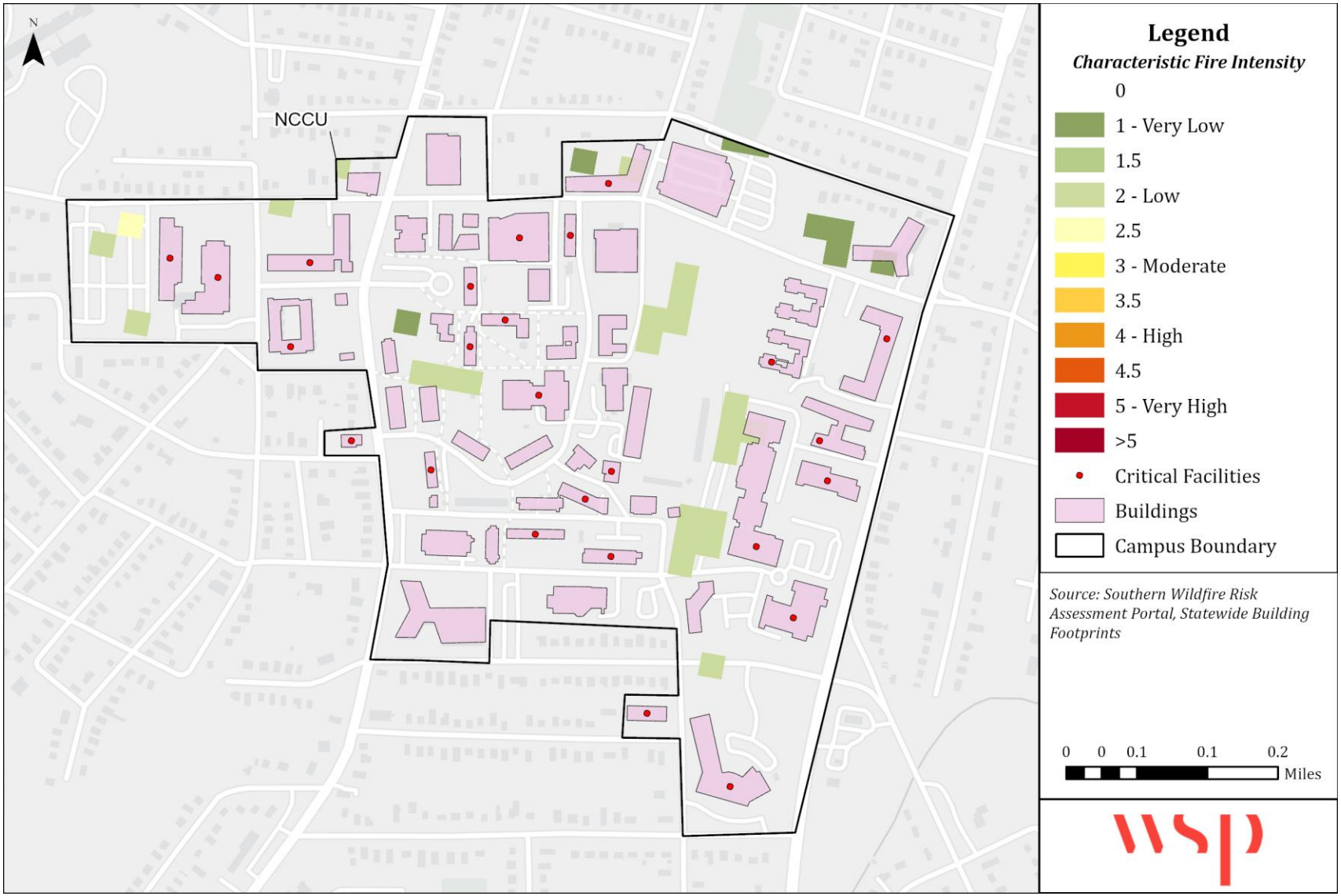
| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **127** | **100%** |

Source: Southern Wildfire Risk Assessment

The areas with greatest potential fire intensity are within the WUI. The majority of the campus (95%) is rated non-burnable on the characteristic fire intensity scale. Class 2 is the highest classification that the campus is exposed to. Only 4% of the total campus acreage has class 2 fire intensity which is characterized as low fire intensity that is easily suppressed.

*Impact: 2 – Limited*

**Figure D.21 – Characteristic Fire Intensity, NCCU Campus**



## Historical Occurrences

Table 5 45 lists past occurrences of wildfire in Durham County from 1999-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 690 noted wildfires within Durham County between 1999 and 2024. The total acreage burned during this period was 1,364 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Durham County experiences 27.6 fires and 54.6 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 1.98 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table D.42 – Records of Wildfire in Durham County, 1999 – 2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 1999 | 48 | 121.70 | 2.54 |
| 2000 | 21 | 117.20 | 5.58 |
| 2001 | 38 | 65.60 | 1.73 |
| 2002 | 27 | 97.00 | 3.59 |
| 2003 | 16 | 19.70 | 1.23 |
| 2004 | 21 | 21.60 | 1.03 |
| 2005 | 36 | 35.70 | 0.99 |
| 2006 | 40 | 92.10 | 2.30 |
| 2007 | 58 | 82.60 | 1.42 |
| 2008 | 18 | 106.60 | 5.92 |
| 2009 | 18 | 25.00 | 1.39 |
| 2010 | 20 | 58.50 | 2.93 |
| 2011 | 12 | 62.80 | 5.23 |
| 2012 | 8 | 196.00 | 24.50 |
| 2013 | 11 | 37.30 | 3.39 |
| 2014 | 3 | 33.00 | 11.00 |
| 2015 | 15 | 24.27 | 1.62 |
| 2016 | 33 | 3.70 | 0.11 |
| 2017 | 63 | 35.99 | 0.57 |
| 2018 | 28 | 8.96 | 0.32 |
| 2019 | 16 | 10.01 | 0.63 |
| 2020 | 10 | 4.94 | 0.49 |
| 2021 | 29 | 14.27 | 0.49 |
| 2022 | 38 | 52.61 | 1.38 |
| 2023 | 31 | 21.02 | 0.68 |
| 2024 | 32 | 15.96 | 0.50 |
| **Total** | **690** | **1,364.13** | **1.98** |

## Probability of Future Occurrence

The Southern Wildfire Risk Assessment provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the NCCU campus is presented in Table D.43 and illustrated in Figure D.22.

**Table D.43 – Burn Probability, NCCU Campus**

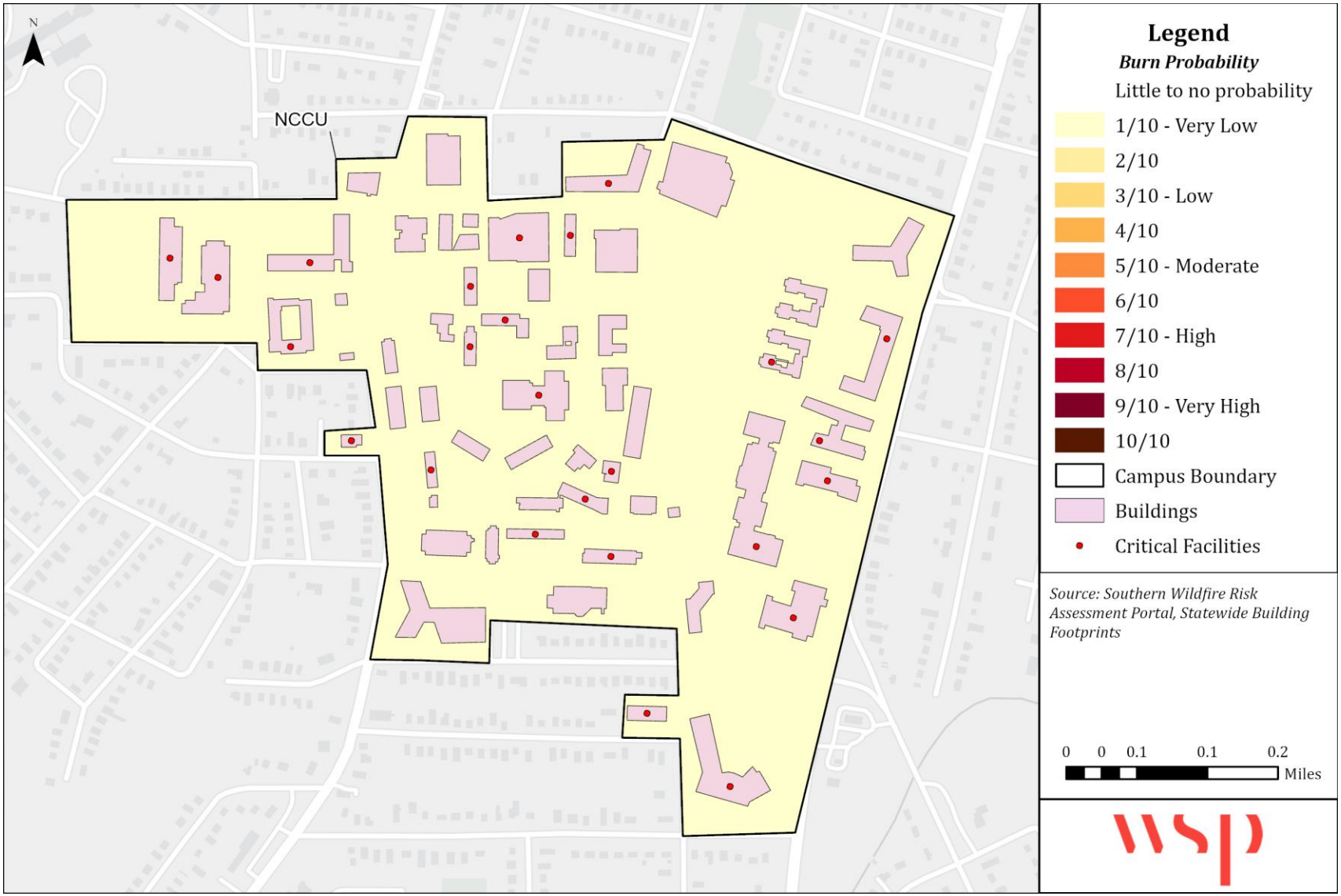
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 127 | 100% |
| | 2/10 | 0.0001000 - 0.0002154 | 0 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **127** | **100%** |

Source: Southern Wildfire Risk Assessment

The entire NCCU campus has very low burn probability. Based on the SWRA results, the probability of wildfire across the campus is considered unlikely.

*Probability: 1 – Unlikely*

**Figure D.22 – Burn Probability, NCCU**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10.

All of the 57 structures assessed on the NCCU campus have a wildfire exposure score of 2/10 or relatively low vulnerability.

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the NCCU campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. A wildfire community protection plan exists for the state of North Carolina. Durham County also has a Forest Protection Program to provide urban and community forestry planning and forest fire protection, among other programs.

## Problem Statements

- The entirety of the NCCU campus falls within the Functional WUI; 5% of campus has primary exposure to wildfires.
- All 57 buildings on campus have a Wildfire Exposure Score of 2/10.

# D.5.9 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Highly Likely | Critical | Large | Less than 6 hrs | More than 1 week | 3.7 |

## Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the NCCU campus, the Information Technology Services (ITS) provides integrated technology support for administrative computing, client services, IT infrastructure systems, and IT security. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

## Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the NCCU campus could cause significant disruption and impact a large number of records.

*Impact: 3 – Critical*

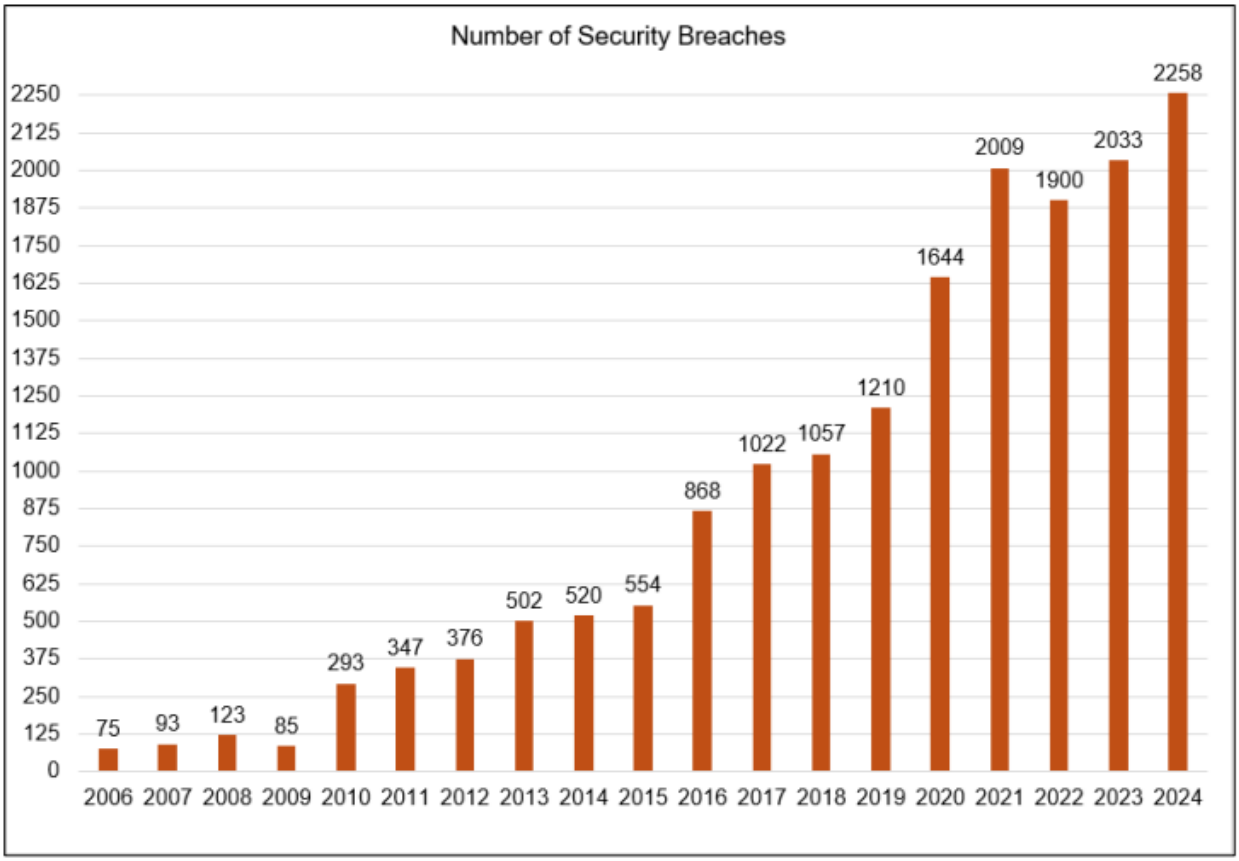
## Historical Occurrences

According to local news reports, the most recent cyber attack on NCCU campus occurred in November of 2023 when the university's digital infrastructure was attacked by a ransomware

program called BlackCat. This attack led to wi-fi and campus technology system disruptions that ultimately cancelled online classes. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break.

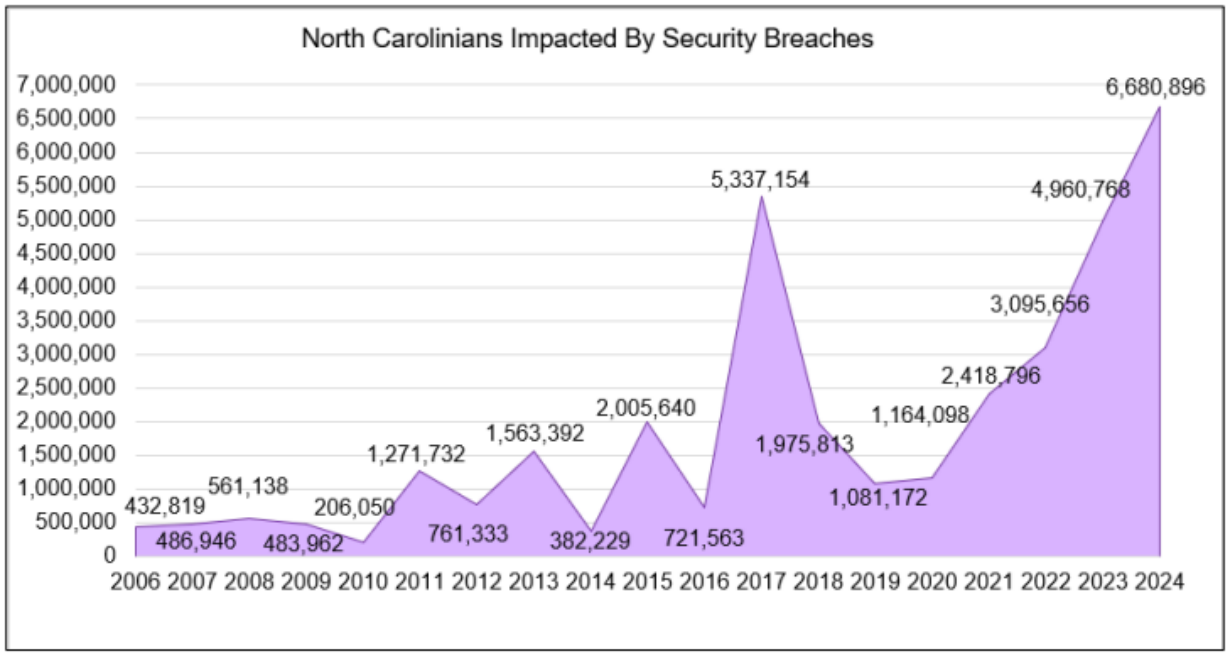
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure D.23 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure D.24 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been some notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included. (https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/)
- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).

## Probability of Future Occurrence

Cyber attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of NCCU are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the University are less likely but cannot be ruled out. Due to recent cyber attacks at NCCU campus, the HMPC felt that it was highly likely to experience cyber attacks in the future.

*Probability: 4 – Highly Likely*

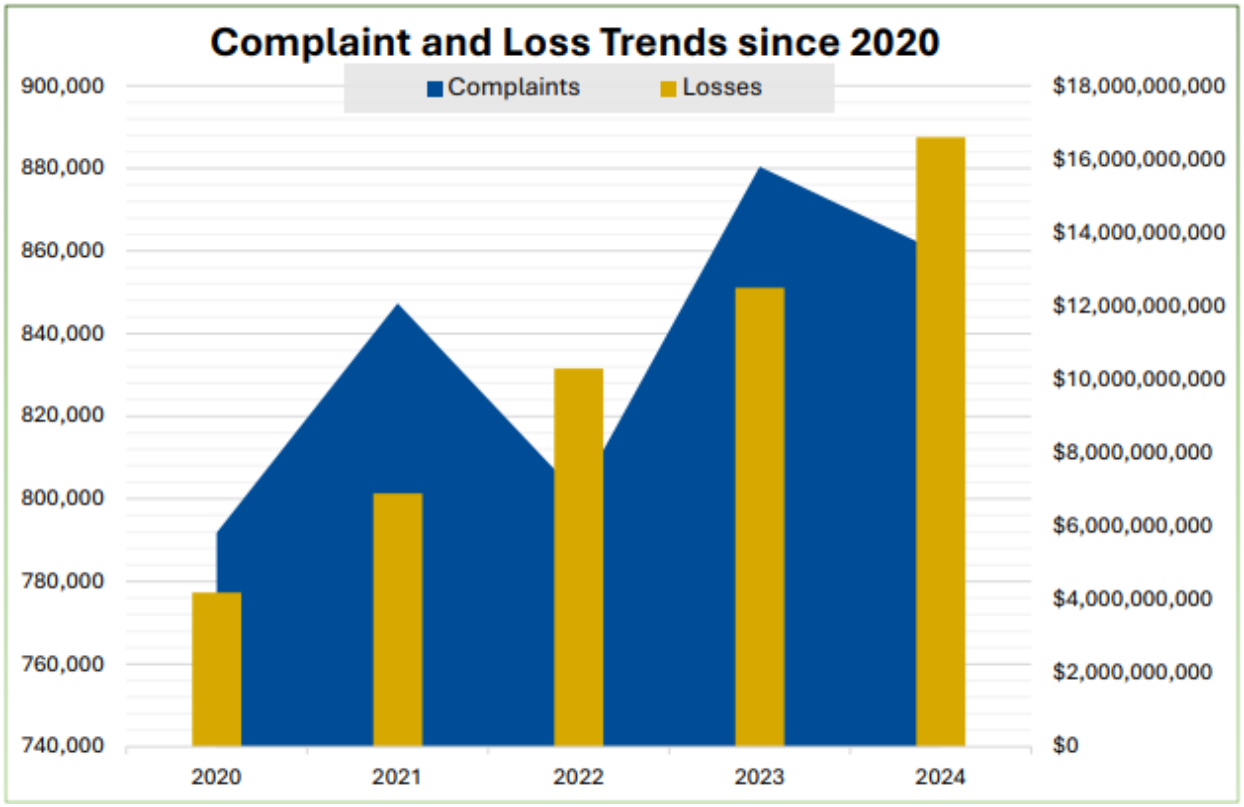
## Vulnerability Assessment

As discussed above, the impacts from a cyber attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure D.25.

**Figure D.25 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers continued usage of online services, such as banking and shopping, increase vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attacks against critical infrastructure, property damage from cyber attacks is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment slowly increasing since the last plan, the number of users of campus networks and software has increased. Additionally, with more buildings located on campus, the number of network access points has increased.

For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statements

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Information Technology Services (ITS) addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.

# D.5.10 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Materials Incident | Highly Likely | Minor | Negligible | Less than 6 Hrs | More than 1 week | 2.3 |

## Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory recorded 1 site with hazardous materials within 1 mile of NCCU campus. This site is detailed by location and sector in Table D.44 and shown in Figure D.26. The HMPC identified one critical facility, Heating Plant, on NCCU's campus with hazardous materials.

**Table D.44 – Toxic Release Inventory Sites within 1 Mile of NCCU Campus**

| Facility | Address | Sector | Chemicals Present |
|---|---|---|---|
| Brenntag Mid-South | 2000 E Pettigrew St, Durham, NC | Chemical Wholesalers | Methanol, Methyl methacrylate, Cyclohexane, Certain glycol ethers, Nitric acid, n-Hexane, n-Butyl alcohol, Sodium nitrite, Methyl isobutyl ketone, Toluene, N-Methyl-2-pyrrolidone, Triethylamine, Ammonia |

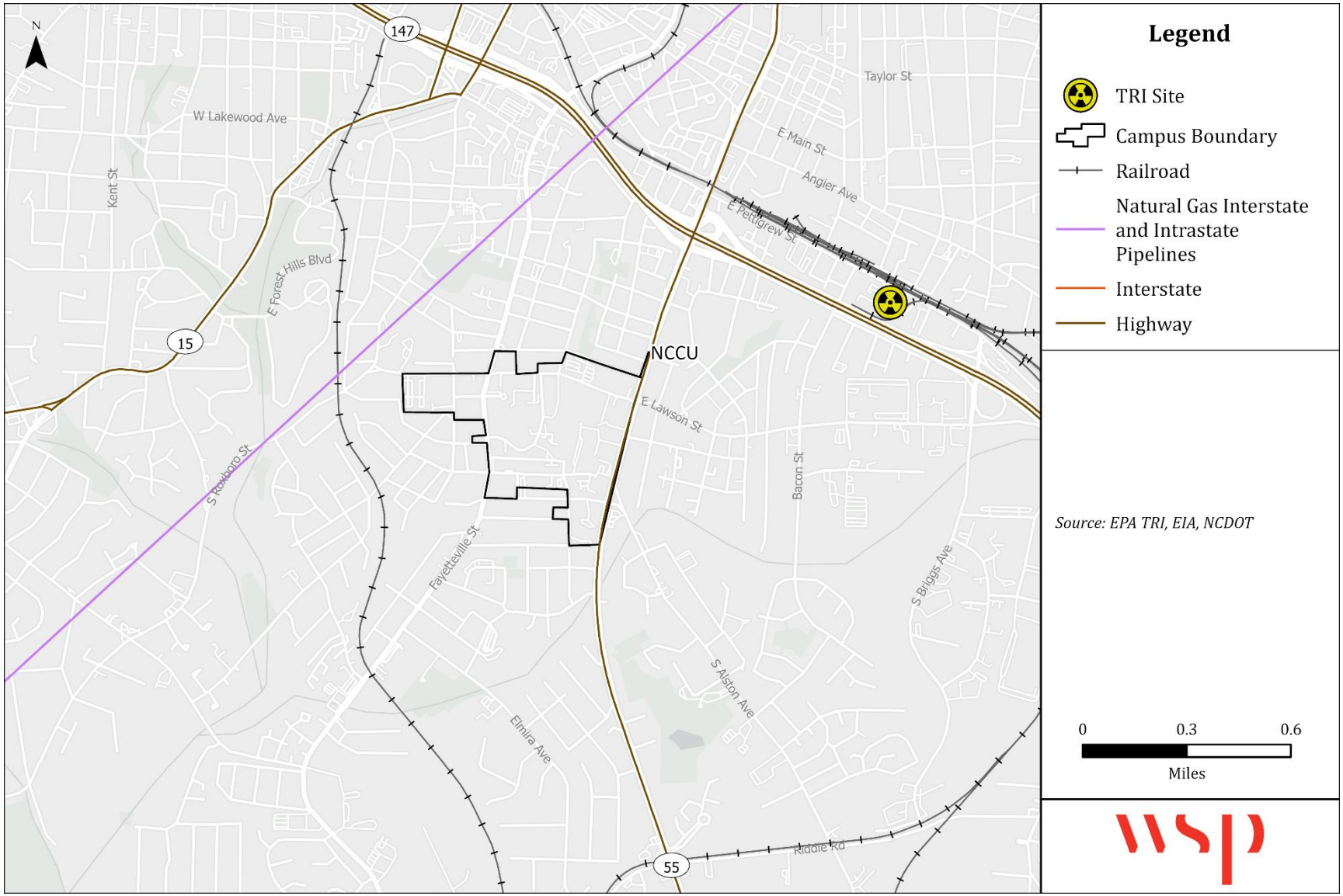
Source: EPA Toxic Release Inventory

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal.

Pipelines exist throughout the state of North Carolina and the planning area and are most commonly used to transport energy sources such as natural gas and petroleum products but are also often used in the transportation of other hazardous liquids. Generally, pipelines are safe and effective, transporting materials where they are needed without incident. Figure D.26 below shows the location of major pipelines and the modes of transportation for hazardous materials adjacent to or through NCCU's campus.

*Spatial Extent: 1 – Negligible*

**Figure D.26 – Hazardous Materials Facilities and Major Transportation Routes, NCCU**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

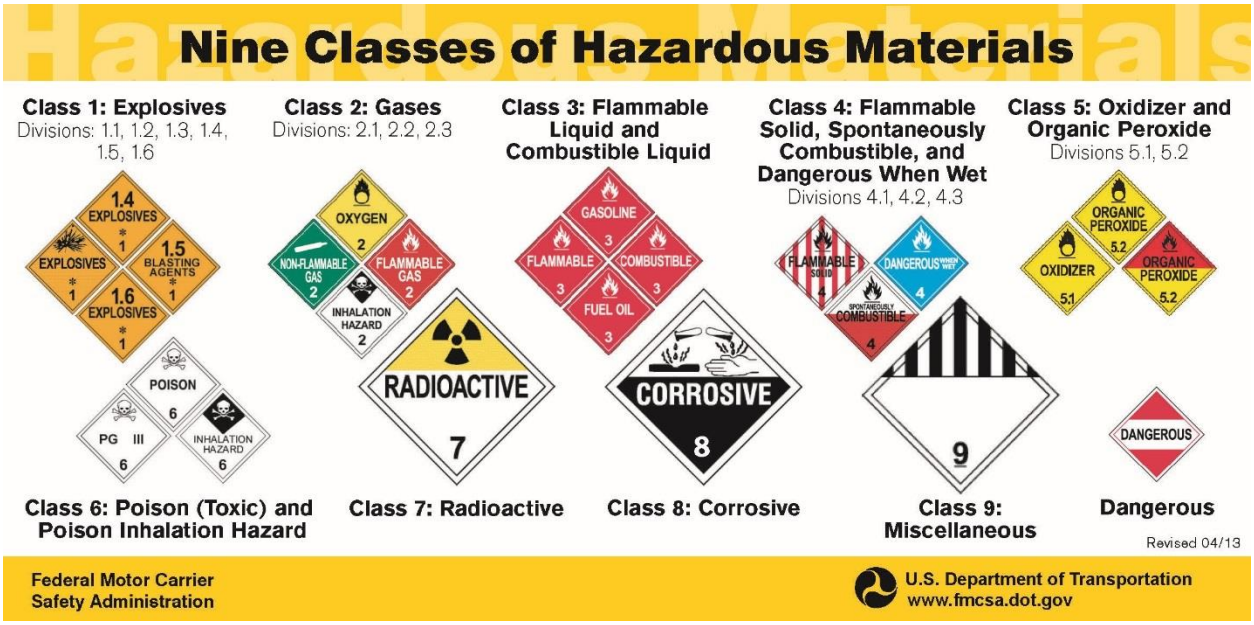
The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 488 recorded releases in the City of Durham from 2000 through 2024. Of these events, only seven were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $407,196 in damage with 93 percent of all incidents occurring on highways and roads. The most common materials spilled in the city were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure D.27 describes all nine hazard classes.

**Figure D.27 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 488 incidents of hazardous materials release in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Durham.

However, the number of serious incidents is significantly lower: only 7 in 25 years or an average of 0.3 serious incidents per year. This means that based on historical data, there is a 28 percent annual chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However, there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $407,196 in damage, which equates to an annualized loss of $16,287 across Durham.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statements

- Transportation and pipeline routes for hazardous materials are located adjacent to the NCCU campus.
- The number of reported incidents within Durham can be approximated to over a 100 percent annual probability.

# D.5.11 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table D.45. according to the World Health Organization.

**Table D.45 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

Another way to measure the extent of an infectious disease is by using the case-fatality rate. The case-fatality rate does not represent the overall spread of the disease but rather the proportion of people diagnosed with the disease who die from it. It should be noted that the case-fatality rate has limitations because it does not take into account unreported cases.

The John Hopkins Coronavirus Resource Center reports that between March 2020 and March 2023, COVID-19 had a case fatality rate of 1.1%. The COVID-19 pandemic disproportionately killed older people, so case-fatality rate does vary significantly amongst age groups.

An additional way to measure extent is the number of deaths per 100,000 people. This captures confirmed cases, unreported cases, and healthy people. Between March 2020 and March 2023, the U.S. had 341.11 deaths per 100,000 people.

*Impact: 3 – Critical*

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by

March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Durham County experienced 103,643 cases of COVID-19 and 397 deaths. Per 100,000 people, Durham County experienced 123 deaths, significantly lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Durham County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 52 deaths to certain infectious and parasitic diseases, excluding COVID-19. The majority of these deaths (31) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Infectious Gastroenteritis, Tuberculosis, Listerial Meningitis, Herpes, Viral Hepatitis, HIV and Staph infection, and other unspecified infectious diseases.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other

natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

While enrollment declined in 2022, it has been growing steadily since then and Fall 2024 surpassed enrollment prior to the COVID-19 pandemic. As of Fall 2025, enrollment continues to climb. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statements

- Based on the recent COVID-19 pandemic, it is clear the NCCU campus population is susceptible to the infectious disease pandemic.
- NCCU has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# D.5.12 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section D.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table D.46 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table D.46 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Critical | Moderate | 6 to 12 hrs | Less than 6 hours | 3.1 |
| Geological - Sinkhole | Possible | Limited | Small | Less than 6 hours | Less than 6 hours | 1.9 |
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| Cyber Security | Highly Likely | Critical | Large | Less than 6 hrs | More than 1 week | 3.7 |
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 Hrs | More than 1 week | 2.3 |
| Infections Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table D.47:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.

**Table D.47 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Flooding<br>Severe Winter Weather<br>Tornadoes & Thunderstorms<br>Cyber Security |
| **Moderate Risk (2.0 – 2.9)** | Hurricane<br>Wildfire<br>Hazardous Substances<br>Infectious Disease |
| **Low Risk (< 2.0)** | Earthquake<br>Geological – Sinkhole |

# D.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- D.6.1 Overview of Capability Assessment
- D.6.2 Planning and Regulatory Capability
- D.6.3 Administrative and Technical Capability
- D.6.4 Fiscal Capability

## D.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## D.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table D.48 lists these local resources currently in place at NCCU.

**Table D.48 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | NCCU Strategic Plan 2025-2030 |
| Stormwater management program | Y | NCCU Facilities Management maintains storm drains as needed, no proactive management program in place |
| Campus master plan | Y | NCCU Comprehensive Campus Master Plan 2018 |
| Capital improvements plan | Y | NCCU Facilities Management Facilities Projects |
| Local emergency operations plan | Y | NCCU Emergency Operations Plan 2022 |

More details on several relevant tools are provided below:

- **Strategic Master Plan** identifies a future vision, values, principles and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The 2023-2033 Campus Master Plan is a building program that includes renovation and renewal.
- **Capital Improvement Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC System campus creates and maintains a 6-year CIP, which helps inform the University of North Carolina System's CIP.
- **Emergency Operations Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster. According to the HMPC, a new EOP will be made available in 2027.

## D.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table D.49 provides a summary of the administrative and technical capabilities for NCCU.

**Table D.49 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Facilities Management<br>Capital Projects |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Facilities Management<br>Capital Projects |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Facilities Management<br>Capital Projects |
| Personnel skilled in GIS | Yes | Several Faculty |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Emergency Manager | Yes | Emergency Management<br>University Police |
| Grant Writer | Yes | Division of Research and Sponsored Programs |
| Public Information Officer | Yes | Communications and Marketing AVC |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | Emergency Management<br>RAVE Mobility System |

Additional resources that may support administrative capability include the following:

- **The Office of Environmental Health and Safety** established goals and objectives based on the University's needs related to occupational safety and health, which could include hazard resilience in future planning initiatives.
- **The NCCU Facilities Management Department** has overseen previous work performed regarding storm drainage, steam line replacement, roof repair, and mold mitigation, among other things, and it therefore well equipped to plan and oversee additional property protection improvements for hazard mitigation.
- **The NCCU Safety and Health Committee** was established to review safety and security concerns throughout the campus and establish goals for implementation.

## D.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table D.50 provides a summary of the fiscal resources at NCCU.

**Table D.50 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y, Repair and Renovation Funds |
| In-Kind Services | Y |
| Tuition & Fees | Y, Limited availability |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources<br>(Gifts, Investment Income, Permanent Endowments) | Y |

# D.7 Mitigation Strategy

## D.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table D.51 summarizes the status of mitigation actions from the 2021 plan. Table D.52 on the following page details all completed and deleted actions from the 2021 plan. More information on the actions being carried forward is provided in Section D.7.2. in the Mitigation Action Plan.

**Table D.51 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| NCCU | 1 | 2 | 8 |

### Table D.52 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| NCCU3 | Pearson Cafeteria - Some food storage areas do not have sufficient shelving to secure contents in the event of a seismic event. All storage areas should have appropriately anchored shelving units to secure contents. | Delete | This is a maintenance issue. EHS will conduct inspection and provide any corrective actions for top heavy shelves or units. BAS will work to fund and schedule corrective actions. |
| NCCU7 | Police Communications/Student Health Building - Medical records are maintained in an area with windows and reliant on window units to provide climate control. The area with medical records should have windows made inoperable to ensure contents are not damaged in the event a window is left open during a downpour. Consider reinforcing the windows against debris impact. | Completed | All physical files have been removed and transferred to digital copies. |
| NCCU8 | Robinson - There were windows with evidence of recent water intrusion. Consider upgrading windows throughout the facility if water intrusion becomes a more persistent issue. | Delete | Contracted for completion/ongoing contract. Will be completed FY26 |

## D.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for NCCU. Each mitigation action recommended for implementation is listed in this table along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table D.53 – Mitigation Action Plan, NCCU**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCCU1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Dent Annex; McDougal-McLendon Gymnasium; Pearson Cafeteria; Physical Plant; Police Communications/Student Health Building; Robinson; Shepard Library; and Taylor | All Hazards | 1.1 | M | Property Protection | Facilities Management | Avg. Approx. $5,000 per site | State appropriated & self-liquidating budget | 2026-2030 | Carry Forward | Current inspections will need to be completed, budgeting secured, then implemented. scheduling and budgeting. Likely FY27 addition. |
| NCCU2 | Strengthen and increase power redundancy by acquiring generators or other forms of redundant power supply to protect critical facilities and infrastructure from power outages; coordinate with utility providers. | All Hazards | 3.2 | H | Property Protection | Facilities Management | $5,000 - >$100,000 per site | State appropriated & self-liquidating budget, State/Federal Grants | 2026-2030 | Carry Forward | Research and data gathering needed in accordance with master plan. Adding to master plan. Some locations are in project phases and will have upgrades added. Action revised to support power redundancy for additional facilities on campus |
| NCCU3 | Physical Plant - Several large trees were adjacent to the fuel tanks. Large trees that pose a threat to the building, fuel oil tanks, or spill containment area should be removed or pruned back. | Hurricane, Tornadoes & Thunderstorms, Severe Winter Weather | 1.1 | L | Property Protection | Facilities Operations | $5,000 - $10,000 | Operating Budget | 2026-2030 | Carry Forward | Trees will be trimmed or removed Spring 2026. EHS will inspect tree status FY26 |
| NCCU4 | Physical Plant - The spill containment measures and tank construction are inadequate and do not meet local code requirements. The spill containment area and fuel tanks should be brought into code compliance immediately. | Flooding | 1.2 | L | Structural Projects | Facilities Operations | >$100,000 | State appropriated budget; Federal/State Grants | 2026-2030 | Carry Forward | EHS will gather information on noted tanks to determine size, applicable standards, and corrective action options. |
| NCCU5 | Windows at various locations on campus (e.g. SOE, Student Health, Farrison-Newton, Shepard Admin, and others) leak significantly during rain events. Windows on campus should be inspected and repaired/replaced as needed. | Hurricane, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Facilities Operations | >$250,000 for contracted inspections and repairs campus wide | State appropriated budget; Federal/State Grants | 2026-2030 | Carry Forward | Planning Phase to identify all affected areas for repair and to create PM schedule. Will be addressed by Facilities Operations FY 26/27 |
| NCCU6 | Shepard and Turner Law libraries- Some shelving units in the library did not have bracing to prevent tipping during a seismic event. All shelving units should have braces installed to reduce the possibility of tipping. | Earthquake | 1.1 | L | Property Protection | Facilities Operations/EHS | $5,000 - $25,000/EA | Operating Budget | 2026-2030 | Carry Forward | EHS will inspect and determine corrective actions |
| NCCU7 | Shepard and Turner Law libraries- Windows in the special collections area increase the potential for exposure of articles to moisture intrusion. Consider installing shatter resistant film and upgraded windows in the special collections area. | Hurricane, Tornadoes & Thunderstorms | 1.2 | L | Property Protection | Facilities Operations | $25,000 - $50,000/EA; Note: May be more considering accessibility | Operating Budget | 2026-2030 | Carry Forward | Researching options for addressing issues. Facilties to correct. |
| NCCU8 | Develop public information process by which EHS/UPD can send emergency information to community and provide education on safety related matters | All Hazards | 1.2 | M | Emergency Services | EHS/NCCU PD | <$5,000 | Operating Budget | 2026-2030 | Carry Forward | EHS in research phase of updating processes and benchmarking. Will work to implement in FY27 |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCCU9 | Identify, designate, and update a primary and secondary facility for emergency sheltering. Ensure Emergency Shelter complies with applicable regulations, including ADA and NFPA 1616. | Hurricane, Tornadoes & Thunderstorms, Severe Winter Weather | 1.1 | H | Emergency Services | EHS and Facilities Operations | MacDougal McLendon Arena (primary emergency shelter est. $3.5M), Walker Complex (secondary shelter est. $500K), and Pearson Cafeteria (support facility est. $500K). TOTAL: $4.5M | State appropriated & self-liquidating budget, State/Federal Grants | 2026-2030 | New | Gaps in sheltering areas identified. In research phase and identifying upgrades and costs per NFPA 1616 and ADA standards to ensure regulatory compliance and quality shelter spaces. Costs reflect MMA (primary), Walker (secondary) and Pearson (support) |
| NCCU10 | Improve PM program for backflows and correlated space heaters to prevent burst pipes and down water systems during cold fronts and winter storm events. Repair issues identified. | Severe Winter Weather | 1.1 | M | Property Protection | EHS/Facilities | $25,000 - $100,000 | Operating Budget | 2026-2030 | New | Inspection Phase. Will work to identify and implement as much as possible before winter 27 |
| NCCU11 | Develop a stormwater management plan or formalized stormwater management program that outlines maintenance needs and practices | Flooding | 3.1 | H | Prevention | Facilities Dept./EHS | $75,000 – $250,000 | State appropriated budget | 2026-2030 | New | |
| NCCU12 | Develop standardized design guidelines or policies to integrate mitigation/risk reduction features into new development on campus. | All Hazards | 3.1 | H | Prevention | Facilities Dept. | $50,000 – $150,000 | State appropriated & self-liquidating budget | 2026-2030 | New | |
| NCCU13 | Develop heat emergency response procedures | Excessive Heat | 3.2 | L | Emergency Services; Prevention | EHS | $10,000 – $40,000 | Operating Budget | 2026-2030 | New | |
| NCCU14 | Increase shade in parking lots and public spaces | Excessive Heat | 2.1 | L | Property Protection | Facilities Dept./EHS | $250,000 – $2,000,000+ | State appropriated & self-liquidating budget | 2026-2030 | New | |
| NCCU15 | Install public cooling stations, misting stations, and water fountains in public spaces | Excessive Heat | 2.1 | L | Structural Projects | Facilities Dept./EHS | $50,000 – $400,000+ | State appropriated budget | 2026-2030 | New | |
| NCCU16 | Conduct outreach campaigns to raise awareness about heat-related risks | Excessive Heat | 2.1 | H | Public Information | Communications & Marketing/EHS | $30,000 – $150,000 | State appropriated budget | 2026-2030 | New | |
| NCCU17 | Add ice protection barriers over doorways and critical equipment to protect people and equipment from falling ice | Severe Winter Weather | 1.1 | M | Property Protection | Facilities Dept. | $5,000 – $25,000 | Operating Budget | 2026-2030 | New | |
| NCCU18 | Retrofit facilities to withstand high winds | Hurricane, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Facilities Dept. | $20,000 – $100,000+ | State appropriated & self-liquidating budget | 2026-2030 | New | |
| NCCU19 | Improve drainage conditions through the identification and implementation of capital improvements projects. | Flooding | 1.1 | H | Structural Projects | Facilities Dept. | $100,000 – $1,500,000+ | Federal/State grants | 2026-2030 | New | |
| NCCU20 | Develop and implement stormwater management projects that align with LID and nature-based solutions design guidelines (rain gardens, retention ponds, etc.) | Flooding | 1.3 | H | Structural Projects | Facilities Dept. | $250,000 – $3,000,000+ | Federal/State grants | 2026-2030 | New | |
| NCCU21 | Identify and repair campus maintained roads, curbs, and storm grates to improve runoff and reduce flooding occurrences. | Flooding | 1.3,3.1 | M | Structural Projects | Facilities Dept./EHS | $150,000 – $2,500,000+ | Federal/State grants | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM

North Carolina School of Science and Mathematics



# UNC System Eastern Campuses

# Regional Hazard Mitigation Plan

## Annex E: North Carolina School of Science and Mathematics

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# Annex E. North Carolina School of Science and Mathematics

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to North Carolina School of Science and Mathematics (NCSSM). This section contains the following subsections:

- E.1 Planning Process Details
- E.2 Campus Profile
- E.3 Asset Inventory
- E.4 Hazard Identification
- E.5 Hazard Profiles, Analysis, and Vulnerability
- E.6 Capability Assessment
- E.7 Mitigation Strategy

## E.1 Planning Process Details

The table below lists the HMPC members who represented NCSSM during the planning process.

**Table E.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Brian Wiggs | Director of Campus Safety; Campus Safety and Security |
| Robert Allen | Vice Chancellor; Finance and Operations |
| Nathan Harmer | Director of IT Infrastructure and Operations |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and use in the plan development.

**Table E.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| NCSSM Strategic Plan | The NCSSM Strategic Plan, developed in 2024, was referenced for the Campus Profile in Section E.2 as well as the Capability Assessment in Section E.6 |
| Durham County and Incorporated Areas Flood Insurance Study (FIS), Revised 7/19/2022 | The FIS report was referenced in the preparation of flood hazard profile in Section E.5. |

| Resource Referenced | Use in this Plan |
|---|---|
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section E.5. The plan was additionally used to track implementation progress and develop the mitigation plan (Section E.7). |
| Eno-Haw Regional Hazard Mitigation Plan, 2025 | The Eno-Haw Regional Hazard Mitigation Plan, which includes Durham, was referenced in compiling the Hazard Identification and Risk Assessment in Section E.5. |

# E.2 Campus Profile

This section provides a general overview of the North Carolina School of Science and Mathematics (NCSSM) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## E.2.1 Location and Setting

North Carolina School of Science and Mathematics is located in northwestern Durham. The 2-year public residential and online high school is situated on 28 acres and focuses on the intensive study of science, mathematics and technology. The school also offers summer programs for students who are rising 5th graders A wide variety of cultural and educational resources are accessible to NCSSM students, and nearly 150 student clubs and organizations are available on campus. NCSSM is known for educating and nurturing academically talented students to become state, national, and global leaders who work for the betterment of their community.

United States Highways 501, 147, and 55 make the school easily accessible by automobile. The City of Durham is on two Interstate highways, I-40 and I-85, and is served by Raleigh-Durham International Airport. Durham is also home to Duke University.

Figure E.1 provides a base map of the campus. For more information on campus buildings and critical facilities, see Section E.3.

**Figure E.1 – NCSSM Campus Base Map**



## E.2.2 Geography and Climate

North Carolina School of Science and Mathematics is in Durham, in the eastern part of North Carolina's Piedmont region. NCSSM's campus is largely flat with a few rolling hills, which reflects the topography of the Piedmont region. In addition, the central location of Durham provides driving access to both the coastal region in the east and to the mountains in the west. Durham has a mild climate with max temperatures dropping to 50 degrees Fahrenheit on average in January and climbing to 89 degrees Fahrenheit in July on average. The annual precipitation for the city is approximately 44 inches per year.

**Figure E.2 – Average Annual Temperature, Durham County**

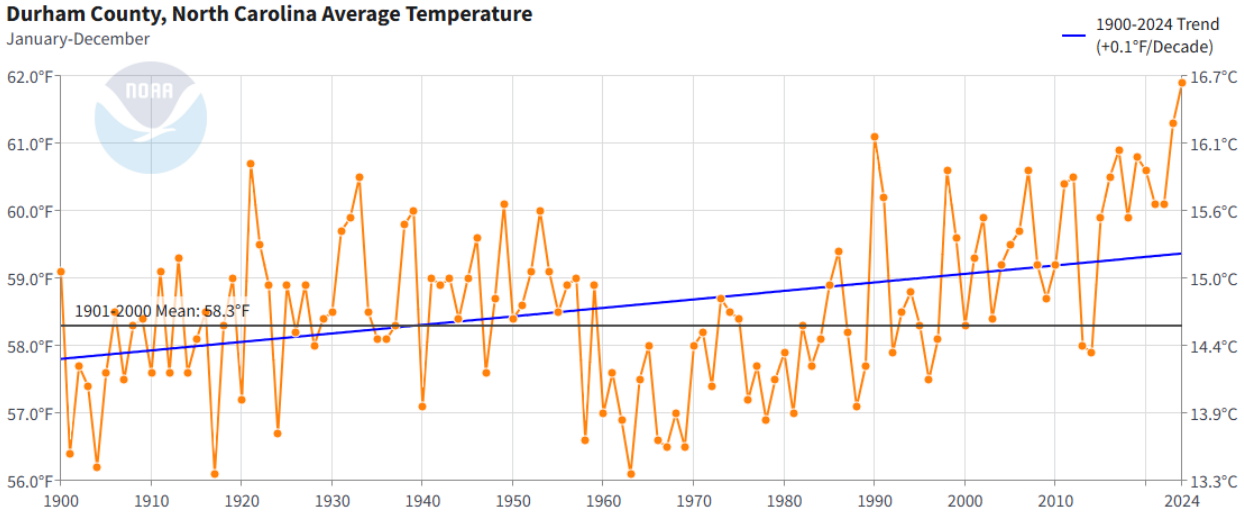
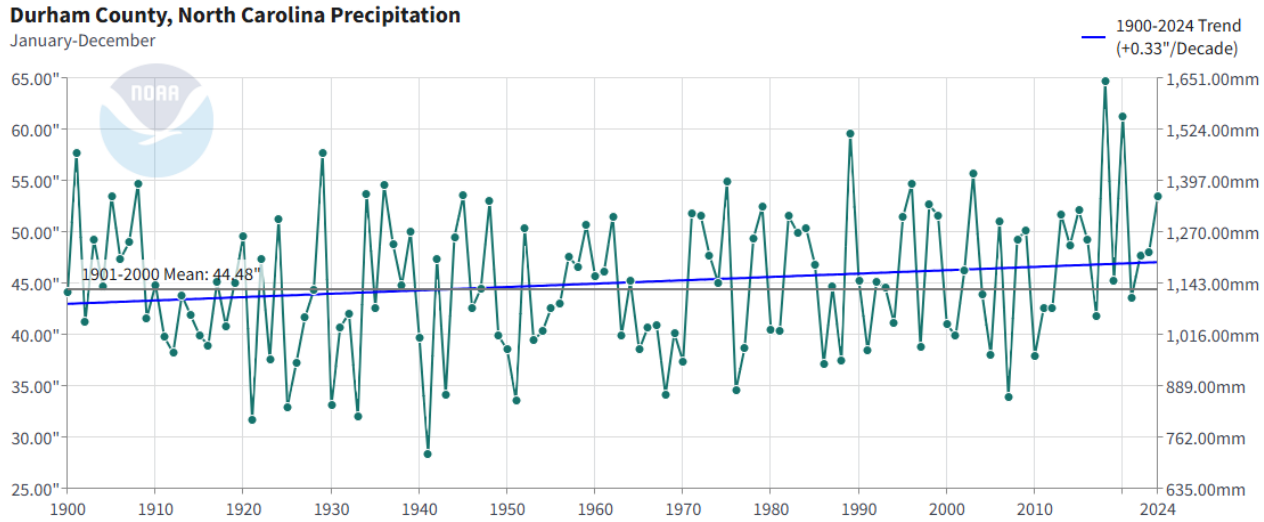



**Figure E.3 – Average Annual Precipitation, Durham County**



## E.2.3 Population and Demographics

Table E.3 provides population counts for NCSSM from Fall 2025, including the number of students from each campus. Note that the focus and scope of this plan is NCSSM's Durham campus.

**Table E.3 – Population Counts for North Carolina School of Science and Mathematics, Fall 2025**

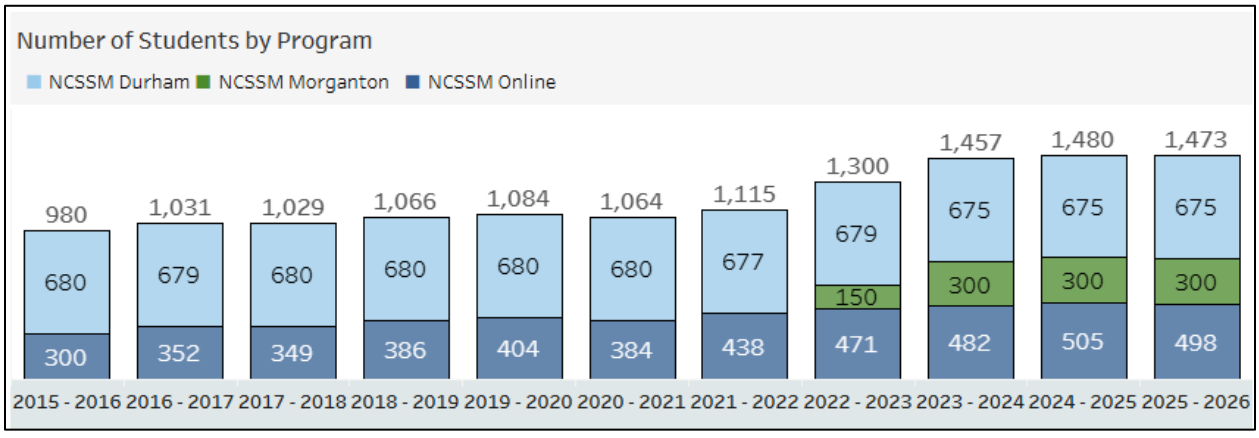
| Group | 2025 Population |
|---|---|
| **Students** | **1,473** |
| *NCSSM-Durham students* | 675 |
| *NCSSM-Morganton Students* | 300 |
| *NCSSM-Online Students* | 498 |

Source: NCSSM Enrollment at a Glance Data Dashboard

According to the NCSSM Interactive Data Dashboard, most students who attend the school come from Wake and Mecklenburg Counties. Approximately 13.1% of all enrolled students come from Wake County.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure E.4. Enrollment has increased slightly over the last five years with the opening of the Morganton campus, but enrollment at the Durham campus has remained consistent over the years. Per the HMPC, at the Durham campus there are 680 beds for students and about 330 temporary and full-time employees.

**Figure E.4 – NCSSM Enrollment, 2016-2025**




Source: NCSSM Enrollment at a Glance Data Dashboard

The racial demographics of the college are presented below in Table E.4.

**Table E.4 – NCSSM Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 3 | 0.2% |
| Black or African American | 82 | 5.6% |
| Hispanic or Latino | 109 | 7.4% |
| Asian | 535 | 36.3% |
| Native Hawaiian or Other Pacific Islander | 2 | 0.1% |
| White | 545 | 37% |
| Race/Ethnicity Unknown | 108 | 7.3% |

Source: NCSSM Enrollment at a Glance Data Dashboard

### E.2.4 Growth and Development Trends

In the summer of 2022, the North Carolina School of Science and Mathematics greatly expanded their institutional scope with the opening of the new Morganton campus located in the western region of the state in the City of Morganton, North Carolina.

Since the previous plan update, NCSSM has identified more than $50 million in facility repairs and renovations needed on the Durham campus due to the old age of most buildings. Approximately, $20 million of this amount will be used towards renovations of several residence halls and construction of a new academic commons buildings extension. The Durham campus opened a newly renovated dining hall after a year of construction in September of 2023.

## E.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the NCSSM campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

### E.3.1 Building Exposure

Table E.5 provides total building exposure for the campus, which was estimated by summarizing building footprints and property values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table E.5 – NCSSM Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 4 | $2,758,003.14 |
| Educational/Extracurricular | 3 | $10,653,837.37 |
| Housing | 8 | $17,027,198.35 |
| Total | **15** | **$30,439,038.86** |

Source: NCEM iRisk database

## E.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt campus continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by NCSSM's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the NCSSM HMPC maintained the list of critical facilities with the exception of buildings that were removed from the building inventory. Factors considered for this ranking included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for NCSSM, as shown in Figure E.5, are listed below along with their scores generated during the original ranking of these facilities for the 2021 Hazard Mitigation Plan:

- Beall Hall/Bryan Center/Bryan Lobby (26)
- Royall Center (24)
- Physical Education Center (PEC) (21)
- Educational Technology Center (ETC) (15)
- Reynolds Residence Hall (14)
- Hill House (12)
- Watts Hall (12)
- Hunt Residence Hall (11)
- Boiler Plant (10)
- Chiller Plant (7)
- Plant Facilities Building (4)
- Cottage (3)

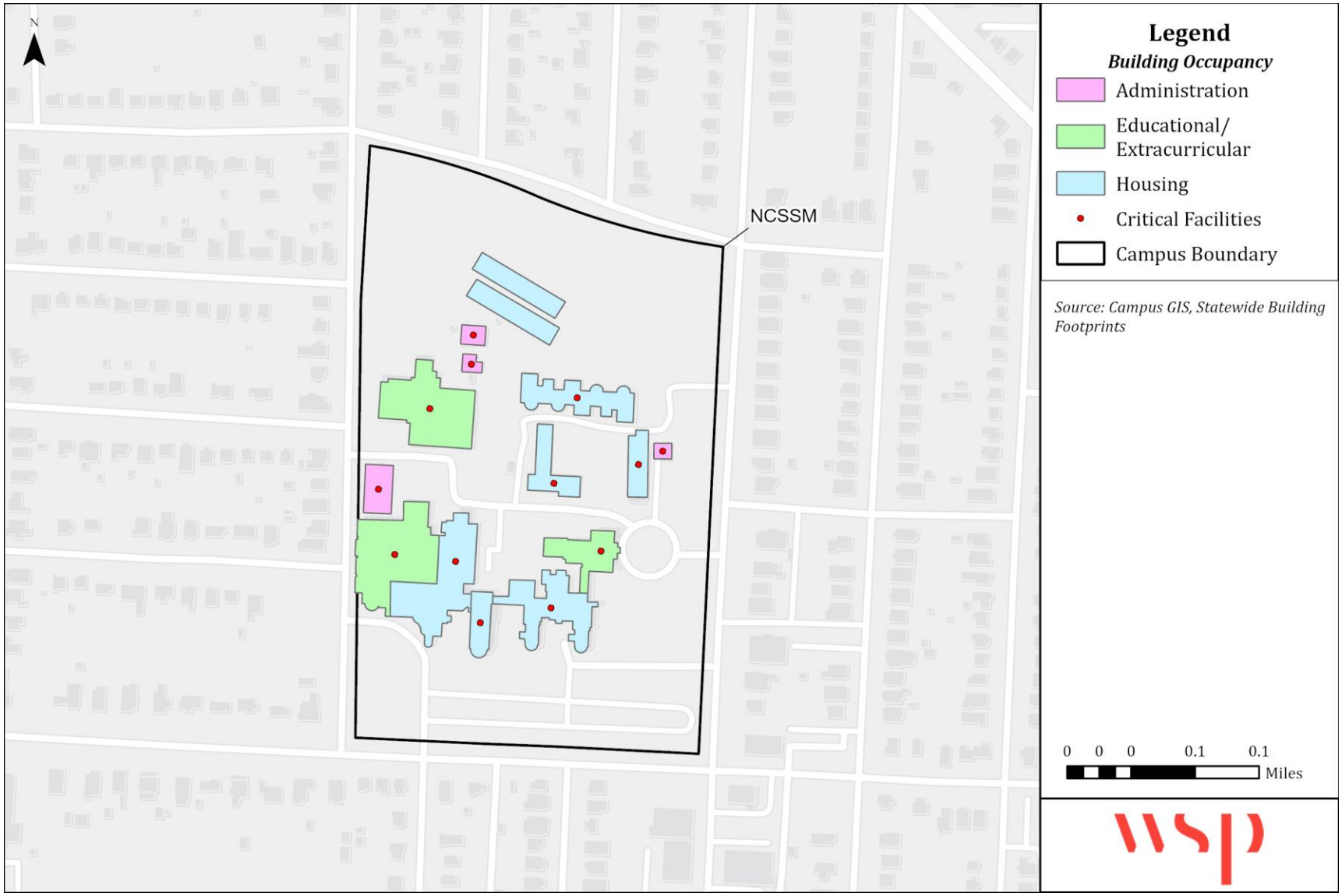
The Royall Center and PEC serve as primary Emergency Operations Centers (EOC) for the Campus; the Beall/Bryan complex services as the secondary EOC. The Beall/Bryan Complex, Royall Center, ETC, Reynolds Hall, Watts Hall, Boiler Plant, Chiller Plant, and Cottage all provide essential campus functions.

The PEC serves as the only emergency shelter on campus; however, the Beall/Bryan Complex, Royall Center, ETC, Reynolds Residence Hall, Hill House, Watts Hall, Hunt Residence Hall, and Plant Facilities Building all provide services essential to sheltering to support the PEC. The following buildings also host generators: Beall/Bryan Complex, Royall Center, PEC, Reynold Residence Hall, Hill House, Hunt Residence Hall, and Boiler Plant.

The Beall/Bryan Complex, Royall Center, PEC, ETC, Hill House, Watts House, Hunt Residence Hall, Boiler Plant, Chiller Plan, and Plant Facilities Building all provide chilled water distribution or contain HVAC systems necessary to sensitive or essential systems. The Boiler Plant, Chiller Plant, PEC, and Beall/Bryan complex also house hazardous materials on site.

Other critical campus buildings host research functions with low tolerance for disruption (Beall/Bryan Complex, ETC, Watts Hall, Hunt Residence Hall, Cottage), stores rare or unique collections or is historically significance (Royall Center, ETC, Reynolds Residence Hall, and Watts Hall), or have hazard specific vulnerabilities such as a basement (Beall/Bryan Complex, Royall Center, ETC, Reynolds, Hill House, and Watts Hall).

**Figure E.5 – NCSSM Map of Critical Facilities**



# E.4 Hazard Identification & Risk Assessment

## E.4.1 Hazard Identification

To identify a full range of hazards relevant to the UNC Eastern Campuses, HMPC representatives from each campus began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan and the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table E.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table E.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP NCSSM Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Extreme Heat | Yes | No |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | No |
| Drought | Yes | No |
| Tornadoes/Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, as Landslide |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | No |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | No |
| Vandalism/Theft | No | Yes |

NCSSM's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP in order to determine whether each hazard was significant enough to assess in this updated Hazard Mitigation Plan. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database

also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Durham County was used to approximate past events that may have affected the NCSSM campus. The NCEI database contains 436 records of storm events that occurred in Durham County in the 25-year period from 2000 through 2024. Table E.7 summarizes these events.

**Table E.7 – NCEI Severe Weather Data for Durham County, 2000 – 2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Flash Flood | 72 | $479,000 | $0 | 0 | 0 |
| Flood | 4 | $11,050,000 | $5,000,000 | 0 | 0 |
| Funnel Cloud | 3 | $0 | $0 | 0 | 0 |
| Hail | 73 | $15,000 | $0 | 0 | 0 |
| Heavy Rain | 5 | $0 | $0 | 0 | 0 |
| Heavy Snow | 1 | $0 | $0 | 0 | 0 |
| High Wind | 2 | $1,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 1 | $205,000 | $0 | 0 | 0 |
| Ice Storm | 1 | $400,000 | $0 | 0 | 0 |
| Lightning | 8 | $163,000 | $0 | 1 | 4 |
| Strong Wind | 19 | $1,498,450 | $6,000 | 1 | 1 |
| Thunderstorm Wind | 179 | $1,263,750 | $0 | 1 | 1 |
| Tornado | 6 | $630,000 | $0 | 0 | 0 |
| Tropical Storm | 3 | $1,200,000 | $25,000 | 0 | 0 |
| Winter Storm | 26 | $1,000,000 | $0 | 0 | 0 |
| Winter Weather | 33 | $30,000 | $0 | 0 | 0 |
| **Total** | **436** | **$17,935,200** | **$5,031,000** | **3** | **6** |

Source: National Center for Environmental Information Events Database, retrieved November 2025

Note: Losses reflect totals for all impacted areas for each event.

reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Durham County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Durham County has been designated in 18 major disaster declarations, as detailed in Table E.8, and 13 emergency declarations, as detailed in Table E.9.

**Table E.8 – FEMA Major Disaster Declarations, Durham County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-827-NC | 17-May-89 | Tornado | Tornadoes | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard Of 96 | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1211-NC | 22-Mar-98 | Severe Storm(s) | Severe Storms Tornadoes, And Flooding | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1312-NC | 31-Jan-00 | Severe Storm(s) | Severe Winter Storm | N/A | N/A | $27,368,108 |
| DR-1448-NC | 12-Dec-02 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | $86,565,180 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7,790 | $21,289,504 | $18,285,917 |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34,713 | $133,948,455 | $632,937,402 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-4889-NC | 9-Sep-2025 | Tropical Depression | Tropical Depression Chantal | N/A | N/A | N/A |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance, IAH = Individuals and Households, PA = Public Assistance

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table E.9 – FEMA Emergency Declarations, Durham County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3033-NC | 02-Mar-77 | Snow | Drought & Freezing |
| EM-3049-NC | 11-Aug-77 | Drought | Drought |
| EM-3110-NC | 17-Mar-93 | Snow | Severe Snowfall & Winter Storm |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 1-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 6-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table E.10 summarizes the determination made for each hazard.

### Table E.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in 2021 NCSSM Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in 2021 NCSSM Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 NCSSM Annex<br>▪ Modeled building damages in iRisk database enable vulnerability assessment |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 NCSSM Annex<br>▪ Durham County has had two disaster declarations for flooding and nine disaster declarations for hurricanes or tropical storms which may have involved flooding |
| Geologic Hazards (Sinkhole & Landslide) | No | ▪ Included in 2021 NCSSM Annex but no landslide risk found |
| Hurricane & Coastal Hazards | Yes | ▪ Included in 2021 NCSSM Annex<br>▪ Durham County has had 8 disaster declarations related to hurricanes<br>▪ Coastal hazards not relevant due to campus's inland location |
| Severe Winter Weather | Yes | ▪ Included in 2021 NCSSM Annex |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 NCSSM Annex<br>▪ Durham County has had three disaster declarations for tornadoes and/or severe storms |
| Wildfire | Yes | ▪ Included in 2021 NCSSM Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in the 2021 NCSSM Annex<br>▪ There are transportation routes with hazardous materials in/near the campus |
| Infectious Disease | Yes | ▪ Included in the 2021 NCSSM Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | No | ▪ Not included in 2021 NCSSM Annex |
| Terrorism | No | ▪ Not included in 2021 NCSSM Annex<br>▪ Addressed by state and federal planning and emergency response |
| Vandalism/Theft | No | ▪ Included in the 2021 NCSSM Annex but HMPC decided this issue should be addressed separate from the mitigation plan |

# E.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on NCCSM's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Durham County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year). The likelihood of future occurrences is categorized into one of the classifications as follows:

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and

assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Eno Haw Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Durham County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table E.11 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Earthquake** | USGS, NCEI | County | iRisk | Census Tract |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricane** | NHC | County | iRisk | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

## Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

## Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

# Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the NCSSM planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table E.12.

PRI ratings are provided by category throughout each hazard profile for the planning area as a whole. Ratings specific to each jurisdiction are provided at the end of each hazard profile. The results of the risk assessment and overall PRI scoring are provided in Section E.5.10 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes. Mitigation actions are not developed for hazards identified as low risk through this process.

## Table E.12 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY What is the likelihood of a hazard event occurring in a given year?** | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?** | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | **4** | |
| **SPATIAL EXTENT How large of an area could be impacted by a hazard event? Are impacts localized or regional?** | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME Is there usually some lead time associated with the hazard event? Have warning measures been implemented?** | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION How long does the hazard event usually last?** | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

## E.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

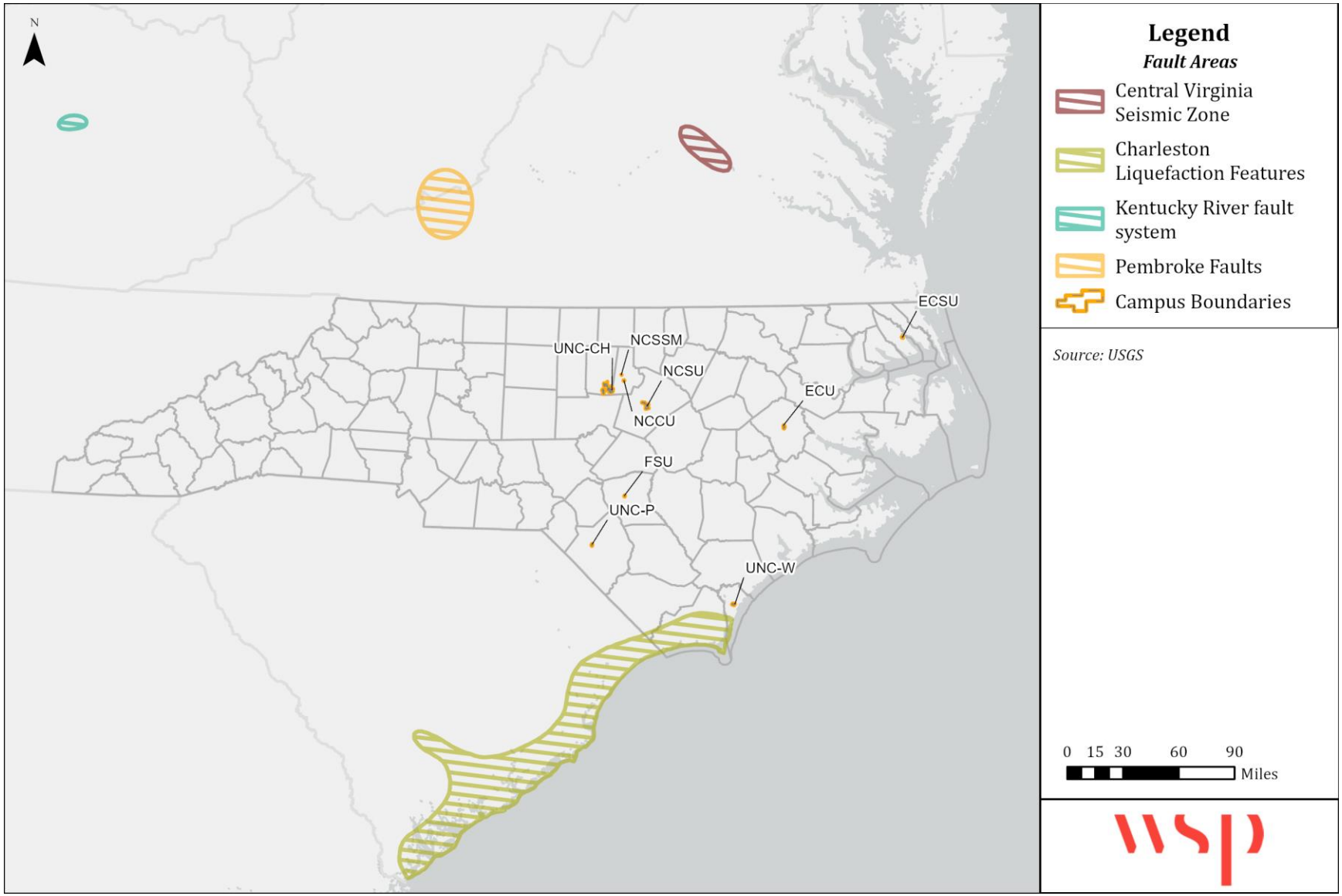
Figure E.6 reflects the quaternary faults that present an earthquake hazard for the NCSSM planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. No active faults were noted in Durham County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Durham County is likely to be felt across most if not all of the planning area.

*Spatial Extent: 4 – Large*

**Figure E.6 – U.S. Quaternary Faults**

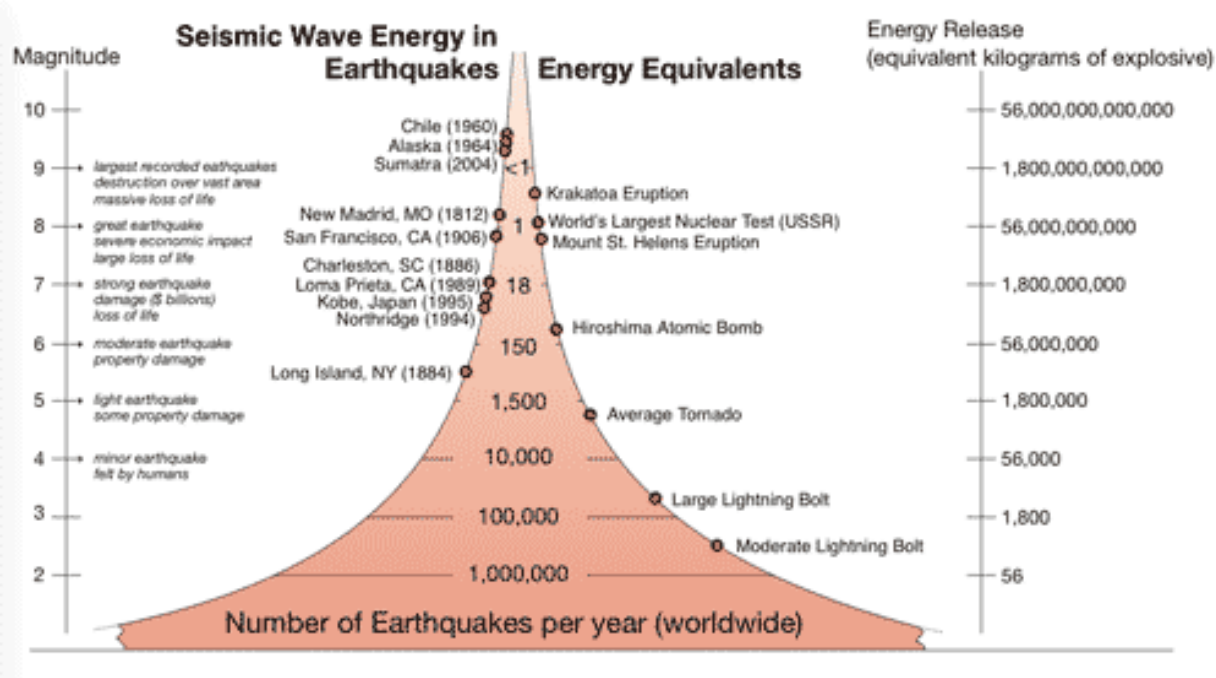


## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure E.7.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table E.13 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

**Figure E.7 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table E.13 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |

| MMI | Shaking | Description/Damage |
|---|---|---|
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

*Impact: 1 – Minor*

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater. Earthquake events that occurred within 100 miles of the NCSSM campus are presented in Table E.14 and Figure E.8.

### Table E.14 – Historical Earthquakes within 100 Miles of NCSSM, 1900-2024

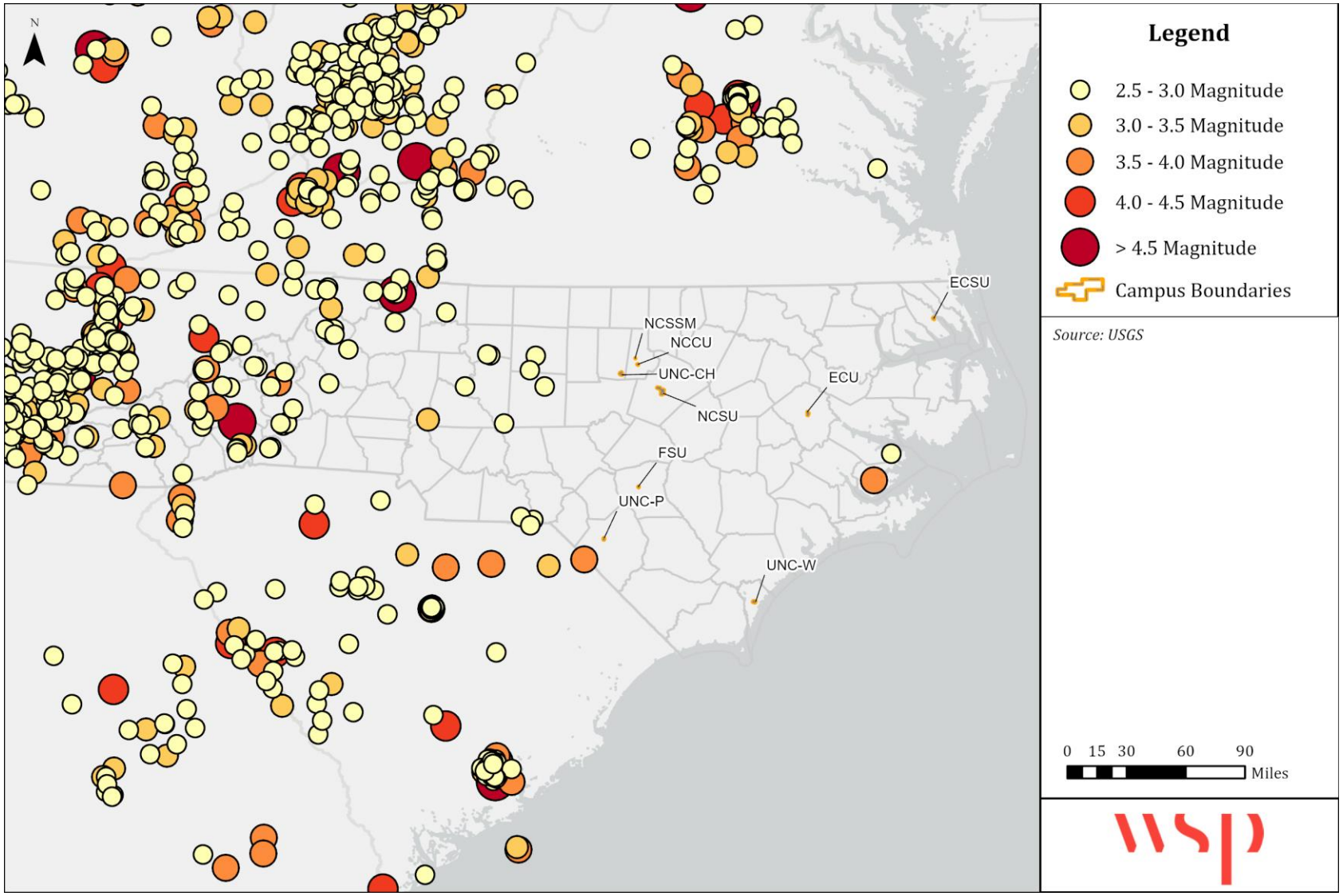
| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 4/22/1980 | 2.8 | 9 km SE of Dobson, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 6/4/1989 | 2.8 | 9 km WNW of Burkeville, Virginia |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 10/21/1998 | 3.8 | 13 km S of Dillwyn, Virginia |
| 8/18/2000 | 2.7 | 2 km SSE of Narrows, Virginia |
| 9/3/2001 | 2.5 | Virginia |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |
| 11/3/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 5/16/2009 | 3.0 | 2 km NNE of Cave Spring, Virginia |
| 11/25/2009 | 2.7 | 14 km S of Arrington, Virginia |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |
| 5/22/2014 | 3.1 | 15 km ENE of Cumberland, Virginia |
| 11/4/2015 | 2.67 | 3 km NE of Dillwyn, Virginia |
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |
| 9/27/2021 | 2.56 | 4 km N of Lafayette, Virginia |
| 5/6/2025 | 2.96 | 8 km S of Dillwyn, Virginia |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there were two earthquakes felt in and around Durham: on September 1, 1886 with an epicenter approximately 365 miles from Durham; and on November 20, 1969 a 4.3 magnitude with an epicenter approximately 242 miles from Durham.

**Figure E.8 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

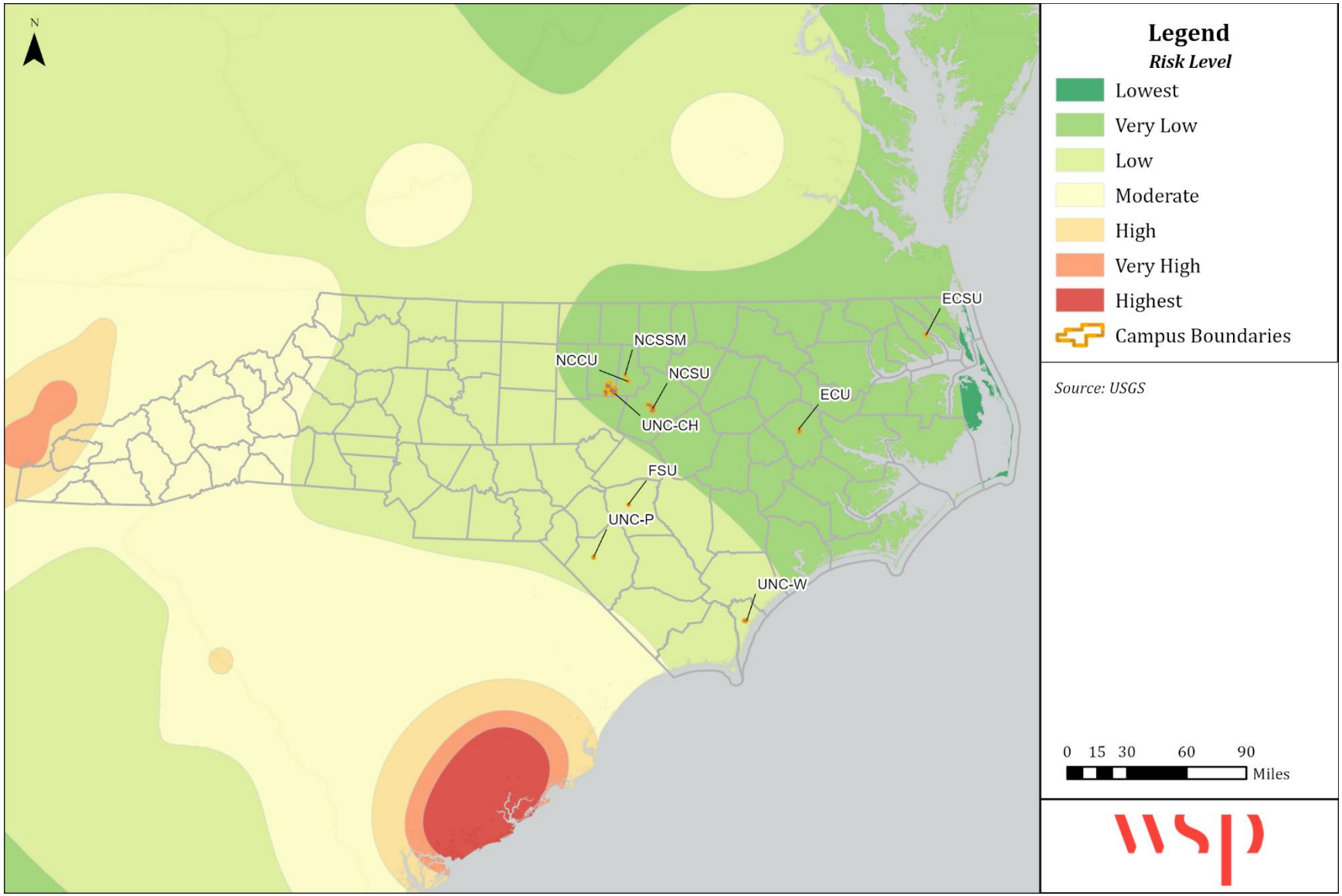
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure E.9 on the following page reflects the seismic hazard for Durham County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Durham County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting NCSSM's campus is unlikely.

*Probability: 1 – Unlikely*

**Figure E.9 – Seismic Hazard Information for Durham County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on NCSSM's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damage to infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRISK analysis, a 500-year earthquake event could cause $195,647 of estimated total building damages.

Durham County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structures. Table E.15 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table E.15 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $1,362.18 | $1,335.97 | $2,698.15 |
| Educational | $2,891.61 | $2,751.06 | $5,642.67 |
| Housing | $4,412.44 | $4,581.11 | $8,993.55 |
| **Total** | **$8,666.23** | **$8,668.14** | **$17,334.37** |
| **500-Year Earthquake Event** | | | |
| Administration | $11,657.31 | $18,037.87 | $29,695.18 |
| Educational | $24,612.72 | $36,583.41 | $61,196.13 |
| Housing | $39,826.00 | $64,929.95 | $104,755.95 |
| **Total** | **$76,096.03** | **$119,551.23** | **$195,647.26** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **1,000-Year Earthquake Event** | | | |
| Administration | $39,029.44 | $57,168.98 | $96,198.42 |
| Educational | $84,870.36 | $117,109.60 | $201,979.96 |
| Housing | $140,394.20 | $222,350.79 | $362,744.99 |
| **Total** | **$264,294.00** | **$396,629.37** | **$660,923.37** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Durham County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type of damage is unlikely based on USGS seismic probability data and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the NCSSM campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at NCSSM have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statement

- While earthquakes are an unlikely hazard event for the NCSSM campus, an estimated $162,390 of total building damage to the campus could occur in the case of a 500-year earthquake event.

## E.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of excessive heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. Table E.16 provides counts of heat index values by threshold recorded from 2009-2024 at the North Durham Water Reclamation Facility in Durham County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Durham County experiences an average of 77 hours per year with heat index values at or above 100°F.

*Impact: 2 – Limited*

**Table E.16 – Historical Heat Index, North Durham Water Reclamation Facility, Durham, NC, 2009-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2009 | 8 | 0 | 0 | 0 | 8 |
| 2010 | 98 | 24 | 0 | 0 | 122 |
| 2011 | 70 | 16 | 0 | 0 | 86 |
| 2012 | 58 | 22 | 1 | 0 | 81 |
| 2013 | 59 | 17 | 0 | 0 | 76 |
| 2014 | 14 | 0 | 0 | 0 | 14 |
| 2015 | 26 | 1 | 0 | 0 | 27 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2016 | 76 | 6 | 0 | 0 | 82 |
| 2017 | 36 | 0 | 0 | 0 | 36 |
| 2018 | 44 | 2 | 0 | 0 | 46 |
| 2019 | 119 | 13 | 0 | 0 | 132 |
| 2020 | 74 | 16 | 0 | 0 | 90 |
| 2021 | 60 | 16 | 0 | 0 | 76 |
| 2022 | 83 | 15 | 0 | 0 | 98 |
| 2023 | 69 | 17 | 0 | 0 | 86 |
| 2024 | 77 | 30 | 7 | 61 | 175 |
| **Sum** | **971** | **195** | **8** | **61** | **1,235** |
| **Average** | **61** | **12** | **1** | **4** | **77** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

NCEI records did not include a heat-related incident between 2000 and 2024 in Durham County. The most recent heat-related incident on record occurred in 1998 and is summarized below. It should be noted that heat-related incidents did occur in Durham County during this time period, as indicated in Table E.16, but they were not captured by NCEI.

- **July 22, 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.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the North Durham Water Reclamation Facility in Durham County, NC. Based on 16 years of data (2009-2024), the Durham station averaged 19 days per year with a heat index of 100 degrees or more.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

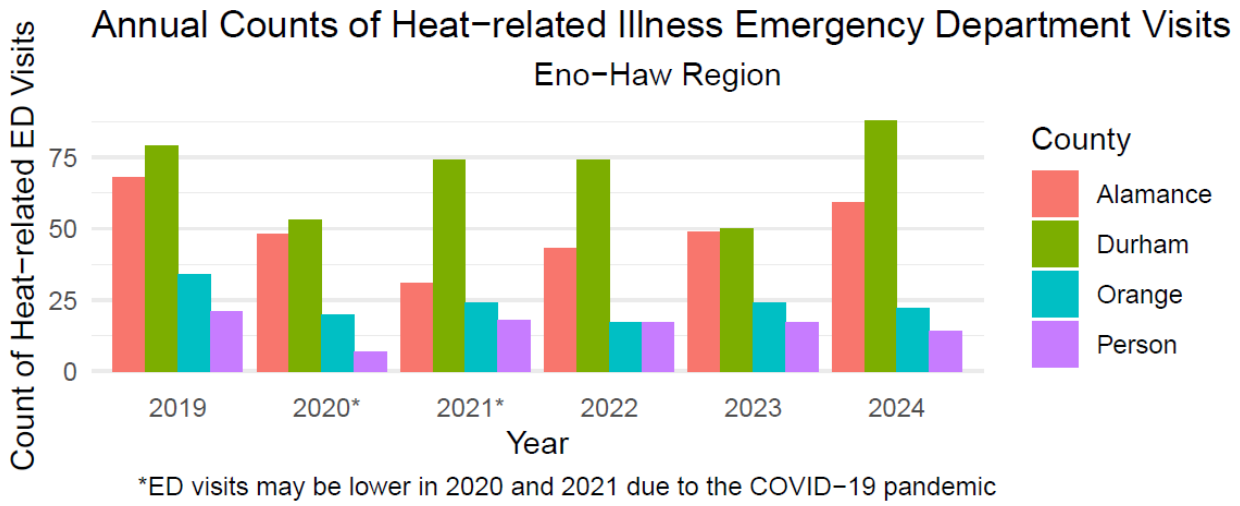
### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease

or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

Emergency department visits for heat related illnesses notably increase when heat index temperatures exceed 100°F. The 2025 Eno-Haw Regional Hazard Mitigation Plan utilized public health syndromic surveillance system data from NC DETECT to show heat related illness emergency department visits by county. Figure E.10 shows the annual count of emergency department visits for heat-related illness in Durham County, which ranged from 50 in 2023 to 88 in 2024.

**Figure E.10 - Annual Heat-Related Illness Emergency Department Visits by County**




Source: North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT)

## Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

## Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized “heat islands.” Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statement

- NCSSM is located in Durham County, which currently averages 77 hours per year with heat index values of 100°F or higher, and therefore, there is a 100% annual chance of heat index values meeting or exceeding 100°F any given year.

## E.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flood | Possible | Minor | Negligible | 6 to 12 hrs | Less than 6 hours | 1.5 |

### Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the NCSSM campus using the FIRM dated October 19, 2018. Figure E.11 reflects the 2018 mapped flood insurance zones. Table E.17 summarizes some of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table E.17 intersect the NCSSM campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Durham and the NCSSM campus. Flood risk is not limited to the 1%-annual-chance floodplain. Although this assessment focuses on riverine flooding, areas of localized stormwater flooding were also considered, as this can occur outside the mapped floodplain. The HMPC reported that flooding is not a significant issue on campus and there are no stormwater flooding hotspots that need to be mitigated.

As shown in Figure E.11, the SFHA does not intersect with the NCSSM campus. However, flooding may also occur on the campus when intense rainfall occurs within the urban area and cannot be carried away by natural or urban drainage systems as fast as it is falling.

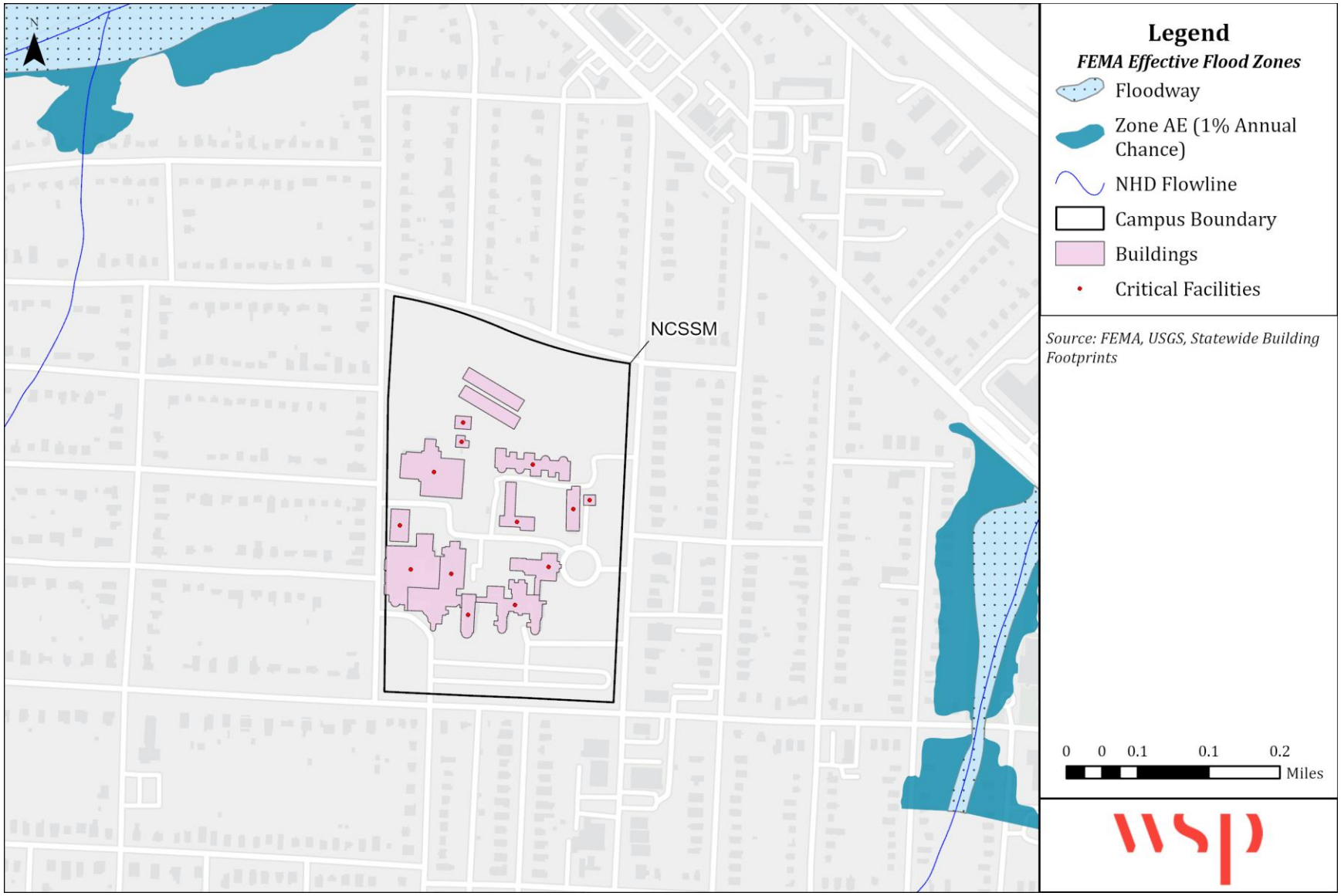
*Spatial Extent: 1 – Negligible*

**Table E.17 – Mapped Flood Insurance Zones within NCSSM**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave |

| Zone | Description |
|---|---|
| | effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **Zone X (unshaded)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |

**Figure E.11 – FEMA Flood Hazard Areas in NCSSM's Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

None of the NCSSM campus falls within the SFHA. Table E.18 provides a summary of the NCSSM campus' total area by flood zone on the 2018 effective DFIRM. Figure E.12 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

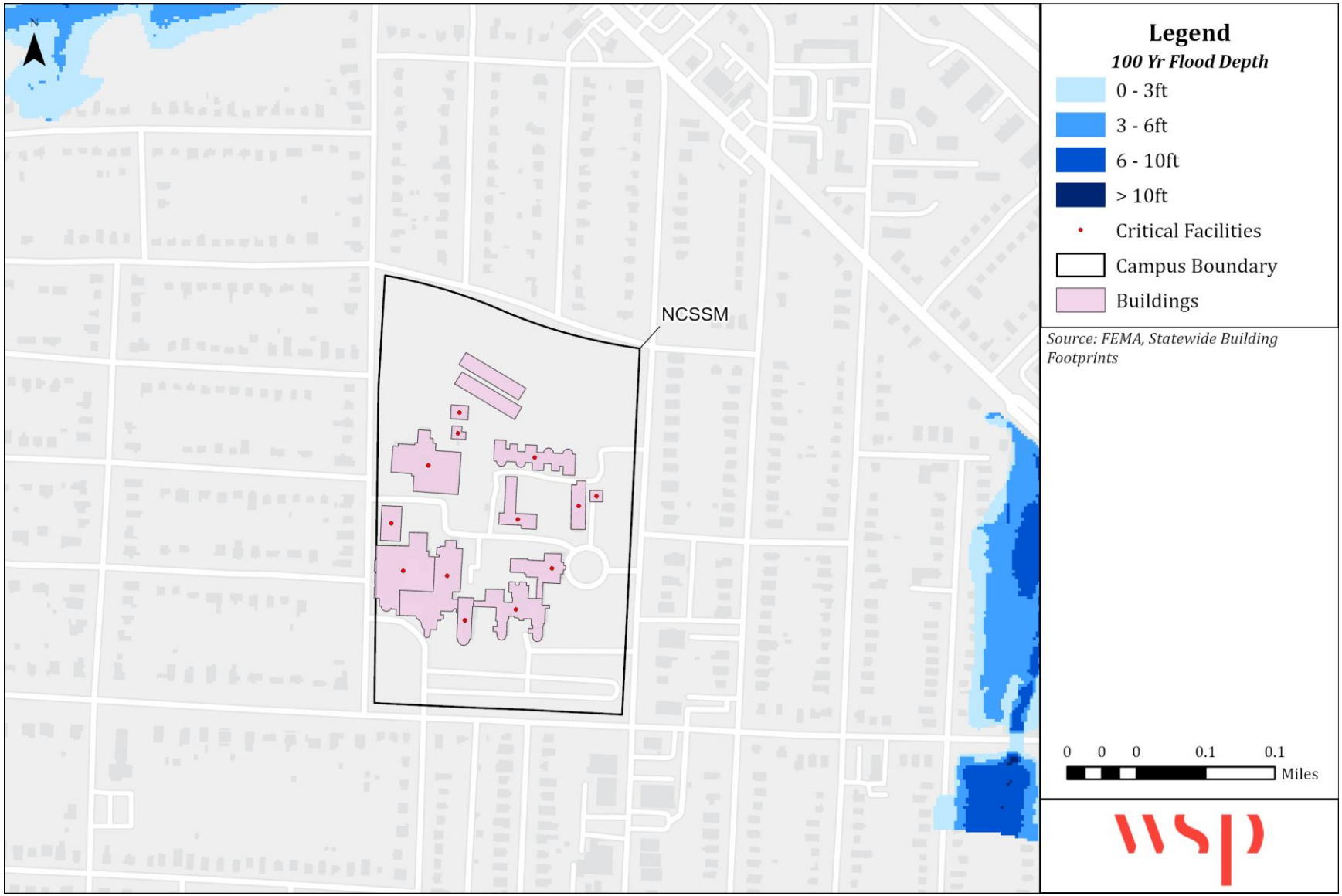
*Impact: 1 – Minor*

**Table E.18 – Flood Zone Acreage on NCSSM Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| Unshaded X | 27.3 | 100.0% |
| **Total** | **27.3** | **100.0%** |
| **SFHA Total** | **0.0** | **0.0%** |

Source: FEMA 2018 DFIRM

**Figure E.12 – Flood Depth, 1-Percent-Annual-Chance Flood, NCSSM**



## Historical Occurrences

Table E.19 details the historical occurrences of flooding for the City of Durham and Durham County identified from 2000 through 2024 by NCEI Storm Events database. The table below summarizes NCEI events that occurred countywide or started or ended in the City of Durham. According to NCEI, 21 recorded flood-related events occurred on 19 separate days in Durham and Durham County from 2000 to 2024 causing $55,000 in property damage, and no injuries, fatalities, or crop damage. Additional property and crop damage likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table E.19 – NCEI Records of Flooding for the City of Durham, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Durham | 7/23/2000 | 0/0 | $0 | $0 |
| Durham | 8/4/2000 | 0/0 | $0 | $0 |
| Durham | 6/22/2001 | 0/0 | $0 | $0 |
| Durham | 10/11/2002* | 0/0 | $0 | $0 |
| County-Wide | 8/9/2003 | 0/0 | $0 | $0 |
| Durham | 5/23/2004 | 0/0 | $0 | $0 |
| Durham | 8/12/2004 | 0/0 | $0 | $0 |
| Durham | 7/13/2006 | 0/0 | $0 | $0 |
| Durham | 11/16/2006 | 0/0 | $0 | $0 |
| East Durham | 9/6/2011 | 0/0 | $0 | $0 |
| Durham | 6/11/2014 | 0/0 | $0 | $0 |
| Durham | 12/30/2015 | 0/0 | $10,000 | $0 |
| West Durham | 4/15/2018 | 0/0 | $0 | $0 |
| Durham | 4/12/2019 | 0/0 | $30,000 | $0 |
| Durham | 7/9/2022 | 0/0 | $0 | $0 |
| West Durham | 6/30/2023 | 0/0 | $0 | $0 |
| West Durham | 9/27/2024* | 0/0 | $15,000 | $0 |
| **Heavy Rain** | | | | |
| Durham | 11/22/2006 | 0/0 | $0 | $0 |
| West Durham | 8/4/2020 | 0/0 | $0 | $0 |
| **Total** | | **0/0** | **$55,000** | **$0** |

Source: NCEI

*More than one report recorded in database

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **August 4, 2000** - Flooding on Hwy 147, 6 to 8 inches of water covered roads in the South Square area.
- **September 6, 2011** – As the remnants of Tropical Storm Lee tracked along a frontal zone that extended from the southern Appalachians into central Virginia, heavy rain and severe storms spread into central North Carolina. The initial severe weather threat, during the early morning hours, was tornadoes, due to the highly sheared environment associated with the former tropical cyclone. As the day progressed, and the remnant low of Lee continued to weaken, the severe weather threat transitioned to straight line winds, as instability increased with the heating of the day. Multiple street closings due to high water were reported by law enforcement in Durham. The intersection of Berkely Street and Englewood Avenue was impassable due to flooding. The intersection of Morrene Road and Tremont Drive was flooded. Indian Trail in Durham was closed due to rising water. High water also forced the closure of the intersection of North Alston Avenue and Juniper Street.
- **December 30, 2015** - Flooding caused minor damage to the Hillandale Road VA Clinic in Durham, where 1-2 inches of water got inside the building. In addition, high water signs were deployed across Durham.
- **April 12, 2019** - Flash flooding was reported on several campus streets at North Carolina Central University. In addition, several buildings reported having water in interior entrances. Several streets were flooded and closed in the Durham area. Also, vehicles were stranded. Flora Street was impassable due to flash flooding.
- **July 9, 2022** – A warm and humid air mass produced widespread showers and storms. Very high moisture, deeply warm low levels, and slow storm motion produced high rainfall rates and flash flooding, ranging from nuisance flooding in most places to road closures in Chapel Hill, Durham, and Wake County. Flooded was reported near the intersection of NC Highway 147 (Durham Freeway) and Fulton St.
- **June 27, 2024** – Isolated to scattered showers and storms developed in the western Piedmont, tracking east and south over the central Piedmont and Sandhills. A few of the storms became severe in Chatham and Orange Counties, along with flash flooding over Durham. The city of Durham reported high water and numerous vehicles stranded.
- **September 27, 2024** – Hurricane Helene weakened to a strong tropical storm. Widespread rainfall totals of 2-4 inches of rain fell over central North Carolina, along with wind gusts of 25-45 mph. Additionally, four tornadoes occurred, with the strongest an EF3, touching down over Rocky Mount in Nash County. A vehicle was trapped in floodwaters on Lakewood Avenue near South Street and additional flooding was reported in the Durham Central Park area.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which have also included damages associated with flooding. Durham County has received one Major Disaster Declaration for a severe storm including elements of flooding in 1998. Additionally, five Major Disaster Declarations for hurricanes and tropical storms in 1996, 1999, 2003, 2018, and 2025 which also may have included damage associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The NCSSM campus does not have any area of land in FEMA-mapped flood hazard areas, which indicates minimal risk. Additionally, although the City of Durham is at risk of other types of flooding such as stormwater and localized flooding that occur outside of the SFHA, the HMPC reported that there are no stormwater flooding hotspots on campus. Still, floods of other magnitudes with varying probabilities may occur, and changes in the watershed and development could affect future flood risk.

Floods of varying severity occur regularly in Durham and impacts from past flood events have been noted by NCEI. NCEI reports 21 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability of 88% for Durham. However, given that the campus is outside of the SFHA and there are no stormwater problem hotspots on campus the probability of flooding is considered only possible.

*Probability: 2 – Possible*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. For the NCSSM campus, there are no structures located within the SFHA.

### People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw

sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.

- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.
- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths caused by flood events in Durham County.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters if they are exposed.

No structures or critical facilities identified for NCSSM are located within the 1%-annual-chance floodplain, therefore there is no estimated damage.

### Environment

During a flood event, chemicals and other hazardous substances may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the NCSSM Plant Facilities and Grounds Departments work to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statement

- While the 1% annual chance floodplain does not impact the NCSSM campus, flooding may also occur on the campus when an intense rainfall occurs within the urban area and cannot be carried away by natural or urban drainage systems as fast as it is falling.

# E.5.4 Hurricane

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |

## Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. NCSSM is not exposed to storm surge, which is limited to coastal areas. However, hurricane winds can occur anywhere within Durham County and impact the entire campus, so the spatial extent was determined to be large.

*Spatial Extent: 4 – Large*

## Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table E.20), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

**Table E.20 – Saffir-Simpson Scale**

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last for several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table E.21 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table E.21 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Tropical cyclones weaken relatively quickly after making landfall; therefore, Durham County will not typically experience major hurricane force winds, though these occurrences are possible. For example, Hurricane Fran passed within 5 miles of NCSSM’s campus as a Category 1 storm with wind speeds around 75 mph in 1996.

*Impact: 3 – Critical*

## Historical Occurrences

According to NCEI, four recorded hurricane-related events affected Durham County from 2000 to 2024 causing an estimated $1,405,000 in property damage and $25,000 in crop damage. There were no injuries or fatalities recorded for any of these events.

**Table E.22 – Recorded Hurricane and Tropical Storm Events for Durham County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/18/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $205,000 | $0 |
| 9/14/2018 | Tropical Storm | Hurricane Florence | 0/0 | $0 | $25,000 |
| 10/11/2018 | Tropical Storm | Tropical Storm Michael | 0/0 | $200,000 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $1,000,000 | $0 |
| **Total** | | | **0/0** | **$1,405,000** | **$25,000** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Florence (2018)** – A large tree was reported down on a home along Piperwood Court.
- **Tropical Storm Michael (2018)** – Tropical storm wind gusts downed numerous trees, caused widespread power outages, and produced a variety of damage to homes and structures across the county. At the peak of the storm, the total peak outages were around 20,000 customers.
- **Hurricane Ian (2022)** - Frequent wind gusts of 40 to 60 mph resulted in scattered to numerous trees and power lines down across Durham County, including some on homes. Numerous customers lost power in Durham County as a result of the tropical storm force wind gusts.

According to the NOAA Historical Hurricane Tracks dataset, 14 hurricanes or tropical storms, passed within 25 miles of NCSSM since 1900. These events are listed in Table E.23, and storm tracks are mapped in Figure E.13.

**Table E.23 – Hurricane Tracks within 25 miles of NCSSM, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 6/17/1902 | Unnamed | Tropical Storm |
| 10/3/1929 | Unnamed | Tropical Storm |
| 9/19/1945 | Unnamed | Tropical Storm |
| 8/18/1955 | Diane | Tropical Storm |
| 9/1/1964 | Cleo | Tropical Depression |
| 6/11/1968 | Abby | Tropical Depression |
| 9/17/1976 | Unnamed | Tropical Depression |

| Date | Storm Name | Storm Category |
|---|---|---|
| 8/19/1985 | Danny | Tropical Depression |
| 9/9/1987 | Unnamed | Tropical Depression |
| 9/7/1996 | Fran | Category 1 |
| 9/6/1999 | Dennis | Tropical Depression |
| 9/20/2000 | Gordon | Tropical Depression |
| 10/12/2018 | Michael | Tropical Storm |
| 7/9/2021 | Elsa | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

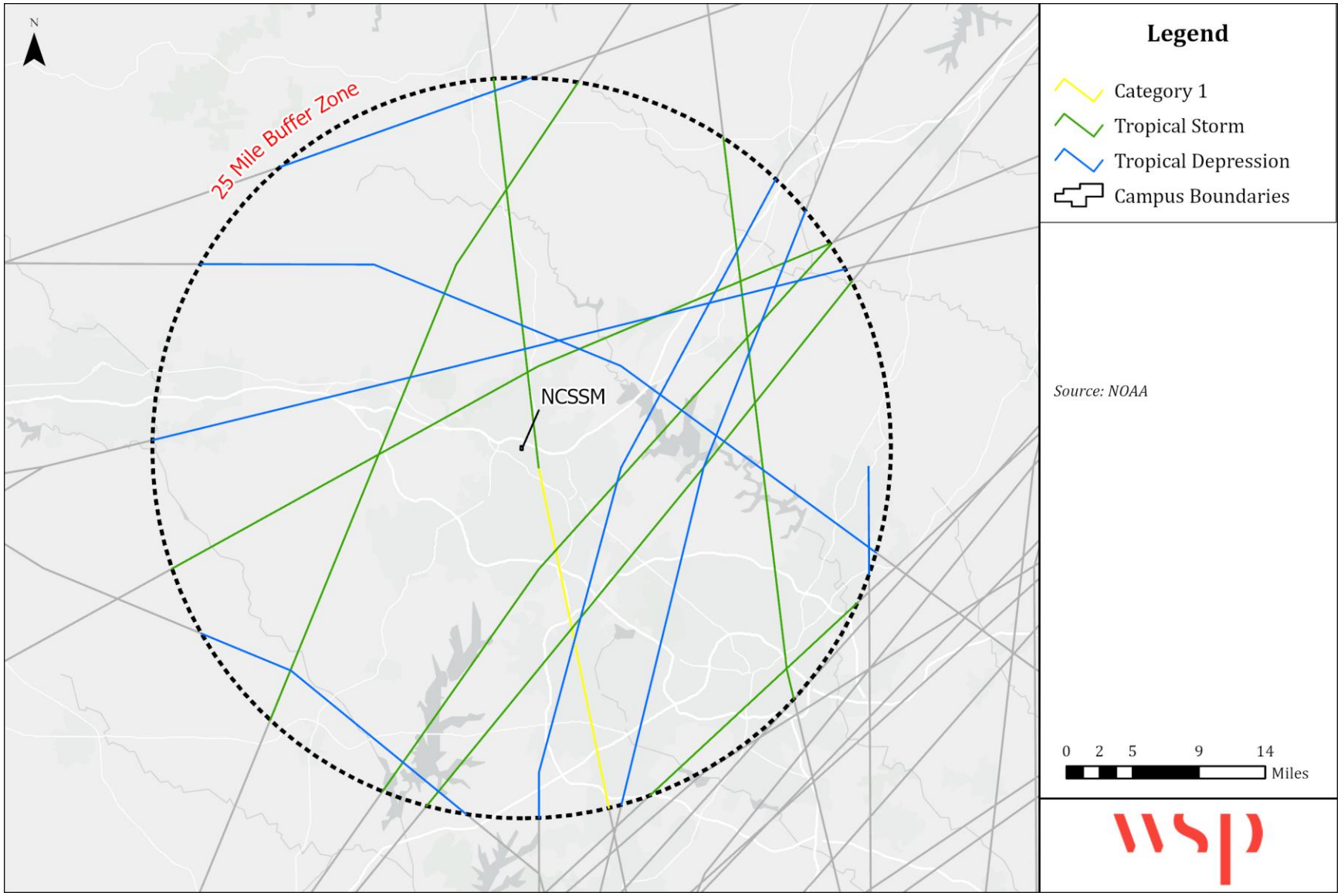
Durham County has received four major disaster declarations and seven emergency declarations for hurricane and tropical storm events, summarized in Table E.24.

**Table E.24 – Hurricane-Related Disaster Declarations & Emergency Declarations**

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd Emergency Declarations |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 10/7/2016 | EM-3380-NC | Hurricane Matthew |
| 9/14/2018 | DR-4393-NC & EM-3401-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

Source: OpenFEMA, 2025

**Figure E.13 – Historical Hurricane and Tropical Storm Tracks within 25 miles of NCSSM, 1990-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, four hurricanes and tropical storms have impacted Durham County, which equates to a 65 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting the County is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, due to limitations in their ability to evacuate. Most on-campus students will need assistance with evacuation and/or sheltering in either are needed. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRISK analysis, a 100-year hurricane wind event could cause over $91,000 of estimated total building damages to NCSSM's campus.

Table E.25 details the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table E.25 – Estimated Building Damage by Hurricane Winds, NCSSM Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $10,666.50 | $1,267.99 | $11,934.49 |
| Educational | $19,503.88 | $2,329.29 | $21,833.17 |
| Housing | $50,712.32 | $7,255.33 | $57,967.65 |
| **Total** | **$80,882.70** | **$10,852.61** | **$91,735.31** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $47,350.90 | $13,671.83 | $61,022.73 |
| Educational | $88,282.32 | $26,570.83 | $114,853.15 |
| Housing | $215,480.11 | $65,700.00 | $281,180.11 |
| **Total** | **$351,113.33** | **$105,942.66** | **$457,055.99** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $212,133.80 | $98,899.49 | $311,033.29 |
| Educational | $417,498.08 | $199,247.09 | $616,745.17 |
| Housing | $876,579.53 | $416,631.62 | $1,293,211.15 |
| **Total** | **$1,506,211.41** | **$714,778.20** | **$2,220,989.61** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statement

- Historical tracks of multiple hurricane events pass within 25-miles of the NCSSM Campus.
- For the 25-year period from 2000 through 2024, Durham County experienced 4 hurricane wind events causing over $1,430,000.

## E.5.5 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Durham County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI), shown in Table E.26 for the Durham County region, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. Durham County may experience any level on the RSI scale. Durham County receives an average of 4 to 6 inches of snowfall per year. According to NCEI, the greatest snowfall amounts to impact Durham County have been between 7-12 inches, with Durham reporting around 9 inches of snowfall. During the snowstorm of January 17, 2018, the county was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

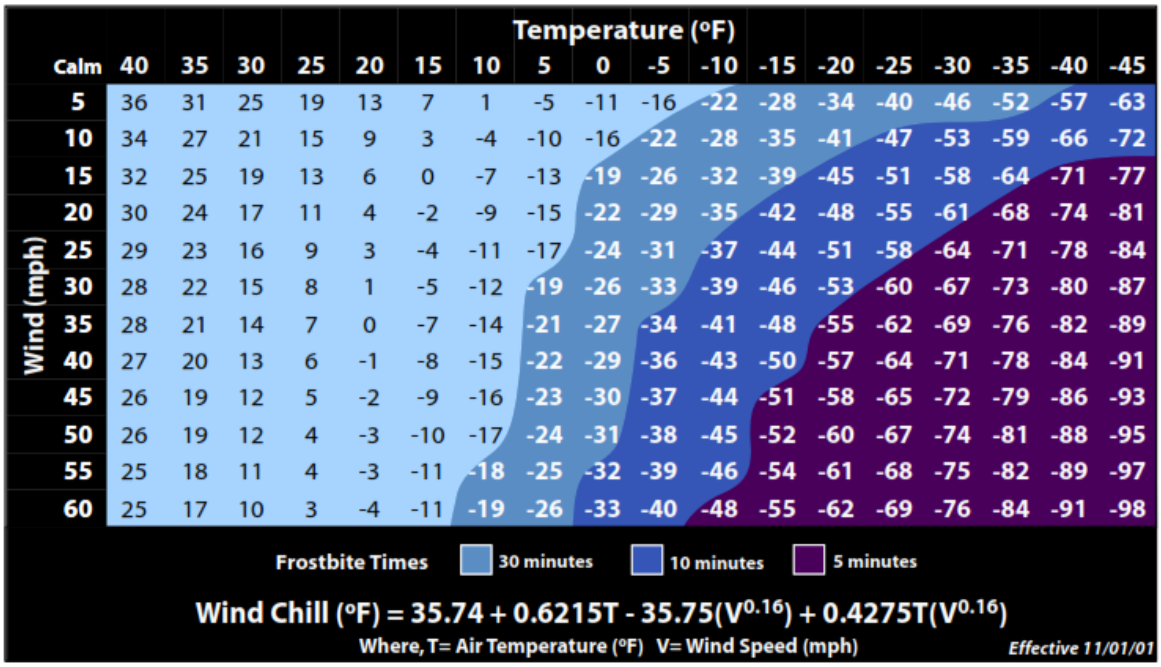
**Table E.26 – Regional Snowfall Index (RSI) Values**

| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure E.14, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure E.14 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Durham County took place December 18th, 1930, with a recorded depth of 18.5 inches of snow occurring within Rougemont, an unincorporated area of the County.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of a severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24-hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one heavy snow event, one ice storm, and 59 combined winter storm/winter weather events in Durham County during the 25-year period from 2000 through 2024. As reported in NCEI, severe winter weather caused $1,430,000 in property damage, but they did not cause any fatalities, injuries, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Durham County by incident are recorded in Table E.27**.**

**Table E.27 – Recorded Severe Winter Weather Events in Durham County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Heavy Snow | 1 | 0 | 0 | $0 | $0 |
| Ice Storm | 1 | 0 | 0 | $400,000 | $0 |

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Winter Storm | 26 | 0 | 0 | $1,000,000 | $0 |
| Winter Weather | 33 | 0 | 0 | $30,000 | $0 |
| **Total** | **61** | **0** | **0** | **$1,430,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **January 29, 2010** – Between 5 to 7 inches of snow fell across the county. Over 600 automobile accidents were reported in the county. Due to the cold temperatures icy road conditions persisted for several days resulting in the closure of schools and businesses.
- **March 6, 2014** – One quarter of an inch of ice from freezing rain resulted in widespread downed trees and powerlines. A strong surface low deepening off the Carolina coast brought a wintry mix of snow, sleet, and freezing rain to the northern-northwestern Piedmont counties. Snowfall amounts of 4 to 7 inches fell Forsyth, Person and Guilford counties. Just to the south and east of this area, a corridor of mainly sleet mixed with freezing rain produced significant icing of a quarter to half inch. This icing produced widespread downed trees and power outages over the northwest Piedmont. At the peak of the storm, over 400,000 customers were without power. A natural disaster was declared in 7 counties across the Raleigh CWA that were impacted by this storm.
- **February 25, 2015 –** Snowfall/sleet amounts of 6 to 8 inches fell across the county. The heavy wet snow caused widespread power outages from falling trees and power lines. At the peak of the storm, over 40,000 customers were without power in the county.
- **January 17, 2018** – Total snowfall amounts ranged from 7 to 12 inches across the county.
- **January 29, 2022 –** An upper low and associated arctic cold front brought precipitation to central North Carolina on the 28th and 29th. Precipitation began as rain on the afternoon of the 28th with a gradual mix and changeover to snow as the front moved through the area. Precipitation wrapped up early on the morning of the 29th. Most locations saw less than 1 inch of snowfall with this event, although there were some locations from Guilford to Randolph Co's that saw over 3 inches of snow.

Durham County has received four FEMA Major Disaster Declarations for a snowstorm in 1977, blizzard in 1996, and severe winter storms in 2000 and 2002.

## Probability of Future Occurrence

NCEI records 61 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $14,484 per day, assuming 10-percent of the on-campus population is impacted.

**Table E.28 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| On-Campus Population (2024) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 680 | 68 | $14,484 |

### Property

The NCEI reported $1,430,000 of property damage in association with any winter weather events between 2000 and 2024 for Durham County. Based on these records, the County experiences an estimated annualized loss of $57,200 in property damage. The average impact from winter weather events per incident in Durham is $23,442.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is out driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. NCSSM may wish to

consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statement

- Severe winter weather events are highly likely for Durham County and the NCSSM campus. The events have also resulted in three presidential disaster declarations for the County.

# E.5.6 Tornadoes/Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornado/Thunderstorm | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally confined to the footprint of its associated thunderstorm. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas.

*Spatial Extent: 4 – Large*

### TORNADO

Tornados can occur anywhere on NCSSM's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado damage isn't increased in one area of the campus versus another. All of NCSSM is exposed to this hazard.

### THUNDERSTORM WINDS

The entirety of NCSSM's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area, approximately 50% to 100% of the planning area could be impacted by one event.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of NCSSM is exposed to lightning.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates

(not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table E.29 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table E.29 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

The most intense tornadoes to pass through Durham County in the past 75 years were 3 F2s occurring in 1984, 1989, and 1998. Combined these incidents resulted in 5 injuries and caused $28.1 million in property damage.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage

The strongest recorded thunderstorm wind event for Durham occurred on August 15, 2023 with the highest gusts recorded at 73 mph on August 15, 2023. The event did not result in fatalities or injuries but did cause $26,500 in property damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table E.30, is a common parameter that is part of fire weather forecasts nationwide.

**Table E.30 – Lightning Activity Level Scale**

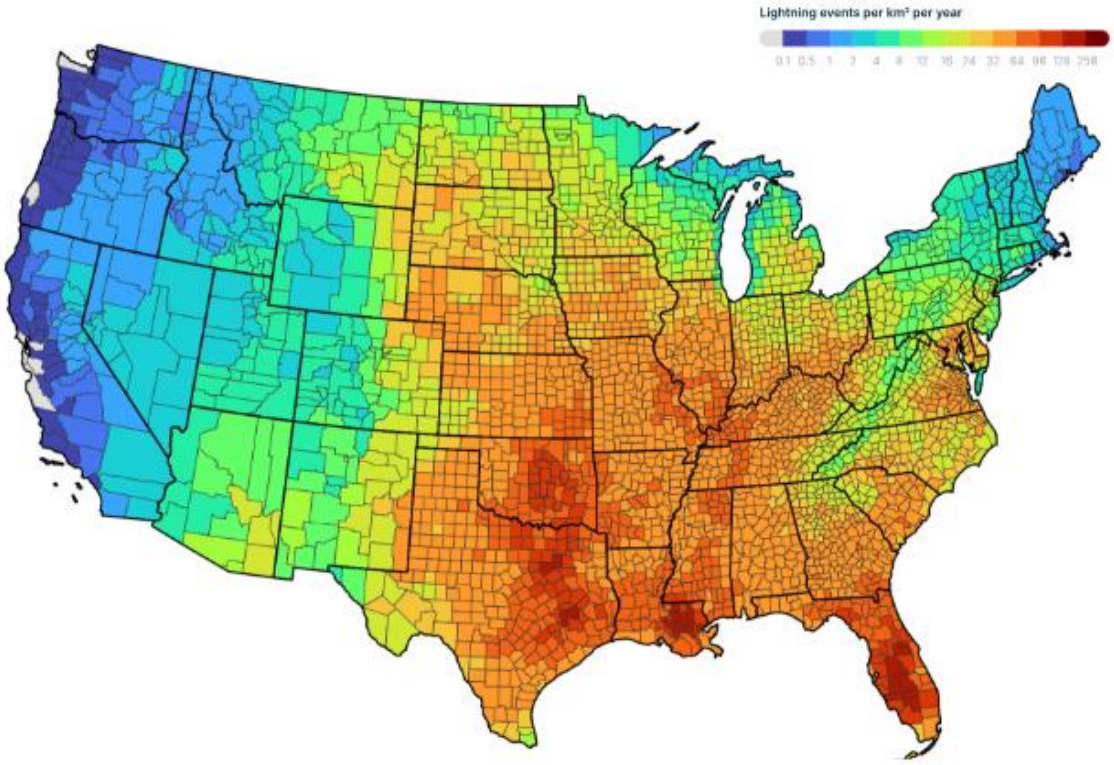
| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

According to the Vaisala flash density map, Durham County experiences between 16 and 24 lightning flashes per km per year.

**Figure E.15 – Lightning Density in the U.S. (2024)**




*Impact: 1 – Minor*

## HAIL

The National Weather Service classifies hail by diameter size and corresponding everyday objects to help relay scope and severity to the population, as listed in Table E.31.

**Table E.31 – Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts.

**Table E.32 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Durham was a little over 1" in diameter; the largest hailstone recorded was 1.75", recorded on April 17, 2000, July 28, 2005, May 14, 2006 and March 14, 2016.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Durham County experienced 5 injuries and $28.8 million dollars in property damage. Table E.33 shows historical tornadoes in

Durham County from 1950 to 2024, and Table E.33 shows tornado paths within 10 miles of NCSSM.

**Table E.33 – Recorded Tornadoes in Durham County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 12/31/1975 | 1615 | F0 | 0 | 0 | $250 |
| - | 4/4/1984 | 1800 | F2 | 0 | 4 | $2,500,000 |
| - | 5/5/1989 | 1720 | F2 | 0 | 0 | $25,000,000 |
| - | 7/16/1989 | 835 | F1 | 0 | 0 | $25,000 |
| Bahama | 3/20/1998 | 1830 | F2 | 0 | 1 | $600,000 |
| Gorman | 5/14/2006 | 1710 | F0 | 0 | 0 | $0 |
| Hope Vly | 5/15/2014 | 1710 | EF1 | 0 | 0 | $250,000 |
| Huckleberry Spg | 2/24/2016 | 1600 | EF1 | 0 | 0 | $100,000 |
| Clegg | 3/31/2022 | 1449 | EF1 | 0 | 0 | $100,000 |
| Weaver | 5/23/2022 | 1507 | EF0 | 0 | 0 | $150,000 |
| Mangum Store | 9/27/2024 | 1713 | EF1 | 0 | 0 | $30,000 |
| **Total** | | | | **0** | **5** | **$28,755,250** |

Source: NCEI

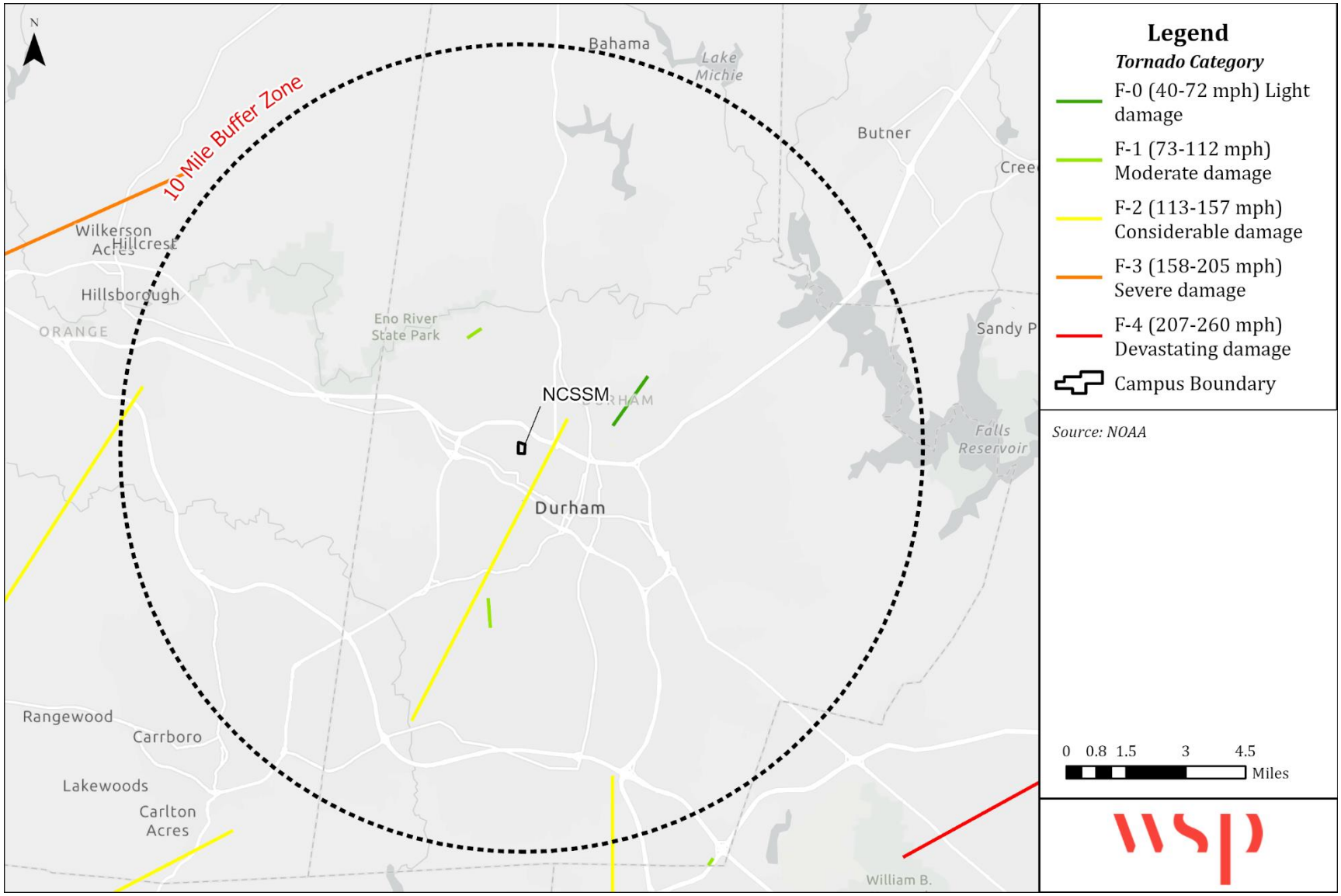
Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **April 4, 1984** – The tornado substantially damaged Northgate Mall and adjacent areas. Several cars in the parking lot were overturned. Parts of the mall roof were torn off, several houses were unroofed and four people were injured by flying glass. The tornado moved north-east to Quarry Park. Tree and roof damage occurred along its path.
- **May 5, 1989** – The tornado touched down 1.5 miles southwest of the intersection of Interstate 40 and State Highway 54. The tornado moved northeast and took a slightly “S” shaped path 8.75 miles long through the south and east part of the City of Durham. The storm reached its greatest intensity (F2) and with (100 yards) as it crossed State Highway 55 and Riddle Road. A convenience store was nearly demolished at this point. The tornado destroyed 16 homes and 2 businesses. It damaged 46 homes, 5 businesses, and an elementary school. In spite of the severe damage there were no deaths or serious injuries.
- **March 20, 1998** – A tornado first touched down in rural northeast Durham county off Bahama Road. The tornado moved northeast and took the roof off a manufactured home on a brick foundation. One minor injury occurred in the home. Down the road a half mile on Range Road, the tornado damaged farm sheds and sent sheets of tin flying in all directions. The tornado then hit a frame house with only minor roof damage. A large oak tree, without leaves, was snapped off at the base. Just 100 yards away, the tornado hit a manufactured home and reduced it to just splinters and rubble. The tornado picked up the home, turned it 90 degrees, and slammed it into the ground. The entire structure was then sheared off at the base and spread into the adjacent field and woods. Thankfully, no one was home at the time. This tornado reached its maximum intensity (F2) at this point. Minor damage occurred

down the road to some businesses and houses and the storm lifted before reaching the Person county line. Home damage was estimated by Emergency Management to be nearly $450K and damage to businesses was nearly $150K.

- **May 15, 2014** – A storm survey confirmed an EF-1 tornado near Durham. Damage consisted of dozens of snapped and uprooted trees and approximately 40 homes that experienced roof or other structural damage. Most of the damage to the homes was caused by falling trees and other debris. However, there were at least a half a dozen homes that experienced minor roof damage solely from the wind. In one case, a large oak tree was uprooted and fell onto a home, slicing through the roof and an exterior wall.
- **February 24, 2016** – The National Weather Service in Raleigh, NC has confirmed a brief tornado touchdown 5 miles northwest of downtown Durham in Durham County North Carolina. The touchdown occurred in a dense forest area near the intersection of Hillandale Road and Rose of Sharon Road. In this area, tree damage was extensive, mainly consisting of snapped trees.

**Figure E.16 – Tornado Paths within 10 Miles of NCCSM, 1950-2024**



### THUNDERSTORM WINDS

Between 2000 and 2024, the NCEI recorded wind speeds for 63 separate incidents of thunderstorm winds, occurring on 48 separate days, for Durham. These events caused $361,250 in recorded property damage and no injuries or fatalities. The recorded gusts averaged 58.3 miles per hour, with the highest gusts recorded at 73 mph on August 15, 2023. Wind gusts with property damage recorded averaged $14,450 in damage, with the highest reported damage being a total of $100,000 between multiple events on May 11, 2017. These incidents are aggregated by the date the events occurred and are recorded in Table E.34. These records specifically note Thunderstorm Wind impacts for Durham.

**Table E.34 – Recorded Thunderstorm Winds, Durham, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| DURHAM | 4/8/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 5/20/2000* | 58 | 0 | 0 | $0 |
| DURHAM | 5/25/2000 | 69 | 0 | 0 | $0 |
| DURHAM | 8/10/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 12/17/2000 | 58 | 0 | 0 | $0 |
| DURHAM | 8/27/2001 | 58 | 0 | 0 | $0 |
| DURHAM | 5/13/2002 | 58 | 0 | 0 | $0 |
| DURHAM | 9/15/2002 | 58 | 0 | 0 | $0 |
| DURHAM | 2/22/2003 | 58 | 0 | 0 | $0 |
| DURHAM | 6/11/2004 | 58 | 0 | 0 | $0 |
| DURHAM | 9/28/2004 | 69 | 0 | 0 | $0 |
| DURHAM | 1/14/2005 | 58 | 0 | 0 | $0 |
| DURHAM | 7/28/2005 | 58 | 0 | 0 | $0 |
| DURHAM | 4/3/2006 | 58 | 0 | 0 | $0 |
| DURHAM | 7/19/2006 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 6/9/2007* | 58 | 0 | 0 | $0 |
| WEST DURHAM | 7/4/2008 | 58 | 0 | 0 | $0 |
| WEST DURHAM | 7/9/2008 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 5/9/2009 | 58 | 0 | 0 | $0 |
| EAST DURHAM | 5/28/2010* | 58 | 0 | 0 | $0 |
| DURHAM | 6/23/2010 | 58 | 0 | 0 | $15,000 |
| WEST DURHAM | 8/5/2010 | 58 | 0 | 0 | $0 |
| DURHAM | 4/5/2011 | 58 | 0 | 0 | $25,000 |
| DURHAM | 2/24/2012 | 58 | 0 | 0 | $0 |
| WEST DURHAM | 6/29/2012 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 9/8/2012 | 58 | 0 | 0 | $750 |
| DURHAM | 6/11/2014 | 58 | 0 | 0 | $25,000 |
| WEST DURHAM | 6/19/2014* | 58 | 0 | 0 | $8,000 |
| EAST DURHAM | 6/29/2016* | 58 | 0 | 0 | $0 |
| WEST DURHAM | 5/11/2017* | 58 | 0 | 0 | $100,000 |
| WEST DURHAM | 6/10/2018 | 58 | 0 | 0 | $1,000 |
| DURHAM | 7/22/2018 | 58 | 0 | 0 | $5,000 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| WEST DURHAM | 4/19/2019* | 58 | 0 | 0 | $16,000 |
| WEST DURHAM | 6/20/2019 | 58 | 0 | 0 | $5,000 |
| DURHAM | 7/4/2019 | 58 | 0 | 0 | $20,000 |
| WEST DURHAM | 6/11/2020 | 58 | 0 | 0 | $2,500 |
| EAST DURHAM | 7/5/2020 | 58 | 0 | 0 | $40,000 |
| EAST DURHAM | 5/19/2022 | 58 | 0 | 0 | $0 |
| NORTH DURHAM | 5/23/2022 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 6/17/2022 | 63 | 0 | 0 | $0 |
| DURHAM | 1/12/2023 | 58 | 0 | 0 | $25,000 |
| WEST DURHAM | 6/19/2023* | 58 | 0 | 0 | $5,000 |
| WEST DURHAM | 8/7/2023 | 58 | 0 | 0 | $10,000 |
| WEST DURHAM | 8/15/2023* | 73 | 0 | 0 | $26,500 |
| DURHAM | 9/8/2023 | 58 | 0 | 0 | $1,500 |
| EAST DURHAM | 1/9/2024 | 58 | 0 | 0 | $5,000 |
| WEST DURHAM | 7/23/2024 | 59 | 0 | 0 | $0 |
| WEST DURHAM | 8/30/2024 | 58 | 0 | 0 | $5,000 |
| **Total** | | | **0** | **0** | **$344,750** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **April 8, 2000** – Strong wind gusts knocked down a tree that crashed into a mobile home and ripped a roof off a building.
- **April 3, 2006** – Tin roofs torn off a carport and barn and blown 1000 to 1500 feet downwind. Well house knocked down and shingles torn off a home on Shaw Road.
- **June 11, 2014** – Multiple trees were blown down within the city of Durham. In addition, 2 trees fell onto cars and 1 tree fell on a house. Monetary damage was unknown and were estimated.
- **July 4, 2019** – One tree was blown down onto a residence along Dacian Avenue in Durham. A lightning strike also resulted in a house fire near the 100 block of Presidents Drive.

### LIGHTNING

According to NCEI data, there were 2 lightning strikes reported between 2000 and 2024. The lightning strike event in 2007 recorded an estimated $10,000 worth of property damage. No crop damage, injuries, and fatalities were recorded by this strike. However, 3 people were injured in a lightning strike on September 8, 2021.

It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table E.35 details NCEI-recorded lightning strikes from 2000 through 2024 for Durham.

**Table E.35 – Recorded Lightning Strikes in Durham, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| DURHAM | 3/27/2007 | 2200 | 0 | 0 | $10,000 |
| DURHAM | 9/8/2021 | 1040 | 0 | 3 | $0 |
| | | **Total** | **0** | **3** | **$10,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Durham:

- **March 27, 2007** – Lightning struck an apartment complex and sparked a fire. There was no immediate information on the extent of the damage.
- **September 8, 2021** – Lightning struck an apartment complex along Broad Street and injured 3 men.

### HAIL

NCEI records 22 days with hail incidents between 2000 and 2024 in Durham. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the city was 1.75 inches, which occurred on four different occasions in 2000, 2005, 2006, and 2016. The average hail size of all events in the City was just over one inch in diameter. Table E.36 summarizes hail events for Durham. In some cases, hail was reported for multiple locations on the same day.

**Table E.36 – Summary of Hail Occurrences in Durham 2000-2024**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| DURHAM | 4/17/2000 | 1.75 |
| DURHAM | 4/29/2000 | 1 |
| DURHAM | 8/13/2000 | 0.75 |
| DURHAM | 8/27/2001 | 0.88 |
| DURHAM | 4/26/2003 | 0.75 |
| EAST DURHAM | 8/22/2003 | 0.75 |
| DURHAM | 10/3/2004 | 0.88 |
| DURHAM | 6/7/2005 | 0.75 |
| DURHAM | 7/28/2005 | 1.75 |
| DURHAM | 4/8/2006 | 0.75 |
| DURHAM | 5/14/2006 | 1.75 |
| DURHAM | 8/7/2006 | 0.75 |
| DURHAM | 7/27/2007 | 0.88 |
| WEST DURHAM | 3/4/2008 | 0.75 |
| NORTH DURHAM | 5/31/2008 | 1.25 |
| NORTH DURHAM | 6/2/2009 | 0.88 |
| WEST DURHAM | 5/27/2011 | 1 |
| WEST DURHAM | 3/24/2012 | 1.25 |
| DURHAM SKYPARK ARPT | 5/22/2012 | 1 |
| NORTH DURHAM | 3/14/2016 | 1.75 |

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| EAST DURHAM | 6/29/2016 | 1 |
| WEST DURHAM | 10/17/2022 | 0.75 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **July 28, 2005 –** Golf ball size hail was reported in Research Triangle Park.
- **May 22, 2012 –** Quarter sized hail was reported covering the ground along Interstate 85 near mile marker 184.
- **March 14, 2016 –** Hail up to the size of golf balls was reported along a swath from Duke Homestead Boulevard near Highway 157 to approximately 5 miles west-northwest of Gorman.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Durham averages 1.92 days with wind events per year. Over this same period, two lightning events were reported as having caused property damage or injuries, which equates to an average of 0.08 damaging lightning strikes per year.

The average hailstorm in Durham occurs in the evening and has a hail stone with a diameter of just over one inch. Over the 25-year period from 2000 through 2024, Durham experienced 22 days with reported hail incidents; this averages to 0.88 days per year with reported incidents somewhere in the City.

In a 75-year period between 1950 and 2024, Durham County experienced 11 tornado events. This correlates to 14.6% annual probability that the County will experience a tornado somewhere in its boundaries.

Based on these historical occurrences, there is between a 10% to 100% chance that Durham will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on NCSSM's campus.

## People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes. In 2021, a lightning event injured 3 people.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $14,484 per day, assuming 10-percent of the on-campus population is impacted.

**Table E.37 – Loss of Use Estimates for Power Failure Associated with Severe Winter Weather**

| On-Campus Population (2024) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 680 | 68 | $14,484 |

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population.

## Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Durham, the only event with recorded property damage was due to lightning striking a vehicle.

NCEI records lightning impacts over 25 years (2000-2024), with $10,000 in property damage recorded during one event in 2007. Based on these records, the planning area experiences an annualized loss of $400 in property damage. The average impact from lightning per incident in Durham is $5,000.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Durham, NCEI did not report any property damage as a direct result of hail.

It should be noted that property damage due to hail is usually an insured loss, with damage covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damage in Durham, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $361,250 in property damage, which equates to an annualized loss of $14,450 across the City.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in Durham County are directly responsible for $28,755,250 worth of damage to property according to NCEI data. This equates to an annualized loss of $383,403. It should be noted that just one tornado event in 1989 accounts for $25 million of property damage. Per the iRisk analysis, an F2 tornado event could cause over $209 million of estimated total building and contents damage on campus.

Table E.38 details the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table E.38 – Estimated Building Damage by Tornado Events, NCSSM Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $322,281.78 | $319,706.84 | $641,988.62 |
| Educational | $649,837.73 | $618,249.63 | $1,268,087.36 |
| Housing | $1,166,038.30 | $1,284,509.02 | $2,450,547.32 |
| **Total** | **$2,138,157.81** | **$2,222,465.49** | **$4,360,623.30** |
| **F1 Tornado Event** | | | |
| Administration | $2,594,565.06 | $2,573,835.29 | $5,168,400.35 |
| Educational | $5,231,590.47 | $4,977,287.09 | $10,208,877.56 |
| Housing | $9,387,320.24 | $10,341,081.89 | $19,728,402.13 |
| **Total** | **$17,213,475.77** | **$17,892,204.27** | **$35,105,680.04** |
| **F2 Tornado Event** | | | |
| Administration | $15,469,525.26 | $15,345,928.56 | $30,815,453.82 |
| Educational | $31,192,211.00 | $29,675,982.90 | $60,868,193.90 |
| Housing | $55,969,838.56 | $61,656,433.27 | $117,626,271.83 |
| **Total** | **$102,631,574.82** | **$106,678,344.73** | **$209,309,919.55** |
| **F3 Tornado Event** | | | |
| Administration | $15,469,525.26 | $15,345,928.56 | $30,815,453.82 |
| Educational | $31,192,211.00 | $29,675,982.90 | $60,868,193.90 |
| Housing | $55,969,838.56 | $61,656,433.27 | $117,626,271.83 |
| **Total** | **$102,631,574.82** | **$106,678,344.73** | **$209,309,919.55** |
| **F4 Tornado Event** | | | |
| Administration | $15,469,525.26 | $15,345,928.56 | $30,815,453.82 |
| Educational | $31,192,211.00 | $29,675,982.90 | $60,868,193.90 |
| Housing | $55,969,838.56 | $61,656,433.27 | $117,626,271.83 |
| **Total** | **$102,631,574.82** | **$106,678,344.73** | **$209,309,919.55** |

Source: NCEM iRISK Database

## Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statement

- The most intense tornadoes to pass through Durham County in the past 75 years were 3 F2s (EF2) occurring in 1984, 1989, and 1998. Combined, these incidents resulted in 5 injuries and caused $28.1 million in property damage.
- The strongest recorded thunderstorm wind event for Durham between 2000 and 2024 occurred on August 15, 2023 with a measured gust of 73 mph. This event reportedly resulted in no property damage.
- The average hailstone recorded between 2000 and 2024 was a little over one inch. The largest hailstone recorded was 1.75”, which occurred on four different occasions in 2000, 2005, 2006, and 2016.
- Tornadoes and thunderstorms are frequent hazard events in Durham County and the NCSSM campus. Reported damages for the 25-year period from 2000-2024 include $361,250 for thunderstorm winds and $10,000 for lightning strikes. Between 1950-2024, Durham County experienced $28.7 million in property damage due to tornadoes.

# E.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Minor | Large | More than 24 hrs | More than 1 week | 1.8 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 18 percent of the NCSSM campus is within the primary exposure category and 82 percent is within the secondary exposure category of the Functional WUI. Table E.39 details the Functional WUI acreage in the NCSSM campus, and Figure E.17 below shows the Functional WUI areas. On a county level, there are higher concentrations of primary exposure in the northern and eastern portions of the County. Durham County, particularly the outer perimeter, is predominately classified as Wildfire

Transmission Zone with very little to no housing density. The City of Durham has low to no exposure but is surrounded by secondary exposure and pockets of primary exposure in the developed areas outside the urban core. Wildfire transmission zone is found throughout the County with more contiguous areas concentrated in the north.

The expansion of residential development from urban centers out into more rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI increases the risk of wildfire.

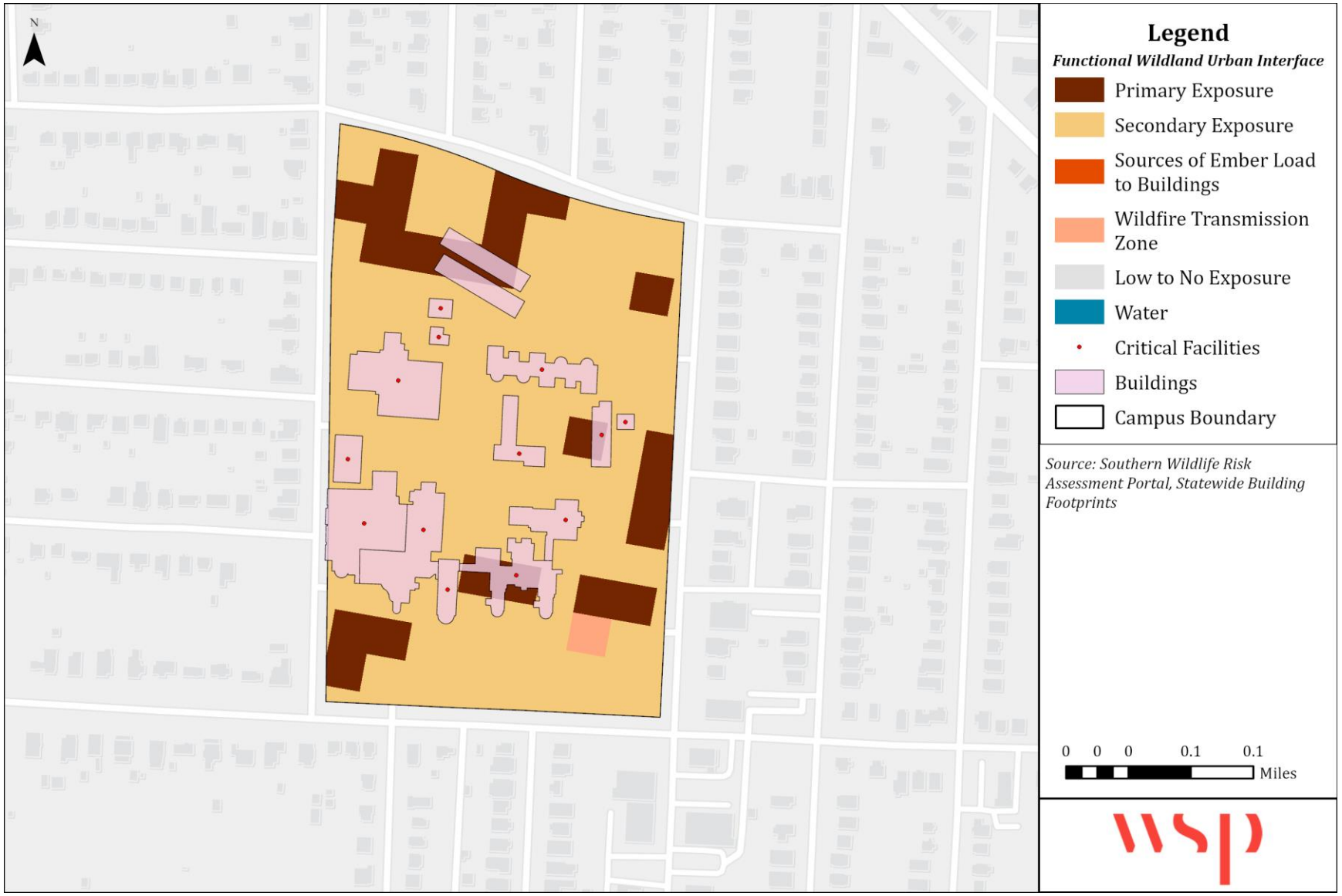
*Spatial Extent: 2 – Large*

**Table E.39 – Functional Wildland Urban Interface, NCSSM Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 5 | 18% |
| | Secondary Exposure | 22 | 82% |
| | Sources of Ember Load to Buildings | 0 | 1% |
| | Wildfire Transmission Zone | 0 | 0% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **27** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure E.17 – Wildland Urban Interface Areas, NCSSM**



## Extent

The entire state is at risk to a wildfire occurrence. 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.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table E.40, consists of five classes, as defined by SWRA. Table E.41 and

Figure E.18 detail the characteristic fire intensity scale across the NCSSM campus.

**Table E.40 – Fire Intensity Scale**

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

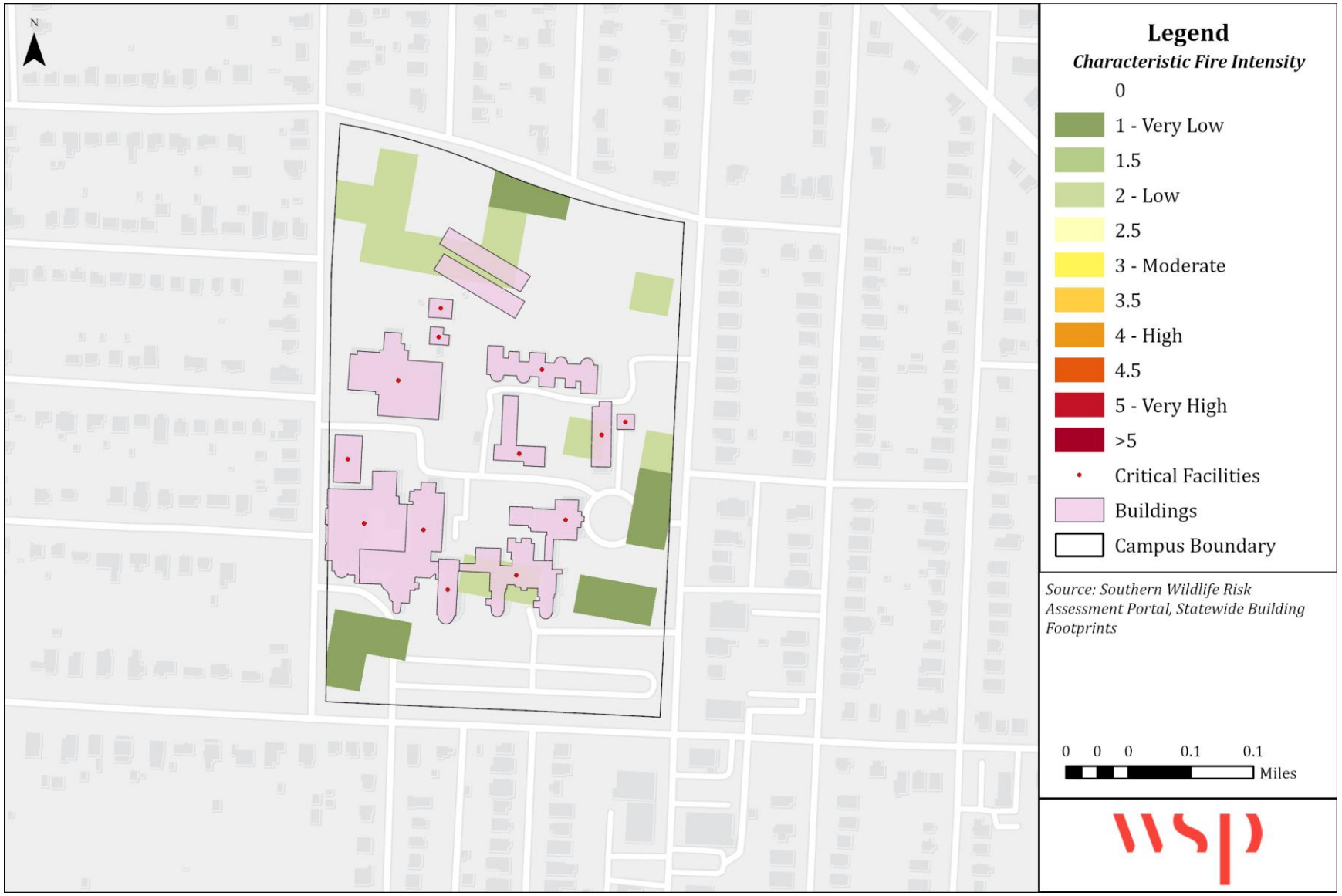
**Table E.41 – Characteristic Fire Intensity, NCSSM Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 22 | 82% |
| | 1 - Very Low | 2 | 7% |
| | 1.5 | 0 | 0% |
| | 2 - Low | 3 | 11% |
| | 2.5 | 0 | 0% |
| | 3 - Moderate | 0 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **27** | **100%** |

The majority of the campus (82%) is rated non-burnable on the characteristic fire intensity scale. The remaining portions of campus has very low or low fire intensity, which is characterized as areas where fires are easily suppressed. The areas with greatest potential fire intensity are within the WUI.

*Impact: 1 – Minor*

**Figure E.18 – Characteristic Fire Intensity, NCSSM**



## Historical Occurrences

Table E.42 lists past occurrences of wildfire in Durham County from 1999-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 690 noted wildfires within Durham County between 1999 and 2024. The total acreage burned during this period was 1,364 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Durham County experiences 27.6 fires and 54.6 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 1.98 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table E.42 – Records of Wildfire in Durham County, 1999 – 2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 1999 | 48 | 121.70 | 2.54 |
| 2000 | 21 | 117.20 | 5.58 |
| 2001 | 38 | 65.60 | 1.73 |
| 2002 | 27 | 97.00 | 3.59 |
| 2003 | 16 | 19.70 | 1.23 |
| 2004 | 21 | 21.60 | 1.03 |
| 2005 | 36 | 35.70 | 0.99 |
| 2006 | 40 | 92.10 | 2.30 |
| 2007 | 58 | 82.60 | 1.42 |
| 2008 | 18 | 106.60 | 5.92 |
| 2009 | 18 | 25.00 | 1.39 |
| 2010 | 20 | 58.50 | 2.93 |
| 2011 | 12 | 62.80 | 5.23 |
| 2012 | 8 | 196.00 | 24.50 |
| 2013 | 11 | 37.30 | 3.39 |
| 2014 | 3 | 33.00 | 11.00 |
| 2015 | 15 | 24.27 | 1.62 |
| 2016 | 33 | 3.70 | 0.11 |
| 2017 | 63 | 35.99 | 0.57 |
| 2018 | 28 | 8.96 | 0.32 |
| 2019 | 16 | 10.01 | 0.63 |
| 2020 | 10 | 4.94 | 0.49 |
| 2021 | 29 | 14.27 | 0.49 |
| 2022 | 38 | 52.61 | 1.38 |
| 2023 | 31 | 21.02 | 0.68 |
| 2024 | 32 | 15.96 | 0.50 |
| **Total** | **690** | **1,364.13** | **1.98** |

## Probability of Future Occurrence

The Southern Wildfire Risk Assessment provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the ECU campus is presented in Table 0 47 and illustrated in Figure 0 25.

**Table E.43 – Burn Probability, NCSSM Campus**

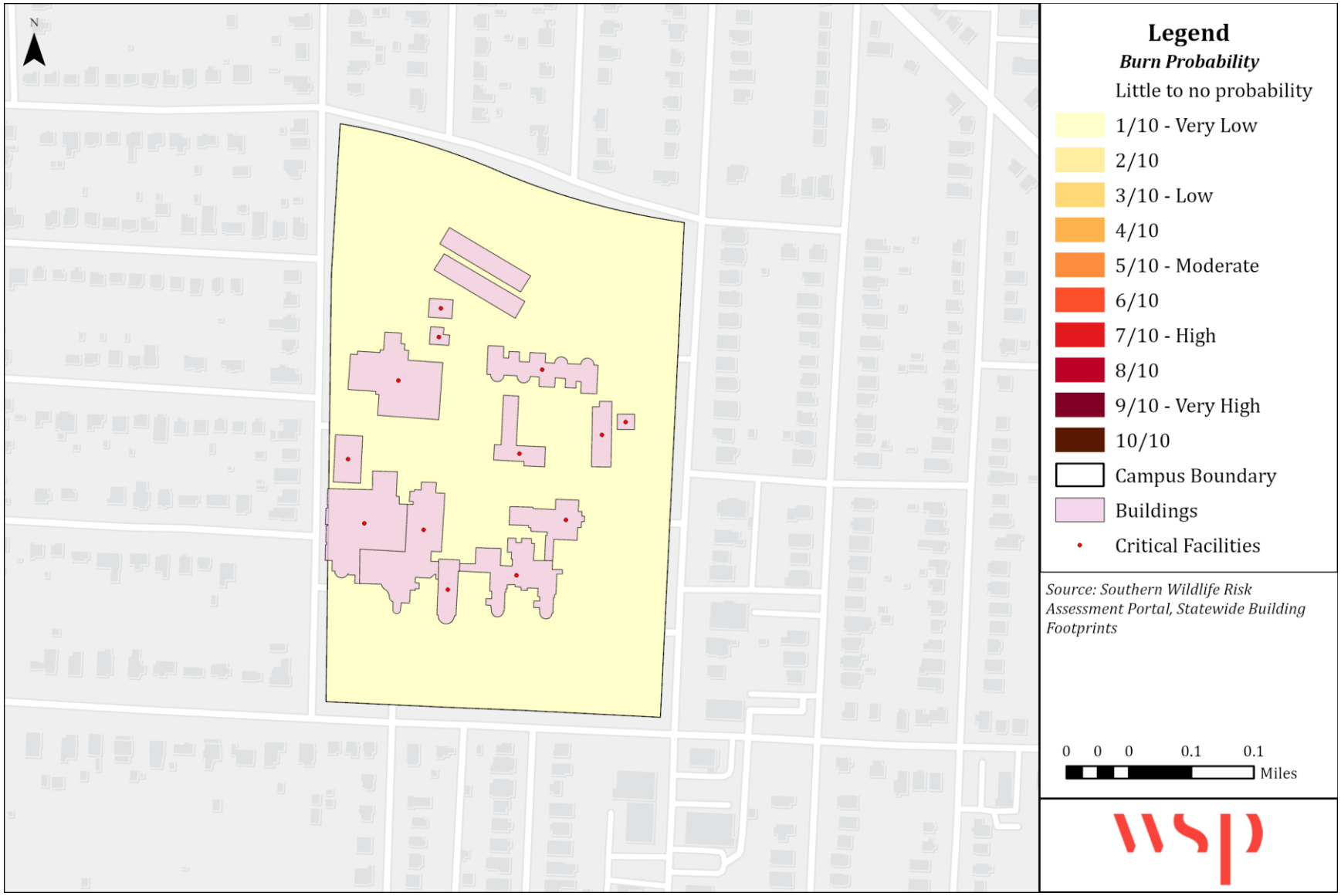
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 27 | 100% |
| | 2/10 | 0.0001000 - 0.0002154 | 0 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **27** | **100%** |

Source: Southern Wildfire Risk Assessment

The NCSSM campus has very low burn probability – 100 percent of the campus falls within burn probability category 1. Based on the SWRA results, the probability of wildfire across the campus is considered unlikely.

*Probability: 1 – Unlikely*

**Figure E.19 – Burn Probability, North Carolina School of Science and Mathematics**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10.

All of the 15 structures assessed on the NCSSM campus have a wildfire exposure score of 2/10 or relatively low vulnerability.

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the NCSSM campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. A wildfire community protection plan exists for the state of North Carolina. Durham County also has a Forest Protection Program to provide urban and community forestry planning and forest fire protection, among other programs.

## Problem Statement

- The entirety of the NCSSM campus falls within the Functional WUI; 18% of campus has primary exposure to wildfires.
- All 15 buildings on campus were given a Wildfire Exposure Score of 2/10.

## E.5.8 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Materials Incident | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |

### Location

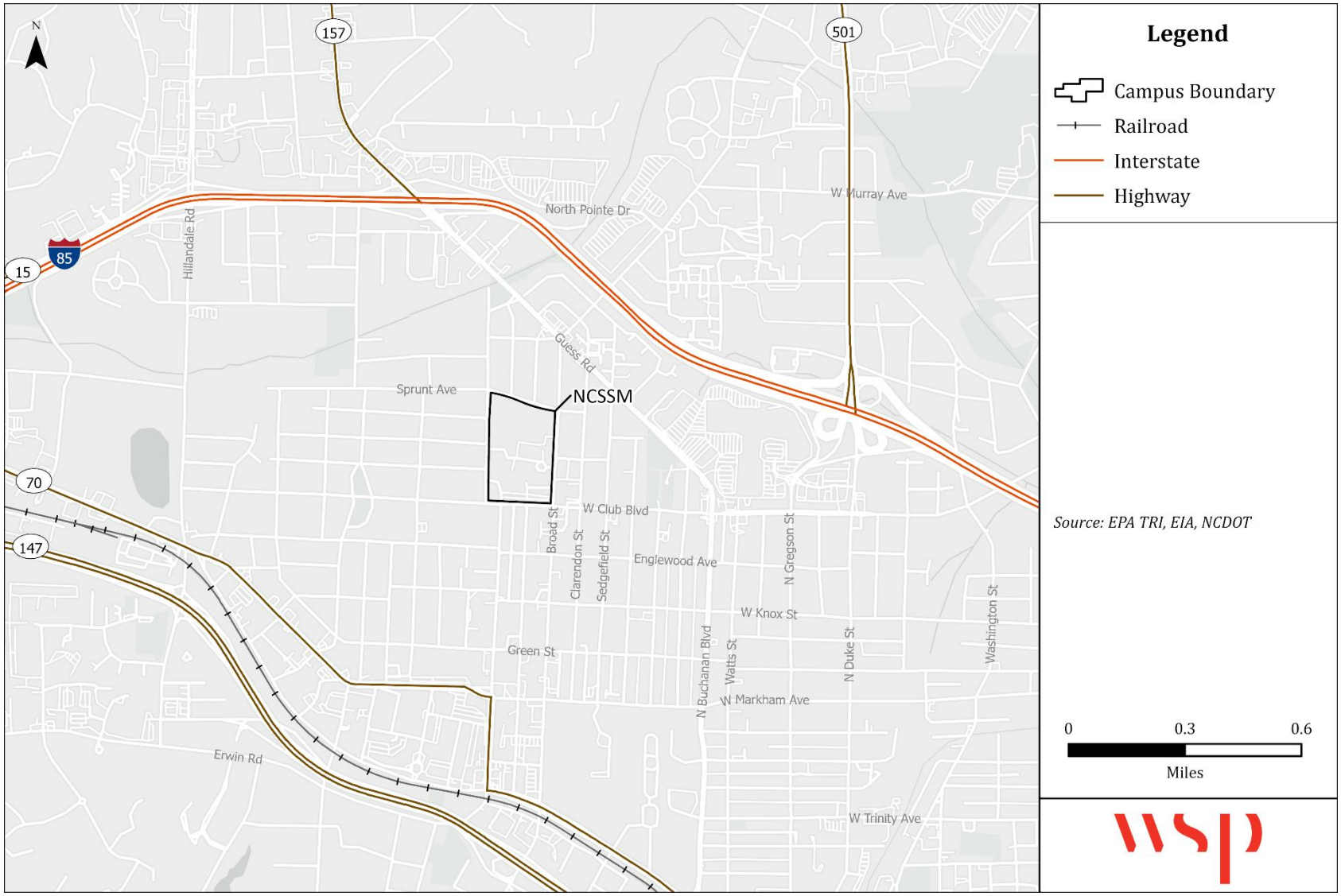
Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of NCSSM campus. HMPC identified three locations on NCSSM's campus with hazardous materials: the Boiler House, the maintenance and facilities area, and the Chemistry Department in Bryan Hall.

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure E.20 below shows the modes of transportation for hazardous materials adjacent to or through NCSSM's campus.

*Spatial Extent: 1 – Negligible*

**Figure E.20 – Major Transportation Routes, NCSSM**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damages, with clean-ups that can last for years.

*Impact: 1 - Minor*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 488 recorded releases in the City of Durham from 2000 through 2024. Of these events, only seven were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $407,196 in damage with 93 percent of all incidents occurring on highways and roads. The most common materials spilled in the City were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure E.21 describes all nine hazard classes.

**Figure E.21 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 488 incidents of hazardous materials release in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Durham.

However, the number of serious incidents is significantly lower: only 7 in 25 years or an average of 0.3 serious incidents per year. This means that based on historical data, there is a 28 percent annual chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility where hazardous materials are stored and used is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may be limited to the extent of the spill and remediated if needed. Cleanup costs from major spills can be significant, but do not typically cause significant long-term impacts to property.

Hazardous materials spills in Durham reported by PHMSA for the 25-year period from 2000 through 2024 totaled $407,196 in damage, which equates to an annualized loss of $16,287.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statement

- Transportation routes for hazardous materials are located adjacent to the NCSSM campus.
- The number of reported incidents within Durham can be approximated to over a 100 percent annual probability.

# E.5.9 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table E.44. according to the World Health Organization.

**Table E.44 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

Another way to measure the extent of an infectious disease is by using the case-fatality rate. The case-fatality rate does not represent the overall spread of the disease but rather the proportion of people diagnosed with the disease who die from it. It should be noted that the case-fatality rate has limitations because it does not take into account unreported cases.

The John Hopkins Coronavirus Resource Center reports that between March 2020 and March 2023, COVID-19 had a case fatality rate of 1.1%. The COVID-19 pandemic disproportionately killed older people, so case-fatality rate does vary significantly amongst age groups.

An additional way to measure extent is the number of deaths per 100,000 people. This captures confirmed cases, unreported cases, and healthy people. Between March 2020 and March 2023, the U.S. had 341.11 deaths per 100,000 people.

*Impact: 3 – Critical*

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by

March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Durham County experienced 103,643 cases of COVID-19 and 397 deaths. Per 100,000 people, Durham County experienced 123 deaths, significantly lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Durham County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 52 deaths to certain infectious and parasitic diseases, excluding COVID-19. The majority of these deaths (31) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Infectious Gastroenteritis, Tuberculosis, Listerial Meningitis, Herpes, Viral Hepatitis, HIV and Staph infection, and other unspecified infectious diseases.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of campus.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

Enrollment at NCSSM has remained steady over the past ten years with all 680 available on campus beds being filled nearly every year. As of Fall 2025, enrollment continues to remain steady with approximately 675 students living on the Durham campus. Due to the full occupancy of residential halls and close living quarters, it is likely that a pandemic could spread quickly throughout NCSSM campus.

## Problem Statement

- Based on the recent COVID-19 pandemic, it is clear the NCSSM campus population is susceptible to the infectious disease pandemic.
- NCSSM has a Pandemic Response Plan in place to provide a guide for the school to follow in the event of an infectious disease pandemic in North Carolina.

# E.5.10 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section E.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table E.45 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table E.45 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hours | Less than 1 week | 3.0 |
| Flooding | Possible | Minor | Negligible | 6 to 12 hrs | Less than 6 hours | 1.5 |
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorm | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Minor | Large | More than 24 hrs | More than 1 week | 1.8 |
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table E.46:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal. This is not a priority hazard.

**Table E.46 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Severe Winter Weather<br>Tornado / Thunderstorm |
| **Moderate Risk (2.0 – 2.9)** | Hurricane<br>Hazardous Materials<br>Infectious Disease |
| **Low Risk (< 2.0)** | Wildfire<br>Earthquake<br>Flooding |

# E.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- E.6.1 Overview of Capability Assessment
- E.6.2 Planning and Regulatory Capability
- E.6.3 Administrative and Technical Capability
- E.6.4 Fiscal Capability

## E.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## E.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table E.47 lists these local resources currently in place at NCSSM.

**Table E.47 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | NCSSM Strategic Plan 2024-2030 |
| Stormwater management program | N | Plant Facilities, Grounds Staff |
| Capital improvements plan | Y | |
| Local emergency operations plan | Y | 2022-2023 Emergency Preparedness & Crisis Response Plan |

More details on several relevant tools are provided below:

- **Strategic Master Plan** identifies a future vision, values, principles and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth.
- **Capital Improvement Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC System campus creates and maintains its own 6-year CIP, which helps inform the UNC System's overall CIP.
- **Emergency Preparedness & Crisis Response Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster.

## E.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table E.48 provides a summary of the administrative and technical capabilities for NCSSM.

**Table E.48 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | No | Plant Facilities, Grounds Staff |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | No | Plant Facilities, Grounds Staff |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | NCSSM Campus Safety & Security |
| Personnel skilled in GIS | Yes | Various Faculty |
| Grant Writer | Yes | Various Faculty |
| Public Information Officer | Yes | Communications/Director of Communications |
| Student Engagement | Yes | Student Services |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Warning Systems | Yes | Fire Alarm<br>(including smoke & sprinklers)<br>2 Outdoor Warning Sirens<br>RAVE Alert System |

Additional resources that may support administrative capability for mitigation include the following:

- **The NCSSM Communications Office** is responsible for providing information about NCSSM to the media, the full range of the NCSSM community, and to the general public.
- NCSM uses its basements as **shelters** for students and staff. Additionally, NCSSM has participated in **tabletop exercises** with local emergency management entities.

## E.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table E.49 provides a summary of the fiscal resources at NCSSM.

**Table E.49 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y, State Repair & Renovation Funding/Fundraising Initiatives |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y, Repair & Renovation |
| Sales & Services | Y |
| Other Sources<br>(Gifts, Investment Income, Permanent Endowments) | Y |

# E.7 Mitigation Strategy

## E.7.1 Implementation Strategy

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table E.50 details the status of mitigation actions from the previous plan. Table E.51 on

the following pages details all completed and deleted actions from the 2011 plan. More detail on the actions being carried forward is provided in the Mitigation Action Plan.

**Table E.50 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| NCSSM | 3 | 14 | 9 |

### Table E.51 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| NCSSM1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Physical Education Center. | Delete | This is a maintenance issue. |
| NCSSM4 | Bryan Center and Beall Hall - The cupolas and dumb waiter towers are in poor condition and rapidly deteriorating. The cupolas and dumb waiters should be repaired before a severe storm causes more extensive damage. | Delete | This is a maintenance issue. |
| NCSSM6 | Educational Technology Complex - Several areas of the roof do not have snow guards and personnel report large chunks of ice/snow fall off the roof during winter weather. Snow guards should be added to the roof in areas frequented by pedestrians. | Delete | Consolidate all snow guard actions |
| NCSSM7 | Educational Technology Complex - Several clay tiles were observed to be missing at the time of the inspection. The missing roof tiles should be replaced and the fascia boards repainted to prevent further deterioration. | Delete | This is a maintenance issue. |
| NCSSM8 | Educational Technology Complex - Flashing was found to be falling off the façade in several locations. The fascia boards were showing signs of weathering and need to be repainted. The deteriorating flashing should be repaired to prevent water damage. | Delete | This is a maintenance issue. |
| NCSSM9 | Hill House - There is an area of the tunnel roof experiencing water intrusion, leading to moisture damage. The moisture intrusion issue in the tunnel should be corrected to prevent further structural deterioration. | Delete | This is a maintenance issue. |
| NCSSM10 | Hunt Hall - The EIFS coating has reached the end of its service life and needs to be waterproofed to prevent water intrusion. The EIFS system should be re-waterproofed to prevent water intrusion and mold growth. | Completed | |
| NCSSM11 | Hunt Hall - The outdoor water heater should be relocated to the mechanical basement to protect it from severe weather. The outdoor water heater should be relocated to the basement mechanical room to protect it from severe weather. | Completed | |
| NCSSM12 | Physical Education Center - The existing fiberglass skylight panels are degrading and are close to the end of their service life. The fiberglass skylight panels should be retrofitted or replaced to ensure their performance during storm events. | Delete | This is a maintenance issue. |
| NCSSM13 | Reynold's, ITS, and Art Studio - Reynolds Hall does not have snow guards on the roof. Personnel report large sheets of snow/ice fall off of roof during winter weather. Snow guards should be added to the roof over areas frequented by pedestrians or where falling debris causes gutter damage. | Delete | Consolidated all snow guard actions |

| Action # | Action Description | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| NCSSM14 | Reynold's, ITS, and Art Studio - The cupolas and dumb waiter towers are in poor condition and rapidly deteriorating. The cupolas and dumb waiters should be repaired before a severe storm causes more extensive damage. | Delete | This is a maintenance issue. |
| NCSSM15 | Reynold's, ITS, and Art Studio - Gutters were in poor condition with numerous missing or damaged segments. The gutters and downspouts should be repaired to reduce water damage to the facility's facade. | Delete | This is a maintenance issue. |
| NCSSM18 | Royall Center - Royall Center does not have snow guards on the roof. Personnel report large sheets of snow/ice fall off of roof during winter weather. Snow guards should be added to the roof in areas frequented by pedestrians or where falling debris causes gutter damage. | Delete | Consolidated all snow guard actions |
| NCSSM19 | Royall Center - The building only has one network path back to ITS. The existing network path must pass through three other buildings before reaching ITS. The facility hosts critical network services. A supplemental direct network connection should be installed between Royall and ITS to enhance redundancy. | Completed | |
| NCSSM22 | Watts Hall - Many areas of gutter are either missing or damaged. The gutters and downspouts should be repaired to direct water away from the facility. | Delete | This is a maintenance issue. |
| NCSSM23 | Watts Hall - The wood framed windows are beginning to deteriorate from moisture damage. The windows should be repaired and painted as necessary to prevent further deterioration. | Delete | This is a maintenance issue. |
| NCSSM26 | Watts Hall - Reynolds Hall does not have snow guards on the roof. Personnel report large sheets of snow/ice fall off of roof during winter weather. Snow guards should be added to the roof in areas frequented by pedestrians or where falling debris causes gutter damage. | Delete | Consolidated all snow guard actions |

## E.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for NCSSM. Each mitigation action recommended for implementation is listed in this table along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table E.52 – Mitigation Action Plan, NCSSM**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCSSM1 | Campus-Wide – Upgrade back-up power capabilities to critical facilities as needed. | All Hazards | 1.1 | Medium | Property Protection | Plant Facilities | $5,000-$100,000 per site | Operating Budget | 2021-2026 | Carry Forward | No progress reported, but backup power remains a need. |
| NCSSM2 | Beall Hall, the Educational Technology Complex, Reynolds Hall, Royall Center, and Watts Hall do not have snow guards on the roof. Large sheets of snow/ice may fall off of roof during winter weather. Snow guards should be added to the roof in areas frequented by pedestrians or where falling debris causes gutter damage. | Severe Winter Weather | 1.2 | High | Property Protection | Plant Facilities | <$5,000 | Operating Budget | 2021-2026 | Carry Forward | Consolidated all existing snow guard actions |
| NCSSM3 | Bryan Center - Consideration should be given to adding a limited battery backup for radio equipment in the Bryan penthouse. | Tornadoes & Thunderstorms | 1.1 | Low | Property Protection | Plant Facilities | $5,000-$25,000 | Operating Budget, State/ Federal Grants | 2021-2026 | Carry Forward | Action revised to remove maintenance activities |
| NCSSM4 | Reynolds and Art Studio - The drains in Reynolds wing C have clogged in the past causing water damage. Reynolds wing C should have an emergency drain added at ground level to prevent water damage in the event of primary drainage failure. | Flood | 1.2 | Low | Structural Projects | Plant Facilities | $5,000-$25,000 | Operating Budget, State/ Federal Grants | 2021-2026 | Carry Forward | No progress reported |
| NCSSM5 | Reynolds and Art Studio - Many of the windows, particularly in the breezeway are in poor condition and would likely blow open in an intense storm. Older windows should be repaired and upgraded to withstand intense storms. | Hurricane, Tornadoes & Thunderstorms | 1.2 | High | Property Protection | Plant Facilities | <$5,000 | Operating Budget | 2021-2026 | Carry Forward | No progress reported |
| NCSSM6 | Chiller Plant and Boiler Plant - The Boiler Plant's electrical service enters through a switch and transformer located below windows which are already damaged and could allow water to damage the equipment. The windows in the Boiler Plant should be replaced with impact resistant windows to prevent water damage to electrical equipment. | Tornadoes & Thunderstorms | 1.2 | Low | Property Protection | Plant Facilities | <$5,000 | Operating Budget | 2021-2026 | Carry Forward | No progress reported |
| NCSSM7 | Chiller Plant and Boiler Plant - The steam distribution piping has exceeded its service life and has many leaks. The steam distribution system should be repaired as required to ensure it is serviceable during an emergency. | All Hazards | 1.2 | High | Property Protection | Plant Facilities | <$5,000 | Operating Budget | 2021-2026 | Carry Forward | No progress reported |
| NCSSM8 | Watts Hall - The basement stairwells rely on gravity drains. Flooding of the basement would ruin insulation on cold/hot water piping. Supplemental emergency drainage should be installed in the basement area to prevent another flood event. | Flooding | 1.2 | High | Structural Projects | Plant Facilities | $5,000-$25,000 | Operating Budget, State/ Federal Grants | 2021-2026 | Carry Forward | No progress reported |
| NCSSM9 | Watts Hall - The building's dewatering system is poorly designed and there is evidence of ongoing water penetration through the basement walls. Existing design requires facility personnel to manually connect dewatering pumps to power using an extension cord. The dewatering system should be modified to allow it to continuously pump automatically, rather than relying on manual operation. | Flooding | 1.2 | High | Property Protection | Plant Facilities | $5,000-$25,000 | Operating Budget | 2021-2026 | Carry Forward | No progress reported |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM



# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

## Annex F: North Carolina State University

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# Annex F. North Carolina State University

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and following subsections:

- F.1 Planning Process Details
- F.2 Campus Profile
- F.3 Asset Inventory
- F.4 Hazard Identification
- F.5 Hazard Profiles, Analysis, and Vulnerability
- F.6 Capability Assessment
- F.7 Mitigation Strategy

## F.1 Planning Process Details

Table F.1 lists the HMPC members who represented NCSU during the planning process.

**Table F.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Chris Octetree | Emergency Manager; Emergency Management and Mission Continuity |
| Todd Becker | Director; Emergency Preparedness |
| Ian Toms | University Fire Marshal; Fire and Life Safety |
| Alicia Knight | Associate Vice Chancellor; Environmental, Health, and Public Safety |
| Doug Morton | Associate Vice Chancellor; Facilities |
| Allen Boyette | Assistant Vice Chancellor; Campus Operations and Maintenance |
| Drew Nicholson | Manager; Insurance and Risk Management |
| Greg Sparks | Associate Vice Chancellor; Communication Technologies |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

Table F.2 lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table F.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| NCSU Physical Master Plan | The NCSU Physical Master Plan, developed in 2014, was referenced for the Campus Profile in Section F.2 as well as the Capability Assessment in Section F.6 |

| Resource Referenced | Use in this Plan |
|---|---|
| Wake County and Incorporated Areas Flood Insurance Study (FIS), Revised 7/19/2022 | The FIS report was referenced in the preparation of flood hazard profile in Section F.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section F.5. The plan was additionally used to track implementation progress (Section 2) and develop the mitigation plan (Section 7). |
| Wake County Multi-Jurisdictional Hazard Mitigation Plan, 2024 | The Wake County Multi-Jurisdictional Hazard Mitigation Plan was referenced in compiling the Hazard Identification and Risk Assessment in Section F.5. |

# F.2 Campus Profile

This section provides a general overview of the North Carolina State University (NCSU) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## F.2.1 Location and Setting

NCSU is located in Raleigh, North Carolina. Situated midway between the Blue Ridge Mountains and the Atlantic Ocean, Raleigh is North Carolina's capital city and is located in the heart of the state's Triangle region and minutes from world-renowned Research Triangle Park, the largest research park in the world and home to industry giants like IBM Cisco, GlaxoSmithKline, Lenovo, Nortel Networks, Sony Ericsson and others.

With a campus size of 2,099 acres consisting of over 1,000 buildings, NCSU is the largest four-year college in the state and offers more than 300 undergraduate and graduate degree programs through 68 departments. NCSU also has more than 700 student organizations, along with 70 intramural and club sports programs and 22 Division I varsity teams, which help cater to any area of interest a student may have, whether it be political, athletic, professional, social, ethnic, or academic.

As a land-grant university, NCSU strives to help create a better world through community service. NCSU's students serve those in need on campus, across North Carolina and around the globe, and their commitment to service is a key reason NC State made the 2012 and 2013 President's Higher Education Community Service Honor Roll.

Interstates 40 and 440 along with US Highways 401 and 70 make the University easily accessible by automobile. Raleigh also offers different modes of public transportation throughout the city.

Figure F.1, Figure F.2, and Figure F.3 provide base maps of the Centennial, North, Central, South, and West campuses that make up NCSU's main campus. For more details on campus buildings and critical facilities, see Section F.3.

**Figure F.1 – NCSU Campus Base Map – Centennial Campus**

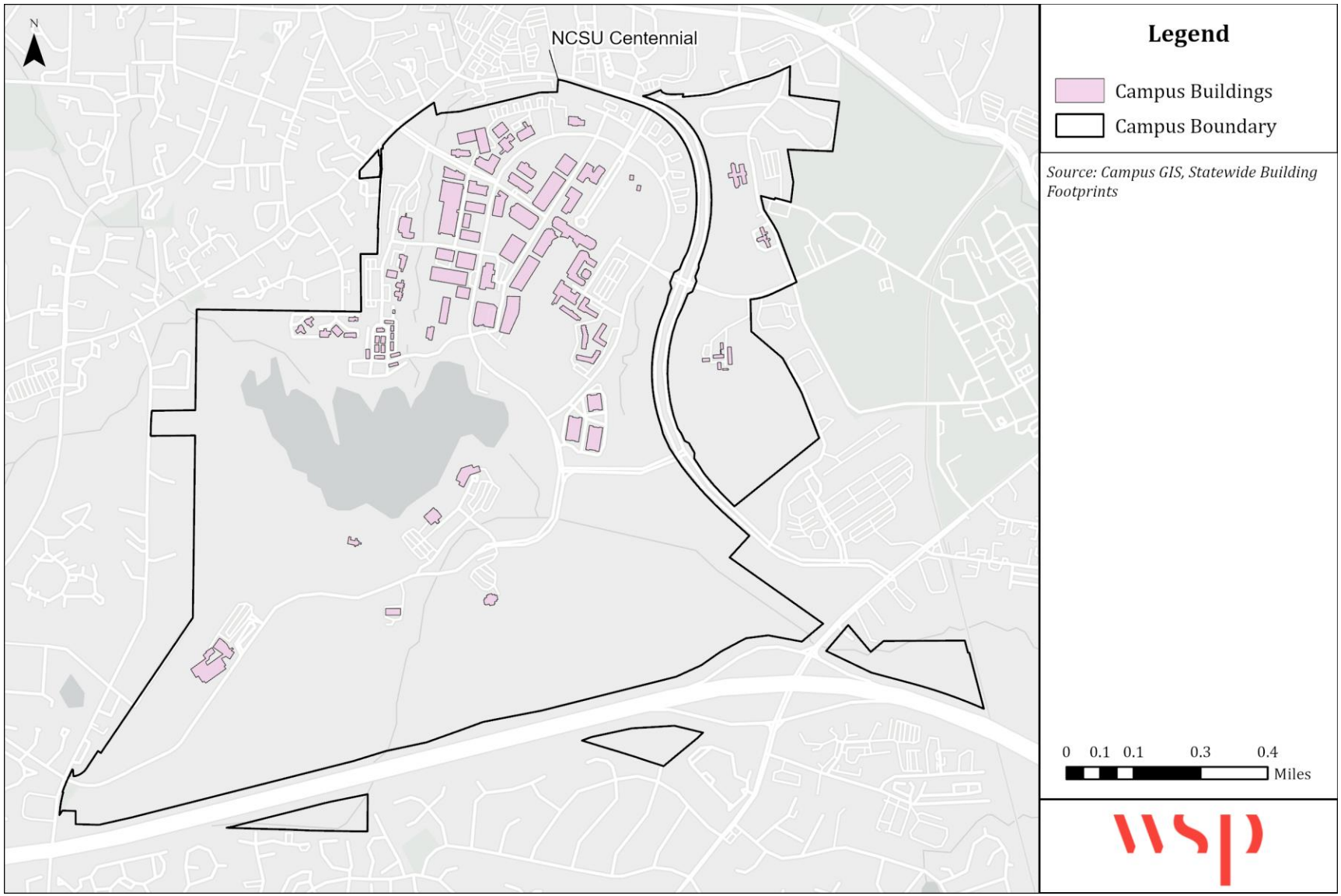


**Figure F.2 – NCSU Campus Base Map – North, Central, and South Campus**

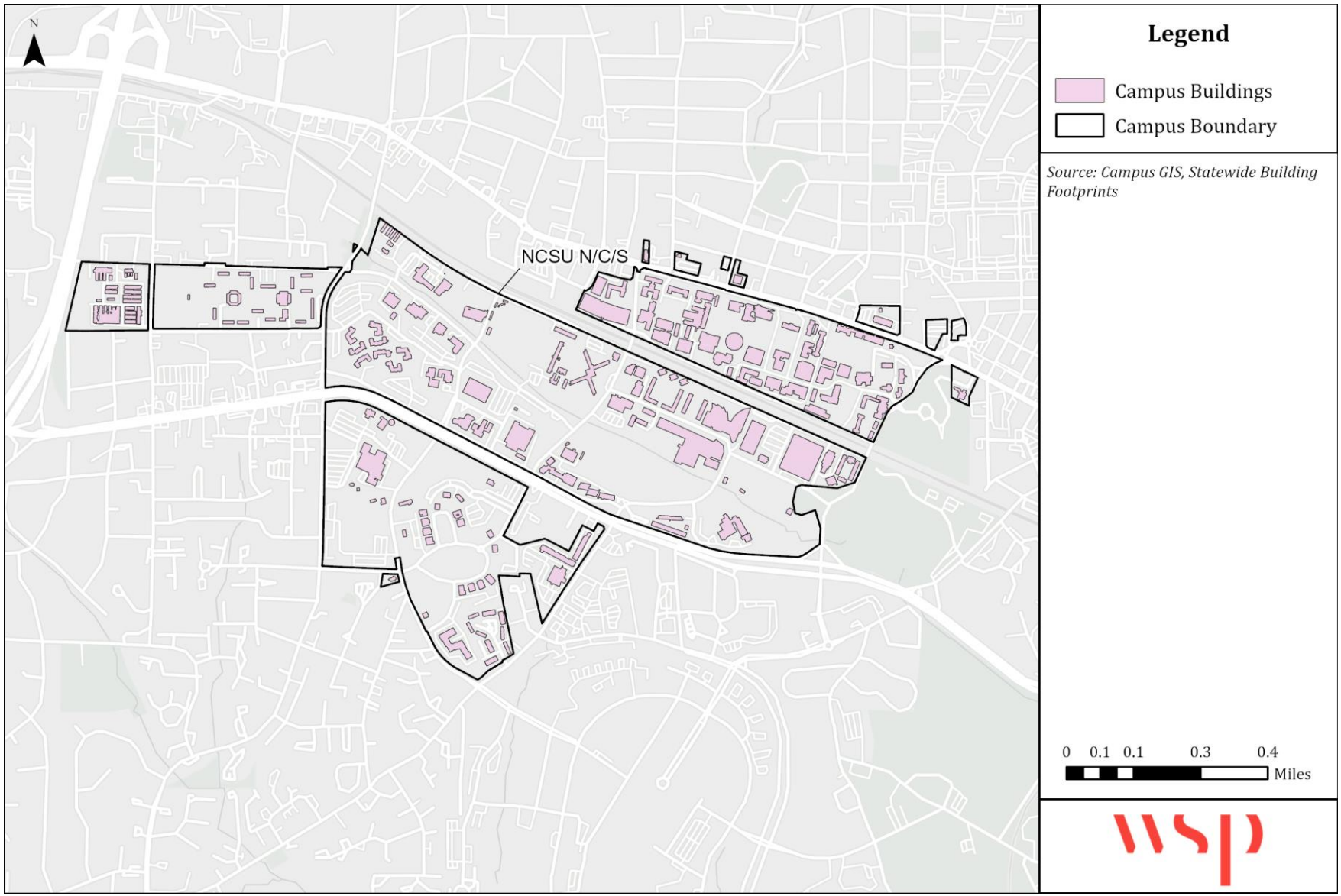
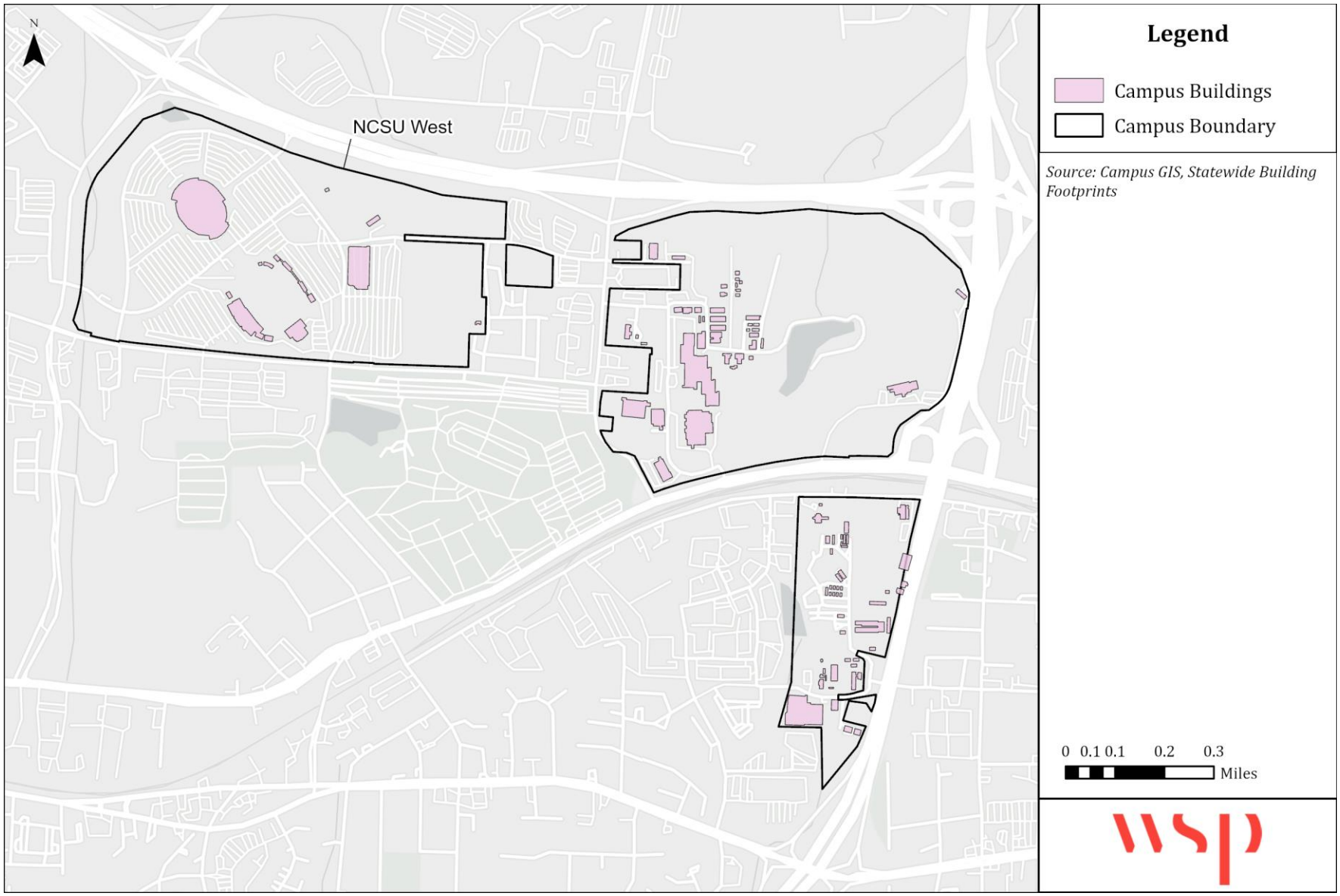


**Figure F.3 – NCSU Campus Base Map – West Campus**



## F.2.2 Geography and Climate

NCSU is in Raleigh, in the eastern part of North Carolina's Piedmont region. NCSU's campus is largely flat with a few rolling hills, which reflects the topography of the Piedmont region. In addition, the central location of Raleigh provides driving access to both the coastal region in the east and to the mountains in the west. Raleigh has a favorable, mild climate with max temperatures dropping to 51 degrees Fahrenheit on average in January and climbing to 89 degrees Fahrenheit on average in July. The annual precipitation for the city is approximately 45 inches per year. Average annual temperature and precipitation for Wake County are shown in Figure F.4 and Figure F.5.

**Figure F.4 – Average Annual Temperature, Wake County**

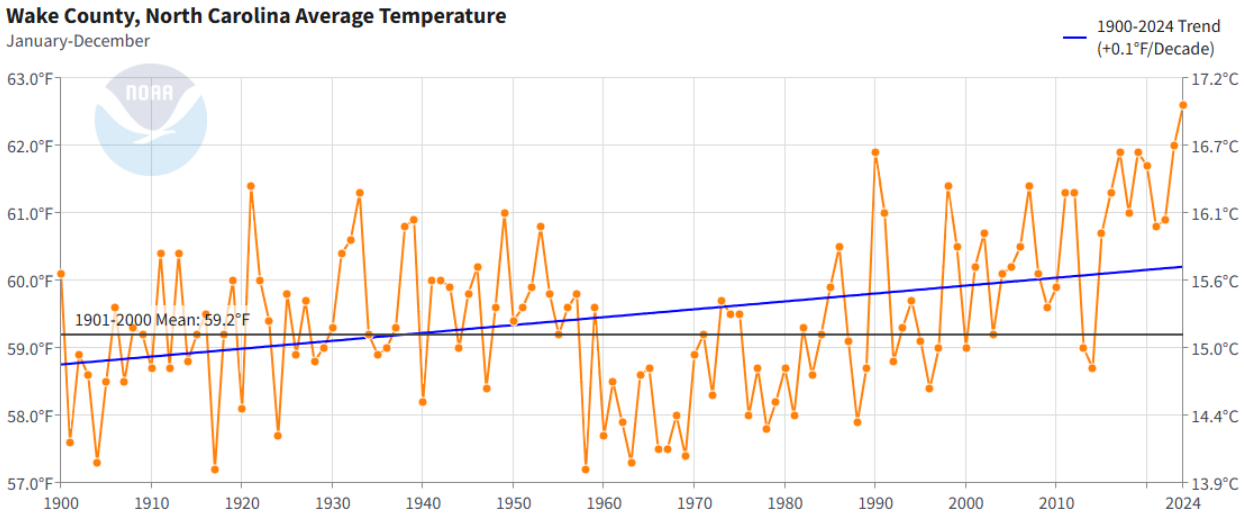
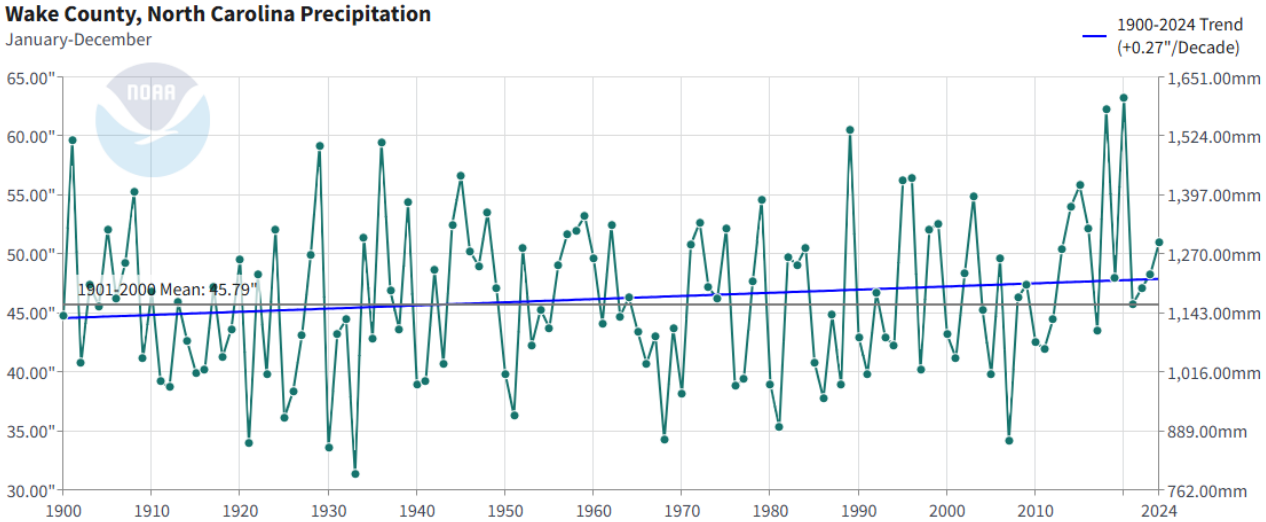



**Figure F.5 – Average Annual Precipitation, Wake County**



## F.2.3 Population and Demographics

Table F.3 provides population counts for NCSU from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to NCSU's website, the campus has a student to faculty ratio of 15 to 1 and supports over 2,500 faculty and 7,700 staff members.

**Table F.3 – Population Counts for North Carolina State University, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **39,259** |
| *Undergraduate Students* | 29,340 |
| *Graduate Students* | 9,919 |
| *Full-Time Students* | 35,723 |
| *In-State Residency* | 32,018 |
| *Out-of-State Residency* | 7,241 |

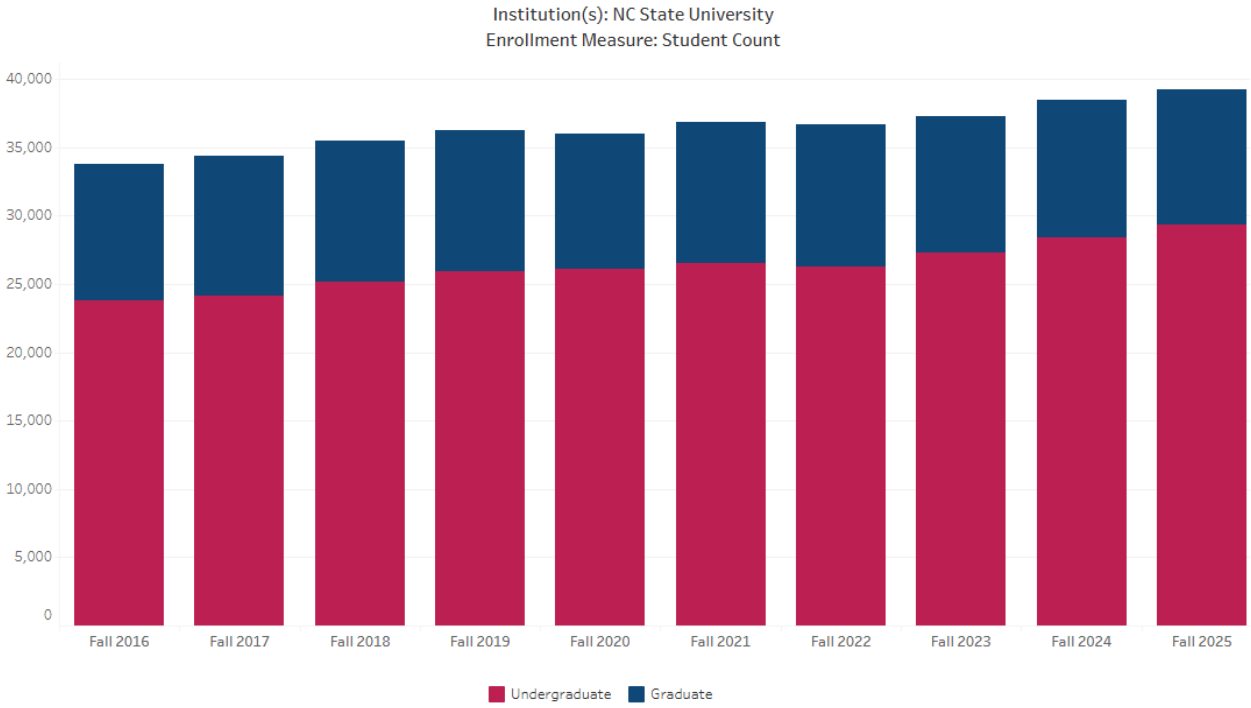
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Wake, Mecklenburg, and Guilford Counties as well as other counties located in the central region of North Carolina. Approximately 33.2% of all enrolled students come from Wake County.

Among the NCSU student population, the most popular majors for undergraduates were Engineering, Business Management, and Biological and Biomedical Sciences. The top graduate majors were Engineering, Education, and Business Management.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure F.6. Enrollment has increased slightly over the last five years.

**Figure F.6 – NCSU Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 23,827 | 24,150 | 25,199 | 25,973 | 26,150 | 26,505 | 26,254 | 27,323 | 28,422 | 29,340 |
| Graduate | 9,928 | 10,282 | 10,280 | 10,331 | 9,892 | 10,326 | 10,446 | 10,000 | 10,042 | 9,919 |
| Total | 33,755 | 34,432 | 35,479 | 36,304 | 36,042 | 36,831 | 36,700 | 37,323 | 38,464 | 39,259 |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table F.4.

**Table F.4 – NCSU Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 117 | 0.3% |
| Black or African American | 2,446 | 6.2% |
| Hispanic or Latino | 3,562 | 9.1% |
| Two or More Races | 1,816 | 4.6% |
| Asian | 3,622 | 9.2% |
| Native Hawaiian or Other Pacific Islander | 19 | 0.0% |
| White | 23,574 | 60.0% |
| Race/Ethnicity Unknown | 661 | 1.7% |
| U.S. Nonresident | 3,442 | 8.8% |

Source: UNC System Interactive Data Dashboards

## F.2.4 Growth and Development Trends

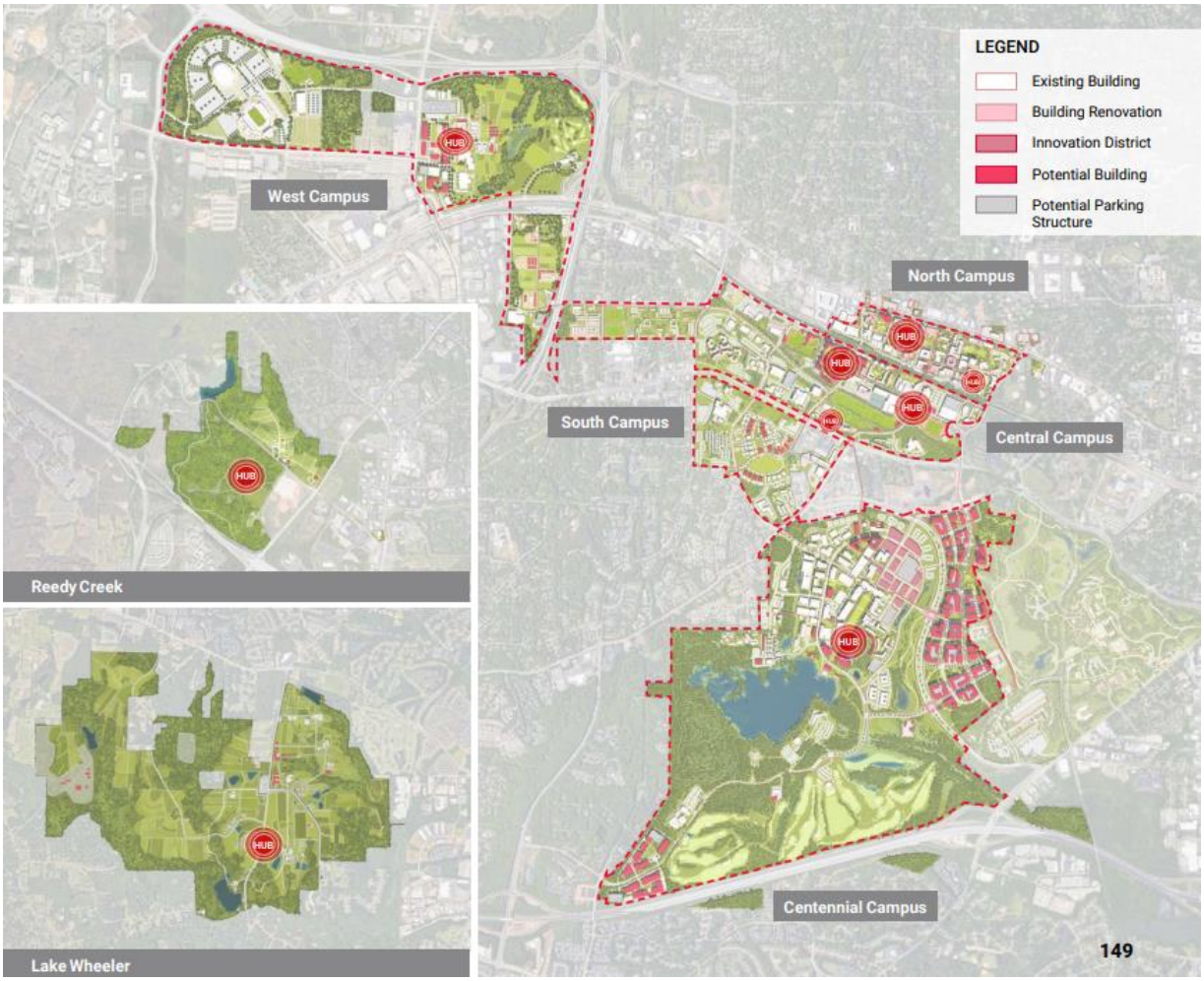
According to NCSU's website, the university is currently working on multiple renovation projects such as widening Ligon Bridge which crosses over I-440 and connects West Campus to Central Campus. NCSU has made multiple renovations to several academic buildings across campus and has been working on a new Integrative Sciences Building that is scheduled to open in 2026.

Additionally, the university plans to demolish and replace the Lee, Sullivan, Bragaw, and West Dunn Residence Halls and the Fountain Dining Hall located on the Central Campus precinct.

According to the 2023 NCSU Physical Master Plan Update, the overarching intent and vision of future growth is to strengthen the academic, research, and student life experience on campus through the addition of new facilities, renovations, open spaces, and the creation of dynamic, new Neighborhood Hubs throughout all campus precincts. NCSU has a polycentric campus organization system, and they are focused on improving and building around the established neighborhood hubs of each campus precinct.

Additionally, this plan highlights “Opportunity Zones” across campus that highlight areas of potential acquisition or growth in the future but the specific use for these areas has not yet been identified. Figure F.7 shows the neighborhood hubs and locations of campus improvements across all campus precincts.

**Figure F.7 – Building Improvement Plans for NCSU**




Source: NCSU Physical Master Plan, 2023

# F.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the NCSU campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## F.3.1 Building Exposure

Table F.5 through Table F.7 provide total building exposure for NCSU's campuses, which was estimated by summarizing building footprints and building replacement values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table F.5 – NCSU Centennial Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 8 | $24,638,274.96 |
| Educational/Extracurricular | 54 | $672,094,283.01 |
| Housing | 24 | $60,453,207.28 |
| **Total** | **86** | **$757,185,765.25** |

Source: NCEM iRisk database

**Table F.6 – NCSU North, Central, and South Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 20 | $46,070,124.99 |
| Educational/Extracurricular | 110 | $1,624,295,602.04 |
| Housing | 80 | $266,737,453.47 |
| **Total** | **210** | **$1,937,103,180.50** |

Source: NCEM iRisk database

**Table F.7 – NCSU West Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 7 | $8,651,123.88 |
| Educational/Extracurricular | 96 | $517,484,790.39 |
| Housing | 1 | $248,071.53 |
| **Total** | **104** | **$526,383,985.80** |

Source: NCEM iRisk database

## F.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by NCSU's HMPC representatives. After reviewing the following criteria designed to evaluate all critical buildings in the UNC System Hazard Mitigation Plan, the NCSU HMPC maintained the list of critical facilities from the previous plan except for one building that was removed because it is under reconstruction. Factors considered for this ranking included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for NCSU are listed below:

## Centennial Campus

- Centennial Campus Central Utility Plant
- Centennial Substation
- CMDF – Partners Building I

## North/Central/South Campus

- Administrative Services III
- Bragaw Switchyard
- Cates Central Utility Plant
- Public Safety Building
- SMDF - Main Distribution
- Sullivan Drive Switchstation
- West Chiller Plant
- Yarborough Drive Steam Plant

## West Campus

- Centennial Biomedical Campus
- Centennial Biomedical Campus Substation
- WMDF – CVM Research Building

Campus building classifications and critical facilities are shown in Figure F.8 through Figure F.10.

**Figure F.8 – NCSU Map of Buildings and Critical Facilities – Centennial Campus**

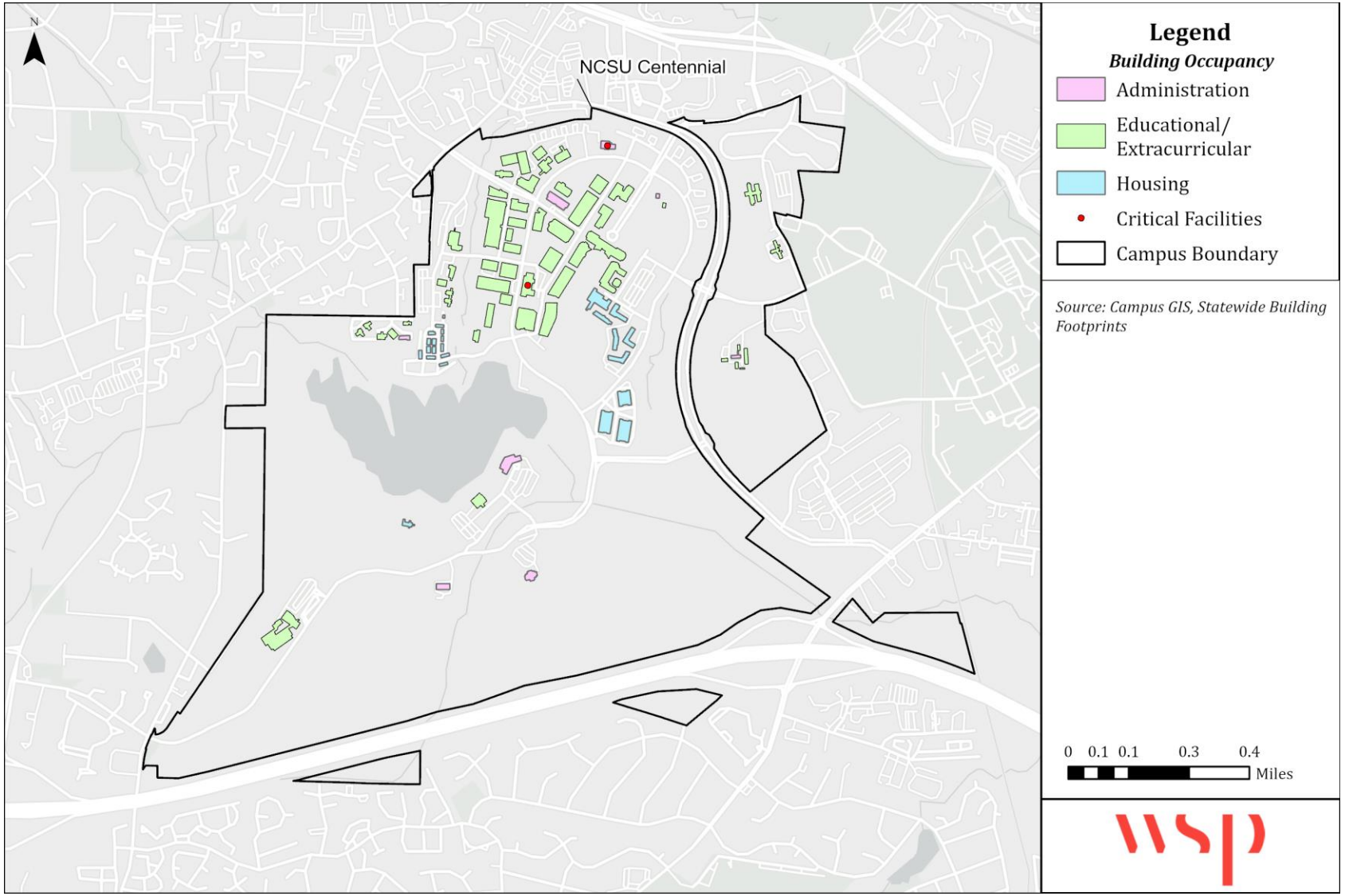


**Figure F.9 – NCSU Map of Buildings and Critical Facilities – North, Central, and South Campus**

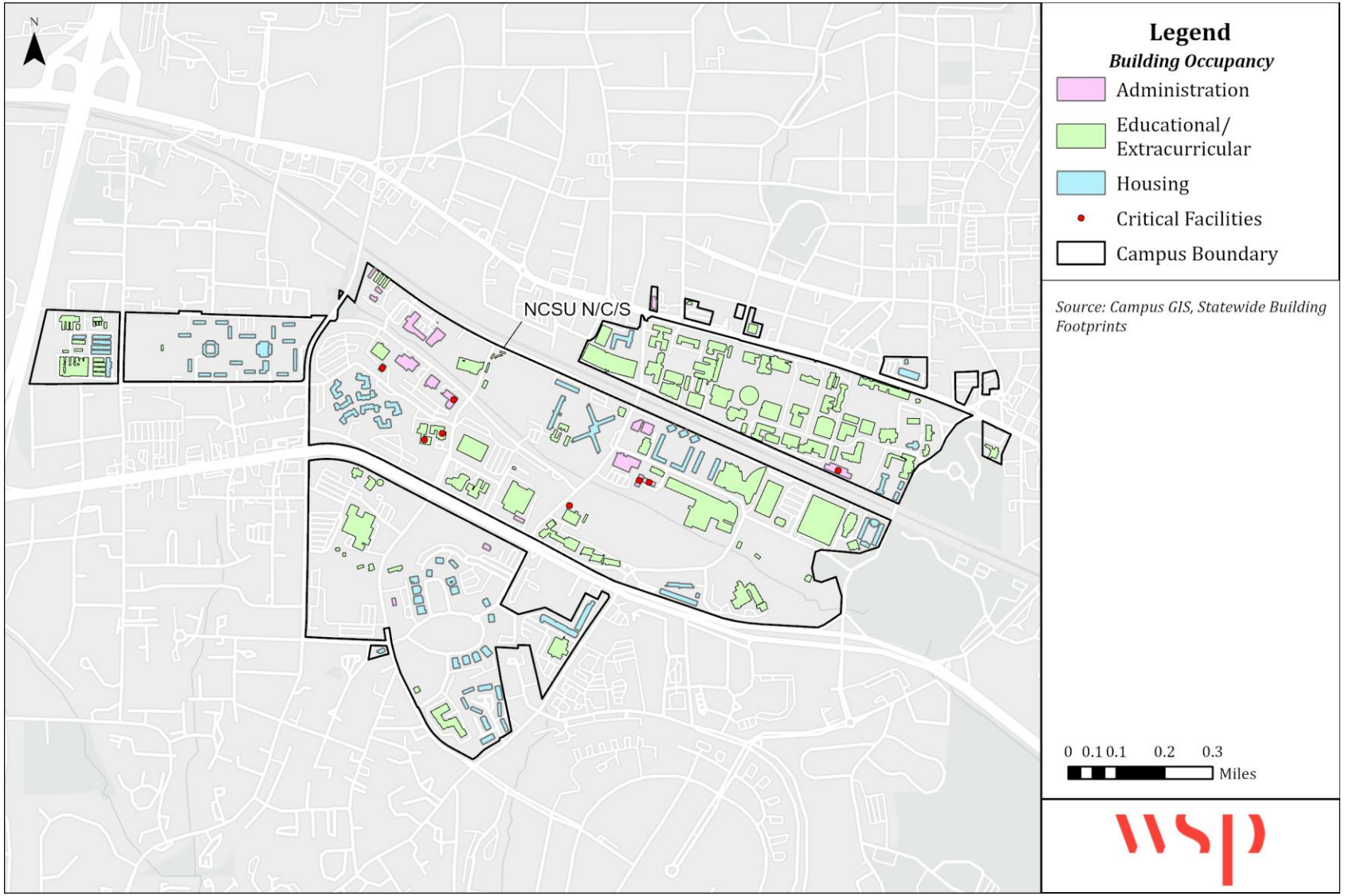
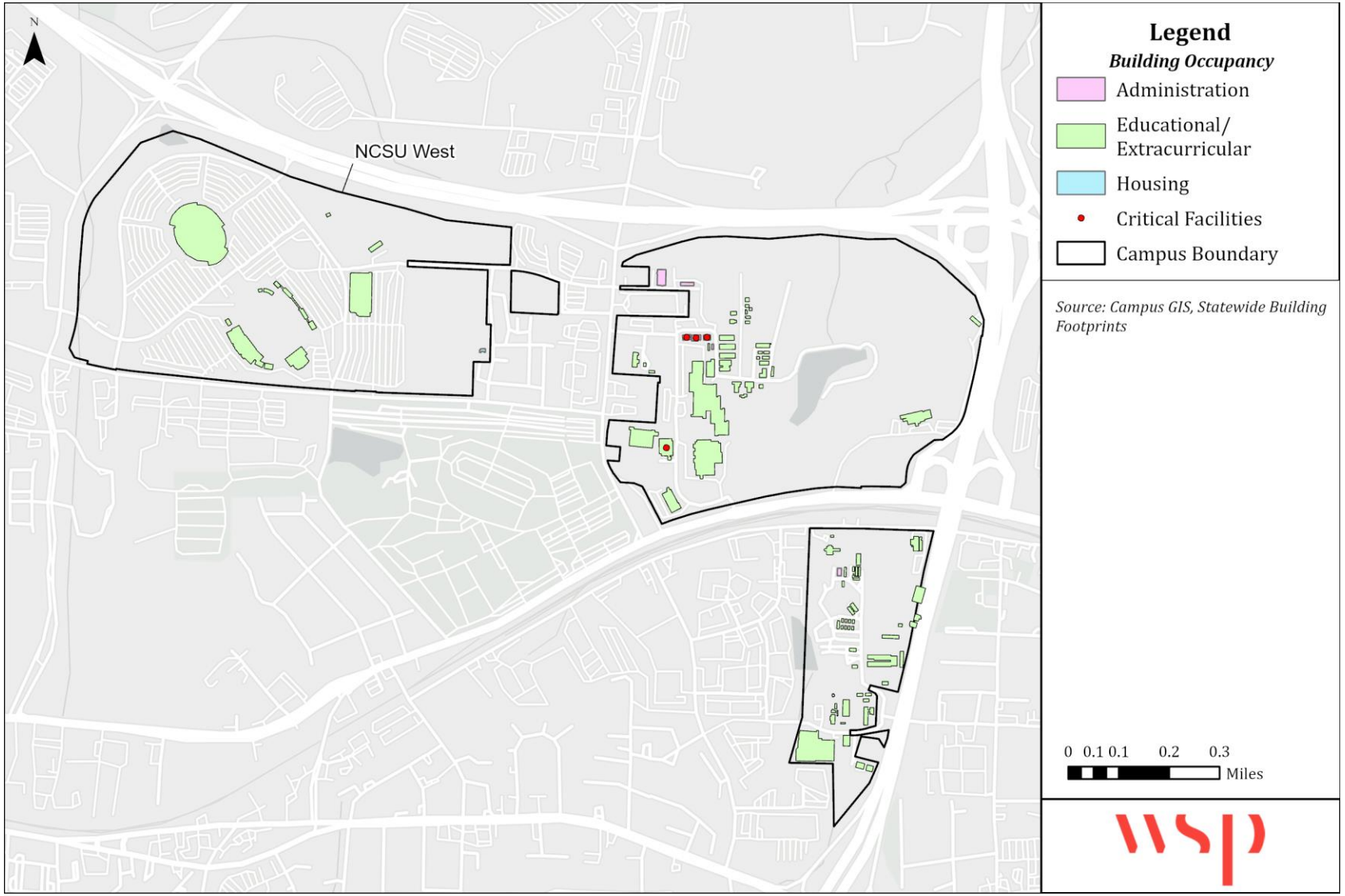


**Figure F.10 – NCSU Map of Buildings and Critical Facilities – West Campus**



# F.4 Hazard Identification & Risk Assessment

## F.4.1 Hazard Identification

To identify a full range of hazards relevant to NCSU, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the NCSU Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table F.8. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table F.8 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP NCSU Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Excessive Heat | Yes | No |
| Earthquake | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failure | Yes | No |
| Drought | Yes | No |
| Tornadoes & Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | Yes |
| Cyber Security | Yes | Yes |

NCSU's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Wake County was used to approximate past events that may have affected the NCSU campus. The NCEI database contains 1,267 records of storm events that occurred in Wake County in the 25-year period from 2000 through 2024. Table F.9 summarizes these events.

**Table F.9 – NCEI Severe Weather Data for Wake County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Flash Flood | 246 | $70,237,500 | $0 | 1 | 0 |
| Flood | 7 | $5,000,000 | $20,000,000 | 0 | 0 |
| Funnel Cloud | 2 | $0 | $0 | 0 | 0 |
| Hail | 282 | $110,000,000 | $0 | 0 | 0 |
| Heat | 1 | $0 | $0 | 0 | 1 |
| Heavy Rain | 23 | $0 | $0 | 0 | 0 |
| Heavy Snow | 1 | $0 | $0 | 0 | 0 |
| High Wind | 3 | $135,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 1 | $890,000 | $0 | 0 | 0 |
| Lightning | 38 | $2,614,000 | $0 | 3 | 1 |
| Strong Wind | 17 | $2,543,000 | $5,000 | 1 | 1 |
| Thunderstorm Wind | 567 | $4,402,750 | $4,000 | 2 | 14 |
| Tornado | 14 | $116,683,000 | $25,000 | 4 | 68 |
| Tropical Storm | 7 | $2,471,500 | $0 | 0 | 1 |
| Wildfire | 1 | $1,000,000 | $0 | 0 | 0 |
| Winter Storm | 28 | $1,000,000 | $0 | 0 | 0 |
| Winter Weather | 29 | $40,000 | $0 | 0 | 0 |
| **Total** | **1,267** | **$317,016,750** | **$20,034,000** | **11** | **86** |

Source: National Center for Environmental Information Events Database, retrieved October 2025
Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Pitt County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.

- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Wake County has been designated in 19 major disaster declarations, as detailed in Table F.10, and 13 emergency declarations, as detailed in Table F.11.

**Table F.10 – FEMA Major Disaster Declarations, Wake County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-234-NC | 10-Feb-68 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | N/A |
| DR-818-NC | 02-Dec-88 | Tornado | Severe Storms & Tornadoes | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard of 96 | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1211-NC | 22-Mar-98 | Severe Storm(s) | Severe Storms Tornadoes, & Flooding | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1312-NC | 31-Jan-00 | Severe Storm(s) | Severe Winter Storm | N/A | N/A | $27,368,108 |
| DR-1448-NC | 12-Dec-02 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | $86,565,180 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7790 | $21,289,504 | $18,285,917 |
| DR-1969-NC | 20-Apr-11 | Severe Storm(s) | Severe Storms, Tornadoes, & Flooding | 1778 | $5,391,278 | N/A |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28971 | $98,842,213 | $291,092,954 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance; IAH = Individuals and Households; PA = Public Assistance
Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table F.11 – FEMA Emergency Declarations, Wake County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3033-NC | 02-Mar-77 | Snow | Drought & Freezing |
| EM-3049-NC | 11-Aug-77 | Drought | Drought |
| EM-3110-NC | 17-Mar-93 | Snow | Severe Snowfall & Winter Storm |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 01-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 06-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table F.12 summaries the determination made for each hazard.

### Table F.12 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | Yes | ▪ Two high hazard dams are owned by NCSU |
| Drought | No | ▪ Not included in 2021 NCSU Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 NCSU Annex<br>▪ iRisk database enables vulnerability assessment |
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Wake County has had four disaster declarations related to flooding and eight other disaster declarations for hurricanes which may have involved flooding |
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Not included in 2021 NCSU Annex<br>▪ No known risk areas on campus; does not warrant evaluation |
| Hurricane | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Wake County has had eight disaster declarations for hurricanes |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Severe Winter Weather | Yes | ▪ Included in 2021 NCSU Annex and rated a high-risk hazard<br>▪ Potential for power outages, freezing temperatures, and dangerous travel conditions presents risk to campus |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Wake County has received two disaster declarations for tornadoes.<br>▪ A past tornado track passed through NCSU campus |
| Wildfire | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Fixed facility sites and transportation routes with hazardous materials are present in and around the campus |
| Infectious Disease | Yes | ▪ Included in 2021 NCSU Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Frequency of cyber security incidents and vulnerability to threats warrants inclusion |
| Terrorism | Yes | ▪ Included in 2021 NCSU Annex<br>▪ Included in Wake County Multi-Jurisdictional HMP |

# F.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on NCSU's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Wake County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and structure values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;

- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2024 Wake County Multi-Jurisdictional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Wake County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table F.13 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Dam Failure** | NC Dam Inventory, NCDEQ | Campus | Qualitative Analysis | Campus |
| **Earthquake** | USGS, NCEI | County | iRisk | Census Tract |

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricane** | NHC | County | iRisk | Census Tract |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |
| **Terrorism** | SPLC | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, SPLC = Southern Poverty Law Center, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the NCSU planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table F.14.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile.The results of the risk assessment and overall PRI scoring are provided in Section F.5.13 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table F.14 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

# F.5.1 Dam Failure

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Dam Failure | Possible | Critical | Negligible | Less than 6 hours | Less than 1 week | 2.4 |

## Location

The North Carolina Dam Inventory, maintained by North Carolina Department of Environmental Quality, provides a detailed inventory of all dams in the state. As of November 2025, there are 8 dams located on or near campus with inundation areas affecting the NCSU campus; 1 of these dams is rated low hazard while the other 7 dams are all rated high hazard. Of the high hazard dams in the planning area, none were given a condition assessment of “poor” on the last inspection. However, 4 of the high hazard dams were given a condition assessment of “fair” on the last inspection. There are three dams located within the boundary of the NCSU campus that are rated as a high hazard: Lake Raleigh Dam, NCSU Centennial Campus Farm Pond Dam, and NCSU Unit #4 Dam.

Figure F.11 shows all dams located either on or near campus that have inundation areas that intersect the NCSU campus boundary. Table F.15 lists all dams located on NCSU campus and their current hazard potential and conditions as of last inspection.

*Spatial Extent: 1 – Negligible*

**Table F.15 – Dams Located on NCSU Campus**

| Dam Name | NID ID | Hazard Potential | Condition as of Last Inspection | Max Capacity (Ac-Ft) | River/Stream |
|---|---|---|---|---|---|
| Lake Raleigh Dam | NC00863 | High | Satisfactory | 1921 | Walnut Creek |
| NCSU Centennial Campus Farm Pond Dam | NC01283 | High | Fair | 20 | Swift Creek |
| NCSU Hillsborough Street Pond Dam | NC04454 | Low | Fair | 59 | House Creek |
| NCSU Unit No. 4 Dam | NC04615 | High | Fair | 26 | Walnut Creek |

Source: North Carolina Dam Inventory, November 2025

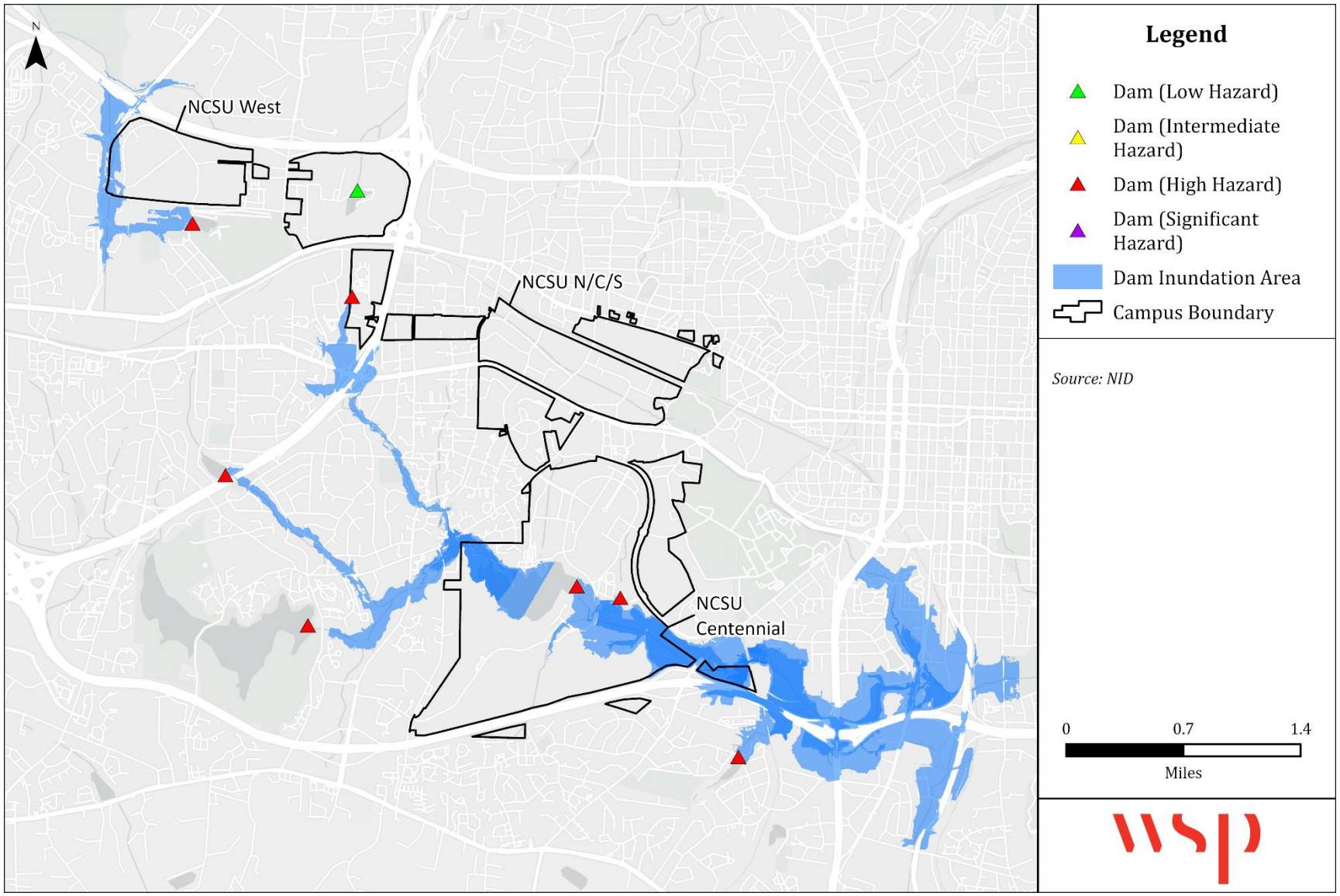
North Carolina Emergency Management contains dam inundation data that shows areas of potential flooding in the event of a dam failure. Table F.16 lists the dams located near campus with inundation areas that may impact NCSU’s campus.

**Table F.16 – Dams with Inundation Areas that Intersect NCSU Campus**

| Dam Name | NID ID | Hazard Potential | Condition as of Last Inspection | Max Capacity (Ac-Ft) | River/Stream |
|---|---|---|---|---|---|
| Carolina Pines Dam | NC05753 | High | Fair | 53 | UT to Walnut Creek |
| Lake Johnson Dam | NC00862 | High | Satisfactory | 3090 | Walnut Creek |
| State Fair H & L Dam | NC04539 | High | Fair | 78 | Richland Creek |
| White Oak Lake Dam | NC04516 | High | Not Rated | 20 | Simmons Branch |

Source: North Carolina Dam Inventory, November 2025

**Figure F.11 – Dam Locations with Inundation Areas on NCSU Campus**



Based on dam locations and modeled dam inundation areas, Centennial campus and west campus could be impacted by dam failure.

## Extent

Each state has definitions and methods to determine the hazard potential of a dam. In North Carolina, dams are regulated by the state if they are 25 feet or more in height and impound 50 acre-feet or more. Dams and impoundments smaller than that may fall under state regulation if it is determined that failure of the dam could result in loss of human life or significant damage to property. The height of a dam is from the highest point on the crest of the dam to the lowest point on the downstream toe, and the storage capacity is the volume impounded at the elevation of the highest point on the crest of the dam.

Dam Safety Program engineers determine the "hazard potential" of a dam, meaning the probable damage that would occur if the structure failed, in terms of loss of human life and economic loss or environmental damage. Dams are assigned one of three classes based on the nature of their hazard potential:

- Class A (Low Hazard) includes dams located where failure may damage uninhabited low value non-residential buildings, agricultural land, or low volume roads.
- Class B (Intermediate Hazard) includes dams located where failure may damage highways or secondary railroads, cause interruption of use or service of public utilities, cause minor damage to isolated homes, or cause minor damage to commercial and industrial buildings. Damage to these structures will be considered minor only when they are located in backwater areas not subjected to the direct path of the breach flood wave; and they will experience no more than 1.5 feet of flood rise due to breaching above the lowest ground elevation adjacent to the outside foundation walls or no more than 1.5 feet of flood rise due to breaching above the lowest floor elevation of the structure.
- Class C (High Hazard) includes dams located where failure will likely cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, primary highways, or major railroads.

**Table F.17 – Dam Hazard Classifications**

| Hazard Classification | Description | Quantitative Guidelines |
|---|---|---|
| **Low** | Interruption of road service, low volume roads | Less than 25 vehicles per day |
| | Economic damage | Less than $30,000 |
| **Intermediate** | Damage to highways, interruption of service | 25 to less than 250 vehicles per day |
| | Economic damage | $30,000 to less than $200,000 |
| | Loss of human life* | Probable loss of 1 or more human lives |
| **High** | Economic damage | More than $200,000 |
| | *Probable loss of human life due to breached roadway or bridge on or below the dam | 250 or more vehicles per day |

Source: NCDEQ

Based on classification criteria, a high hazard dam failure could cause death and/or injury as well as severe property damage and economic impacts within the affected area. Therefore, though the affected area would be negligible in size relative to the entire planning area, the potential impact of a high hazard dam failure is critical.

*Impact: 3 – Critical*

## Historical Occurrences

According to the current Wake County Hazard Mitigation Plan, which includes anecdotal evidence, there are no records of historical dam failures occurrences in or affecting the planning area in recent years.

## Probability of Future Occurrence

Given the presence of high hazard dams on and around campus with inundation areas that could affect campus, failure of a dam is possible. Dam failure has not occurred in the region; however historical events alone do not provide an adequate estimate of potential future occurrence. With heavy rain events becoming more frequent and intense, conditions conducive to dam failure may occur more frequently as well.

*Probability: 2 – Possible*

## Vulnerability Assessment

### Methodologies and Assumptions

Developed by North Carolina Emergency Management (NCEM), the Statewide Emergency Response Analysis (SERA) provides standardized inundation modeling to support emergency preparedness. SERA data uses the 100-year storm event and assumes a full pond overtopping failure. This modeling approach is intentionally conservative and does not reflect the operational design of individual dams, many of which are engineered to avoid overtopping during such events. However, it provides a useful starting point to understand potential downstream risk. Based on a visual assessment of the inundation areas provided by SERA, the NCSU campus could be impacted by the failure of dams with high hazard potential: Lake Raleigh Dam, NCSU Centennial Campus Farm Pond Dam, NCSU Unit #4 Dam, Carolina Pines Dam, Lake Johnson Dam, State Fair H&L Dam, and the White Oak Lake Dam.

### People

There are seven high hazard dams in the planning area, which by definition would cause probable loss of life in the event of a failure. A person’s immediate vulnerability to a dam failure is directly associated with the person’s distance downstream of the dam as well as proximity to the stream carrying the floodwater from the failure. For dams that have an Emergency Action Plan (EAP), the vulnerability of loss of life for persons in their homes or on their property may be mitigated by following the EAP evacuation procedures; however, the displaced persons may still

incur sheltering costs. Additionally, even if they are able to evacuate in time, displaced persons may still incur sheltering costs. According to NID records, all but one of the high hazard dams on or near NCSU campus have an Emergency Action Plan.

For persons located on the river (e.g. for recreation) the vulnerability of loss of life is significant. People are also vulnerable to the loss of the uses of the lake upstream of a dam following failure. Several uses are minor, such as aesthetics or recreational use. However, some lakes serve as drinking water supplies and their loss could disrupt the drinking water supply and present a public health problem.

### Property

Vulnerability of the built environment includes damage to the dam itself and any man-made feature located within the inundation area caused by the dam failure. Downstream of the dam, vulnerability includes potential damage to homes, personal property, commercial buildings and property, and government owned buildings and property; destruction of bridge or culvert crossings; weakening of bridge supports through scour; and damage or destruction of public or private infrastructure that cross the stream such as water and sewer lines, gas lines and power lines. Water dependent structures on the lake upstream of the dam, such as docks/piers, floating structures or water intake structures, may be damaged by the rapid reduction in water level during the failure.

### Environment

Aquatic species within the lake will either be displaced or destroyed. The velocity of the flood wave will likely destroy riparian and instream vegetation and destroy wetland function. The flood wave will like cause erosion within and adjacent to the stream. Deposition of eroded deposits may choke instream habitat or disrupt riparian areas. Sediments within the lake bottom and any low oxygen water from within the lake will be dispersed, potentially causing fish kills or releasing heavy metals found in the lake sediment layers.

## Changes in Development

Increased development downstream from dams generally increases exposure. Such development may necessitate upgrading the rating based on the guidelines in Table F.17.

## Problem Statements

- While a dam failure has not occurred in the County to date, failure in the future is still possible. There are three high hazard dams located on NCSU campus; one on west campus and one on Centennial campus.
- There are four additional high hazard dams located near NCSU with inundation areas that could impact campus in the event of a dam failure. Three dams could impact Centennial campus and one could impact west campus.

## F.5.2 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

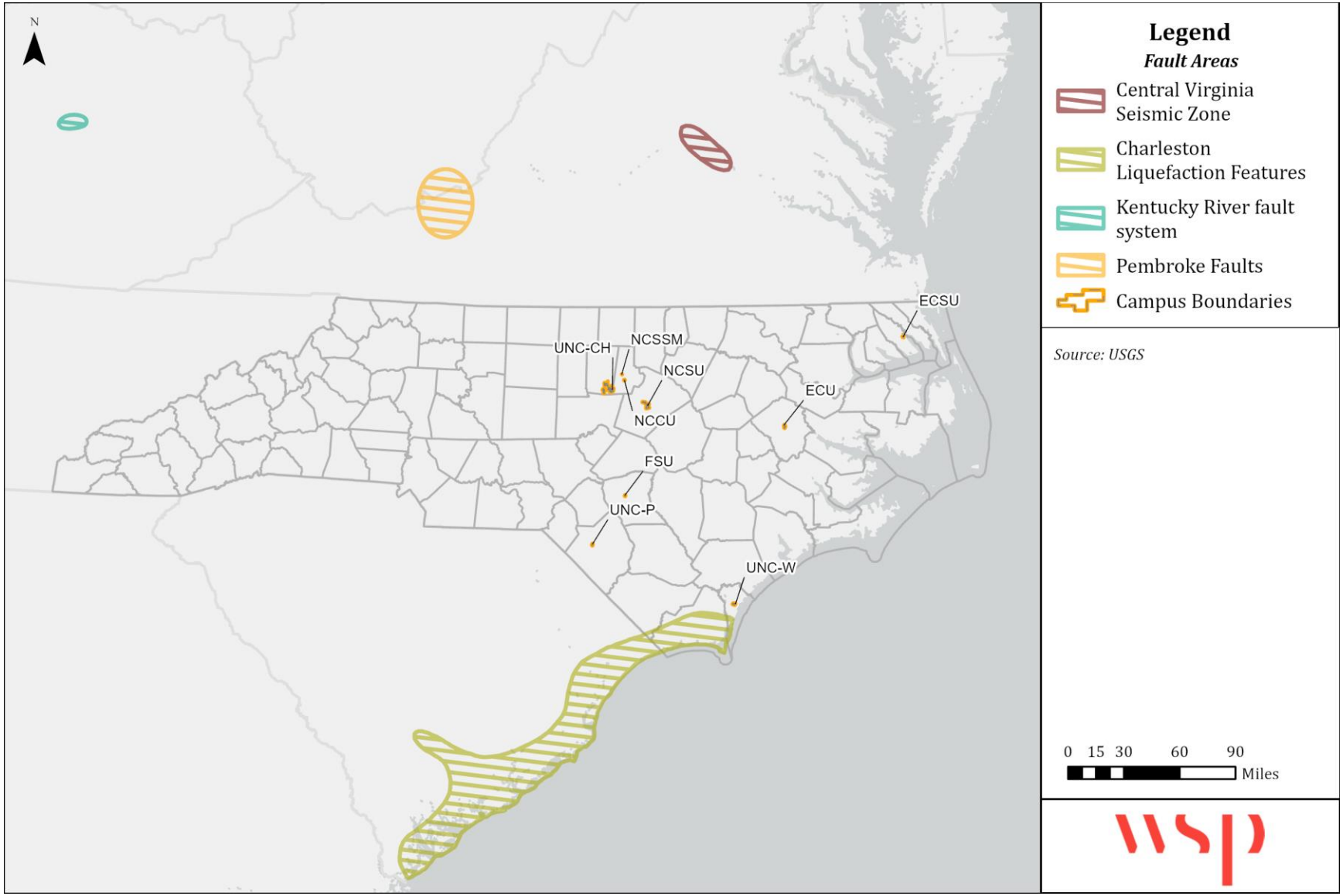
Figure F.12 reflects the quaternary faults that present an earthquake hazard for the NCSU planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. There are no active faults in Wake County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Wake County is likely to be felt across the entire campus.

*Spatial Extent: 4 – Large*

**Figure F.12 – U.S. Quaternary Faults**



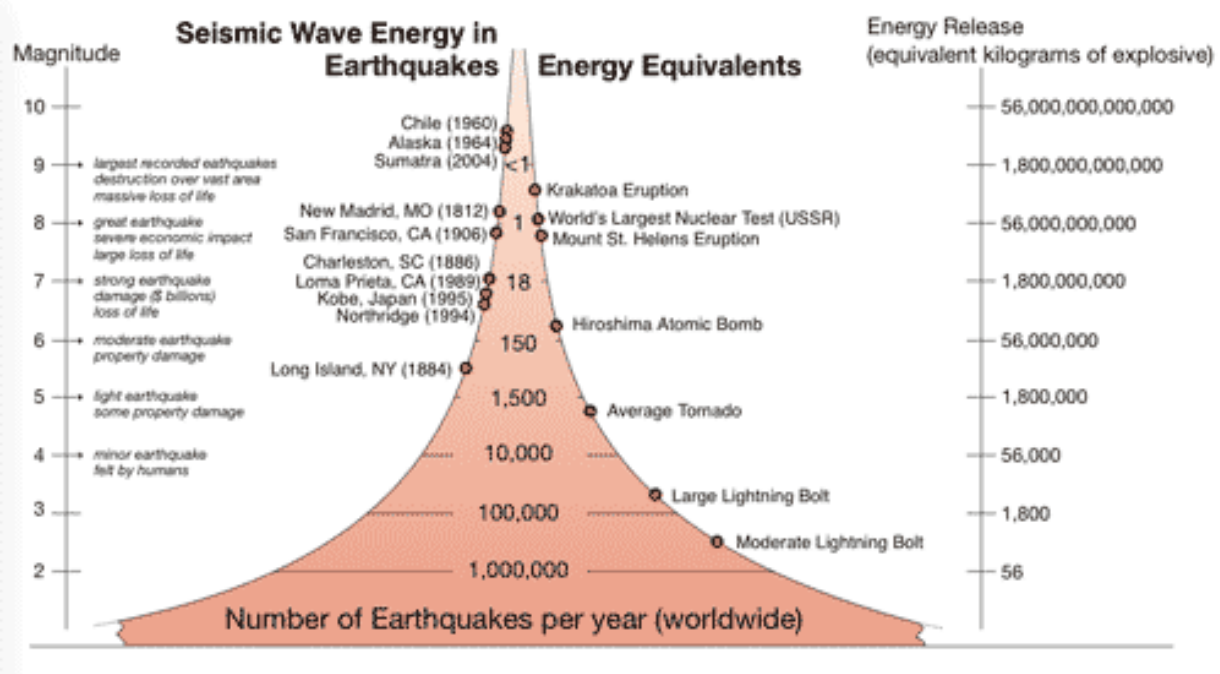
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure F.13.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table F.18 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure F.13 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table F.18 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater. Earthquake events that occurred within 100 miles of the NCSU campus and Wake County are presented in Table F.19, and Figure F.14 shows the epicenter of these events.

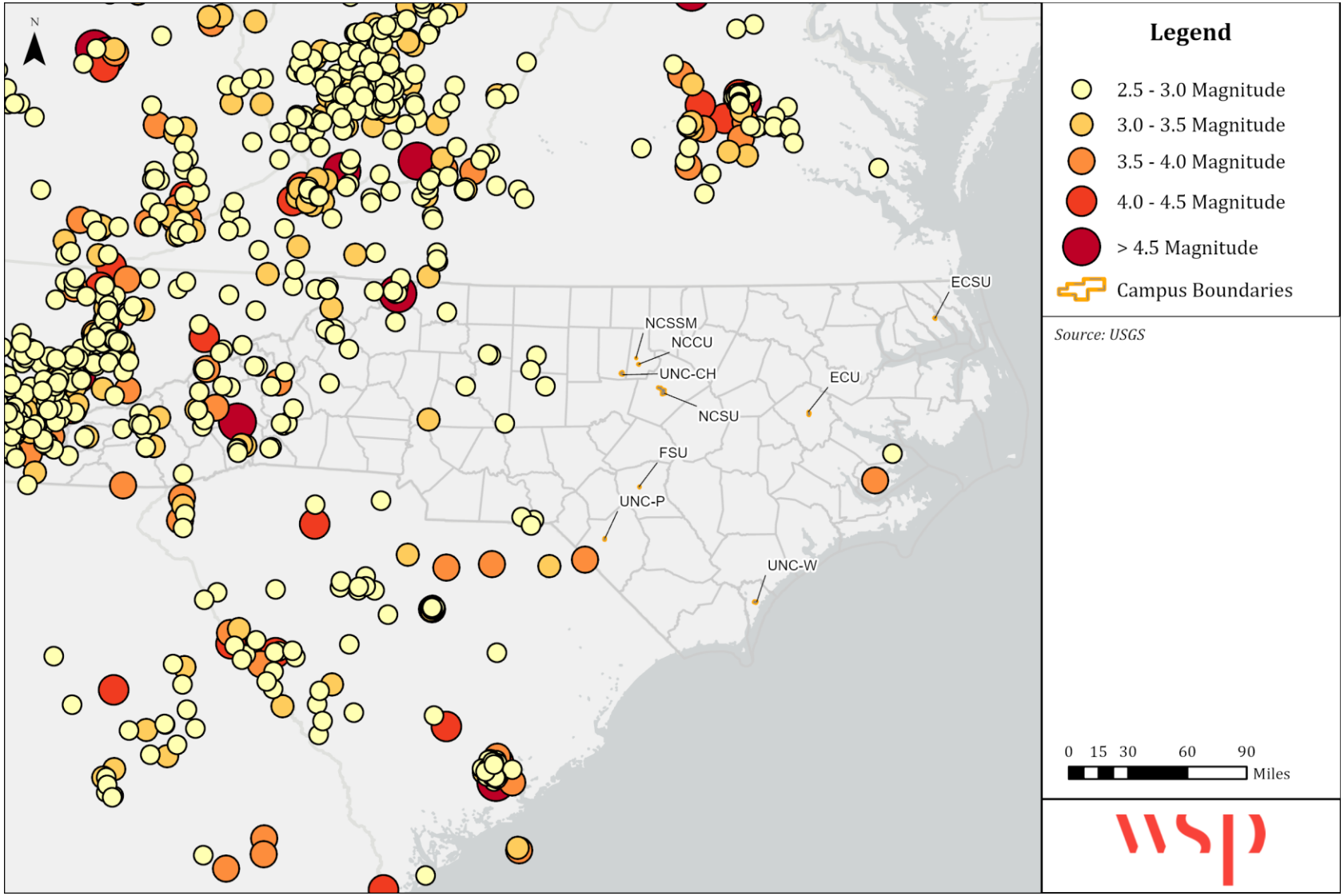
**Table F.19 – Historical Earthquakes within 100 Miles of NCSU, 1900-2024**

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 6/4/1989 | 2.8 | 9 km WNW of Burkeville, Virginia |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 8/6/1994 | 3.6 | 4 km SSW of Bayboro, North Carolina |
| 10/21/1998 | 3.8 | 13 km S of Dillwyn, Virginia |
| 9/3/2001 | 2.5 | Virginia |
| 9/22/2006 | 3.4 | 4 km WSW of Blenheim, South Carolina |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |
| 11/3/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |
| 2/11/2014 | 2.9 | 7 km NW of Hobucken, North Carolina |
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there were 13 earthquakes felt in and around Raleigh with MMI ranging from II in January 1812 to VIII in September 1886.

**Figure F.14 – Historical Earthquakes by Magnitude, 1900-2024**




Source: USGS

## Probability of Future Occurrence

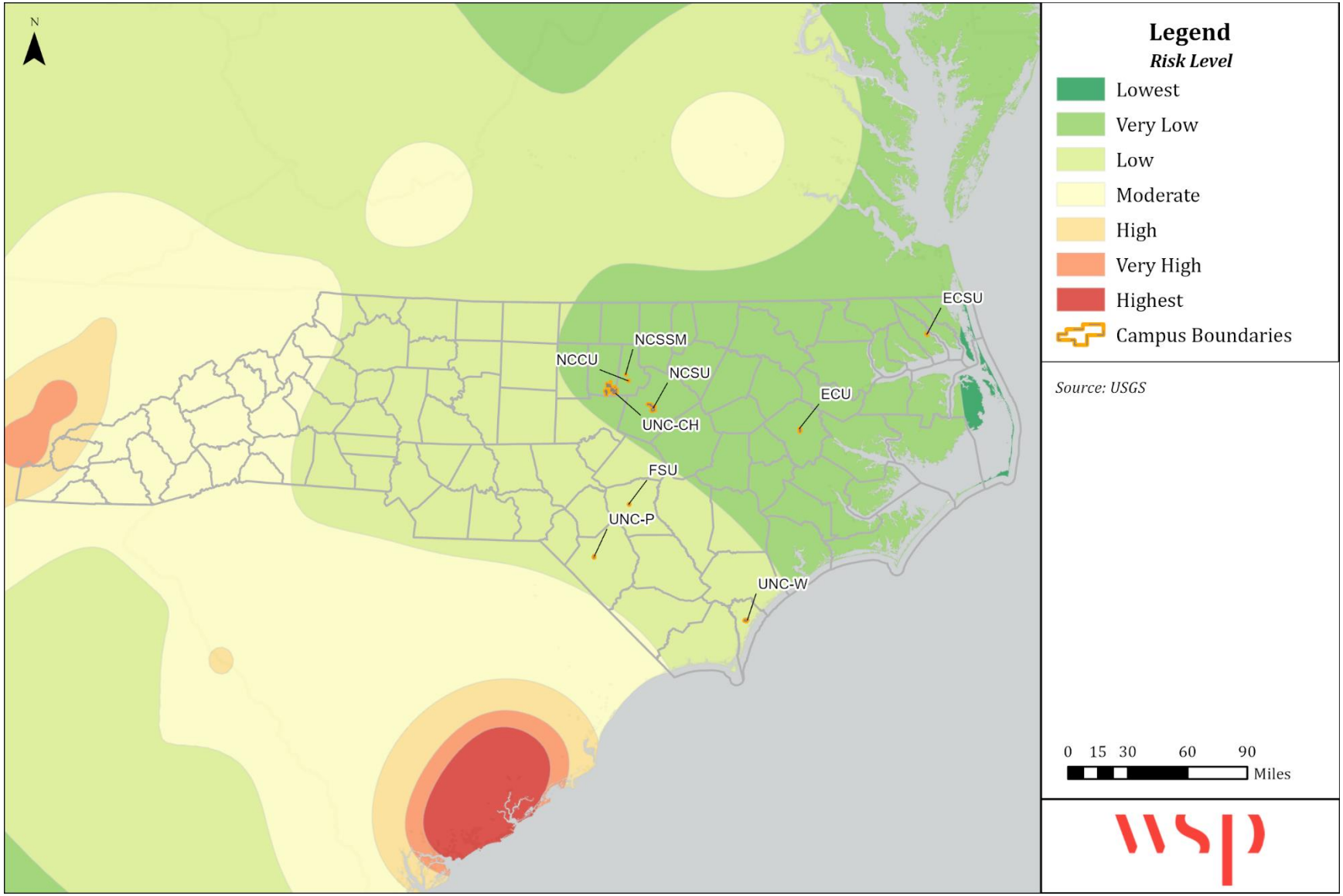
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure F.15 on the following page reflects the seismic hazard for NCSU based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Wake County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting NCSU is unlikely.

*Probability: 1 – Unlikely*

**Figure F.15 – Seismic Hazard Information for Wake County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damages from NCEM's iRisk database were compiled for buildings on NCSU's campus.

### People

Earthquakes are not expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also damage infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRISK analysis, a 500-year earthquake event could cause over $3.3 million of estimated total building damages across all NCSU campuses.

Wake County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structure. Table F.20 through Table F.22 detail the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table F.20 – Estimated Buildings Impacted by Earthquake Events, NCSU Centennial Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $1,031.35 | $1,001.82 | $2,033.17 |
| Educational | $26,014.30 | $19,329.42 | $45,343.72 |
| Housing | $0.00 | $0.00 | $0.00 |
| **Total** | **$27,045.65** | **$20,331.24** | **$47,376.89** |
| **500-Year Earthquake Event** | | | |
| Administration | $10,833.20 | $12,512.67 | $23,345.87 |
| Educational | $339,568.75 | $376,555.82 | $716,124.57 |
| Housing | $559.89 | $521.79 | $1,081.68 |
| **Total** | **$350,961.84** | **$389,590.28** | **$740,552.12** |
| **1,000-Year Earthquake Event** | | | |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Administration | $40,483.62 | $39,894.11 | $80,377.73 |
| Educational | $1,398,974.74 | $1,545,217.18 | $2,944,191.92 |
| Housing | $4,159.93 | $3,037.16 | $7,197.09 |
| **Total** | **$1,443,618.29** | **$1,588,148.45** | **$3,031,766.74** |

Source: NCEM iRISK Database

### Table F.21 – Estimated Buildings Impacted by Earthquake Events, NCSU North, Central, and South Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $2,227.80 | $3,411.10 | $5,638.90 |
| Educational | $48,418.79 | $71,652.26 | $120,071.05 |
| Housing | $10,964.70 | $11,630.33 | $22,595.03 |
| **Total** | **$61,611.29** | **$86,693.69** | **$148,304.98** |
| **500-Year Earthquake Event** | | | |
| Administration | $24,062.36 | $42,675.62 | $66,737.98 |
| Educational | $672,398.44 | $1,192,398.44 | $1,864,796.88 |
| Housing | $99,100.06 | $153,948.63 | $253,048.69 |
| **Total** | **$795,560.86** | **$1,389,022.69** | **$2,184,583.55** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $102,129.30 | $153,798.47 | $255,927.77 |
| Educational | $3,221,419.11 | $5,158,020.49 | $8,379,439.60 |
| Housing | $443,762.95 | $586,888.66 | $1,030,651.61 |
| **Total** | **$3,767,311.36** | **$5,898,707.62** | **$9,666,018.98** |

Source: NCEM iRISK Database

### Table F.22 – Estimated Buildings Impacted by Earthquake Events, NCSU West Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $278.98 | $227.66 | $506.64 |
| Educational | $17,990.74 | $14,309.79 | $32,300.53 |
| Housing | $0.00 | $0.00 | $0.00 |
| **Total** | **$18,269.72** | **$14,537.45** | **$32,807.17** |
| **500-Year Earthquake Event** | | | |
| Administration | $3,104.41 | $3,751.42 | $6,855.83 |
| Educational | $248,809.12 | $169,041.43 | $417,850.55 |
| Housing | $22.39 | $21.74 | $44.13 |
| **Total** | **$251,935.92** | **$172,814.59** | **$424,750.51** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $13,002.71 | $15,707.40 | $28,710.11 |
| Educational | $1,004,447.73 | $645,156.85 | $1,649,604.58 |
| Housing | $162.69 | $125.17 | $287.86 |
| **Total** | **$1,017,613.13** | **$660,989.42** | **$1,678,602.55** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Wake County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on USGS seismic probability data and historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the NCSU campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at NCSU have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statements

- While earthquakes are an unlikely hazard event for the NCSU campus, an estimate of over $3.3 million of total building damage across all NCSU campuses could occur in the case of a 500-year earthquake event.

## F.5.3 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Critical | Large | More than 24 hrs | Less than 1 week | 3.3 |

### Location

The entire planning area is susceptible to high temperatures and incidents of excessive heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of excessive heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. The extent of extreme heat can be defined by the maximum temperature reached is based on the heat index. Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. Table F.23 provides counts of heat index threshold recorded from 2001 to 2024 at the Reedy Creek Field Laboratory in Raleigh, NC. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. Based on this data, Raleigh experiences an average of 23 hours per year with heat index values of 100°F or higher.

*Impact: 3 – Critical*

**Table F.23 – Historical Heat Index, Reedy Creek Field Laboratory, Raleigh, NC, 2001-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2001 | 11 | 0 | 0 | 0 | 11 |
| 2002 | 12 | 0 | 0 | 0 | 12 |
| 2003 | 3 | 0 | 0 | 9 | 12 |
| 2004 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 39 | 4 | 0 | 0 | 43 |
| 2006 | 30 | 5 | 0 | 0 | 35 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2007 | 28 | 3 | 0 | 0 | 31 |
| 2008 | 5 | 0 | 0 | 0 | 5 |
| 2009 | 2 | 0 | 0 | 0 | 2 |
| 2010 | 40 | 9 | 0 | 0 | 49 |
| 2011 | 36 | 2 | 0 | 0 | 38 |
| 2012 | 34 | 7 | 0 | 0 | 41 |
| 2013 | 1 | 0 | 0 | 0 | 1 |
| 2014 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 10 | 0 | 0 | 0 | 10 |
| 2016 | 40 | 5 | 0 | 0 | 45 |
| 2017 | 22 | 1 | 0 | 0 | 23 |
| 2018 | 4 | 0 | 0 | 0 | 4 |
| 2019 | 2 | 0 | 0 | 0 | 2 |
| 2020 | 13 | 0 | 0 | 0 | 13 |
| 2021 | 32 | 0 | 0 | 0 | 32 |
| 2022 | 41 | 2 | 0 | 0 | 43 |
| 2023 | 29 | 5 | 0 | 0 | 34 |
| 2024 | 59 | 15 | 0 | 0 | 74 |
| **Sum** | **493** | **58** | **0** | **9** | **560** |
| **Average** | **21** | **2** | **0** | **0** | **23** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

Wake County experienced 1 heat-related incident according to NCEI between 2000 and 2024, which is summarized below. The 2007 incident resulted in one injury. Please note that additional heat-related incidents did occur in Wake County between 2000 and 2024, but they were not captured by NCEI.

- **August 22, 2007** – An athlete from Enloe High School running track collapsed from heat exhaustion and was sent to the hospital in critical condition. The student remained in the hospital in critical condition for several days.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Reedy Creek Field Laboratory in Raleigh, NC. Based on 24 years of data (2001-2024), the Raleigh station averages 7.9 days per year with a heat index of 100 degrees or more. However, in the last four years (2021-2024), Raleigh has experienced a steep increase in the number of days with a heat index of 100 degrees or more. For example, in the years 2021 and

2024, the Reedy Creek Field Laboratory noted 19 days with heat index of 100 degrees or higher, which is the highest in the station's period of record.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized "heat islands." Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statements

- NCSU is located in Raleigh, which currently averages 23 hours per year with a heat index of 100°F or higher, and there is a 100% annual chance of heat index values at or above 100°F in any given year.
- Athletes, grounds crews, and others outside during peak heat and sun exposure are most vulnerable to heat-related illness.

# F.5.4 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Limited | Small | 6 to 12 hrs | Less than 1 week | 2.8 |

## Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the NCSU Campus using the FIRM dated July 19, 2022. Figure F.16 through Figure F.18 reflect the 2022 mapped flood insurance zones. Table F.24 summarizes some of the flood insurance zones identified by a Digital FIRM (DFIRM). Note that not all flood zones outlined in Table F.24 intersect the NCSU campus.

Primary sources of flooding on the NCSU campus include Richard Creek, Rocky Branch, House Creek, Walnut Creek, Simmons Branch, and Lake Raleigh.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Raleigh and the NCSU campus. Flood risk is not limited to the 1%-annual-chance floodplain. Although no detailed studies were completed by FEMA for several smaller tributaries that run through campus, it should be noted that these waterways could be a source of flooding.

This assessment focuses on riverine flooding, but it is also important to note that localized stormwater flooding can occur on campus and may affect areas outside the mapped floodplain. The HMPC reported that stormwater flooding is minor and limited to very few locations on campus.

*Spatial Extent: 2 – Small*

**Table F.24 – Mapped Flood Insurance Zones**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |

| Zone | Description |
|---|---|
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. The Coastal AE Zone is differentiated from the AE Zone by the Limit of Moderate Wave Action (LiMWA) and includes areas susceptible to wave action between 1.5 to 3 feet. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure F.16 – FEMA Flood Hazard Areas in NCSU's Centennial Campus Boundary**

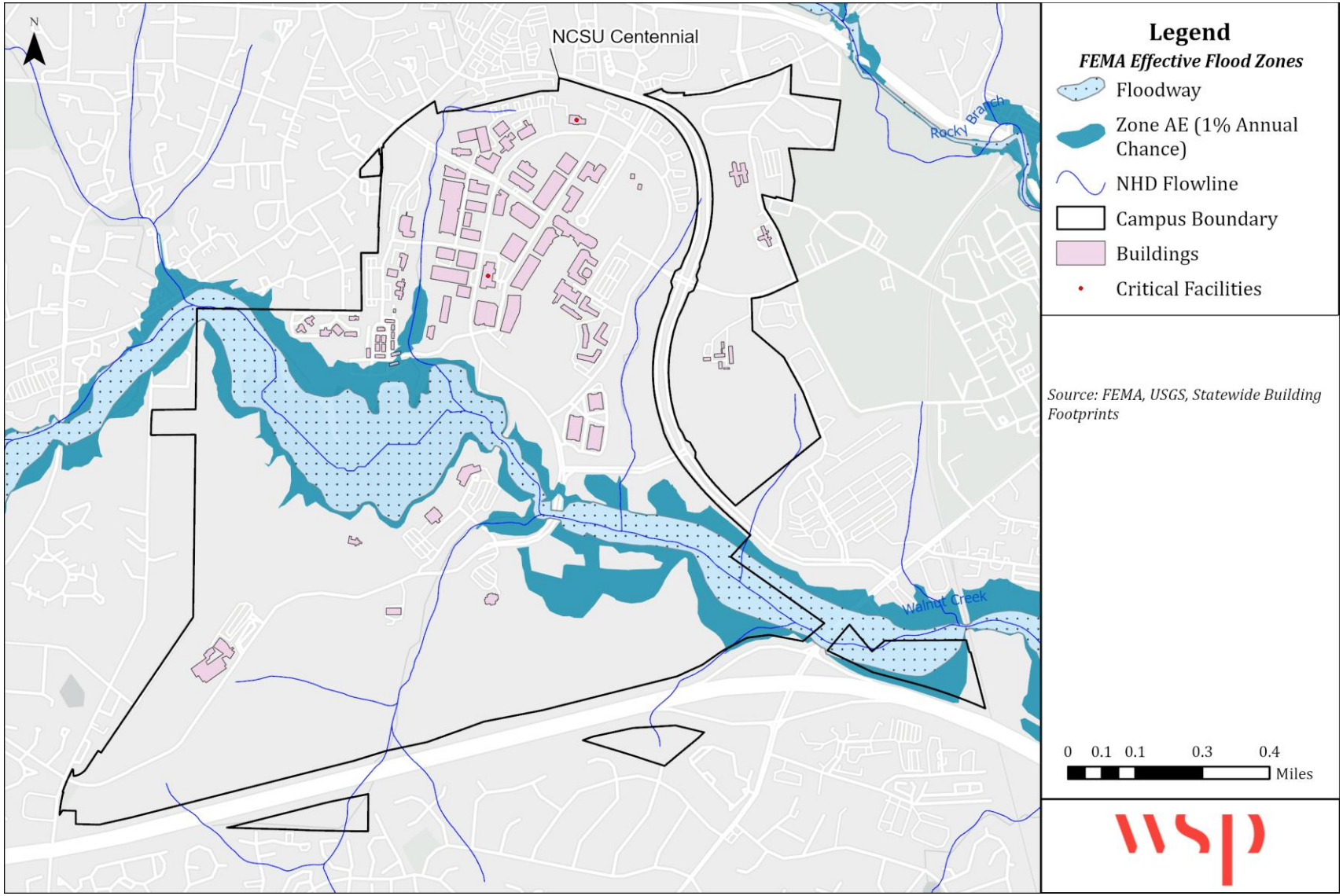


**Figure F.17 – FEMA Flood Hazard Areas in NCSU's North, Central, and South Campus Boundary**

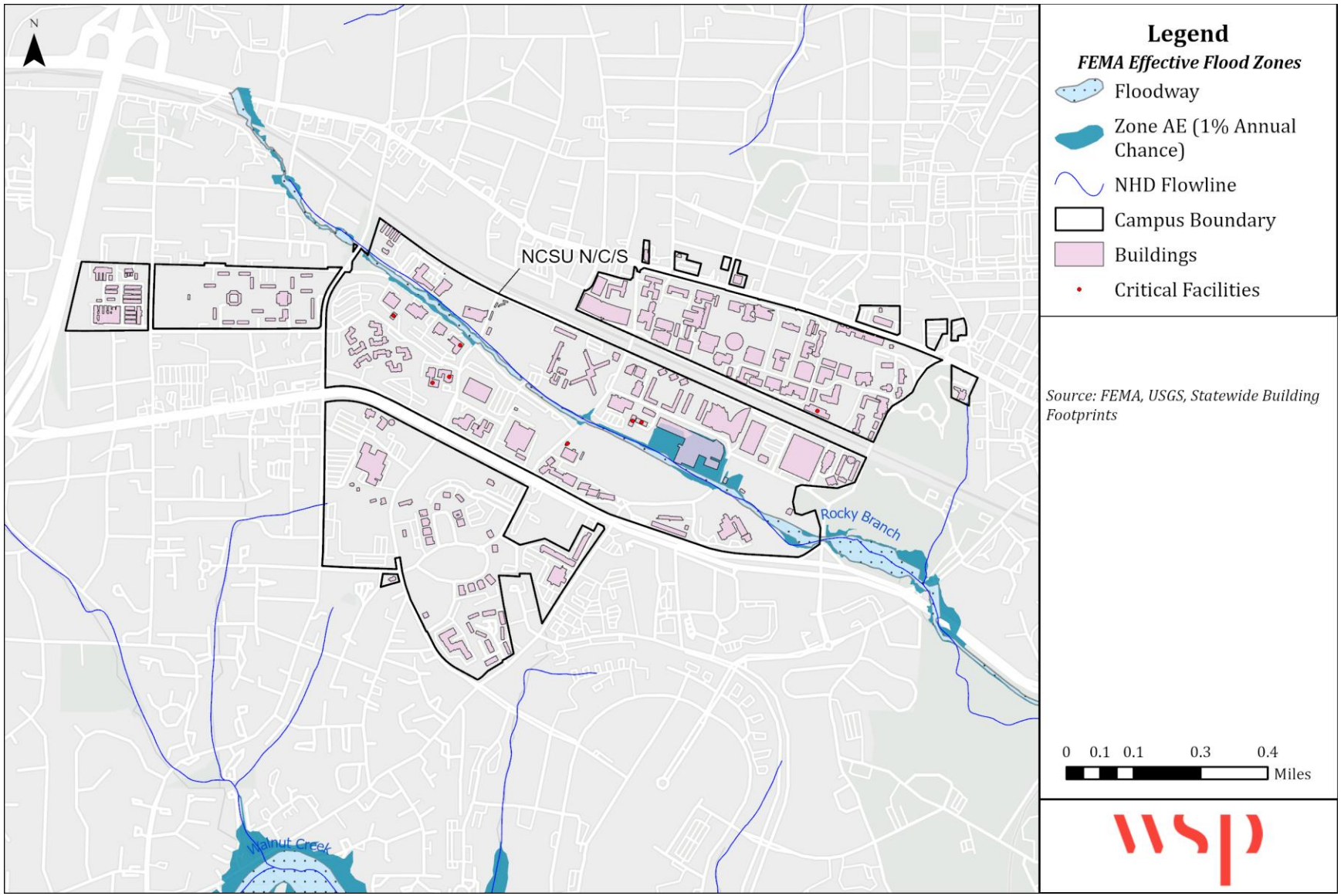
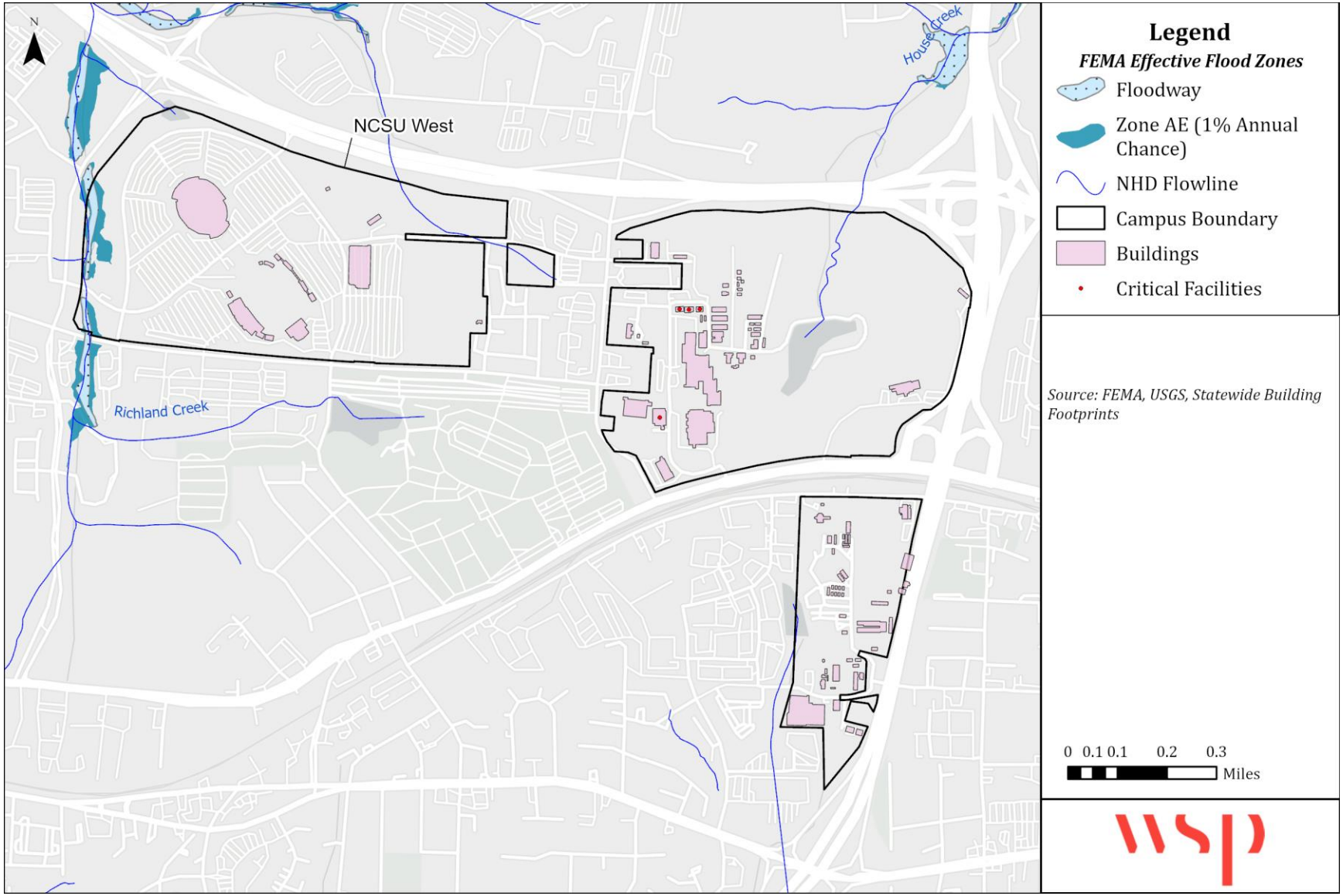


**Figure F.18 – FEMA Flood Hazard Areas in NCSU's West Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Approximately 11.8 percent of the combined NCSU Campuses fall within the SFHA. None of the NCSU campuses fall within the lower risk 0.2%-annual chance flood zone. The majority of NCSU campuses are outside of the floodplain. Table F.25 provides a summary of the NCSU Campus' total area by flood zone on the 2022 effective DFIRM. Figure F.19 through Figure F.21 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

*Impact: 2 – Limited*

**Table F.25 – Flood Zone Acreage on NCSU Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| **Centennial Campus** | | |
| AE | 224.8 | 20.1% |
| Floodway* | 132.9 | 11.9% |
| 0.2% annual-chance | 0.0 | 0.0% |
| Unshaded X | 892.0 | 79.9% |
| **Total** | **1,116.8** | **--** |
| **SFHA Total** | **224.8** | **20.1%** |
| **North/Central/South Campus** | | |
| AE | 21.9 | 4.2% |
| Floodway* | 8.7 | 2.0% |
| 0.2% annual-chance | 0.0 | 0.0% |
| Unshaded X | 498.6 | 95.8% |
| **Total** | **529.1** | **--** |
| **SFHA Total** | **21.9** | **4.2%** |
| **West Campus** | | |
| AE | 5.1 | 1.1% |
| Floodway* | 2.0 | 0.4% |
| 0.2% annual-chance | 0.0 | 0.0% |
| Unshaded X | 476.8 | 98.9% |
| **Total** | **481.9** | **--** |
| **SFHA Total** | **5.1** | **1.1%** |

Source: FEMA 2022 DFIRM

*Floodway is part of the AE zone. Floodway acreage is accounted for in AE totals.

**Figure F.19 – Flood Depth, 1-Percent-Annual-Chance Flood, NCSU Centennial Campus**

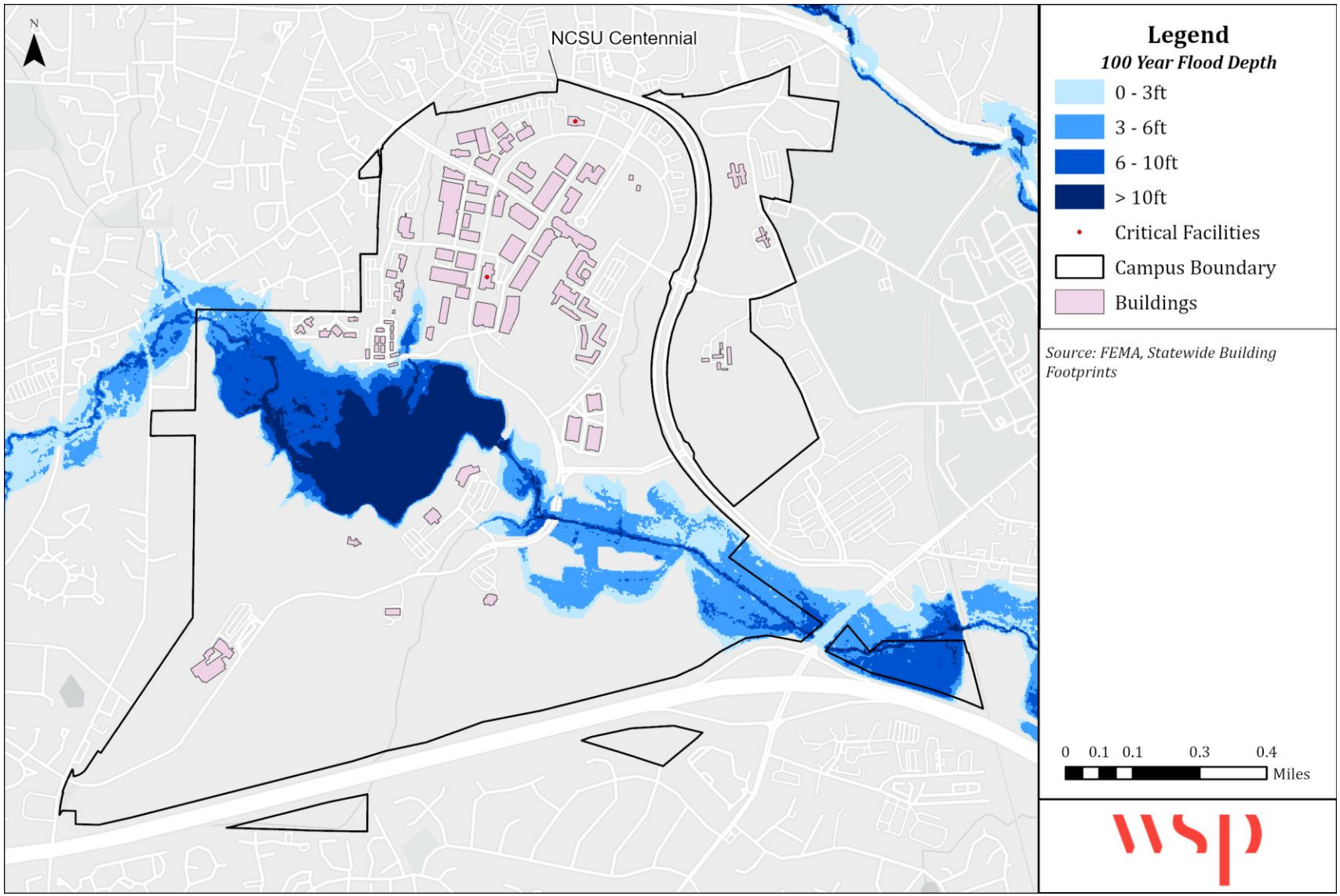


**Figure F.20 – Flood Depth, 1-Percent-Annual-Chance Flood, NCSU North, Central, and South Campuses**

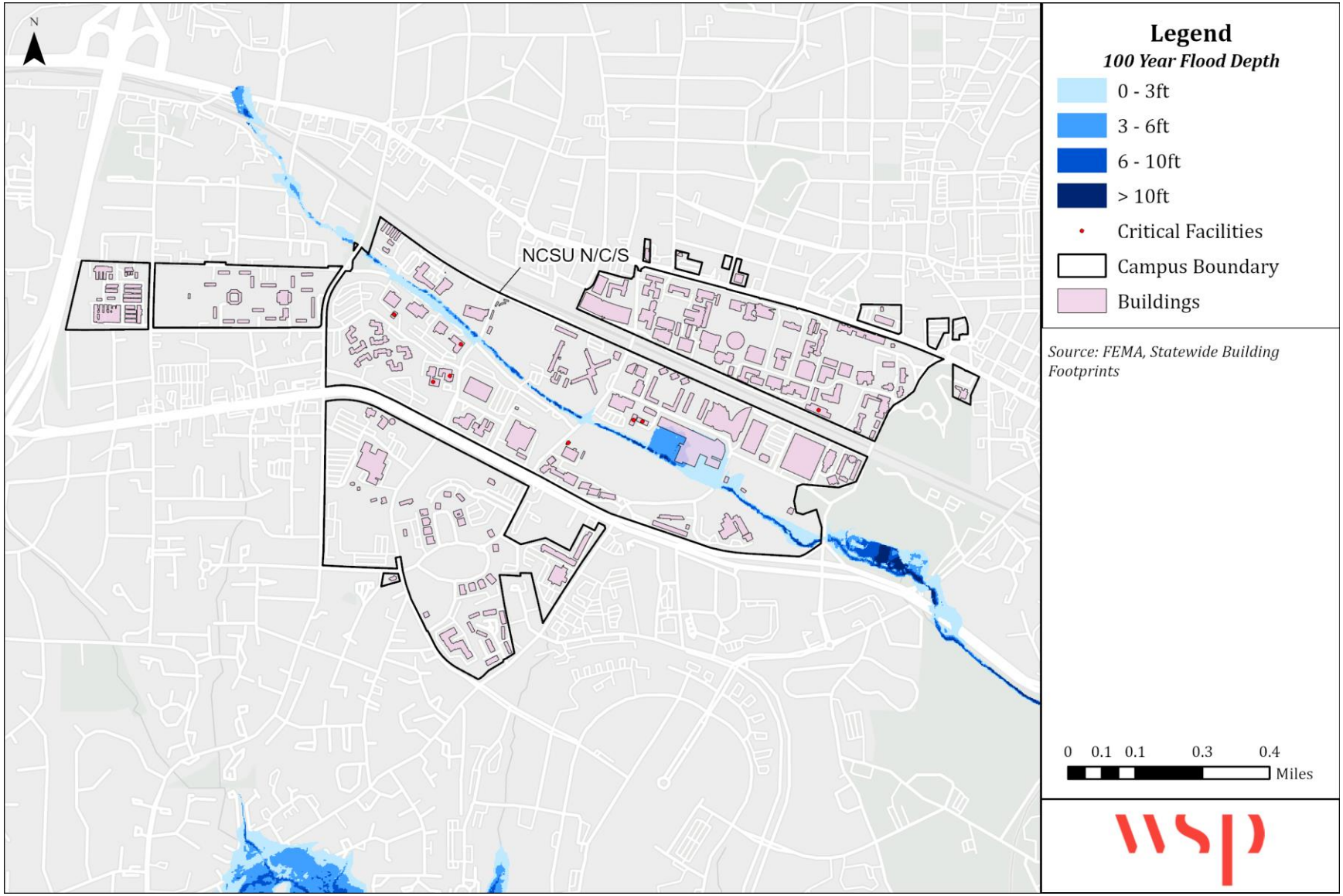
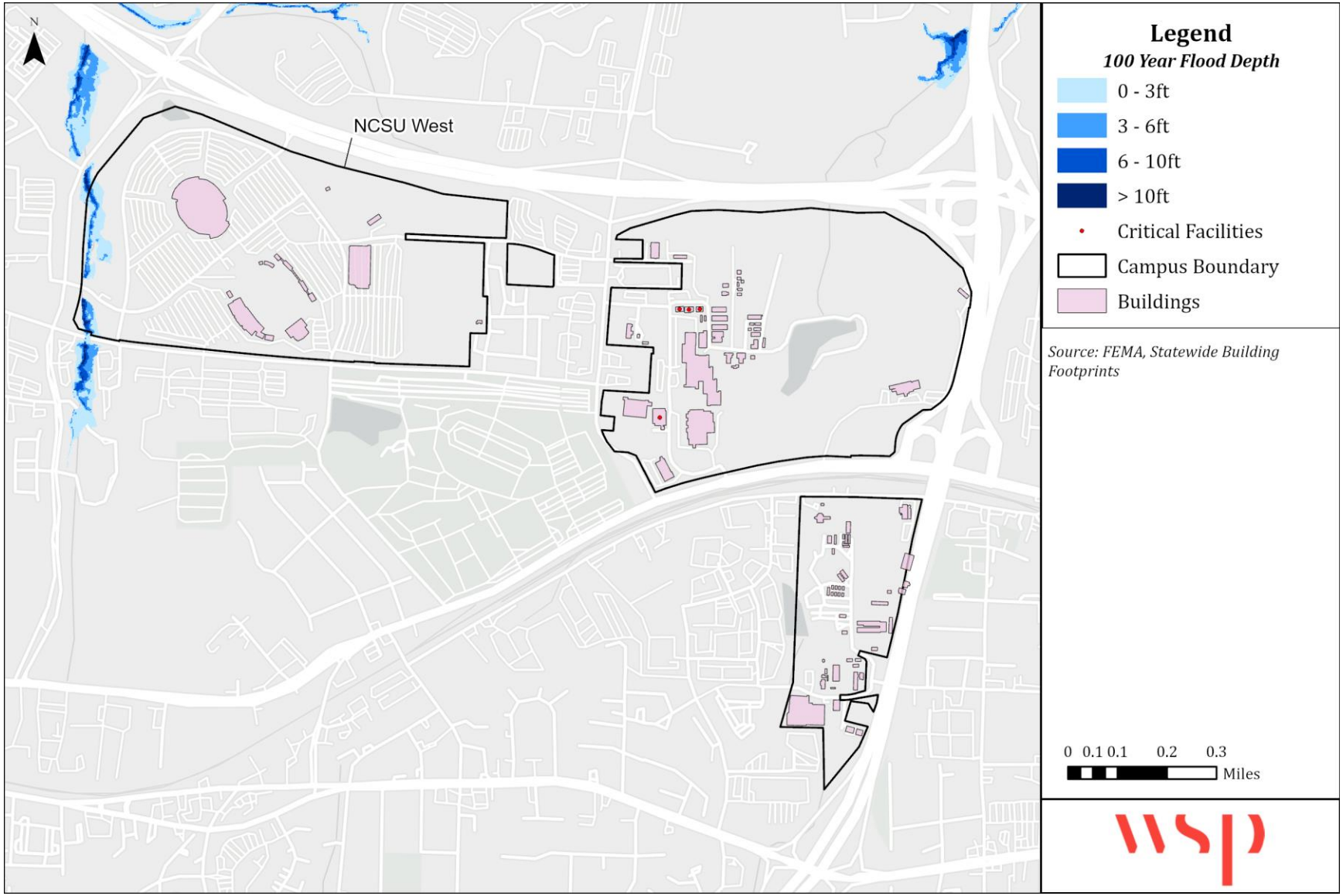


**Figure F.21 – Flood Depth, 1 – Percent–Annual-Chance Flood, NCSU West Campus**



## Historical Occurrences

Table F.26 details the historical occurrences of flooding for Raleigh identified from 2000 through 2024 by NCEI Storm Events database. The table below summarizes NCEI events that occurred countywide or started or ended in the City of Raleigh. According to NCEI, 63 recorded flood-related events occurred on 55 separate days in Raleigh and Wake County from 2000 to 2024 causing $2,694,000 in property damage, and no injuries, fatalities, or crop damage. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table F.26 – NCEI Records of Flooding for the City of Raleigh, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Raleigh | 7/29/2000 | 0/0 | $0 | $0 |
| Raleigh | 8/1/2000 | 0/0 | $0 | $0 |
| Raleigh | 8/4/2000 | 0/0 | $0 | $0 |
| Raleigh | 9/3/2000 | 0/0 | $0 | $0 |
| Raleigh | 9/4/2000 | 0/0 | $0 | $0 |
| Raleigh | 9/25/2000 | 0/0 | $0 | $0 |
| County-Wide | 6/16/2001 | 0/0 | $0 | $0 |
| Raleigh | 3/31/2002 | 0/0 | $0 | $0 |
| Raleigh | 6/28/2002 | 0/0 | $0 | $0 |
| Raleigh | 8/26/2002 | 0/0 | $0 | $0 |
| Raleigh | 10/11/2002 | 0/0 | $0 | $0 |
| Raleigh | 6/7/2003 | 0/0 | $0 | $0 |
| Raleigh | 7/29/2003 | 0/0 | $0 | $0 |
| Raleigh | 8/12/2004 | 0/0 | $0 | $0 |
| Raleigh | 8/13/2004 | 0/0 | $0 | $0 |
| Raleigh | 8/30/2004 | 0/0 | $0 | $0 |
| Raleigh | 6/7/2005 | 0/0 | $0 | $0 |
| Raleigh | 6/14/2006 | 0/0 | $0 | $0 |
| Raleigh | 6/23/2006 | 0/0 | $0 | $0 |
| Raleigh | 6/16/2009 | 0/0 | $0 | $0 |
| College View | 12/2/2009 | 0/0 | $0 | $0 |
| Raleigh | 1/25/2010 | 0/0 | $0 | $0 |
| Raleigh | 9/30/2010* | 0/0 | $0 | $0 |
| Raleigh | 8/6/2011 | 0/0 | $0 | $0 |
| College View | 9/21/2011 | 0/0 | $5,000 | $0 |
| College View | 9/8/2012 | 0/0 | $0 | $0 |
| Raleigh | 8/12/2014 | 0/0 | $2,500,000 | $0 |
| College View | 6/18/2015 | 0/0 | $0 | $0 |

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| (RDU)Raleigh-Durham | 4/25/2017 | 0/0 | $10,000 | $0 |
| (RDU)Raleigh-Durham | 6/16/2017 | 0/0 | $0 | $0 |
| Raleigh | 7/6/2018 | 0/0 | $0 | $0 |
| College View | 8/19/2018* | 0/0 | $0 | $0 |
| Raleigh | 8/20/2018* | 0/0 | $80,000 | $0 |
| Raleigh | 2/6/2020 | 0/0 | $0 | $0 |
| Raleigh | 8/31/2020 | 0/0 | $50,000 | $0 |
| College View | 1/3/2022 | 0/0 | $0 | $0 |
| Raleigh | 3/17/2022 | 0/0 | $0 | $0 |
| Raleigh | 5/7/2022 | 0/0 | $0 | $0 |
| Raleigh | 7/7/2022 | 0/0 | $15,000 | $0 |
| (RDU)Raleigh-Durham | 7/15/2022 | 0/0 | $15,000 | $0 |
| Raleigh | 8/11/2022 | 0/0 | $0 | $0 |
| College View | 7/8/2023 | 0/0 | $0 | $0 |
| Raleigh | 7/9/2023* | 0/0 | $0 | $0 |
| College View | 1/9/2024 | 0/0 | $0 | $0 |
| Raleigh | 5/25/2024 | 0/0 | $0 | $0 |
| Raleigh | 7/12/2024 | 0/0 | $0 | $0 |
| Raleigh | 7/18/2024 | 0/0 | $10,000 | $0 |
| Raleigh | 8/3/2024 | 0/0 | $4,000 | $0 |
| Raleigh | 9/1/2024* | 0/0 | $5,000 | $0 |
| Raleigh | 9/27/2024 | 0/0 | $0 | $0 |
| **Flood** | | | | |
| Raleigh | 7/17/2016 | 0/0 | $0 | $0 |
| **Heavy Rain** | | | | |
| Raleigh | 11/22/2006* | 0/0 | $0 | $0 |
| College View | 8/4/2020 | 0/0 | $0 | $0 |
| Raleigh | 9/1/2020 | 0/0 | $0 | $0 |
| (RDU)Raleigh-Durham | 9/23/2023 | 0/0 | $0 | $0 |
| **Total** | | **0/0** | **$2,694,000** | **$0** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **September 4, 2000** – Numerous roads were flooded across Raleigh. A creek was flowing across Avent Ferry Rd, Highway 401N was flooded, and some trucks were flooded up to their hoods in a car lot.
- **June 16, 2001** – Flooding was reported on Capital Blvd. at Brentwood Road and on Highway 70 in Garner. A pond overflowed onto Wycliff Road at Lake Boone Trail. Avent Ferry Road was closed near the N.C. State campus, causing several apartments to be evacuated.

- **June 14, 2006** – Widespread flooding throughout the county and numerous road closures from 7 to 8 inches of rain. Wake County officials said emergency workers made about 30 water rescues. Crabtree Creek rose to some of the highest levels ever.
- **06/16/2009** - Numerous roads closed due to flash flooding in and around Raleigh. Rescuers evacuated 15 to 20 occupants at the Southgate Community Center and surrounding apartments due to high flood waters from Walnut Creek.
- **September 30, 2010** – A cold front stalled across central and eastern portions of North Carolina. Central North Carolina received 2 to 5 inches of widespread rainfall, but because of ongoing severe drought conditions, no flooding occurred. Central North Carolina saw an additional 3 to 6 inches on the 29th and 30th. The combined rainfall of 6 to 10 inches from the 26th through the 30th of September resulted in flashing flooding and minor river flooding. Sullivan Drive on the campus of North Carolina State University was closed due to flash flooding.
- **8/6/2011** - Numerous flooding was reported with flood waters infiltrating several businesses and residences. Eight people were displaced from a house at 320 Hill Street. Another 45 to 50 people at the Milner Hotel were taken to shelter. The lower units of the Capital Inn were also evacuated due to flood waters. Monetary damages were unknown.
- **9/21/2011** - Multiple roads were blocked across Raleigh due to flooding, including Blue Ridge Road at Western Boulevard, Hillsboro Street near the Chapel Hill Road split and Avent Ferry Road at Trailwood Drive. Also, a vehicle stalled in approximately 3 feet of water on Old Wake Forest Road, with another stalled vehicle on Millbrook Road at Hoyle Drive. Monetary damage was estimated.
- **8/12/2014** - Multiple businesses had to be evacuated from the 1600-1800 block of Capital Boulevard. As many as 71 people had to be rescued and evacuated from businesses in this area. In addition, at the nearby intersection of Atlantic Avenue and Old Louisburg Road cars were reported flooded and stuck in the flood waters. Another car was reported stranded in the flood waters nearby at the intersection of Atlantic Avenue and Hodges Street. Monetary damages were estimated to be around 2-3 million dollars.
- **8/20/2018** - Water rescues were conducted as multiple vehicles were submerged in over 4 feet of water on Wake Forest Road near Georgetown Road.
- **May 7, 2022** – One strong storm in Wake County led to an isolated flash flood. The showers and storms weakened by late evening as the trough moved east. Several hours of heavy rain led to flooding near Pullen Park, as the Rocky Branch river gage in Raleigh reached minor flood stage.
- **July 9, 2023** – A southward moving cold front from the Ohio Valley led to the development of a line of showers and thunderstorms in central North Carolina. Numerous reports of damaging winds and flash flooding were reported throughout central North Carolina. Flooding reports were made near W Franklin St and Semart Dr led to road closures. The intersection of Melbourne Rd and Aukland Dr was closed due to flash flooding.
- **January 9, 2023** – Widespread gusty winds developed across North Carolina ahead of this low, and a line of showers and thunderstorms swept through North Carolina. Widespread tree damage was associated with this event, both within the gradient winds ahead of the

thunderstorms, and the convective line itself. Several feet of water were flowing across Avent Ferry Rd near Trailwood Drive. The road was blocked due to high water.

- **July 18, 2024** – A line of scattered to numerous showers and storms tracked southeastward ahead of the front during the afternoon and evening hours. Numerous downed trees and powerlines were reported, as well as some isolated flash flooding across Wake and Durham Counties. Local media reported flooding in downtown Raleigh. A water rescue was also reported.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which have also included damages associated with flooding. Additionally, Wake County has received two Major Disaster Declaration for severe storms including elements of flooding in 1998 and 2011, along with four Major Disaster Declarations for Hurricanes in, 1996, 1999, 2003, 2016 which also may have included damages associated with flooding.

The HMPC reported that NCSU's campus has not sustained notable flood-related damage in recent years. Much of the campus' vulnerability to flooding was addressed through mitigation projects about 10 years ago, which have successfully reduced flood risk and incidence of damage.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The NCSU campuses have some land within the FEMA-mapped flood hazard areas. This delineation is a useful way to identify the most at-risk areas, but NCSU campuses are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Raleigh and impacts from past flood events have been noted by NCEI. NCEI reports 63 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability greater than 100% for Raleigh. Therefore, the probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. In total, there are 400 buildings on NCSU's campus; of these, 4 are located within the SFHA. These were the buildings evaluated as part of this analysis.

Flood damage is directly related to the depth of flooding by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a specific percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure F.19 through Figure F.21 depict the depth of flooding that can be expected within the NCSU campus during the 1-percent-annual-chance flood event.

The four exposed buildings are shown in Figure F.22 and Figure F.23 on the following pages. Each of these buildings has a first-floor elevation that is higher than the modeled 1% annual chance flood water surface elevation. Therefore, no estimated losses are expected from the 1% annual chance flood.

**Figure F.22 – Buildings Exposed to Flood Risk on NCSU Centennial Campus**

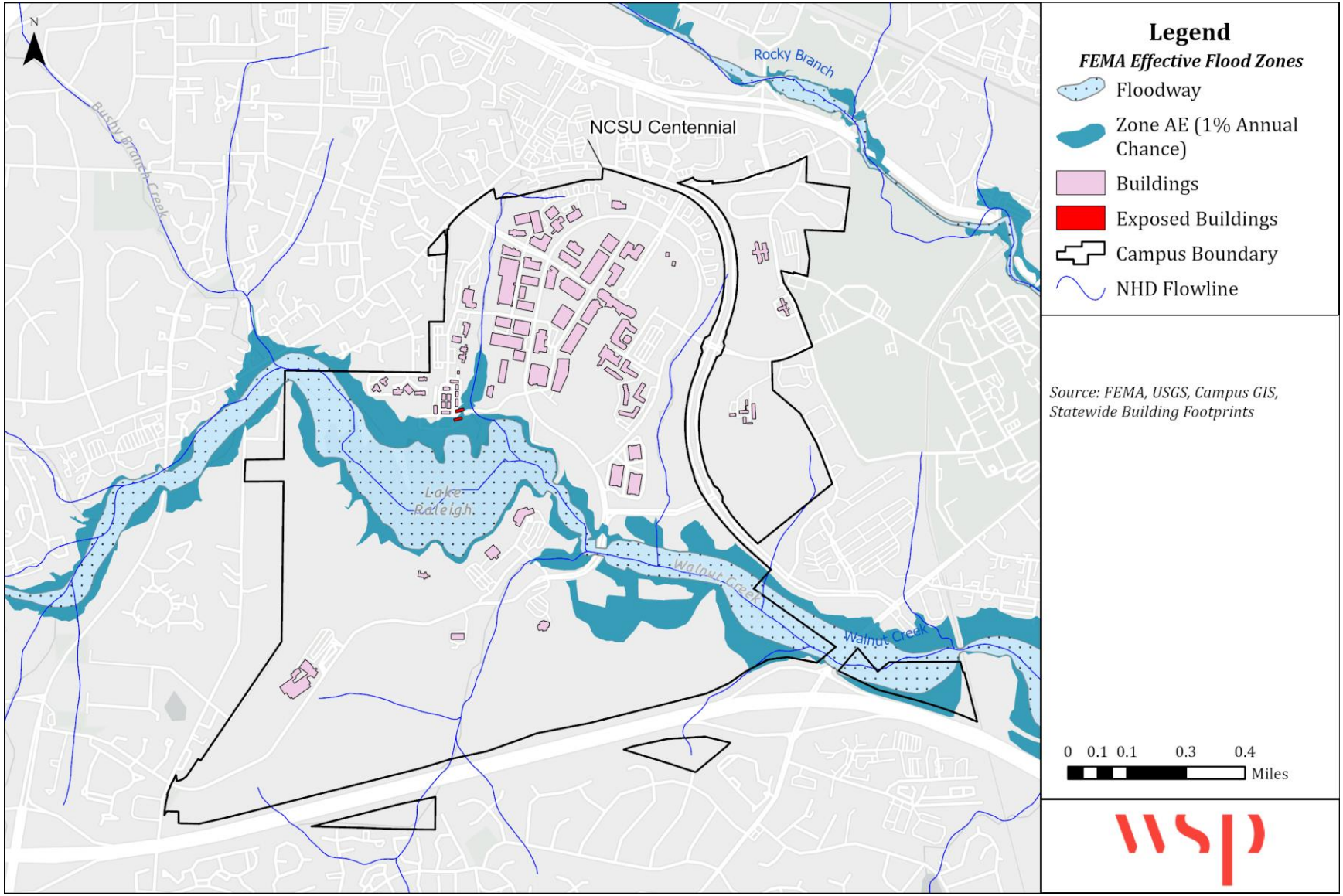
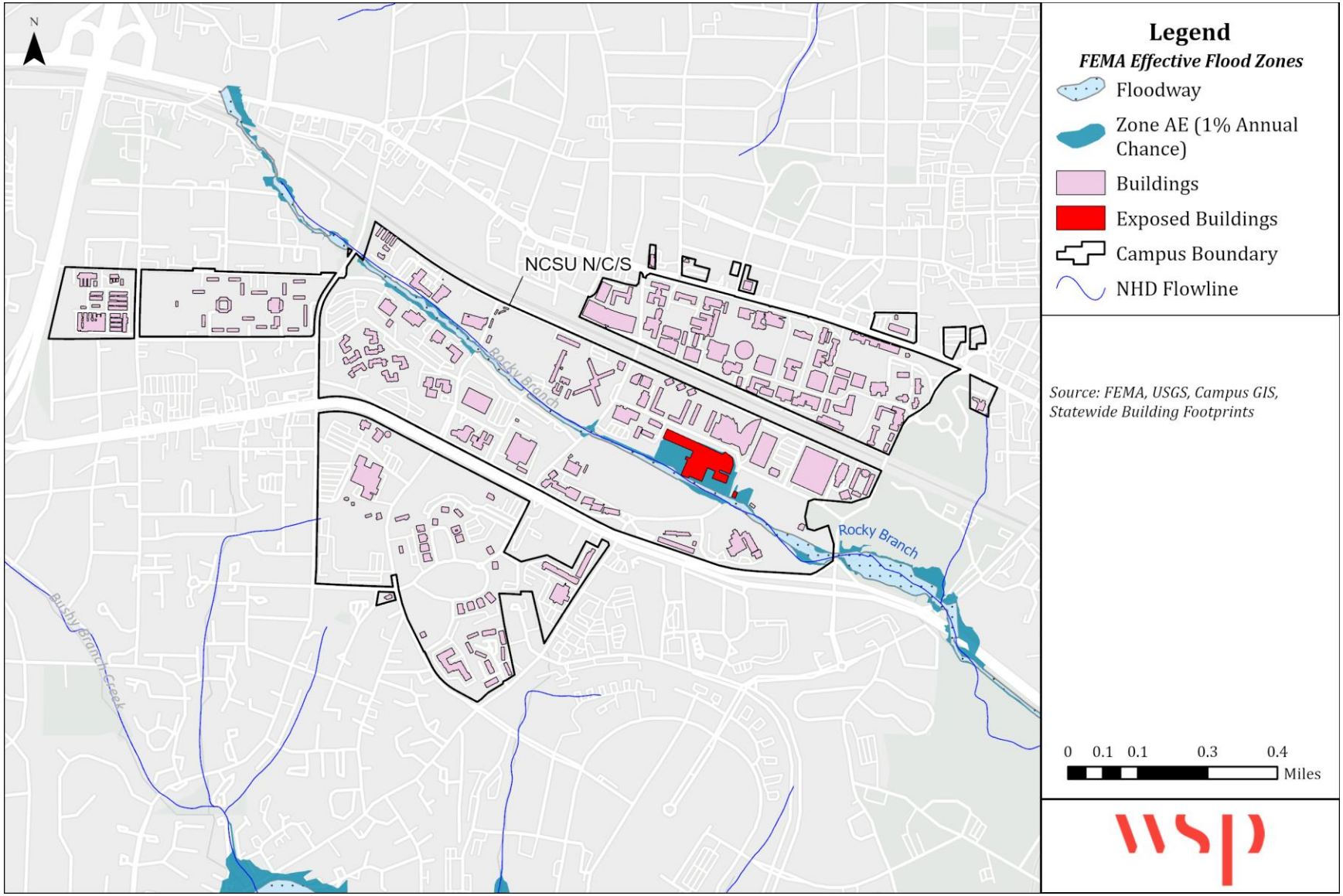


**Figure F.23 – Buildings Exposed to Flood Risk on NCSU Central Campus**



## People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.

- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths caused by flood events in Raleigh.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

The first-floor elevation (FFE) of the structures that intersect the SFHA are higher than the flood elevation of the 1%-annual-chance flood zone, so no loss estimates were generated for these structures.

None of the critical facilities identified for NCSU are located within the 1%-annual-chance floodplain, therefore there is no estimated damage.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, NCSU Facilities Services works to maintain compliance with all applicable state and federal regulations regarding water resources, provides

a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statements

- The 1%- annual-chance floodplain extends onto 10 percent of the combined NCSU campuses. However, there are no loss estimates for structures within the SFHA as each structure has a FFE higher than the flood elevation level for the 1%-annual-chance flood.
- There are no critical facilities within the SFHA, but two buildings on the NCSU Central campus (Carmichael Gymnasium and Dail Softball Stadium Batting Cage) and two buildings on Centennial campus (in North Shore Residential Development) are exposed to the 1% annual chance floodplain. While these buildings are not expected to sustain damage from the 1% annual chance flood, flooding could nonetheless impact building access. Along with these buildings, there is potential for roadways to be impacted during flood events.
- Flooding is not limited to the SFHA. Localized flooding can still impact facilities, roadways, and other locations on campus.
- During a flash flood event in September 2010, Sullivan Drive on the campus of North Carolina State University was closed due to water over the roadway.
- Flooding may also occur on the campus when an intense rainfall occurs and cannot be carried away by natural or urban drainage systems as fast as it is falling.

## F.5.5 Hurricane

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland and can occur anywhere within Wake County. NCSU is not exposed to storm surge. Hurricane winds can impact the entire campus, so the spatial extent is considered large.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table F.27), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table F.27 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

### Table F.27 – Saffir-Simpson Scale

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

**Table F.28 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Hurricane Fran is illustrative of the potential impact of hurricanes on the Wake County planning area. In Wake County alone, Fran caused oved $900 million in residential and commercial property damage and at least one death. Additional losses included infrastructure damage and power outages.

*Impact: 3 – Critical*

## Historical Occurrences

According to NCEI, eight recorded hurricane-related events affected Wake County from 2000 to 2024 causing an estimated $3,615,500 in property damage. There were no injuries, fatalities, or crop damage recorded for any of these events.

**Table F.29 – Recorded Hurricane and Tropical Storm Events for Wake County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 9/18/2003 | Hurricane (Typhoon) | Hurricane Isabel | 0/0 | $890,000 | $0 |
| 9/1/2006 | Tropical Storm | Tropical Storm Ernesto | 0/0 | $0 | $0 |
| 9/2/2016 | Tropical Storm | Tropical Storm Hermine | 0/0 | $20,000 | $0 |
| 9/13/2018 | Tropical Storm | Hurricane Florence | 0/0 | $1,000,000 | $0 |

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 10/11/2018 | Tropical Storm | Tropical Storm Michael | 0/1 | $200,000 | $0 |
| 9/5/2019 | Tropical Storm | Hurricane Dorian | 0/0 | $1,500 | $0 |
| 8/4/2020 | Tropical Storm | Hurricane Isaias | 0/0 | $250,000 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0 | $1,000,000 | $0 |
| **Total** | | | **0/1** | **$3,361,500** | **$0** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Florence (2018)** – A large tree was reported down on a home along Piperwood Court.
- **Tropical Storm Michael (2018)** – Tropical storm wind gusts downed numerous trees, caused widespread power outages, and produced a variety of damage to homes and structures across the county. At the peak of the storm, the total peak outages were around 20,000 customers.
- **Hurricane Ian (2022)** - Frequent wind gusts of 40 to 60 mph resulted in scattered to numerous trees and power lines down across Durham County, including some on homes. Numerous customers lost power in Durham County as a result of the tropical storm force wind gusts.

According to the NOAA Historical Hurricane Tracks dataset, 16 hurricanes or tropical storms, passed within 25 miles of NCSU since 1900. These events are listed in Table F.30, and storm tracks are mapped in Figure F.24.

**Table F.30 – Hurricane Tracks within 25 miles of NCSU, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 6/17/1902 | Unnamed | Tropical Storm |
| 10/3/1929 | Unnamed | Tropical Storm |
| 10/21/1944 | Unnamed | Tropical Storm |
| 9/19/1945 | Unnamed | Tropical Storm |
| 8/18/1955 | Diane | Tropical Storm |
| 9/1/1964 | Cleo | Tropical Depression |
| 6/11/1968 | Abby | Tropical Depression |
| 5/27/1970 | Alma | Tropical Storm |
| 9/17/1976 | Unnamed | Tropical Depression |
| 9/9/1987 | Unnamed | Tropical Depression |
| 9/7/1996 | Fran | Category 1 |
| 9/6/1999 | Dennis | Tropical Depression |
| 9/20/2000 | Gordon | Tropical Depression |
| 8/31/2004 | Gaston | Tropical Depression |
| 10/12/2018 | Michael | Tropical Storm |
| 7/9/2021 | Elsa | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

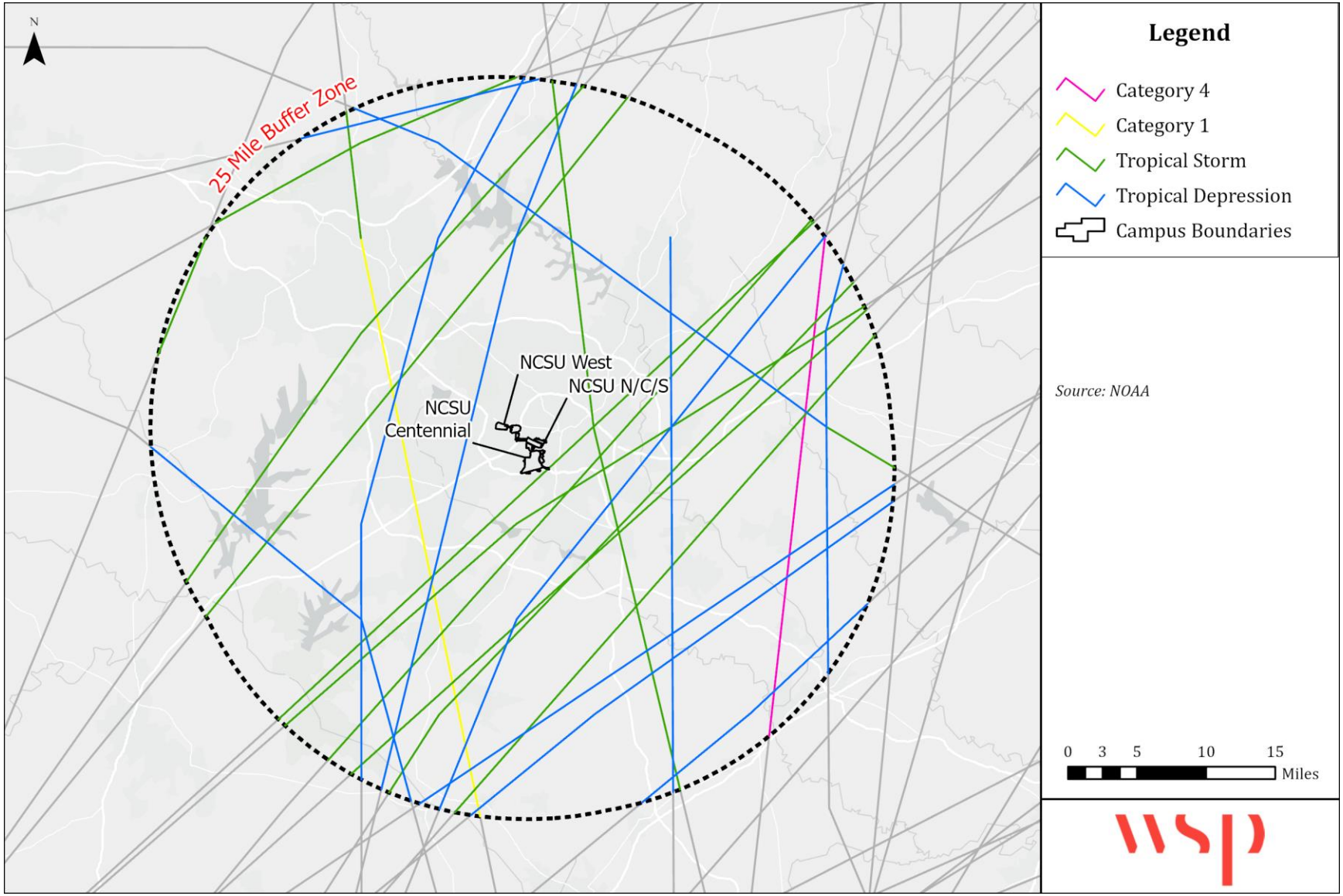
Wake County has received four major disaster and seven emergency declarations for Hurricane and Tropical Storm events summarized in Table F.31.

### Table F.31 – Hurricane-Related Disaster Declarations & Emergency Declarations

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 9/15/1999 | DR-1292-NC & EM-3146-NC | Hurricane Floyd |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 10/7/2016 | DR-4285-NC & EM-3380-NC | Hurricane Matthew |
| 9/1/2018 | EM-3401-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

Source: OpenFEMA, 2025

**Figure F.24 – Historic Hurricane and Tropical Storm Tracks within 25 miles of NCSU, 1900-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, six hurricanes and tropical storms have impacted Wake County, which equates to a 24 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting NCSU is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. The on-campus student population may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRISK analysis, a 100-year hurricane wind event could cause over $15.9 million of estimated total building damages across all NCSU's campuses.

Table F.32 through Table F.34 detail the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

### Table F.32 – Estimated Building Damage by Hurricane Winds, NCSU Centennial Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $93,481.15 | $5,858.28 | $99,339.43 |
| Educational | $1,312,116.84 | $78,610.24 | $1,390,727.08 |
| Housing | $22,970.98 | $1,374.76 | $24,345.74 |
| **Total** | **$1,428,568.97** | **$85,843.28** | **$1,514,412.25** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $1,082,198.11 | $367,527.95 | $1,449,726.06 |
| Educational | $10,904,355.42 | $2,418,119.15 | $13,322,474.57 |
| Housing | $288,340.94 | $97,872.43 | $386,213.37 |
| **Total** | **$12,274,894.47** | **$2,883,519.53** | **$15,158,414.00** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $1,082,198.11 | $367,527.95 | $1,449,726.06 |
| Educational | $10,904,355.42 | $2,418,119.15 | $13,322,474.57 |
| Housing | $288,340.94 | $97,872.43 | $386,213.37 |
| **Total** | **$12,274,894.47** | **$2,883,519.53** | **$15,158,414.00** |

Source: NCEM iRISK Database

Note: iRISK data showed the same total damage amounts for the 300- and 700-year hurricane events for the NCSU Centennial Campus

### Table F.33 – Estimated Building Damage by Hurricane Winds, NCSU North, Central, and South Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $90,127.35 | $17,135.12 | $107,262.47 |
| Educational | $9,279,491.36 | $3,487,941.34 | $12,767,432.70 |
| Housing | $349,051.32 | $27,319.30 | $376,370.62 |
| **Total** | **$9,718,670.03** | **$3,532,395.76** | **$13,251,065.79** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $487,506.48 | $172,843.39 | $660,349.87 |
| Educational | $40,525,671.81 | $20,968,971.92 | $61,494,643.73 |
| Housing | $1,673,594.31 | $398,522.71 | $2,072,117.02 |
| **Total** | **$42,686,772.60** | **$21,540,338.02** | **$64,227,110.62** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $759,121.66 | $308,881.42 | $1,068,003.08 |
| Educational | $41,760,666.31 | $21,527,956.64 | $63,288,622.95 |
| Housing | $2,372,805.62 | $647,668.45 | $3,020,474.07 |
| **Total** | **$44,892,593.59** | **$22,484,506.51** | **$67,377,100.10** |

Source: NCEM iRISK Database

### Table F.34 – Estimated Building Damage by Hurricane Winds, NCSU West Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $8,792.15 | $645.41 | $9,437.56 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Educational | $1,090,513.58 | $35,186.55 | $1,125,700.13 |
| Housing | $380.91 | $0.91 | $381.82 |
| **Total** | **$1,099,686.64** | **$35,832.87** | **$1,135,519.51** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $30,119.92 | $6,468.67 | $36,588.59 |
| Educational | $3,372,142.21 | $296,728.05 | $3,668,870.26 |
| Housing | $741.94 | $14.69 | $756.63 |
| **Total** | **$3,403,004.07** | **$303,211.41** | **$3,706,215.48** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $86,200.30 | $32,310.63 | $118,510.93 |
| Educational | $9,347,909.77 | $1,703,248.82 | $11,051,158.59 |
| Housing | $1,541.16 | $207.65 | $1,748.81 |
| **Total** | **$9,435,651.23** | **$1,735,767.10** | **$11,171,418.33** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statements

- Historical tracks of multiple hurricane events have passed within 25-miles of the NCSU campus.
- For the 25-year period from 2000 through 2024, there have been 6 hurricane wind events causing around $3.6 million in damage for Wake County.
- Assuming impacts to all buildings on campus, a 100-year hurricane wind event could cause over $15.9 million in building damage.

# F.5.6 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

## Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Wake County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can impact the entire NCSU campus.

*Spatial Extent: 4 – Large*

## Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI), shown in Table F.35 for the Wake County region, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. The county may experience any level on the RSI scale. Wake County receives an average of 4 to 6 inches of snowfall per year. According to NCEI, the greatest snowfall amounts to impact Wake County have been between 7-11 inches. During the snowstorm of December 24 to December 26, 2010, the county was classified as a Category 1 on the RSI scale. It is possible that more severe events and impacts could be felt in the future.

**Table F.35 – Regional Snowfall Index (RSI) Values**

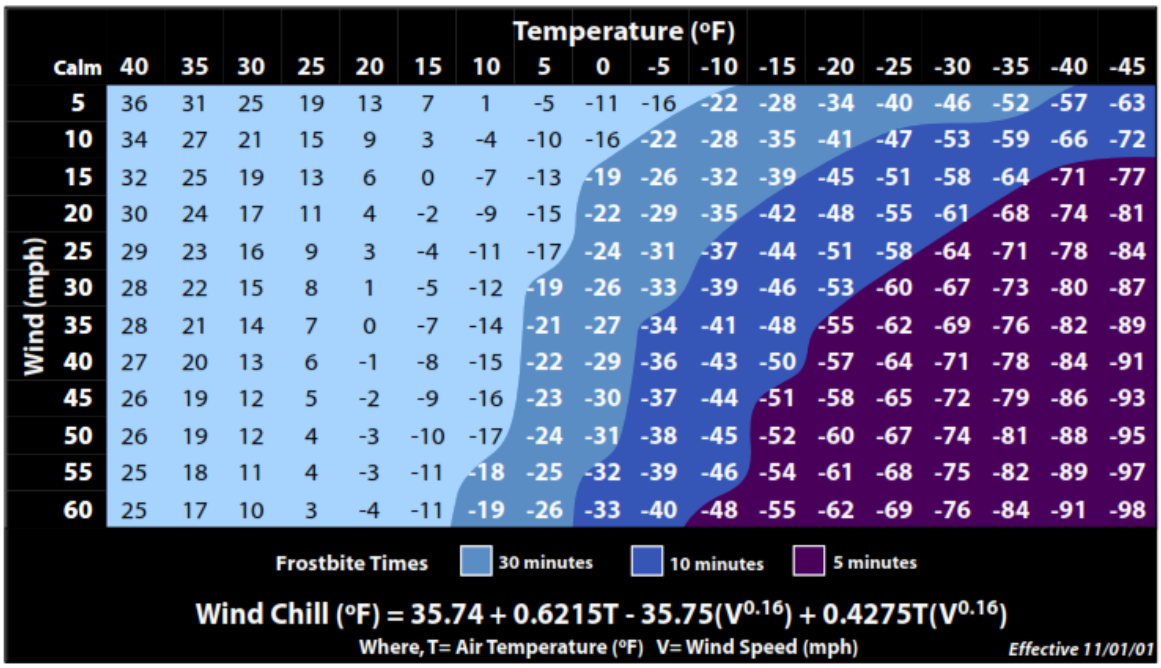
| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure F.25, provides a formula for calculating the dangers of

winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure F.25 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Wake County took place January 25th, 2000, with a recorded depth of 17.9 inches of snow occurring in the City of Raleigh.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.

- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24-hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements. Defined by NWS Raleigh Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one heavy snow event, and 57 combined winter storm/winter weather events in Wake County during the 25-year period from 2000 through 2024. As reported in NCEI, severe winter weather caused $1,040,000 in property damage, but they did not cause any fatalities, injuries, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Wake County by incident are recorded in Table F.36.

**Table F.36 – Recorded Severe Winter Weather Events in Wake County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Heavy Snow | 1 | 0 | 0 | $0 | $0 |
| Winter Storm | 28 | 0 | 0 | $1,000,000 | $0 |
| Winter Weather | 29 | 0 | 0 | $40,000 | $0 |
| **Total** | **58** | **0** | **0** | **$1,040,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **January 20, 2009** – Between 5 to 7 inches of snow fell across the county over a 12-hour period. Roads were quickly covered with snow resulting in several traffic accidents and the closing of local schools and businesses. Over 700 automobile accidents were reported in the county along with a few house fires.
- **January 29, 2010** – Between 4 to 6 inches of snow fell across the county. Hundreds of vehicle accidents and some power outages were reported. Due to the cold temperatures, icy road conditions persisted for several days resulting in the closure of schools and businesses.
- **December 25, 2010 –** 7 to 11 inches of snow fell countywide with the highest amounts falling from Raleigh east to Wendell, Zebulon and Garner. Many roads were impassable due to the heavy snow, however, other than a few minor accidents no other problems were reported due to the holiday.
- **January 26, 2016** – One quarter to one half of an inch of freezing rain accrual was reported across the county. In addition, snowfall/sleet amounts of a trace to 2 inches fell. Icy roads created difficult travel conditions during the morning of the 22nd, with numerous automobile accidents reported across the county.
- **January 29, 2022** – An upper low and associated arctic cold front brought precipitation to central North Carolina on the 28th and 29th. Precipitation began as rain on the afternoon of the 28th with a gradual mix and changeover to snow as the front moved through the area. Precipitation wrapped up early on the morning of the 29th. Most locations saw less than 1 inch of snowfall with this event, although there were some locations from Guilford to Randolph Co's that saw over 3 of snow.

Wake County received six FEMA Major Disaster Declarations for a snowstorm in 1977, severe winter storm in 1993, blizzard in 1996 and severe ice/winter storms in 1968, 2000 and 2002.

## Probability of Future Occurrence

NCEI records 58 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $836,025, which assumes that 10% of the on-campus population is impacted.

**Table F.37 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 39,259 | 3,925 | $836,025 |

### Property

NCEI reported $1,040,000 of property damage in association with any winter weather events between 2000 and 2024 for Wake County. Based on these records, the County experiences an estimated annualized loss of $41,600 in property damage. The average impact from winter weather events per incident in Raleigh is $17,931.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. NCSU may wish to consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statements

- Severe winter weather events are highly likely for Wake County and the NCSU campus. The events have also resulted in four presidential disaster declarations for the County.
- Primary concerns for NCSU are power outages, dangerous travel conditions, and falling limbs or trees.

# F.5.7 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas. All of NCSU is exposed to tornadoes and thunderstorms. Overall, due to the small size of the planning area, any given event will likely impact most, if not all, of the planning area, so the spatial extent of a tornado or thunderstorm event is considered large.

*Spatial Extent: 4 – Large*

### TORNADO

Tornados can occur anywhere on NCSU's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado damage isn't increased in one area of the campus versus another.

### THUNDERSTORM WINDS

The entirety of NCSU's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates

(not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table F.38 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table F.38– Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

The most intense tornado to pass through Raleigh between 1950 and 2024 was an F4 (EF4) on November 28, 1988. NCEI reports this event causing around $250 million in property damage, and narratives of the event reported two fatalities, 105 injuries, and severe property damage.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.

- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Raleigh between 2000 and 2024 occurred on March 4, 2008 with a measured gust of 70.2 mph. The event did not result in any injuries, fatalities, or property damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity on a specific categorical scale. The LAL, shown in Table F.39, is a common parameter that is part of fire weather forecasts nationwide.

**Table F.39 – Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

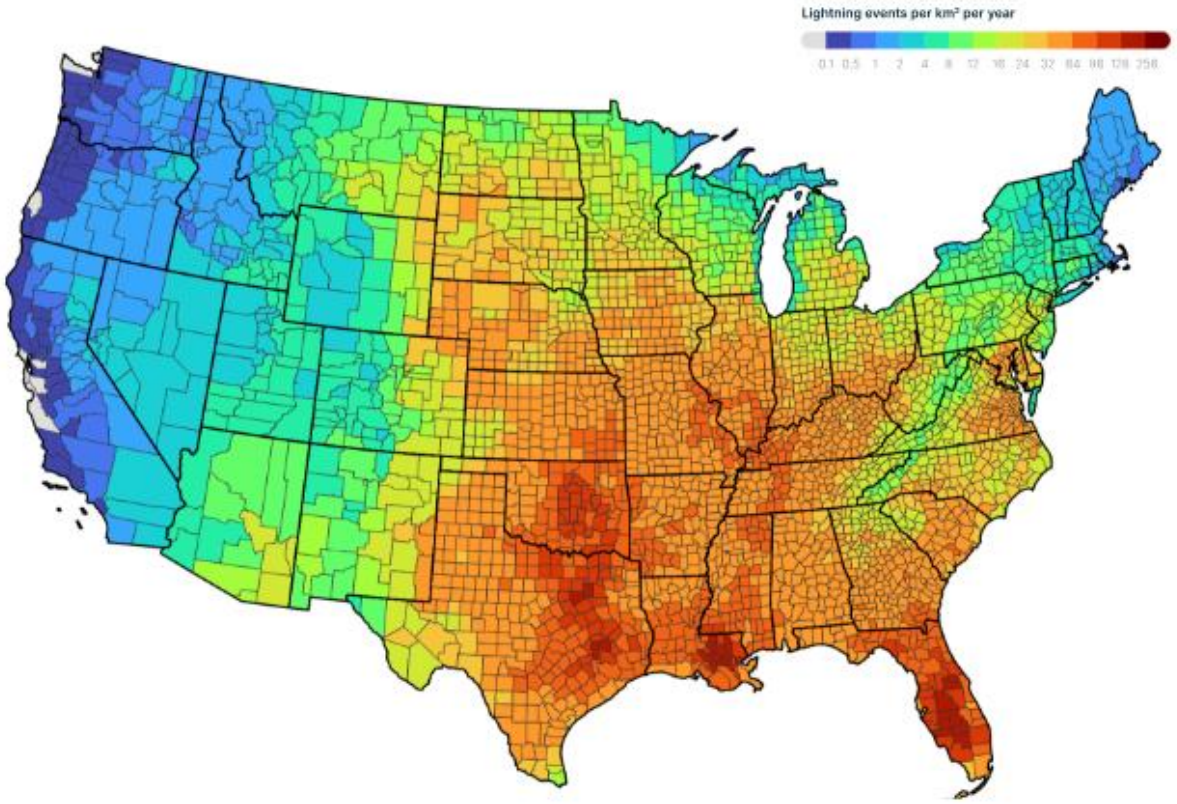
Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption to quality of life.

*Impact: 1 – Minor*

According to the Vaisala flash density map, Wake County experiences between 24 and 32 lightning flashes per km per year.

**Table F.40 – Lightning Density in the U.S. (2024)**




## HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table F.41 indicates the hailstone measurements utilized by the National Weather Service.

**Table F.41 – Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table F.42 describes typical intensity and damage impacts of the various sizes of hail.

**Table F.42 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Raleigh was a little over 1" in diameter; the largest hailstone recorded was 4 inches, recorded on March 28, 2005.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Wake County has 30 recorded tornado events between 1950 and 2024. These tornado events reported $370,963,000 in property damage, $25,000 in crop damage, 203 injuries, and 7 deaths. Table F.43 shows historical tornadoes in Wake County recorded in NCEI between 1975 and 2024, and

Figure F.26 shows tornado paths within 10 miles of NCSU.

**Table F.43 – Recorded Tornadoes in Wake County, 1975-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|---|---|
| - | 12/31/1975 | 1600 | F1 | 0 | 0 | $2,500 | 0 |
| - | 5/7/1977 | 1450 | F0 | 0 | 0 | $2,500 | 0 |
| - | 2/11/1981 | 305 | F2 | 0 | 2 | $250,000 | 0 |
| - | 6/13/1982 | 1410 | F1 | 1 | 0 | $25,000 | 0 |
| - | 6/16/1982 | 1225 | F2 | 0 | 0 | $250,000 | 0 |
| - | 3/14/1986 | 1555 | F1 | 0 | 0 | $25,000 | 0 |
| - | 3/26/1988 | 1955 | F0 | 0 | 0 | $0 | 0 |
| - | 11/28/1988 | 0 | F4 | 2 | 105 | $250,000,000 | 0 |
| - | 10/23/1990 | 218 | F1 | 0 | 0 | $0 | 0 |
| Raleigh | 3/27/1993 | 1605 | F0 | 0 | 0 | $0 | 0 |
| Wendell | 4/15/1996 | 1708 | F0 | 0 | 0 | $10,000 | 0 |
| Wendell | 4/15/1996 | 1725 | F1 | 0 | 26 | $3,000,000 | 0 |
| Cary | 7/12/1996 | 1325 | F0 | 0 | 0 | $50,000 | 0 |
| Holly Spgs | 3/20/1998 | 1815 | F0 | 0 | 0 | $0 | 0 |
| Garner | 3/20/1998 | 1840 | F2 | 0 | 2 | $650,000 | 0 |
| Raleigh | 3/20/1998 | 1845 | F0 | 0 | 0 | $15,000 | 0 |
| Cary | 6/1/2001 | 1300 | F0 | 0 | 0 | $0 | 0 |
| Apex | 9/27/2004 | 1830 | F0 | 0 | 0 | $0 | 0 |
| Garner | 9/14/2007 | 1825 | EF0 | 0 | 0 | $0 | 0 |
| Rockton | 4/25/2010 | 1859 | EF0 | 0 | 0 | $250,000 | $25,000 |
| Rolesville | 3/6/2011 | 1710 | EF0 | 0 | 1 | $100,000 | 0 |
| Burt | 4/16/2011 | 1427 | EF3 | 4 | 67 | $115,000,000 | $0 |
| Zebulon | 9/18/2012 | 1438 | EF0 | 0 | 0 | $0 | $0 |
| South Raleigh Arpt | 3/29/2014 | 1957 | EF0 | 0 | 0 | $8,000 | $0 |
| Williams Xrds | 3/29/2014 | 2008 | EF0 | 0 | 0 | $5,000 | $0 |
| Knightdale Wndll Arp | 4/15/2018 | 2135 | EF1 | 0 | 0 | $150,000 | $0 |
| Knightdale Wndll Arp | 5/13/2019 | 913 | EF2 | 0 | 0 | $1,000,000 | $0 |
| Willow Spgs | 7/23/2019 | 1334 | EF0 | 0 | 0 | $50,000 | 0 |
| Mc Cullers | 12/10/2023 | 1228 | EF1 | 0 | 0 | $0 | 0 |
| Varina | 8/3/2024 | 1628 | EF1 | 0 | 0 | $120,000 | 0 |
| **Total** | | | | 7 | 203 | $370,963,000 | $25,000 |

Source: NCEI

Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **November 28, 1988** – The tornado began at 1 AM EST in Umstead National Park in the NW part of Raleigh. The strongest damage occurred along a four-mile stretch extending northeast from US Highway 70 to four miles east of the Raleigh-Durham airport. Numerous businesses were destroyed along U.S. Highway 70 including a K-Mart. Two children were killed in Raleigh and 105 people were injured.
- **April 15, 1996** – The second is a series of three tornadoes began about 100 yards to the SE of where the first tornado began (off Hwy 64 in Wendell). The storm was initially less than 25 yards wide as it moved NNE and twisted trees and blew shingles off several

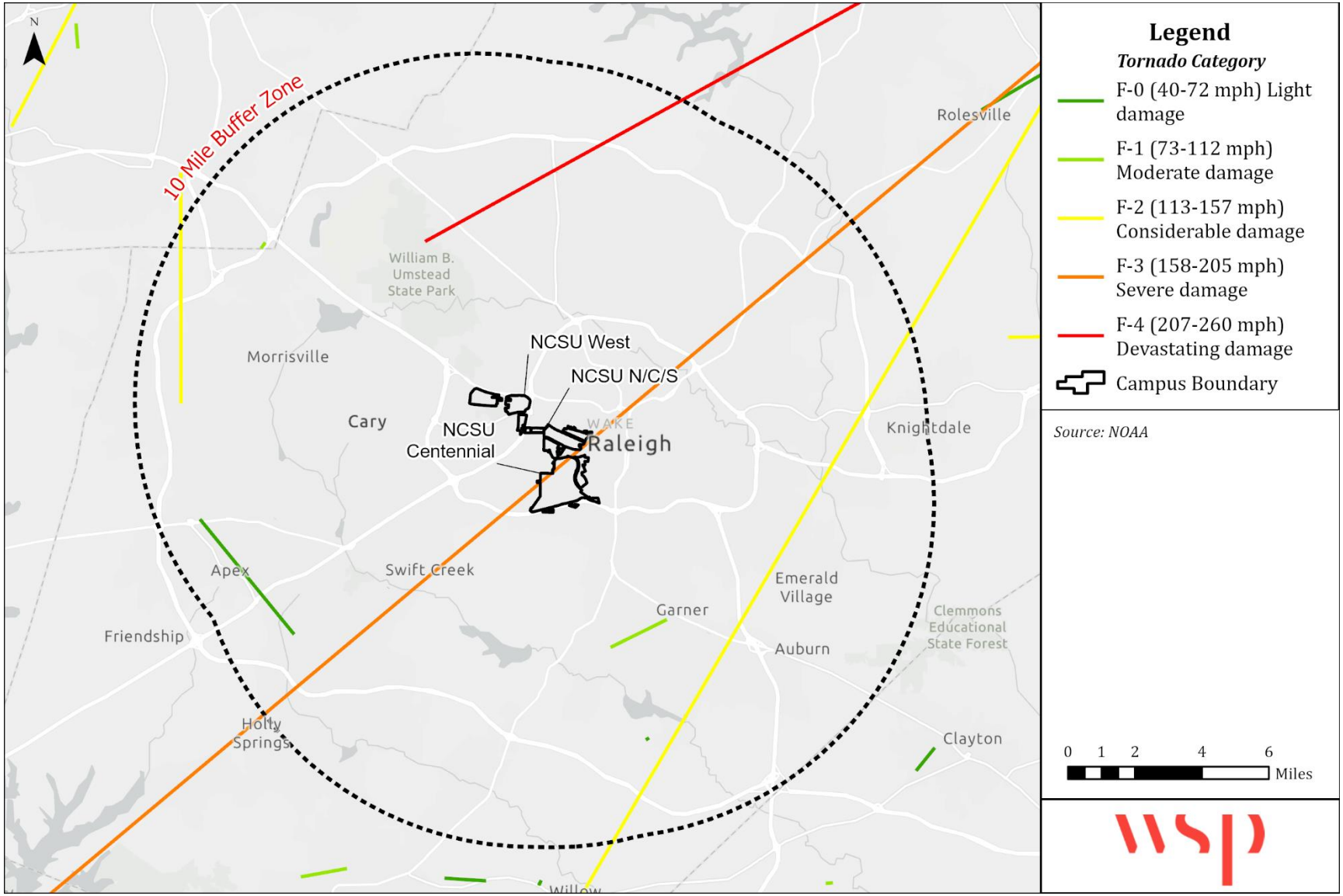
houses. About one half mile from the initial touchdown, the storm widened to 50 yards as it approached the town of Zebulon. Trees were downed and the roof was blown off a brick home near the railroad tracks. Another home and a manufactured home were damaged as the storm crossed a street and moved up a hill. The storm then preceded over and down the hill into a mobile home park. Damage was extensive to all the trailers in the park that were directly in the path. The storm continued moving NNE into downtown Zebulon where it downed numerous large trees. Houses in the direct path of the storm were all brick and sustained only roof damage. The Zebulon Middle School sustained major roof damage to the main building. The tornado was last noted at Karial and Old Bunn Roads where minor damage occurred to a frame house and several trees were twisted.

- **April 16, 2011** – The tornado exited Chatham County and entered southwest Wake County as an EF0. There was multiple tree and roof damage along Avent Ferry Road, southwest of Holly Springs. The tornado intensified to an EF1 with winds of 86 mph as it reached Fire Station Number Two and the Holly Glenn Subdivision before crossing highway 55 and tracking through the Remington subdivision. The tornado continued to track northeastward and caused extensive tree damage and damage to numerous homes, mainly from fallen trees along Pierce Olive, Ten-Ten, Penny Road, and Yates Mill Pond roads, as wind speeds increased to around 100 mph. The tornado crossed Tryon Road, between Lake Wheeler Road and the Raleigh Golf Association Golf Course, before tracking northeast across the entire City of Raleigh, producing EF1 damage in a narrow swath between 50 to 100 yards. It crossed directly over Interstates 40-440, between exits 297 and 298 with damage on both sides of the interstate clearly visible. The tornado continued northeast across South Saunders Street, where 4 businesses were damaged. A body shop was completely destroyed when the roof was ripped off and the side walls collapsed. The tornado continued to snap hardwood trees and powerlines near Mount Hope Cemetery and nearby homes. The tornado weakened as it moved northeast towards Shaw University. Campus dormitories and the university student center had windows blown in with roof damage. The tornado moved northeast along the east side of the major high-rise buildings in downtown Raleigh, downing hundreds of trees, many of which fell on houses. The historic Oakwood to Lion`s Park sections of town, including the historic Oakwood Cemetery were hardest hit. Also, in the path of the tornado was Saint Augustine`s College, which sustained roof damage to every building on campus. The tornado continued to down trees on numerous homes as it crossed North King Charles Road to Yonkers Road, producing EF1 damage to several businesses. The tornado crossed the 440 beltline for a second time, this time on the northeast side of downtown Raleigh near the intersections of Westinghouse and Brentwood roads, again causing damages to several businesses, including the Raleigh Iceplex. The tornado then strengthened to an EF2 with winds greater than 110 mph as it continued northeast producing extensive tree damage in a 100 to 200-yard-wide path from Stony Brook Drive to Buffalo Road. Snapped trees crashed onto and through numerous homes all along the path. Four fatalities occurred when a large tree fell onto a mobile home. Two other mobile homes were thrown 30 to 50 feet when the tie downs snapped from their anchor points with nearly all of the mobile homes in the Stony Brook mobile home park sustained some type of damage. The EF2 tornado continued to move northeast across Buffalo Road, near the Cardinal Grove Subdivision. Several two-story homes were completely destroyed with numerous other homes sustaining moderate to major damage. Damage consistent with an EF2 tornado continued with widespread damage in a 200-yard-wide swath along Forestville road. A couple of mobile homes were destroyed, and several two-story homes suffered extensive roof damage, with continued numerous snapped trees falling on houses. The tornado weakened or lifted as it moved northeast towards Rolesville. Damage

became very sporadic and isolated in nature as it neared the Franklin County line. In total, 2270 homes were damaged, including 67 homes that were destroyed, with another 184 homes experiencing major damage. There were also 34 businesses damaged.

- **May 13, 2019** – The tornado initially touched down just west of Rolesville Road near Tink's Place in eastern Wake County. The tornado initially produced widespread EF-1 damage with sporadic EF-2 damage noted on Weathers Road. Along the path to Weathers Road, numerous trees were either uprooted or snapped and mangled together, consistent with EF-1 damage. At Weathers Road, structural damage was noted as a single-family home had its exterior walls collapsed. Several metal farm buildings were also completely destroyed and strewn about a field. Sheet metal was wrapped around a nearby tree. An RV was flipped over numerous times landing crushed in an open field. In addition, another home had the windows blown out with roof damage. It was in this area that EF-2 damage was determined. The tornado continued tracking east and crossed Edgemont Road just north of HWY 264/64, then crossing HWY 264/64 where numerous trees were downed and snapped. Generally, EF-1 damage was noted here. The tornado then moved east into Zebulon along and near Highway 97 (West Gannon Avenue) where numerous trees snapped and uprooted. It continued east of Zebulon, crossing HWY 264/64 again, and going just north of the Five County Stadium. Generally, EF-0 and EF-1 damage was noted here.

**Figure F.26 – Tornado Paths within 10 Miles of NCSU**



### THUNDERSTORM WINDS

According to NCEI, between 2000 and 2024, Raleigh experienced 76 separate incidents of thunderstorm winds, occurring on 43 separate days. These events caused $201,500 in recorded property damage, 8 injuries, and no fatalities or crop damage. The recorded gusts averaged 58.3 miles per hour, with the highest gusts recorded at 70.2 mph on March 4, 2008. Of these events, 16 caused property damage. Wind gusts with property damage recorded averaged $13,433 in damage, with the highest reported damage being a total of $115,000 on June 30, 2019. The incidents resulting in property damage or injuries for the City of Raleigh are recorded below in Table F.44.

**Table F.44 – Recorded Thunderstorm Winds Resulting in Property Damage, Raleigh, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Raleigh | 8/21/2007* | 57.6 | 0 | 8 | $0 |
| Raleigh | 7/1/2009 | 57.6 | 0 | 0 | $1,000 |
| Raleigh | 7/4/2012* | 57.6 | 0 | 0 | $1,000 |
| Raleigh | 7/24/2012* | 57.6 | 0 | 0 | $10,000 |
| Raleigh | 6/29/2016* | 57.6 | 0 | 0 | $1,500 |
| Raleigh | 6/16/2017 | 57.6 | 0 | 0 | $10,000 |
| Raleigh | 7/6/2018* | 57.6 | 0 | 0 | $10,000 |
| Raleigh | 4/14/2019 | 57.6 | 0 | 0 | $4,000 |
| West Raleigh | 6/30/2019* | 57.6 | 0 | 0 | $115,000 |
| West Raleigh | 8/19/2019 | 57.6 | 0 | 0 | $5,000 |
| East Raleigh | 8/22/2019 | 57.6 | 0 | 0 | $10,000 |
| Raleigh | 4/13/2020 | 57.6 | 0 | 0 | $20,000 |
| Raleigh | 7/7/2022* | 57.6 | 0 | 0 | $5,000 |
| Raleigh | 7/9/2023 | 57.6 | 0 | 0 | $5,000 |
| Raleigh | 9/1/2024 | 57.6 | 0 | 0 | $4,000 |
| **Total** | | | **0** | **8** | **$201,500** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **August 21, 2007** – A spotter reported several trees down at the Walnut Creek Amphitheatre. A roof was also blown off of an outdoor shelter at the amphitheater.
- **June 30, 2019 –** A large tree was reported snapped off and fell on power lines and a car at Beechridge Road and Breeze Road.
- **July 7, 2022 –** A tree was reported down in the Glenwood Village area, near the intersection of Glenwood Ave and Granville Dr. Power outages were also reported in the area.

### LIGHTNING

According to NCEI data, there was four lightning strikes were reported between 2000 and 2024. These lightning strike events recorded an estimated $210,000 worth of property damage. No

crop damage, injuries, fatalities were recorded by these strikes. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table F.45 details NCEI-recorded lightning strikes from 2000 through 2024 for Raleigh.

**Table F.45 – Recorded Lightning Strikes in Raleigh, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Raleigh | 4/3/2006 | 900 | 0 | 0 | $0 |
| Raleigh | 4/22/2006 | 1200 | 0 | 0 | $0 |
| Raleigh | 8/15/2008 | 1500 | 0 | 0 | $200,000 |
| Wilders Grove | 7/17/2010 | 1308 | 0 | 0 | $10,000 |
| | | **Total** | **0** | **0** | **$210,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Raleigh:

- **April 3, 2006** – Lightning destroyed 3 apartment units.
- **April 22, 2006** – Numerous house fires reported throughout the county. At least 4 homes totally destroyed and 24 apartments in Brier Creek community destroyed
- **August 15, 2008** – Two homes struck by lightning in Raleigh and caught fire resulting in extensive damage to each home.
- **July 17, 2010** – Lightning caused a fire to an unoccupied residence on the southeast side of Raleigh. The fire started in the attic and smoldered for a time before igniting.

### HAIL

NCEI records 27 days with hail incidents between 2000 and 2024 in Raleigh. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the City was 4 inches, which occurred on March 28, 2005. The average hail size of all events in the City was just over one inch in diameter. Table F.46 summarizes hail events for Raleigh. In some cases, hail was reported for multiple locations on the same day.

**Table F.46 – Summary of Hail Occurrences in Raleigh**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| RALEIGH | 4/29/2000 | 1.75 |
| RALEIGH | 6/3/2000 | 1.75 |
| RALEIGH | 6/14/2000 | 0.75 |
| RALEIGH | 7/17/2000 | 1 |
| RALEIGH | 3/26/2002 | 0.75 |
| RALEIGH | 3/31/2002 | 0.88 |
| RALEIGH | 7/4/2002 | 0.88 |
| RALEIGH | 3/31/2004 | 0.88 |
| RALEIGH | 7/14/2004 | 0.88 |
| RALEIGH | 3/28/2005* | 4 |
| RALEIGH | 5/12/2005 | 0.75 |
| RALEIGH | 6/7/2005 | 1 |
| RALEIGH | 4/3/2006 | 0.75 |

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| RALEIGH | 4/22/2006* | 1.75 |
| RALEIGH | 5/14/2006* | 1.75 |
| RALEIGH | 5/25/2006* | 1 |
| RALEIGH | 6/11/2006 | 0.75 |
| RALEIGH | 4/15/2007* | 0.88 |
| RALEIGH | 6/9/2007 | 0.75 |
| RALEIGH | 6/29/2007 | 0.75 |
| RALEIGH | 7/17/2007* | 1 |
| RALEIGH | 5/2/2016 | 1.25 |
| WILDERS GROVE | 9/30/2016 | 0.88 |
| WILDERS GROVE | 5/13/2019 | 1 |
| WILDERS GROVE | 4/8/2020 | 1 |
| WILDERS GROVE | 6/19/2020 | 0.75 |
| RALEIGH | 8/15/2023 | 1 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **April 29, 2000 –** Golf ball size hail was reported near Falls Lake at NC 98 and Camp Kanata Road.
- **March 28, 2005 –** 3.5 to 4-inch elongated hail reported at I-540 and Falls of Neuse Road. 3-inch hail reported at Strickland and Falls of Neuse Roads. 2-inch hail reported in Five Points. Golf ball sized hail reported at Cameron Village, Atlantic and New Hope Church Roads, North Raleigh Community Hospital, Green and Lee Spring Roads, and Durant and Falls of Neuse Roads. Ping pong ball sized hail reported on Wake Forest Road. Quarter to half dollar sized hail reported on Highwoods Road. Hen egg sized hail reported on Lake Wheeler Road. Quarter to half dollar sized hail reported in Fuquay Varina and at Highways 401 and 70 in Garner.
- **July 17, 2007 –** Quarter size hail was reported on the campus of North Carolina State University.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Raleigh averages 1.72 days with wind events per year. Over this same period, two lightning events were reported as having caused property damage, which equates to an average of 0.08 damaging lightning strikes per year.

The average hailstorm in Raleigh occurs in the evening and has a hail stone with a diameter of just over one inch. Over the 25-year period from 2000 through 2024, Raleigh experienced 27 days with reported hail incidents; this averages to 1.08 days per year with reported incidents somewhere in the City.

Probability of future occurrence was calculated based on past occurrences and was assumed to be uniform across the county.

In a 75-year span between 1950 and 2024, Wake County has experienced 30 separate tornado incidents. This correlates to a 40 percent annual probability that the County will experience a tornado somewhere in its boundaries. Most of these past events were F0/EF0 or F1/EF1, and five had a magnitude of EF2 or higher. Based on five tornado events having a magnitude higher than EF1, the annual probability of a significant tornado event is less likely with a 6 percent annual chance.

Based on these historical occurrences, there is between a 10% to 100% chance that Raleigh will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on NCSU's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $836,025, which assumes that 10% of the on-campus population is impacted.

**Table F.47 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 39,259 | 3,925 | $836,025 |

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damages.

People and populations exposed to the elements are most vulnerable to tornados. In Wake County, tornadoes have killed 7 people and injured 203. The availability of sheltered locations

such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Raleigh, the two events with recorded property damage were due to fires ignited by lightning strikes.

NCEI records lightning impacts over 25 years (2000-2024), with $210,000 in property damage recorded during two separate events in 2008 and 2010. Based on these records, the City experiences an annualized loss of $8,400 in property damage. The average impact from lightning per incident in Raleigh is $52,500.

General damages to property from hail are direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Raleigh, NCEI did not report any property damage as a direct result of hail.

It should be noted that property damage due to hail is usually an insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damages in Raleigh, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2025 totaled $201,500 in property damage, which equates to an annualized loss of $8,060 across the City.

General damages to property are both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put

tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in the City are directly responsible for $370,963,000 worth of damage to property according to NCEI data. This equates to an annualized loss of $4,964.173. Per the iRISK analysis, an F2 tornado event could cause over $2.8 billion of estimated total building damages across all NCSU's campuses.

Table F.48 through Table F.50 detail the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table F.48 – Estimated Building Damage by Tornado Events, NCSU Centennial Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $861,012.98 | $521,424.97 | $1,382,437.95 |
| Educational | $19,612,232.35 | $18,177,106.26 | $37,789,338.61 |
| Housing | $177,098.55 | $84,051.27 | $261,149.82 |
| **Total** | **$20,650,343.88** | **$18,782,582.50** | **$39,432,926.38** |
| **F1 Tornado Event** | | | |
| Administration | $5,962,933.13 | $3,444,513.53 | $9,407,446.66 |
| Educational | $112,501,967.57 | $100,543,616.22 | $213,045,583.79 |
| Housing | $1,308,042.29 | $620,799.11 | $1,928,841.40 |
| **Total** | **$119,772,942.99** | **$104,608,928.86** | **$224,381,871.85** |
| **F2 Tornado Event** | | | |
| Administration | $13,853,093.88 | $8,860,990.49 | $22,714,084.37 |
| Educational | $309,666,340.56 | $285,688,367.33 | $595,354,707.89 |
| Housing | $2,482,010.76 | $1,177,966.58 | $3,659,977.34 |
| **Total** | **$326,001,445.20** | **$295,727,324.40** | **$621,728,769.60** |
| **F3 Tornado Event** | | | |
| Administration | $18,246,076.82 | $12,222,141.35 | $30,468,218.17 |
| Educational | $442,559,883.60 | $419,257,520.45 | $861,817,404.05 |
| Housing | $2,900,923.44 | $1,376,783.24 | $4,277,706.68 |
| **Total** | **$463,706,883.86** | **$432,856,445.04** | **$896,563,328.90** |
| **F4 Tornado Event** | | | |
| Administration | $18,802,588.57 | $12,753,042.48 | $31,555,631.05 |
| Educational | $472,444,049.50 | $450,439,460.39 | $922,883,509.89 |
| Housing | $2,900,923.44 | $1,376,783.24 | $4,277,706.68 |
| **Total** | **$494,147,561.51** | **$464,569,286.11** | **$958,716,847.62** |

Source: NCEM iRISK Database

**Table F.49 – Estimated Building Damage by Tornado Events, NCSU North, Central, and South Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $746,722.81 | $912,236.23 | $1,658,959.04 |
| Educational | $22,635,040.53 | $31,862,341.14 | $54,497,381.67 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Housing | $3,492,613.19 | $3,853,340.12 | $7,345,953.31 |
| **Total** | **$26,874,376.53** | **$36,627,917.49** | **$63,502,294.02** |
| **F1 Tornado Event** | | | |
| Administration | $6,011,574.50 | $7,344,058.75 | $13,355,633.25 |
| Educational | $185,422,588.35 | $259,707,991.44 | $445,130,579.79 |
| Housing | $29,233,287.55 | $32,138,988.59 | $61,372,276.14 |
| **Total** | **$220,667,450.40** | **$299,191,038.78** | **$519,858,489.18** |
| **F2 Tornado Event** | | | |
| Administration | $21,753,284.78 | $26,574,968.20 | $48,328,252.98 |
| Educational | $648,379,585.55 | $917,186,289.44 | $1,565,565,874.99 |
| Housing | $97,815,479.70 | $108,361,112.86 | $206,176,592.56 |
| **Total** | **$767,948,350.03** | **$1,052,122,370.50** | **$1,820,070,720.53** |
| **F3 Tornado Event** | | | |
| Administration | $34,601,017.01 | $42,270,440.36 | $76,871,457.37 |
| Educational | $1,019,438,000.45 | $1,447,004,936.89 | $2,466,442,937.34 |
| Housing | $151,398,652.32 | $168,187,145.28 | $319,585,797.60 |
| **Total** | **$1,205,437,669.78** | **$1,657,462,522.53** | **$2,862,900,192.31** |
| **F4 Tornado Event** | | | |
| Administration | $35,842,694.84 | $43,787,339.94 | $79,630,034.78 |
| Educational | $1,055,062,310.32 | $1,497,972,737.57 | $2,553,035,047.89 |
| Housing | $156,493,201.99 | $173,885,600.71 | $330,378,802.70 |
| **Total** | **$1,247,398,207.15** | **$1,715,645,678.22** | **$2,963,043,885.37** |

Source: NCEM iRISK Database

### Table F.50 – Estimated Building Damage by Tornado Events, NCSU West Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $190,319.79 | $215,188.85 | $405,508.64 |
| Educational | $15,938,824.90 | $11,418,556.04 | $27,357,380.94 |
| Housing | $7,270.93 | $3,635.47 | $10,906.40 |
| **Total** | **$16,136,415.62** | **$11,637,380.36** | **$27,773,795.98** |
| **F1 Tornado Event** | | | |
| Administration | $947,428.79 | $1,126,936.48 | $2,074,365.27 |
| Educational | $126,145,082.51 | $78,104,237.65 | $204,249,320.16 |
| Housing | $53,702.79 | $26,851.39 | $80,554.18 |
| **Total** | **$127,146,214.09** | **$79,258,025.52** | **$206,404,239.61** |
| **F2 Tornado Event** | | | |
| Administration | $2,378,116.91 | $2,783,753.72 | $5,161,870.63 |
| Educational | $260,454,833.51 | $169,717,201.78 | $430,172,035.29 |
| Housing | $101,901.06 | $50,950.53 | $152,851.59 |
| **Total** | **$262,934,851.48** | **$172,551,906.03** | **$435,486,757.51** |
| **F3 Tornado Event** | | | |
| Administration | $3,236,160.34 | $3,671,042.59 | $6,907,202.93 |
| Educational | $320,253,779.51 | $219,073,313.71 | $539,327,093.22 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Housing | $119,099.88 | $59,549.94 | $178,649.82 |
| **Total** | **$323,609,039.73** | **$222,803,906.24** | **$546,412,945.97** |
| **F4 Tornado Event** | | | |
| Administration | $3,550,475.08 | $3,985,357.33 | $7,535,832.41 |
| Educational | $335,523,673.37 | $234,111,486.57 | $569,635,159.94 |
| Housing | $119,099.88 | $59,549.94 | $178,649.82 |
| **Total** | **$339,193,248.33** | **$238,156,393.84** | **$577,349,642.17** |

Source: NCEM iRISK Database

### Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado. Future development will also affect current stormwater drainage patterns and capacities.

## Problem Statements

- The most intense tornadoes to pass through Wake County in the past 75 years were an F4 and EF3, which combined caused $365 million in damage. The EF3 tornado passed through parts of NCSU's campus and highlighted the need for education and awareness on severe weather safety.
- The strongest recorded thunderstorm wind event for Raleigh between 2000 and 2024 occurred on March 4, 2008 with a measured gust of 70.2 mph. This event reportedly resulted in no property damage.
- The average hailstone recorded between 2000 and 2024 was a little over one inch. The largest hailstone recorded was 4 inches and occurred on March 8, 2005.
- Thunderstorms and tornadoes are frequent hazard events in Wake County and the NCSU campus. Reported damages for the 25-year period from 2000-2024 include $201,500 for

thunderstorm winds and $210,000 for lightning strikes. Between 1950 and 2024, Wake County experienced $116,163,000 in property damage due to tornadoes.

# F.5.8 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI classifies the land near buildings into zones that describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 8 percent of the North/South/Central campus, 12% of the West campus, and 8% of the Centennial campus are within are within the primary exposure category. A larger percentage of each campus falls within the secondary exposure WUI category and the sources of ember load to buildings. A small portion of the West campus and Centennial campus fall within wildfire transmission zone. Table F.51 through Table F.53 detail the Functional WUI acreage in each NCSU campus, and Figure F.27 through Figure F.29 show the Functional WUI areas. Wake County contains a mix

of wildfire transmission zone, sources of ember load to buildings, and primary exposure. The northwestern portions of the county have higher concentrations of primary exposure. The City of Raleigh has low to no exposure but is surrounded by secondary exposure and pockets of primary exposure.

The expansion of residential development from urban centers into rural landscapes increases the potential for wildland fire threat to public safety and damage to forest resources and dependent industries. Population growth within the WUI increases the risk of wildfire.

*Spatial Extent: 4 – Large*

**Table F.51 – Functional Wildland Urban Interface, NCSU Centennial Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 90 | 8% |
| | Secondary Exposure | 249 | 22% |
| | Sources of Ember Load to Buildings | 612 | 55% |
| | Wildfire Transmission Zone | 108 | 10% |
| | Low to No Exposure | 0 | 0% |
| | Water | 59 | 5% |
| | **Total** | **1,117** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table F.52 – Functional Wildland Urban Interface, NCSU North, South, Central Campuses**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 41 | 8% |
| | Secondary Exposure | 425 | 82% |
| | Sources of Ember Load to Buildings | 54 | 10% |
| | Wildfire Transmission Zone | 0 | 0% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **520** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table F.53 – Functional Wildland Urban Interface, NCSU West Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 60 | 12% |
| | Secondary Exposure | 193 | 40% |
| | Sources of Ember Load to Buildings | 195 | 40% |
| | Wildfire Transmission Zone | 29 | 6% |
| | Low to No Exposure | 0 | 0% |
| | Water | 6 | 1% |
| | **Total** | **482** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure F.27 – Wildland Urban Interface Areas, NCSU Centennial Campus**

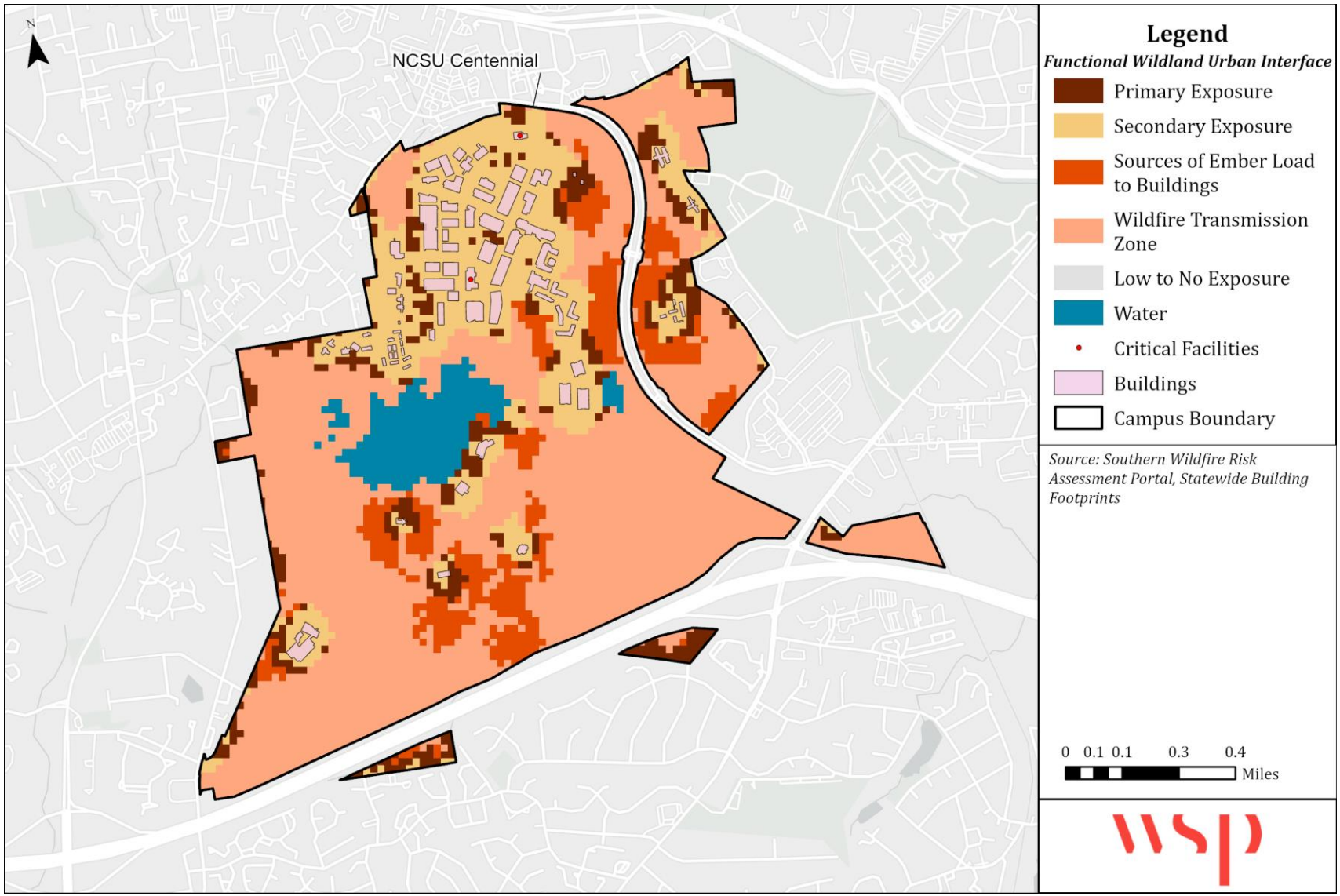


**Figure F.28 – Wildland Urban Interface Areas, NCSU North, Central, South Campuses**

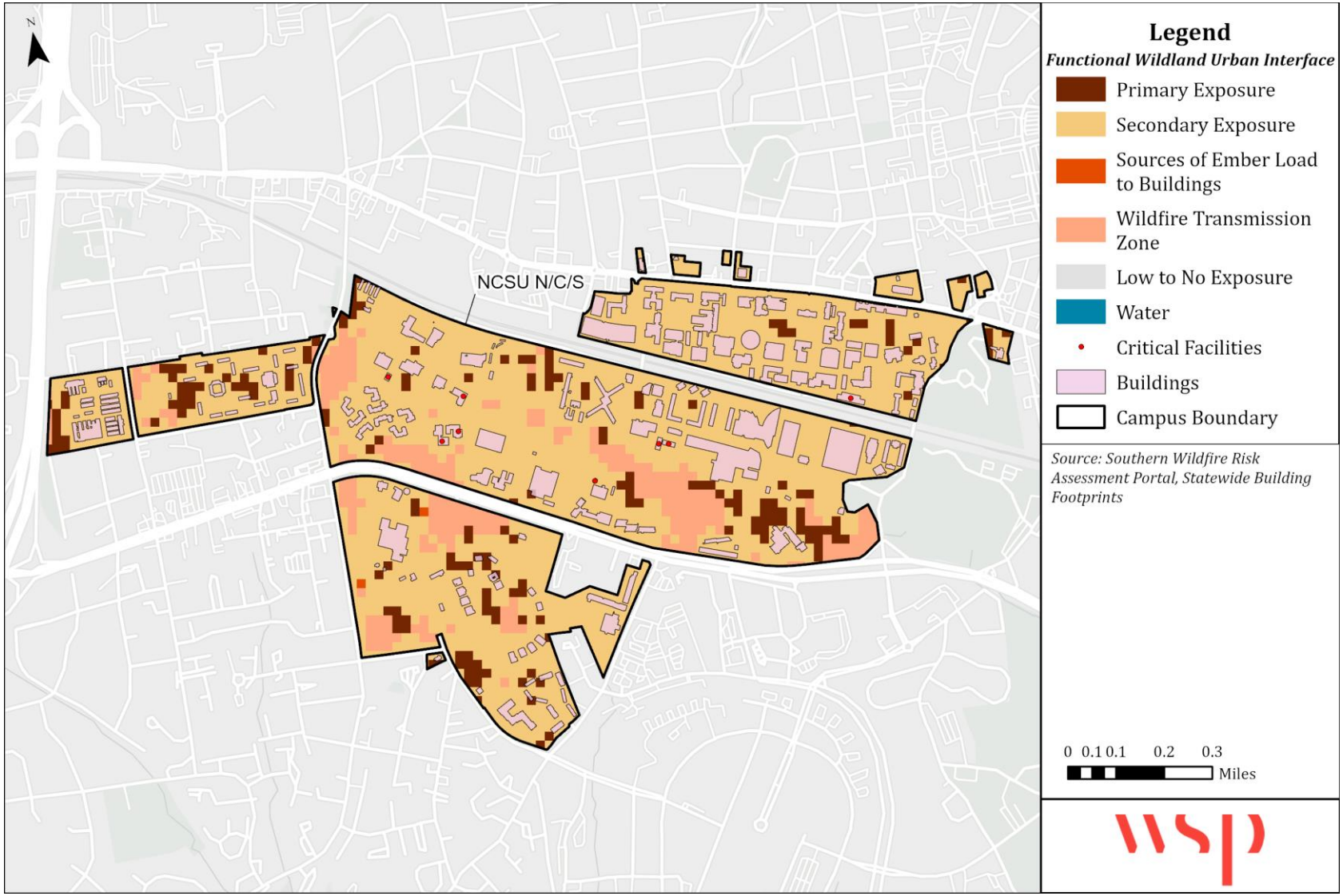
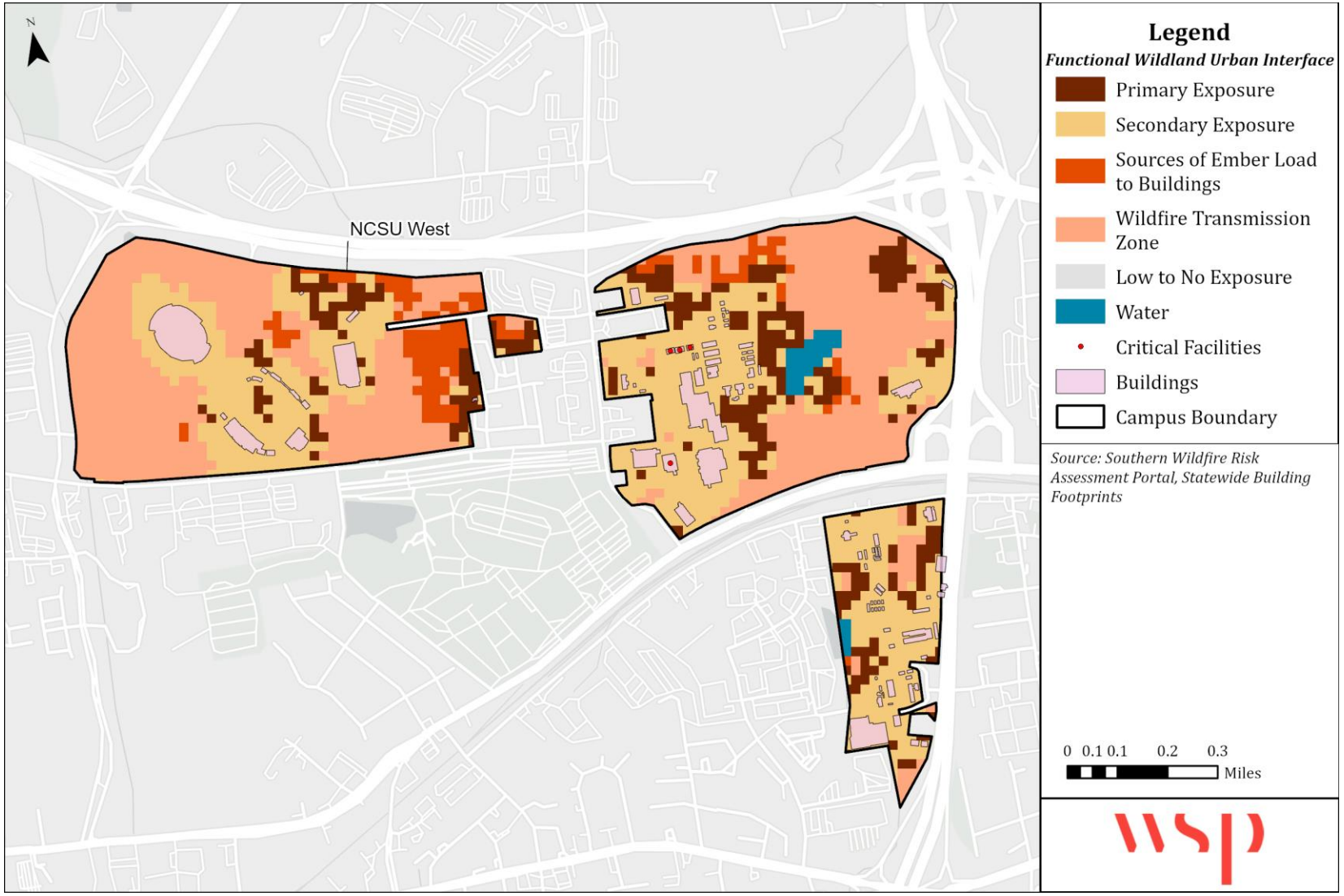


**Figure F.29 – Wildland Urban Interface Areas, NCSU West Campus**



## Extent

The entire state is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor may make wildfire more likely in certain areas.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table F.54, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table F.55 through Source: Southern Wildfire Risk Assessment

Table F.57 and Figure F.30 through Figure F.32 detail the characteristic fire intensity scale across the NCSU campuses.

**Table F.54 – Fire Intensity Scale**

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

**Table F.55 – Characteristic Fire Intensity, NCSU Centennial Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 498 | 45% |
| | 1 - Very Low | 192 | 17% |
| | 1.5 | 271 | 24% |
| | 2 - Low | 44 | 4% |
| | 2.5 | 102 | 9% |
| | 3 - Moderate | 2 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 8 | 1% |
| | 4.5 | 0 | 0% |

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **1,117** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table F.56 – Characteristic Fire Intensity, NCSU North/South/Central Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 463 | 89% |
| | 1 - Very Low | 18 | 3% |
| | 1.5 | 30 | 6% |
| | 2 - Low | 9 | 2% |
| | 2.5 | 1 | 0% |
| | 3 - Moderate | 0 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **521** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table F.57 – Characteristic Fire Intensity, NCSU West Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 463 | 89% |
| | 1 - Very Low | 18 | 3% |
| | 1.5 | 30 | 6% |
| | 2 - Low | 9 | 2% |
| | 2.5 | 1 | 0% |
| | 3 - Moderate | 0 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **521** | **100%** |

Source: Southern Wildfire Risk Assessment

The majority (89%) of both the North, South, and Central campus and the West campus have a rating of 0 on the characteristic fire intensity scale – non-burnable areas. The remaining portions of both campuses are characterized as very low to low fire intensity. Only 45 percent of the

Centennial campus is characterized as non-burnable. Most of the remaining areas on the Centennial campus are characterized as very low fire intensity. Around nine percent of the campus is characterized as 2.5 on the fire intensity scale which is characterized as low-moderate intensity.

*Impact: 2 – Limited*

**Figure F.30 – Characteristic Fire Intensity, NCSU Centennial Campus**

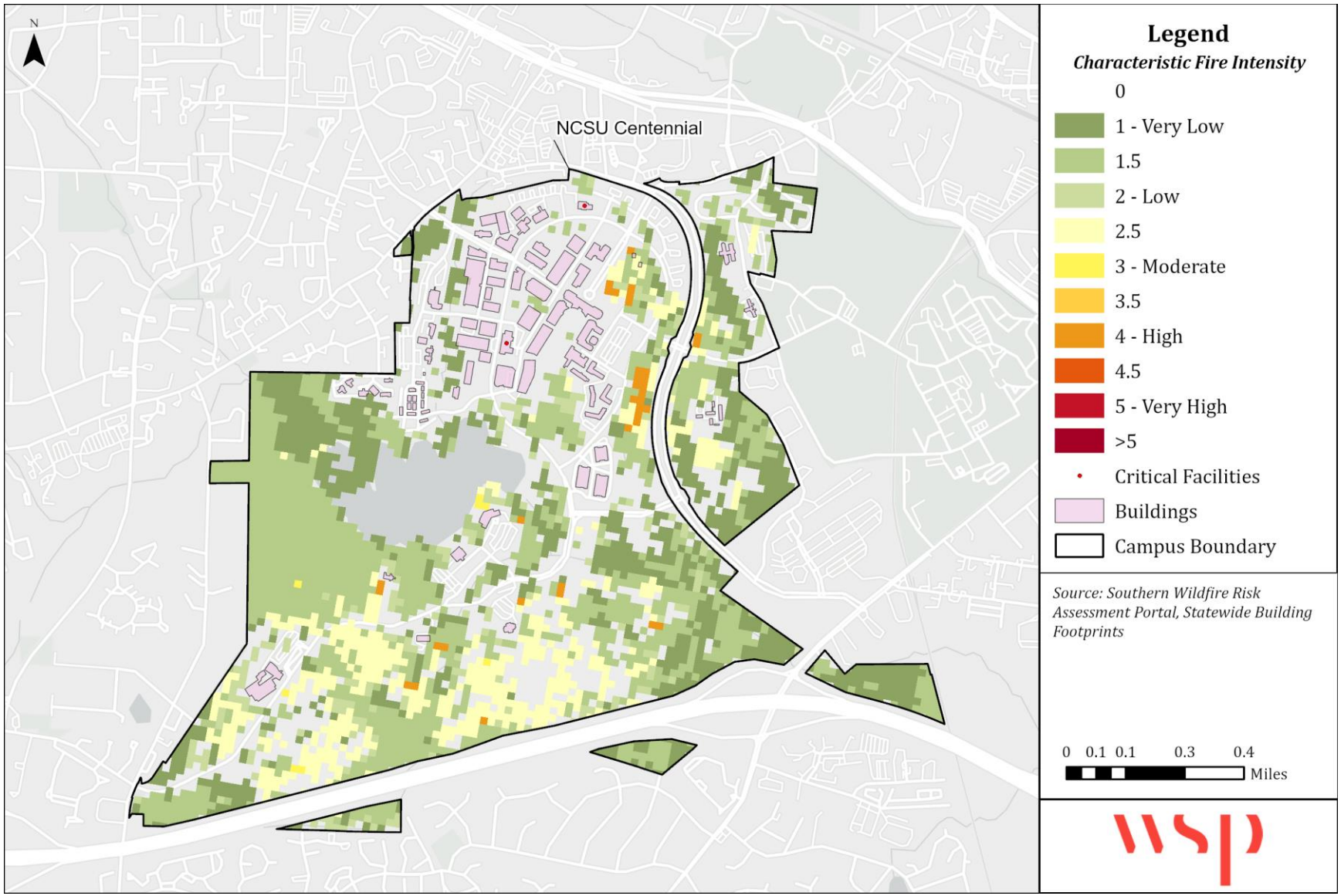


**Figure F.31 – Characteristic Fire Intensity, NCSU North, Central, and South Campus**

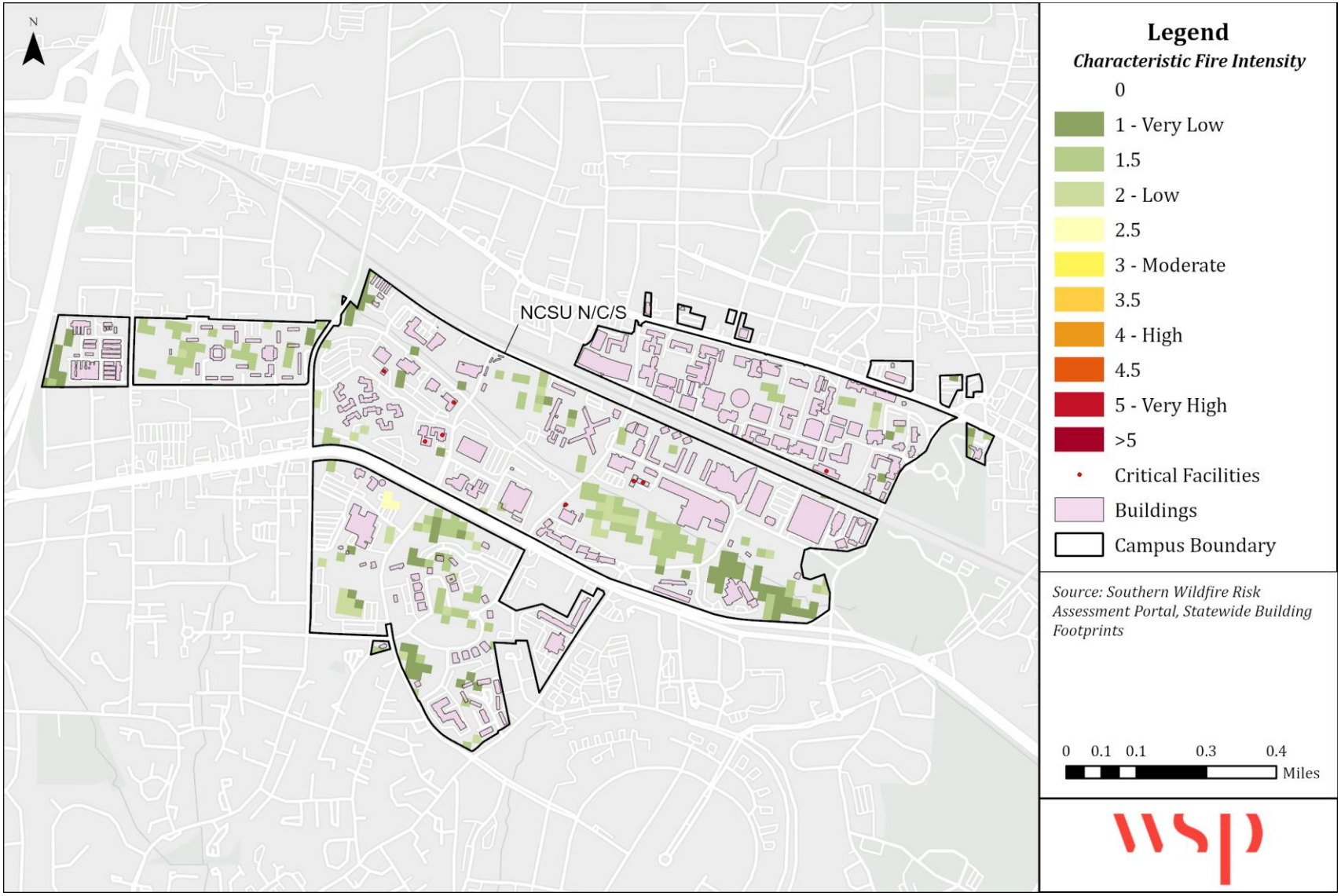
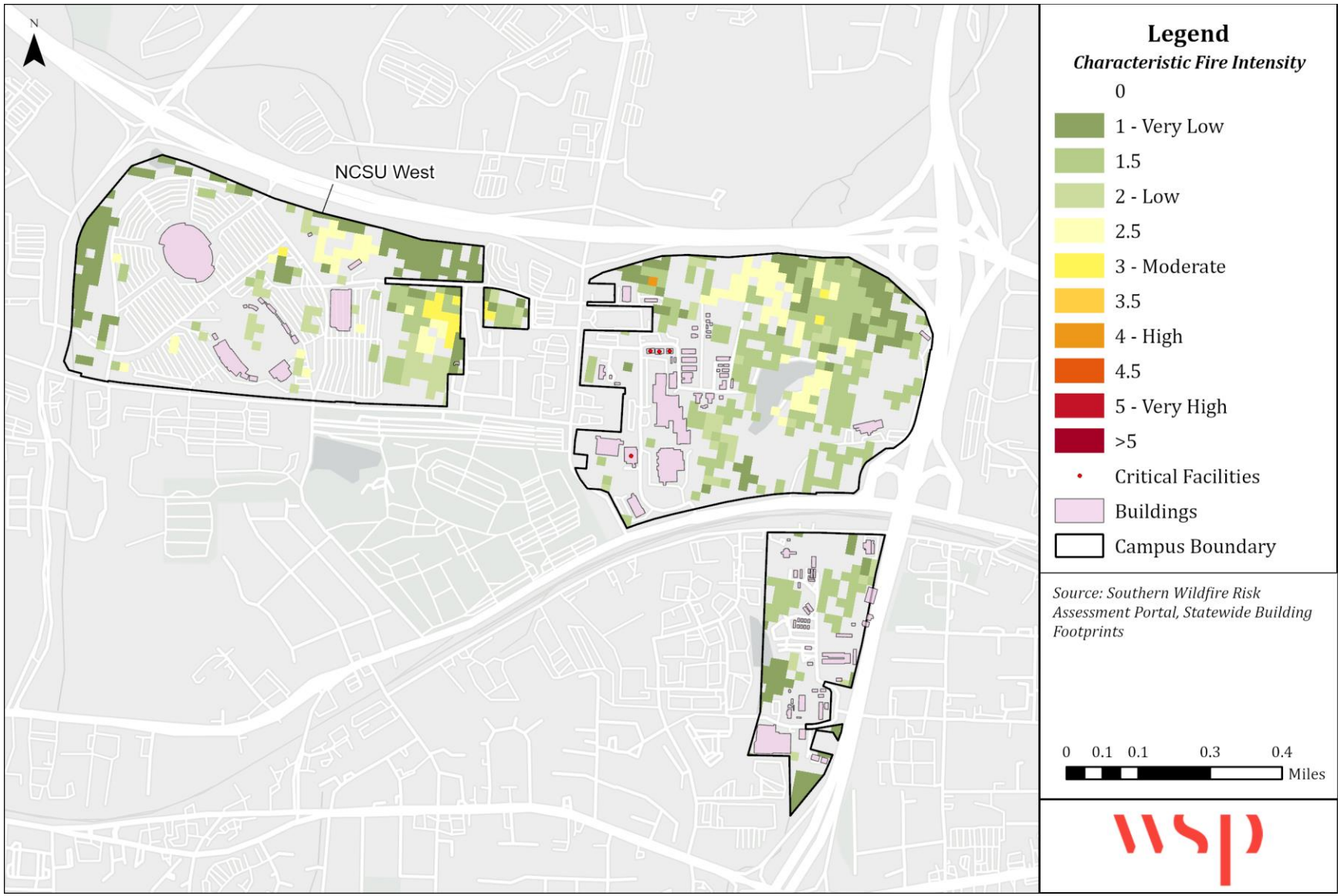


**Figure F.32 – Characteristic Fire Intensity, NCSU West Campus**



## Historical Occurrences

Table F.58 lists past occurrences of wildfire in Wake County from 2000-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 386 noted wildfires within Wake County between 2000 and 2024. The total acreage burned during this period was 1,709 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Wake County experiences 15.4 fires and 68.4 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 4.4 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table F.58 – Records of Wildfire in Wake County, 2000 – 2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 2000 | 16 | 45.20 | 2.83 |
| 2001 | 39 | 113.20 | 2.90 |
| 2002 | 32 | 95.30 | 2.98 |
| 2003 | 9 | 52.30 | 5.81 |
| 2004 | 14 | 28.70 | 2.05 |
| 2005 | 19 | 65.00 | 3.42 |
| 2006 | 24 | 167.40 | 6.98 |
| 2007 | 29 | 120.90 | 4.17 |
| 2008 | 13 | 74.60 | 5.74 |
| 2009 | 3 | 17.30 | 5.77 |
| 2010 | 22 | 120.30 | 5.47 |
| 2011 | 18 | 225.00 | 12.50 |
| 2012 | 14 | 101.00 | 7.21 |
| 2013 | 1 | 2.50 | 2.50 |
| 2014 | 3 | 5.10 | 1.70 |
| 2015 | 3 | 32.14 | 10.71 |
| 2016 | 20 | 75.32 | 3.77 |
| 2017 | 27 | 148.25 | 5.49 |
| 2018 | 11 | 40.24 | 3.66 |
| 2019 | 11 | 37.86 | 3.44 |
| 2020 | 3 | 7.50 | 2.50 |
| 2021 | 8 | 7.63 | 0.95 |
| 2022 | 13 | 38.39 | 2.95 |
| 2023 | 17 | 30.72 | 1.81 |
| 2024 | 17 | 57.59 | 3.39 |
| **Total** | **386** | **1,709.43** | **4.43** |

## Probability of Future Occurrence

SWRA provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the NCSU campuses is presented in Table F.59 through Table F.61 and illustrated in Figure F.33 through Figure F.35.

**Table F.59 – Burn Probability, NCSU Centennial Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 59 | 5% |
| | 1/10 - Very Low | >0 - 0.0001000 | 572 | 51% |
| | 2/10 | 0.0001000 - 0.0002154 | 486 | 44% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **1,117** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table F.60 – Burn Probability, NCSU North/South/Central Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 521 | 100% |
| | 2/10 | 0.0001000 - 0.0002154 | 0 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **521** | **100%** |

**Table F.61 – Burn Probability, NCSU West Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 6 | 1% |
| | 1/10 - Very Low | >0 - 0.0001000 | 368 | 76% |
| | 2/10 | 0.0001000 - 0.0002154 | 108 | 22% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **482** | **100%** |

Source: Southern Wildfire Risk Assessment

Approximately 99 percent of NCSU West campus has a burn probability between 1 and 2 – very low. The remaining portion of West campus has little to no burn probability. Similarly, around 95 percent of the Centennial campus has a burn probability of 1 and 2 and 5 percent has little to no burn probability. The entire portion of the North/South/Central campus also has very low burn probability and falls within category 1. Overall, the probability of wildfire across the campuses is considered unlikely.

*Probability: 3 – Unlikely*

**Figure F.33 – Burn Probability, NCSU Centennial Campus**

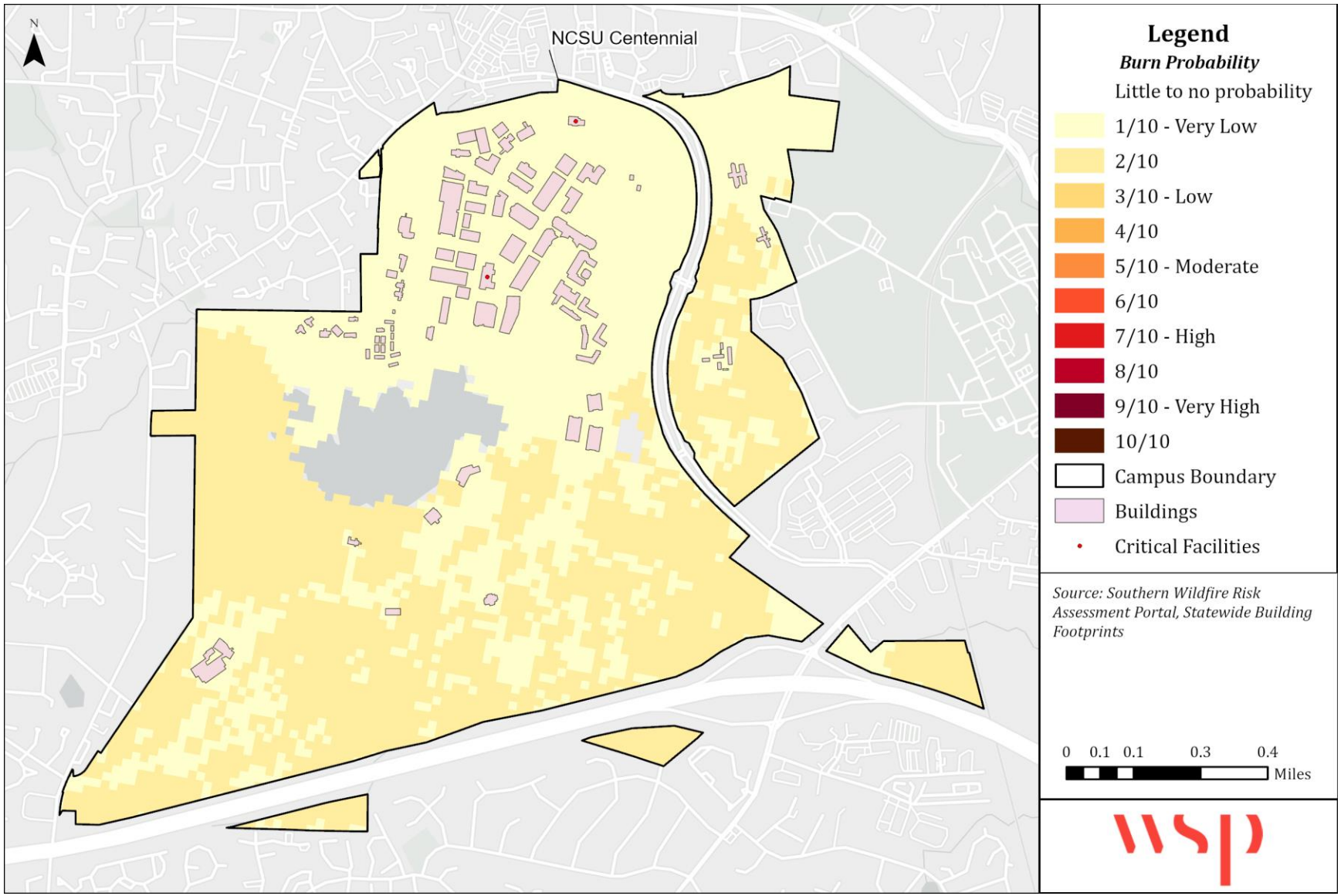


**Figure F.34 – Burn Probability, NCSU North, Central, and South Campus**

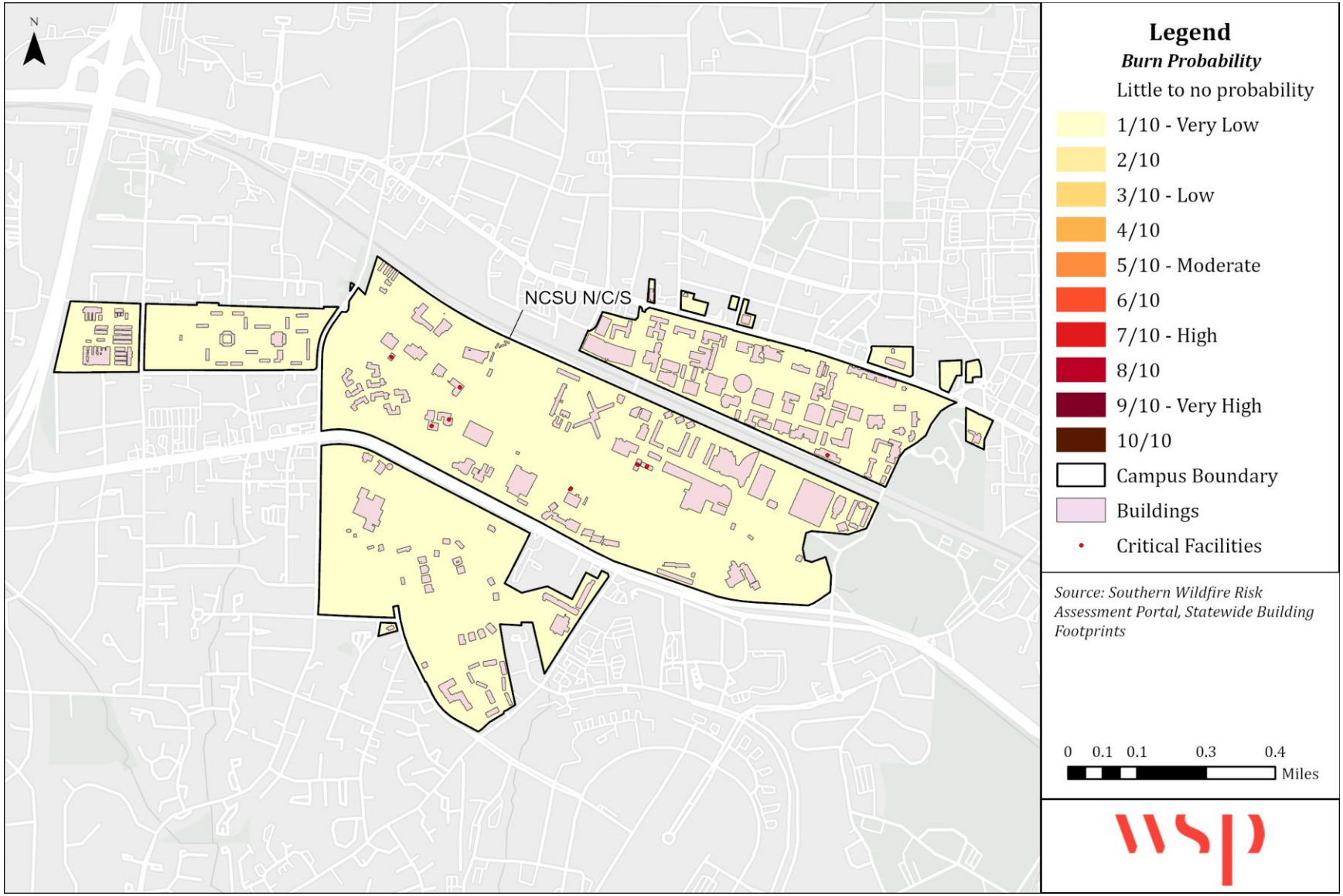
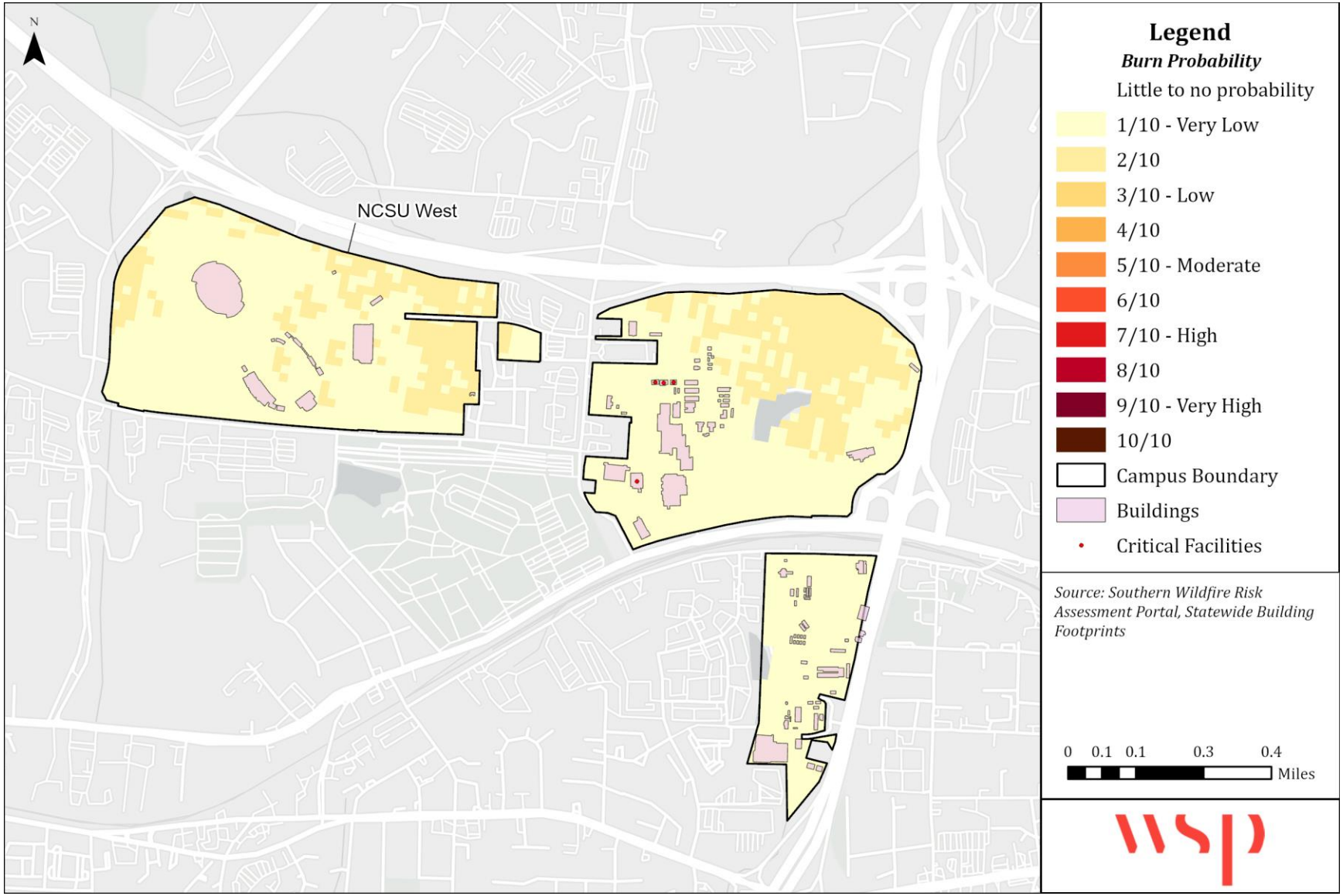


**Figure F.35 – Burn Probability, NCSU West Campus**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from SWRA, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10, and so on.

Almost all structures, 399 of the total 400, assessed on NCSU's campuses have a wildfire exposure score of 2/10, or relatively low vulnerability. Only one administrative building with a structure value of $471,346 located on the NCSU Centennial campus has a wildfire exposure score of 4/10.

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the NCSU campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. The Wake County Fire Services and Emergency Management Department ensures the protection of county residents and property. Although a wildfire community protection plan exists for the state of North Carolina, there are no community wildfire protection plans and no wildfire mitigation review requirements or regulations for development in the wildland-urban interface in Wake County.

## Problem Statements

- All of the NCSU campuses are located within an identified functional WUI area but have low fire intensity and burn probability.
- Wake County experiences wildfires on an annual basis with 15.4 fires and 68.4 acres burned annually, as reported by the NCFS. The actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire department.
- Coordination with the City of Raleigh and/or Wake County is recommended to reduce fuel and establish a local wildfire management plan.
- All buildings except for one on the NCSU campus fall within areas with a Wildfire Exposure score of 2/10, representing low burn probability and low damage potential.

# F.5.9 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

## Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the NCSU campus, the Office of Information Technology (OIT) provides centralized campuswide computing and information and communication technology services in support of the university's academic and administrative goals. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

## Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the NCSU campus could cause significant disruption and impact a large number of records.

*Impact: 3 – Critical*

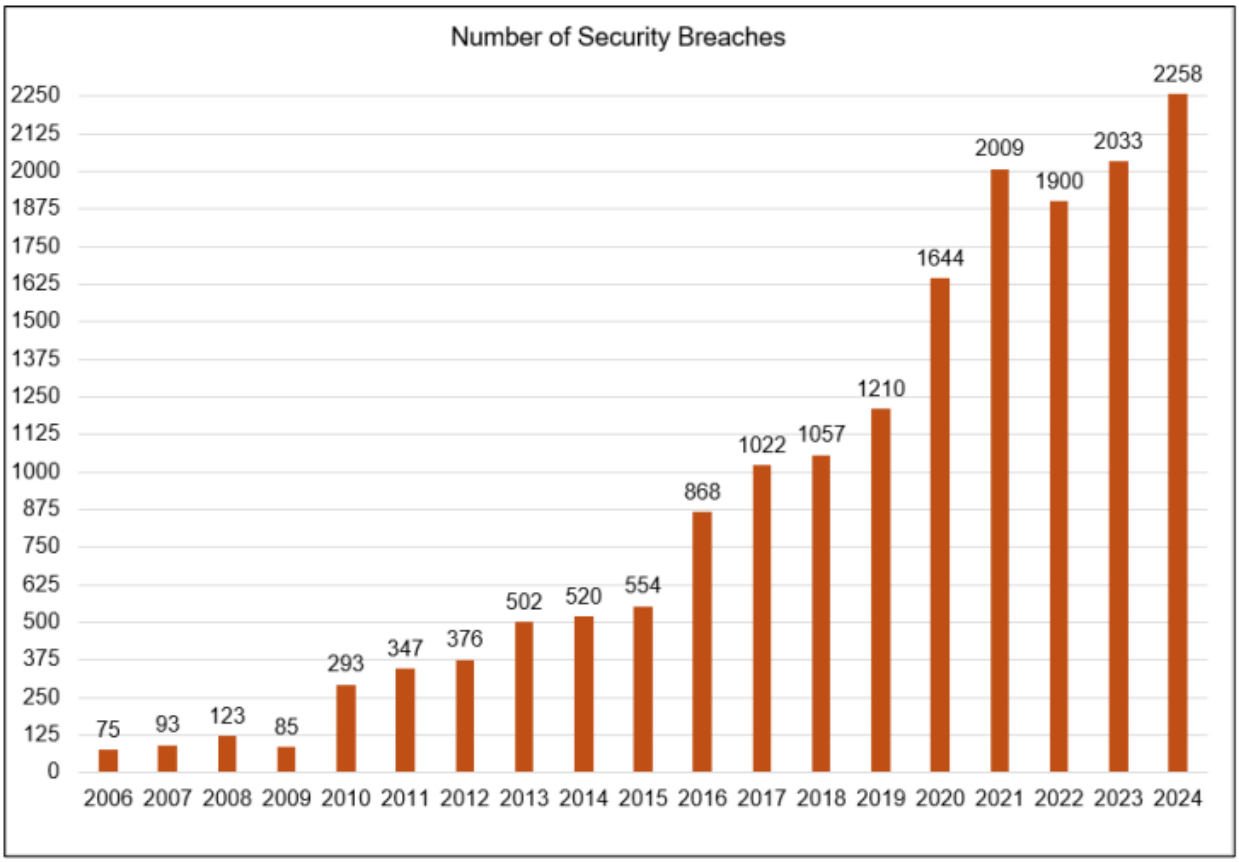
## Historical Occurrences

According to local news reports, one of the most recent cyber threats on NCSU campus occurred in March of 2025 when a phishing attack was sent by email to students, faculty, and

staff. Phishing emails were sent with links to a fake Shibboleth log-in page aimed at stealing passwords and security questions and answers.

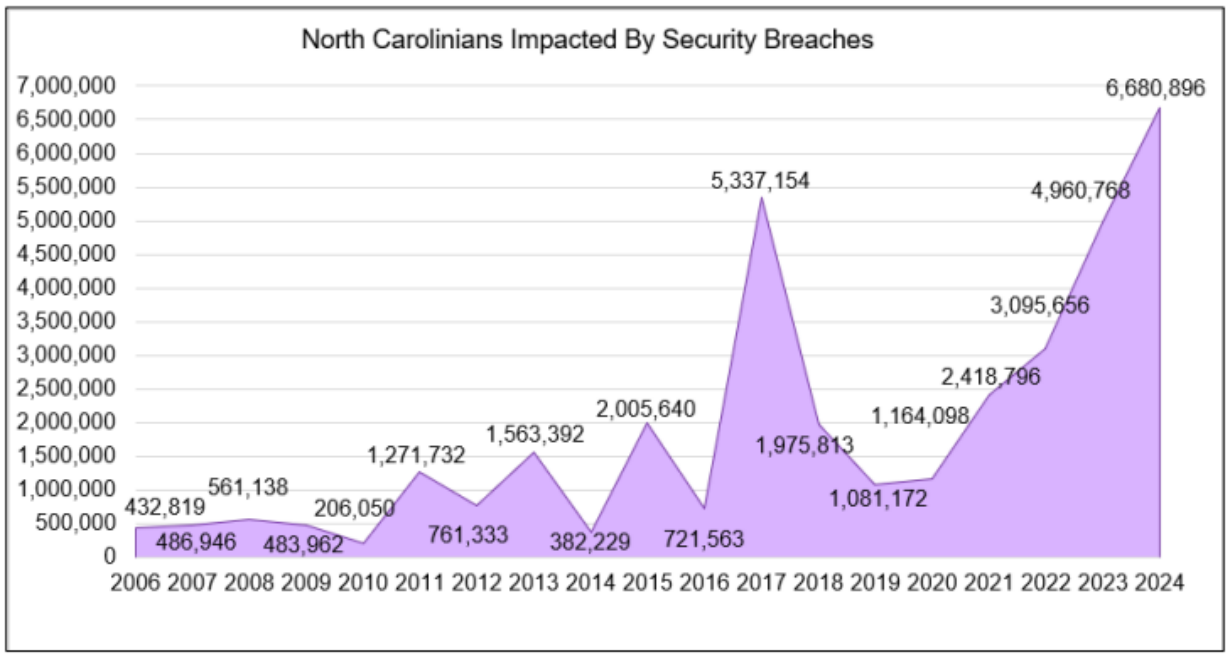
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure F.36 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure F.37 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included. (https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/)

- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).

## Probability of Future Occurrence

Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of NCSU are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the university are less likely but cannot be ruled out.

*Probability: 2 – Possible*

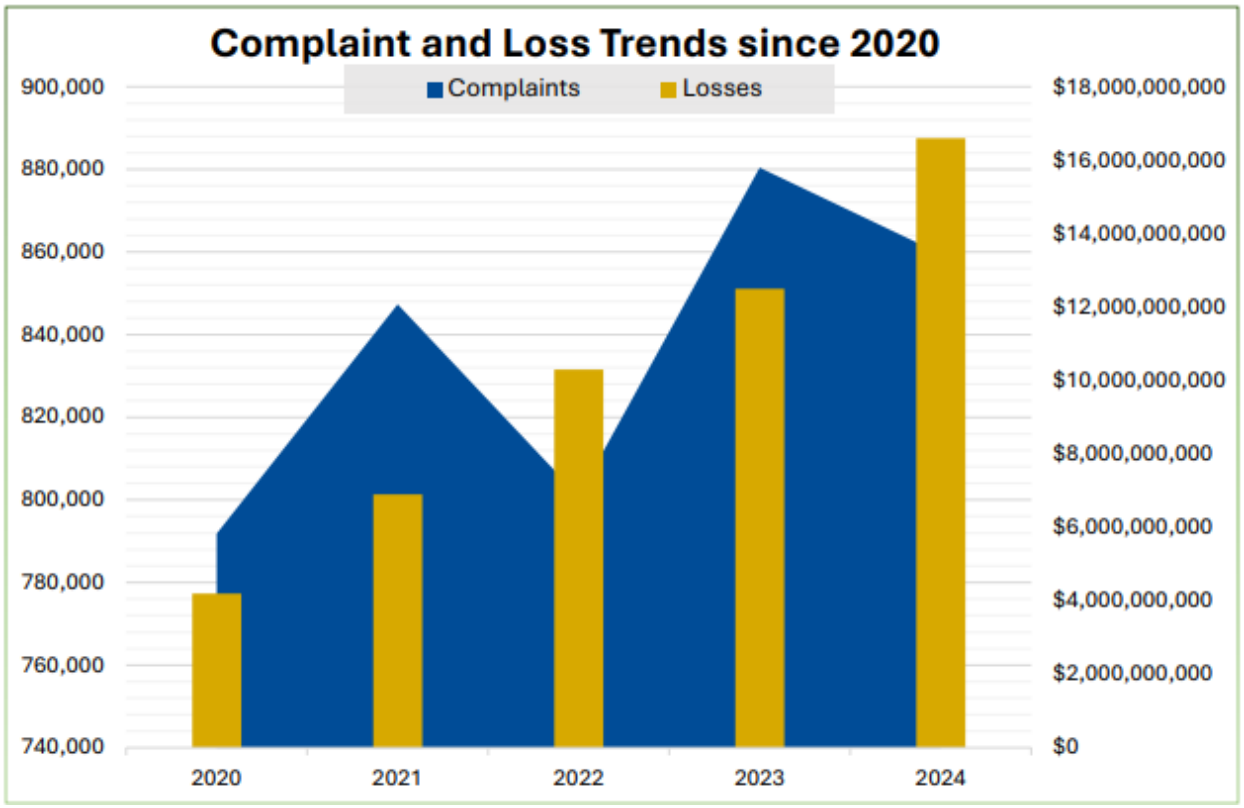
## Vulnerability Assessment

As discussed above, the impacts from a cyber-attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure F.38.

**Figure F.38 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers' continued usage of online services, such as banking and shopping, increases vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attacks against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment increasing since the last plan, the number of users of campus networks and software has increased. For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statements

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Office of Information Technology (OIT) addresses cybersecurity through leadership, governance, and collaboration, as well as, cybersecurity services, compliance assurance, policies, regulations and rules (PRRs), and cybersecurity awareness and training.

# F.5.10 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Materials Incident | Highly Likely | Minor | Negligible | Less than 6 hrs | Less than 24 hrs | 2.3 |

## Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory recorded 1 site with hazardous materials within 1 mile of NCSU campus. This site is detailed by location and sector in Table F.62 and shown in Figure F.39.

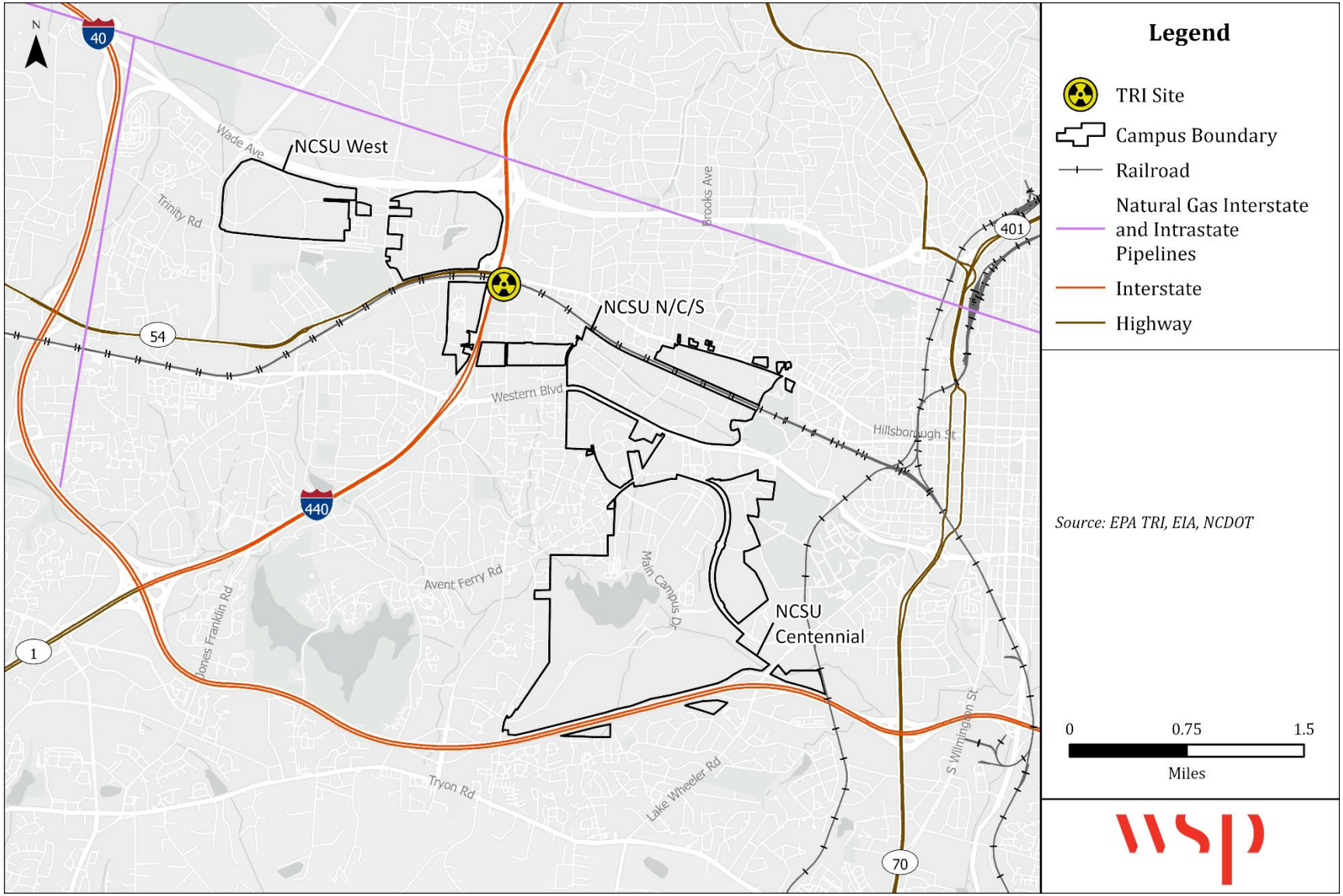
**Table F.62 – Toxic Release Inventory Sites within 1 Mile of NCSU Campus**

| Facility Name | Address | Sector | Chemicals Present |
|---|---|---|---|
| SURTRONICS INC. | 4001 Beryl Rd Raleigh, NC | Fabricated Metals | Nitric Acid |

Source: EPA Toxic Release Inventory

On campus, buildings within the Centennial Biomedical Campus store hazardous materials, as do various campus utilities buildings. Storage quantities were not reported for this mitigation planning effort.

**Figure F.39 – Hazardous Materials Facilities and Major Transportation Routes, NCSU**



Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal.

Pipelines exist throughout the state of North Carolina and the planning area and are most commonly used to transport energy sources such as natural gas and petroleum products but are also often used in the transportation of other hazardous liquids. Generally, pipelines are safe and effective, transporting materials where they are needed without incident. Figure F.39 shows the location of major pipelines and the modes of transportation for hazardous materials adjacent to or through NCSU's campus.

While a hazardous materials incident could occur in many locations across the campus, any individual hazardous material incident would most likely be highly localized.

*Spatial Extent: 1 – Negligible*

## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a "serious incident" as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor's visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damages, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT's PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 510 recorded releases in Raleigh from 2000 through 2024. Of these events, only seven were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $218,087 in damages with 90 percent of all incidents occurring on highways and roads and seven percent occurring by airplane. The most common materials spilled in the City were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure F.40 describes all nine hazard classes.

**Figure F.40 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 510 incidents of hazardous materials released in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Raleigh.

However, the number of serious incidents is significantly lower: only 7 in 25 years or an average of 0.3 serious incidents per year. This means that based on historical data, there is a 28 percent annual chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among people living near certain chemical facilities. However, there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $218,087 in damage, which equates to an annualized loss of $8,723 across the City of Raleigh.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater

and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statements

- Transportation and pipeline routes for hazardous materials are located adjacent to the NCSU Campuses.
- The number of reported incidents within Raleigh can be approximated to over 100-percent annual probability

# F.5.11 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table F.63, according to the World Health Organization.

*Impact: 3 – Critical*

**Table F.63 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period,

rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.

- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Wake County experienced 392,474 cases of COVID-19 and 1,312

deaths. Per 100,000 people, Wake County experienced 117 deaths, significantly lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, Wake County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 126 deaths to certain infectious and parasitic diseases, excluding COVID-19. 55% of these deaths (69) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included intestinal infectious disease, Tuberculosis, Zoonotic bacterial diseases, Pasteurellosis, Viral Hepatitis, Creutzfelt-Jakob disease, HIV, Candidiasis, Aspergillosis, Cryptococcosis, and Streptococcal infection.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously

affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

While enrollment slightly declined in 2020 and 2022, it has continued to increase steadily since the fall of 2023. NCSU's enrollment was the highest in its history in both 2023 and 2024. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statements

- Based on the recent COVID-19 pandemic, it is clear the NCSU campus population is susceptible to the infectious disease pandemic.
- NCSU has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# F.5.12 Terrorism

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Terrorism | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.2 |

## Location

Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR Section 0.85). The threat of terrorism, both international and domestic, is ever present, and an attack is likely to occur when least expected. A terror threat could occur at any location in the area, but are more likely to target highly populated areas, critical infrastructure, or symbolic locations.

Before the September 11, 2001 attacks in New York and the Pentagon, most terrorist incidents in the United States have been bombing attacks, involving detonated and un-detonated explosive devices, tear gas, and pipe and firebombs. The effects of terrorism can vary significantly from loss of life and injuries to property damage and disruptions in services such as electricity, water supply, public transportation and communications. The U.S. government has attempted to reduce vulnerability to terrorist incidents by developing infrastructure protection programs for critical infrastructure and key resource facilities and increased security at airports. In recent decades there have been a higher frequency of violent, low-tech attacks, particularly involving the use of firearms.

While we can never predict what target a terrorist will choose, we do know some of the factors they use when selecting a target. Terrorists want to achieve one or more of the following:

- Produce a large number of victims,
- Attack places that have a symbolic value,
- Get the greatest possible media attention, and
- Produce mass panic.

Terrorists also select targets suited for the type of material being used. For example, some biological agents are not effective in sunlight. Most chemical agents are more damaging indoors with limited airflow. A radioactive material will be most damaging where large numbers of people will pass close by without detecting it. Terrorists are likely to target heavily populated, enclosed areas like stadiums, government buildings, sporting events, airport terminals, subways, shopping malls and industrial manufacturing facilities. For this reason, it is critical that agencies and organizations with large gathering spaces have some type of anti-terrorism plan in place should a terrorist act occur.

A terrorist attack can take several forms, depending on the technological means available to the terrorist, the nature of the political issue motivating the attack, and the points of weakness of the

terrorist's target. Bombings had been the most frequently used terrorist method in the United States, but localized, low-tech attacks, often involving firearms, have become more common. Other possibilities include an attack at transportation facilities, an attack against utilities or other public services or an incident involving chemical or biological agents.

*Spatial Extent: 2 – Small*

## Extent

The extent of a terrorist incident is tied to many factors, including the attack vector, location, time of day, and other circumstances; for this reason, it is difficult to assess a single definition or conclusion of the extent of “terrorism.” As a general rule, terrorism incidents are targeted to where they can do the most damage and have the maximum impact possible, though this impact is tempered by the weapon used in the attack itself.

*Impact: 3 – Critical*

## Historical Occurrences

There are no reported terrorism incidents for the NCSU campus. However, the following shooting incidents have occurred on other university campuses within the State:

- **May 15, 1954 – UNC Chapel Hill** – Three individuals were shot (one fatally) during a fraternity house carnival at the Phi Delta Theta house at the University of North Carolina.
- **November 1, 2015 – Winston-Salem State University** – One person died and another person was injured after someone opened fire on campus. A 21-year-old former WSSU student was charged with murder following the incident.
- **April 30, 2019 – UNC Charlotte** – A 22-year-old former history undergraduate at UNC Charlotte shot six students and killed two.

## Probability of Future Occurrence

While difficult to estimate when a deliberate act like terrorism may occur, it can be inferred that the probability of a terrorist attack on campus is very low at any given time. When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

*Probability: 1 – Unlikely*

## Vulnerability Assessment

### People

People can suffer death or illness as a result of a terrorist attack. Symptoms of illness from a biological or chemical attack may go undetected for days or even weeks. Local healthcare workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People will face increased risk if a biological or chemical agent is

released indoors, as this may result in exposure to a higher concentration of pathogens, whereas agents that are released outdoors would disperse in the direction of the wind. Physical harm from a weapons attack or explosive device is not dependent on location, but risk is greater in areas where higher numbers of people may gather. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack could cause significant stress and anxiety.

### Property

The potential for damage to property is highly dependent on the type of attack. Buildings and infrastructure may be damaged by an explosive device or by contamination from a biological or chemical attack. Impacts are generally highly localized to the target of the attack.

### Environment

Environmental impacts are also dependent on the type of attack. Impacts could be negligible or could require major clean-up and remediation.

## Changes in Development

Increase in development and technology has the potential of making the planning area more of a target for a terrorist attack due to larger numbers of victims and more target areas.

## Problem Statements

- There are no records of past terrorism incidents for the NCSU Campuses.
- There are active hate groups within North Carolina.
- When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

# F.5.13 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section F.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table F.64 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table F.64 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Critical | Large | More than 24 hrs | Less than 1 week | 3.3 |
| Flooding | Highly Likely | Limited | Small | 6 to 12 hrs | Less than 1 week | 2.8 |
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 hrs | More than 1 week | 2.5 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| Terrorism | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.2 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table F.65:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal. This is not a priority hazard.

**Table F.65 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Severe Winter Weather<br>Tornadoes & Thunderstorms<br>Cyber Security |
| **Moderate Risk (2.0 – 2.9)** | Flooding<br>Hurricane<br>Wildfire<br>Hazardous Substances<br>Infectious Disease<br>Terrorism |
| **Low Risk (< 2.0)** | Earthquake |

# F.6 Capability Assessment

This section discusses NCSU's mitigation capabilities, including plans, programs, policies and land management tools, staff resources, and funding that are typically used to implement hazard mitigation activities. It consists of the following subsections:

- F.6.1 Overview of Capability Assessment
- F.6.2 Planning and Regulatory Capability
- F.6.3 Administrative and Technical Capability
- F.6.4 Fiscal Capability

## F.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## F.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table F.66 lists these local resources currently in place at NCSU.

**Table F.66 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic plan | Y | NCSU Strategic Plan 2021-2030 |
| Campus master plan | Y | NCSU Physical Master Plan 2023 |
| Capital improvements plan | Y | NCSU Capital Development Plan 2024 |
| Stormwater management program | Y | NCSU Environmental Health & Safety |
| Local emergency operations plan | Y | Emergency Operations Plan, Pack Ready Continuity Plans |

More details on several relevant tools are provided below:

- **Strategic Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The polycentric campus framework, established in the 2023 plan, establishes multiple neighborhood hubs across NC State's campuses.
- **Capital Improvements Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC System campus creates and maintains a 6-year CIP, which helps inform the University of North Carolina System's CIP. At NCSU, capital improvement requests in 2024 included a study on stormwater system improvements for the Wilson College of Textiles.
- **Stormwater Management Program** seeks to prevent flooding problems caused by stormwater runoff. NCSU's Environmental Health and Safety revies and approves development plans for meeting federal, state, and local stormwater management requirements.
- **Emergency Operations Plan (EOP)** outlines responsibilities and how resources are deployed during and following an emergency or disaster. The EOP includes an Infectious Disease Plan to manage campus response to disease outbreaks. NCSU also uses "Pack Plans" which outline the continuity of operations procedures for different departments and services. The EOP for NCSU campus is updated annually.

## F.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table F.67 provides a summary of the administrative and technical capabilities for NCSU.

**Table F.67 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | NCSU Facilities Division |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | NCSU Facilities Division |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | NCSU Facilities Division |
| Personnel skilled in GIS | Yes | NCSU Facilities Division |
| Grant Writer | Yes | Academic Departments |
| Public Information Officer | Yes | University Communications |
| Student Engagement | Yes | Academic and Student Affairs |
| Warning Systems | Yes | Wolf Alert -<br>Audible Alert System – 16 sirens<br>Alertus Desktop Notification<br>OnCampus App |

Additional resources and departments that may support administrative capabilities include the following:

- **The Department of Emergency Management & Mission Continuity (EM&MC)'s** mission is to lead and facilitate effective campus disaster preparedness, mitigation, response, and recovery activities to minimize the impacts of emergencies on the NC State community, facilities, and environment.
- **Insurance & Risk Management (IRM**) assists university stakeholders with the management of physical, financial, operational, and reputational risks through early identification and appropriate avoidance, mitigation, and transfer of risk.
- **The Fire and Life Safety Office** assists the academic community with recognition of fire hazards and mitigation of fire and medical incidents on university property
- **NCSU Facilities Division** ensures that the campus's physical environment supports the University's mission.
- **The Office of Environmental Health and Safety (EHS)** provides leadership, support, information, training, and consultation of environmental health and safety practices.

## F.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table F.68 provides a summary of the fiscal resources at NCSU.

**Table F.68 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y |

# F.7 Mitigation Strategy

## F.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is also documented in this plan update. Table F.69 summarizes the status of mitigation actions from the 2021 plan. Table F.70 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section F.7.2 in the Mitigation Action Plan.

**Table F.69 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| NCSU | 2 | 3 | 3 |

**Table F.70 – Completed and Deleted Actions from the 2021 Plan**

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| NCSU3 | College of Veterinary Medicine - The standing seam metal roof is reported to leak during intense downpours. One leak is located over an electrical panel serving radiology facilities (Photo 1). Other leaks have been observed to occur in operating rooms. The leaks in the standing seam metal roof should be addressed in critical areas to prevent damage to expensive instruments or contamination of surgical areas. | Delete | This is a maintenance issue. |
| NCSU4 | College of Veterinary Medicine - During driving rain the façade is reported to leak at locations where brick masonry meets with concrete façade elements and around window frames. Areas of the façade prone to water infiltration should be sealed to prevent water damage and mold growth. | Delete | This is a maintenance issue. |
| NCSU6 | DH Hill Library - The gravel ballasted roof of the original low-rise structure is in fair to poor condition and should be replaced. The gravel ballasted roof should be replaced. | Delete | This is a maintenance issue. |
| NCSU7 | Main Distribution Frames (MDFs) - The Dan Allen Drive MDF has several large trees adjacent to the building which could severely damage it if they were to fall. Consider removing the large trees adjacent to the Dan Allen MDF building to prevent damage from falling trees/limbs. | Completed | Have updated it with redundancy, resilience measures, and generators |
| NCSU8 | Public Safety Center - The EOC is not well configured to provide power and telephone service. Provide more power, voice, and data ports throughout the room to facilitate rapid setup and operation of the EOC. | Completed | EOC has been updated with back up generators, and other resilience measures |

## F.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for NCSU. Each mitigation action recommended for implementation is listed in these tables along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table F.71 – Mitigation Action Plan, NCSU**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCSU1 | Campus-Wide – Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational when normal power supply is not available. | All Hazards | 1.2 | M | Structural Projects | Facilities Services | $25,000-$100,000 per site | State/Federal Grants | 2026-2030 | Carry Forward | Four facilities listed have been upgraded. Project revised to include upgrades to other campus facilities that require similar updates |
| NCSU2 | Campus Wide – Continue to develop outreach projects and campus-wide mitigation training to inform the public about hazard impacts and how to stay safe during hazard events through emails, flyers, and online training; severe weather week participation; and cyber security awareness. | All Hazards | 2.1 | L | Public Education & Awareness | EHS, University Communications and Marketing, Police and Public Safety; and DoIT | < 1,000 | Operating Budget | 2026-2030 | Carry Forward | Revised action to develop outreach for all hazard awareness |
| NCSU3 | Dabney and Cox Halls - The rear of the site is served by one primary drain at the rear of Dabney and Cox. In the past, this drain has failed, causing the HAZMAT bunkers to float off their foundations and the basement mechanical room to flood causing a complete power failure (ATS located in basement). An emergency drain should be added to the rear of the site to reduce the likelihood of significant flooding during intense downpours. | Flooding | 1.2 | H | Structural Projects | Facilities Department | $25,000-$100,000 | Operating Budget, State/Federal Grants | 2026-2030 | Carry Forward | Campus is developing larger drainage improvement project that will include the area around these buildings |
| NCSU4 | Improve drainage conditions through the identification and implementation of capital improvements projects. | Flooding | 1.1 | H | Structural Projects | Facilities Department | To be determined | State/Federal Grants | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM



UNC System Eastern Campuses

# Regional Hazard Mitigation Plan

## Annex G: University of North Carolina at Chapel Hill

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# Annex G. University of North Carolina - Chapel Hill

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to University of North Carolina Chapel Hill (UNC-CH). This section contains the following subsections:

- G.1 Planning Process Details
- G.2 Campus Profile
- G.3 Asset Inventory
- G.4 Hazard Identification
- G.5 Hazard Profiles, Analysis, and Vulnerability
- G.6 Capability Assessment
- G.7 Mitigation Strategy

## G.1 Planning Process Details

The table below lists the HMPC members who represented UNC-CH during the planning process.

**Table G.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Abbas Piran | Director, Facilities Technology Group; Facilities Services |
| Joe Magura | Director, Facilities Engineering; Facilities Services |
| John Albrechtsen | Business Systems & Data Analytics Spec; Facilities Services |
| Beatrice Muganda | Project Manager; Energy Services |
| Rahsheem Holland | Captain/Special Projects; Campus Police |
| Laurie Burroughs | Budget Manager; SCE Finance |
| Brigitte Ironside | Budget Analyst; SCE Finance |
| Cathy Brennan | Executive Director; Environmental Health and Safety |
| Darrell Jeter | Director; Emergency Management and Planning |
| Crystal Donaldson | Continuity & Resiliency Planner; Emergency Management and Planning |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and incorporated in the plan development.

**Table G.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| UNC-CH Campus Master Plan | The UNC-CH Campus Master Plan, developed in 2019, was referenced for the Campus Profile in Section G.2 as well as the Capability Assessment in Section G.6 |
| Orange County and Incorporated Areas Flood Insurance Study (FIS), Revised 10/19/2018 | The FIS report was referenced in the preparation of flood hazard profile in Section G.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section G.5. The plan was additionally used to track implementation progress and develop the mitigation plan (Section G.7). |
| Eno-Haw Regional Hazard Mitigation Plan, 2025 | The Eno-Haw Regional Hazard Mitigation Plan was referenced in compiling the Hazard Identification and Risk Assessment in Section G.5. |

# G.2 Campus Profile

This section provides a general overview of the University of North Carolina at Chapel Hill (UNCCH) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## G.2.1 Location and Setting

The University of North Carolina Chapel Hill (UNC-CH) is located primarily within the town of Chapel Hill, a multicultural university town with a resident population of 63,000. The town is located within Orange County with a small portion extending into Durham County. Chapel Hill was originally developed to serve the University. When the University of North Carolina Board of Trustees chose the area around New Hope Chapel as the site for the first State University in 1793, they also named a committee to lay out a town adjacent to the site.

Figure G.1 through Figure G.5 provide a base map of UNC-CH main campus, which comprises central, east, south, north, and west campuses. For more details on campus buildings and critical facilities, see Section G.3.

**Figure G.1 – UNC-CH Location Map, Central Campus**

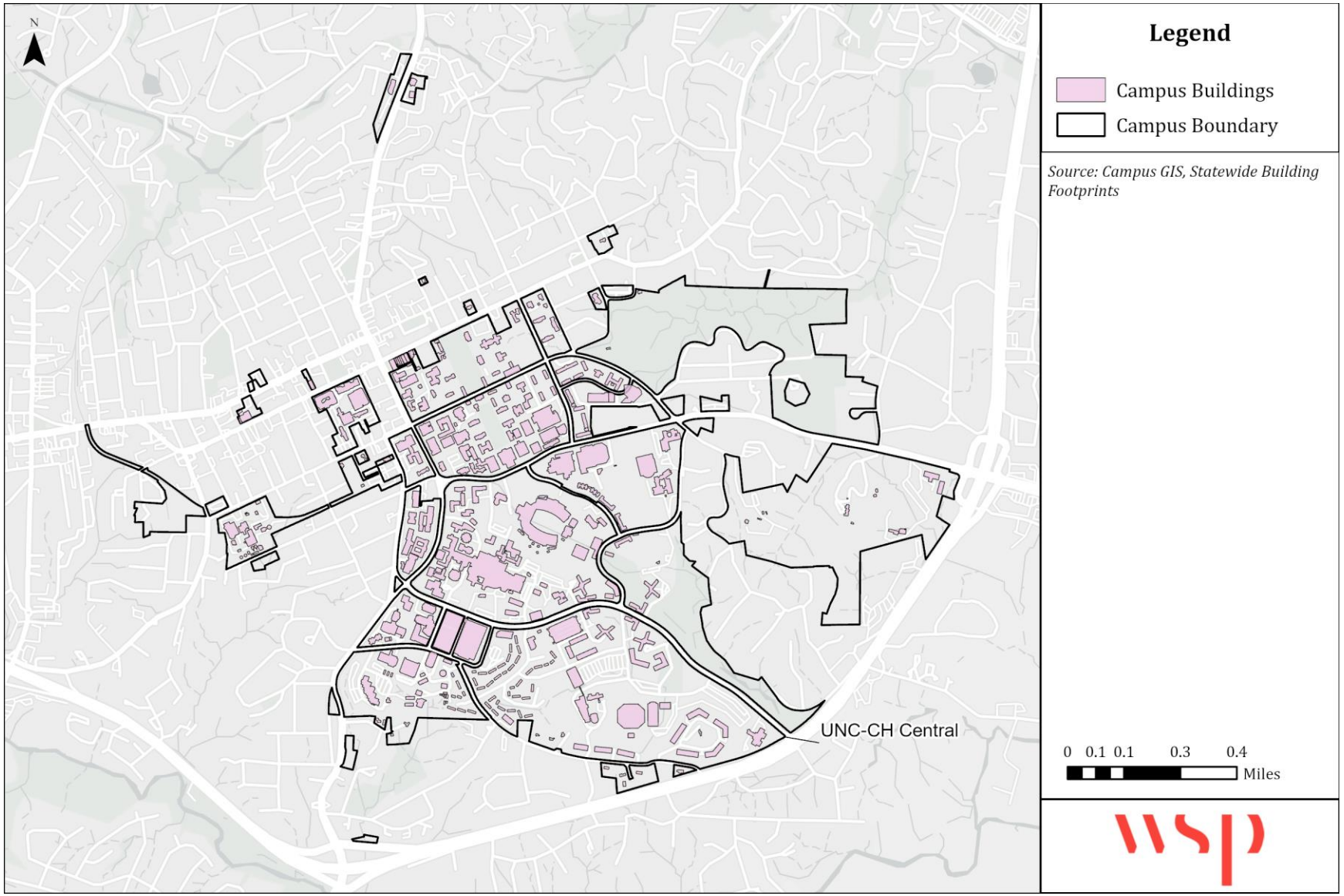


**Figure G.2 – UNC-CH Location Map, East Campus**

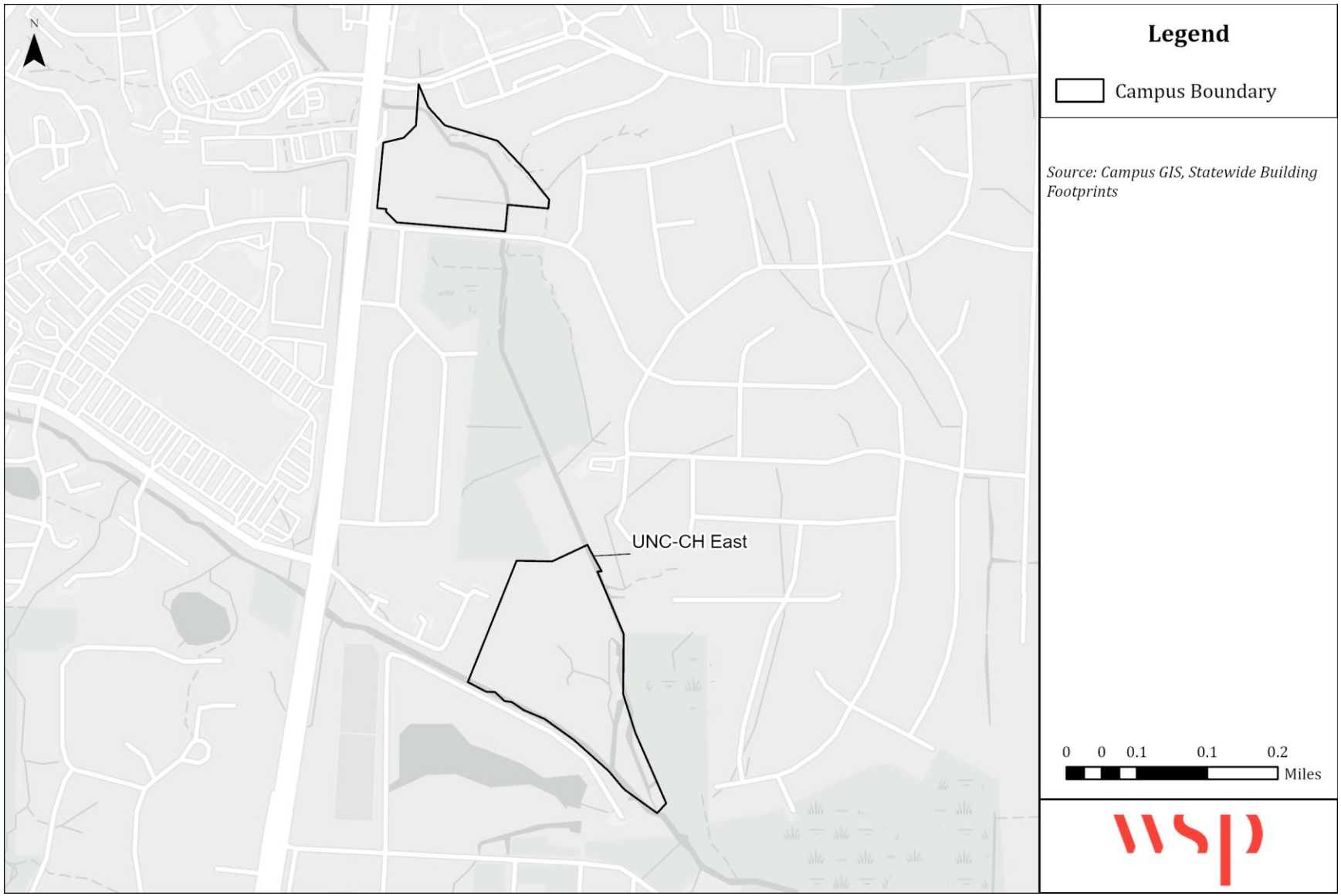


**Figure G.3 – UNC-CH Location Map, South Campus**

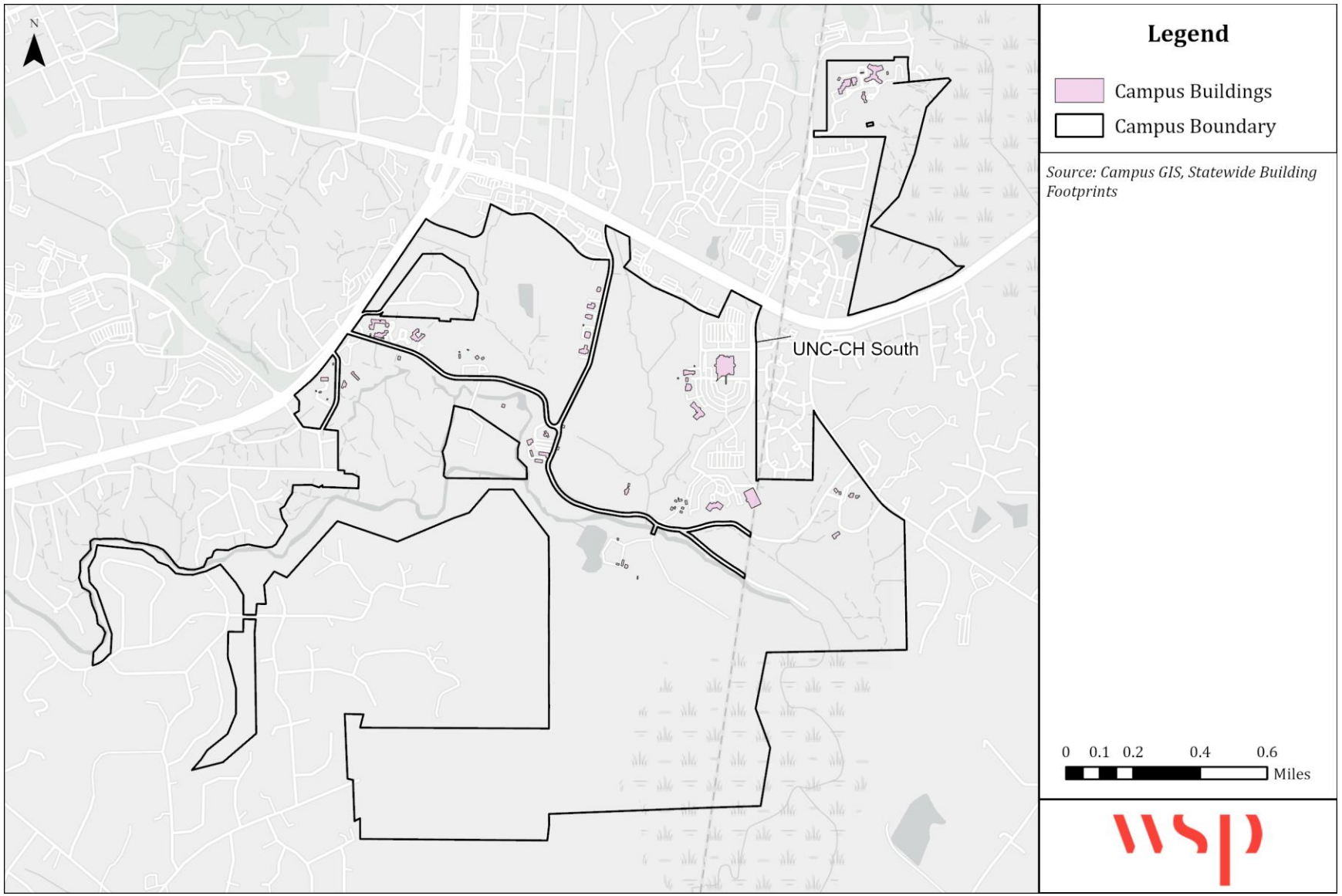


**Figure G.4 – UNC-CH Location Map, North Campus**

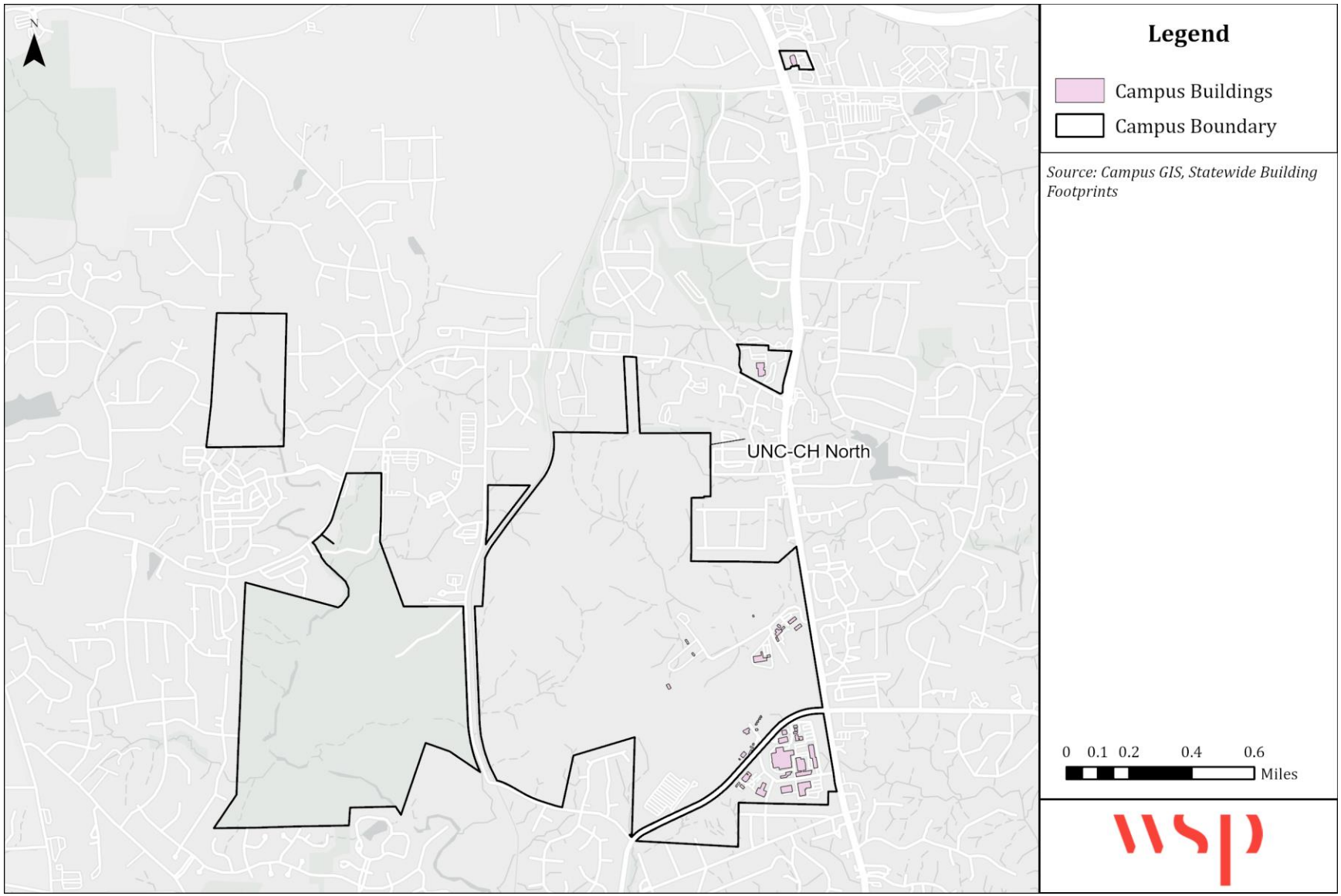
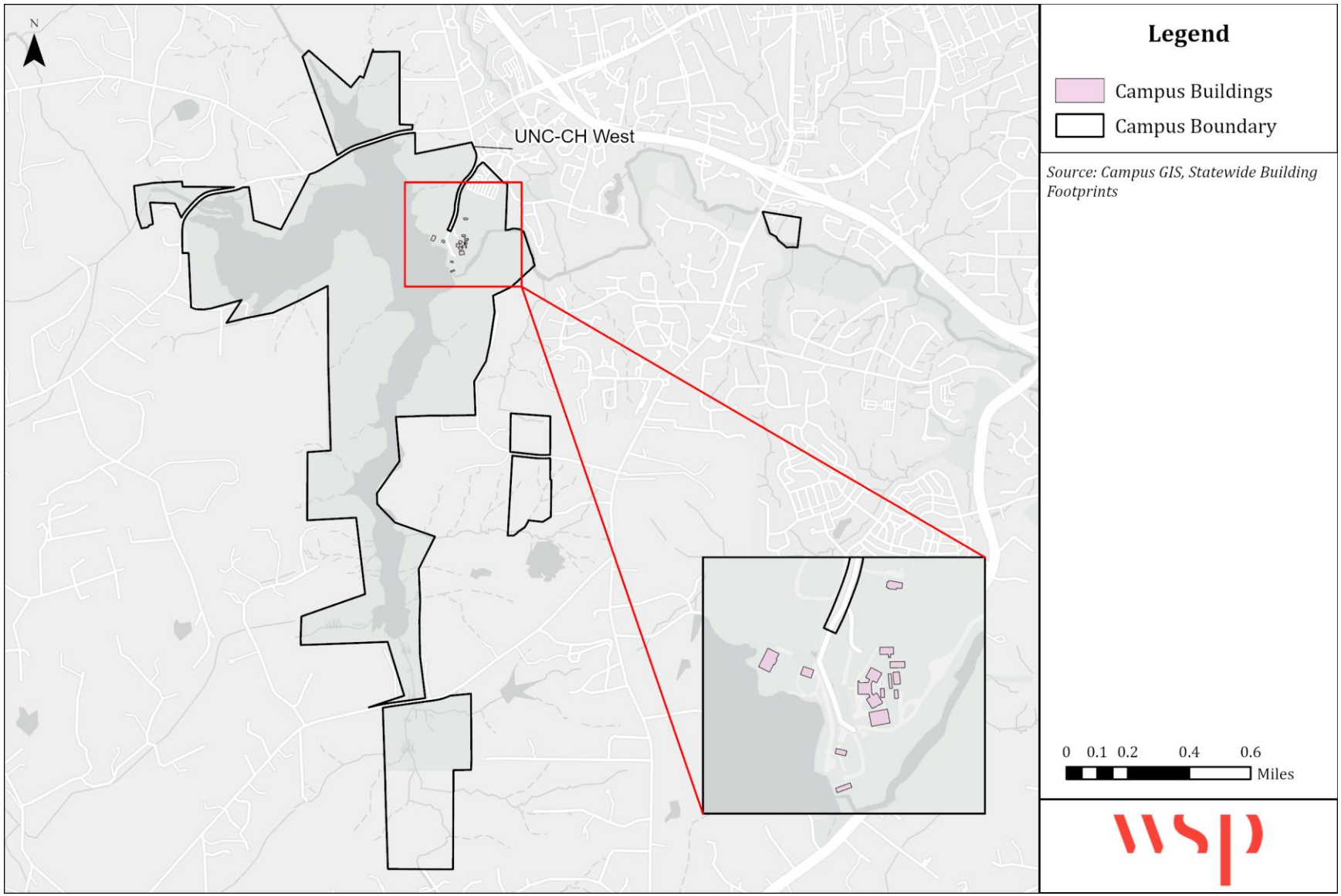


**Figure G.5 – UNC-CH Location Map, West Campus**



## G.2.2 Geography and Climate

The main campus of UNC-CH, covering approximately 760 acres, is located within the Piedmont region of North Carolina. The campus sits on a ridge and encompasses rolling hills and some areas of steep slope. Several small creeks and streams traverse University property, but there are no major watercourses on campus. The campus has an abundance of trees, many of which are venerable and quite large, and some parts of the campus are heavily wooded.

The climate of the Piedmont region of North Carolina is temperate with an average high of 49 degrees Fahrenheit in January, and an average high of 88 degrees Fahrenheit on average in July. The state has a fairly wet climate with an average precipitation for this area averaging approximately 44 inches annually.

**Figure G.6 – Average Annual Temperature, Orange County**

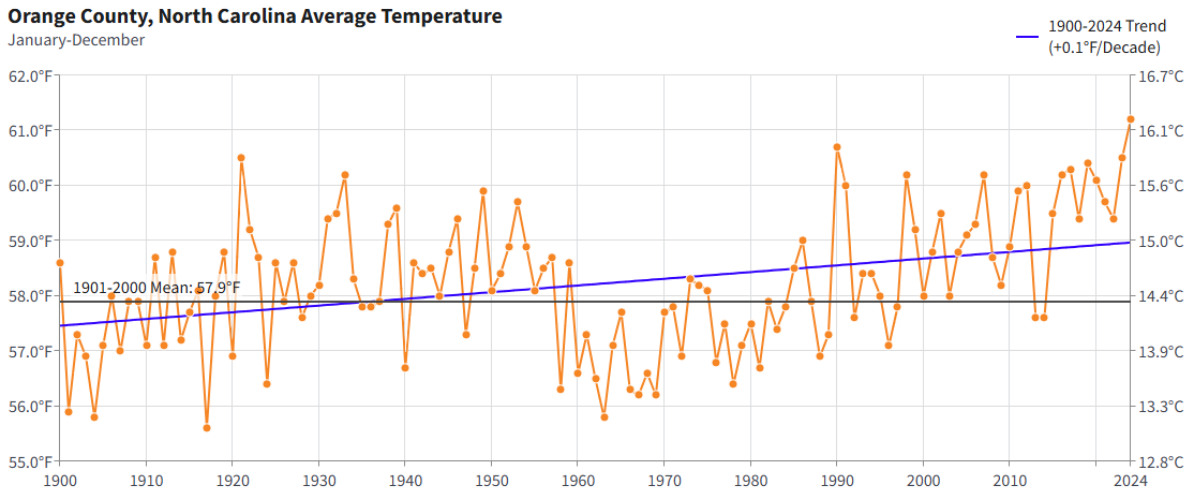
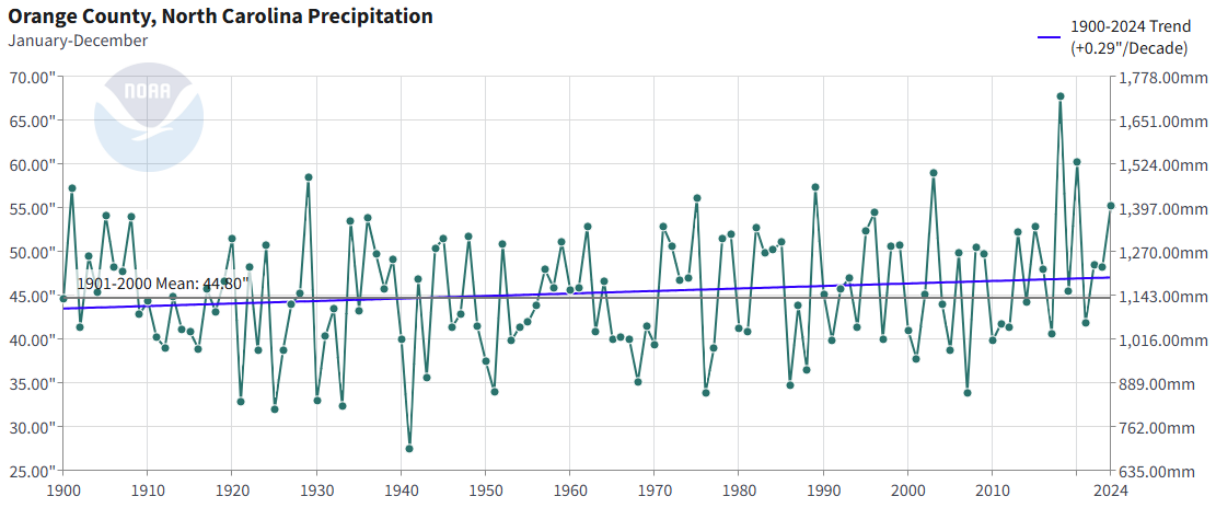



**Figure G.7 – Average Annual Precipitation, Orange County**



## G.2.3 Population and Demographics

Table G.3 provides population counts for University of North Carolina at Chapel Hill from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to UNC-CH's Quick Facts website, the campus has 4,374 faculty members and 10,141 staff members.

**Table G.3 – Population Counts for UNC-Chapel Hill, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **34,099** |
| *Undergraduate Students* | 22,007 |
| *Graduate Students* | 12,092 |
| *Full-Time Students* | 31,321 |
| *In-State Residency* | 24,568 |
| *Out-of-State Residency* | 9,531 |

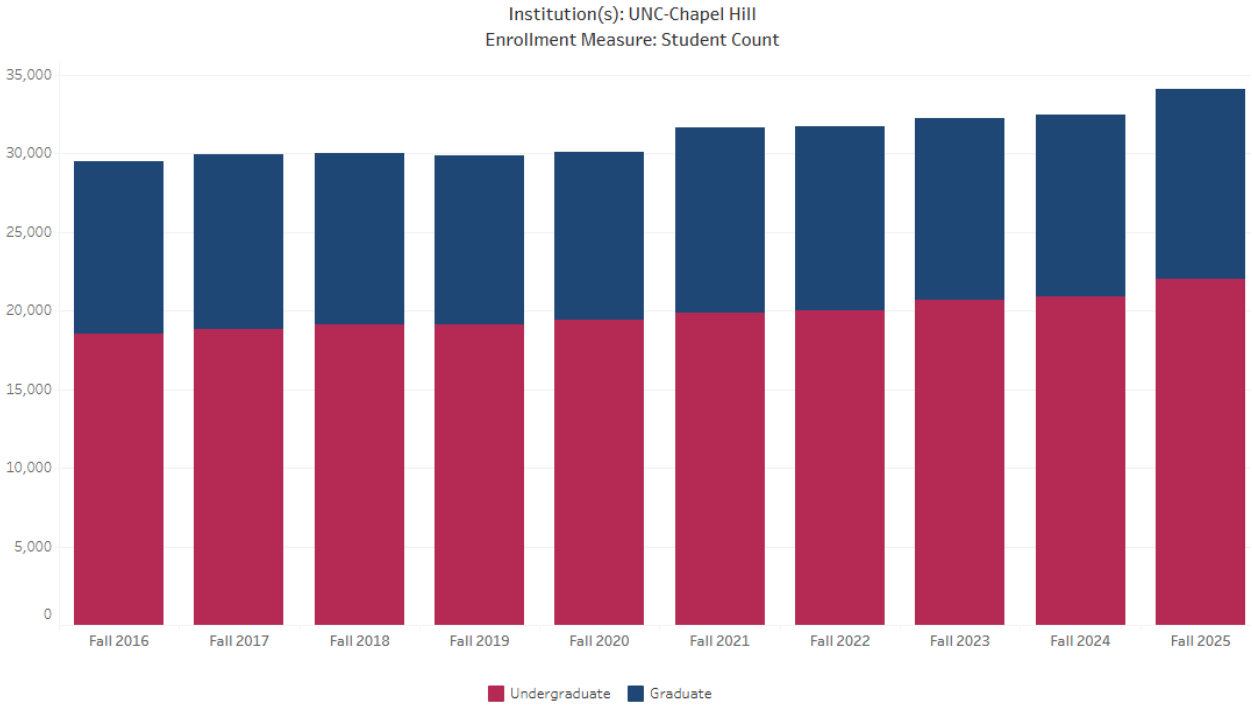
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Wake, Orange, and Mecklenburg Counties as well as other counties located across all regions of North Carolina. Approximately 20.7% of all enrolled students come from Wake County.

Among the UNC-CH student population, the most popular majors for undergraduates were Biological and Biomedical Sciences, Social Sciences, and Multi/Interdisciplinary Studies. The top graduate majors were Health Professions and Related Programs, Business Management, and Biological and Biomedical Sciences.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure G.8. Enrollment has increased slightly over the last five years.

**Figure G.8 – UNC-Chapel Hill Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 18,522 | 18,862 | 19,117 | 19,154 | 19,395 | 19,845 | 20,029 | 20,681 | 20,885 | 22,007 |
| Graduate | 10,946 | 11,049 | 10,894 | 10,723 | 10,697 | 11,796 | 11,676 | 11,553 | 11,553 | 12,092 |
| Total | 29,468 | 29,911 | 30,011 | 29,877 | 30,092 | 31,641 | 31,705 | 32,234 | 32,438 | 34,099 |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table G.4.

**Table G.4 – UNC-Chapel Hill Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 83 | 0.2% |
| Black or African American | 2,629 | 7.7% |
| Hispanic or Latino | 3,120 | 9.1% |
| Two or More Races | 1,573 | 4.6% |
| Asian | 4,823 | 14.1% |
| Native Hawaiian or Other Pacific Islander | 17 | 0.0% |
| White | 17,611 | 51.6% |
| Race/Ethnicity Unknown | 1,051 | 3.1% |
| U.S. Nonresident | 3,192 | 9.4% |

Source: UNC System Interactive Data Dashboards

## G.2.4 Growth and Development Trends

The University has been consistently investing in facility improvements and campus growth over the years. According to the 2019 UNC Chapel Hill Master Plan, the university is focused on modernizing and renovating poor condition spaces and diversify the housing unit types offered

on campus. The Master Plan identified 5.3 million gross square feet of growth capacity on main campus, with 4.1 million of that gross square feet being attributed to new development and the rest to demolition. Additionally, the plan mentions adding a Medical Education Building, graduate housing, parking decks, Translational Research Building, Biotechnology Collaboration Building, and expanding the Business School in the first phase of development. Figure G.9 below shows sites of proposed buildings and major renovations on UNC-Chapel Hill's main campus.

**Figure G.9 – Proposed Future Development Plan for UNC-Chapel Hill Campus**




Source: 2019 UNC Chapel Hill Master Plan

# G.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the UNC-CH campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## G.3.1 Building Exposure

Table G.5 through Table G.8 provide total building exposure by campus, which was estimated by summarizing building footprints and building replacement values provided by the North Carolina Emergency Management (NCEM) iRisk database. Note that there are no buildings on East campus. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table G.5 – UNC-CH Central Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 71 | $296,965,489.90 |
| Educational/Extracurricular | 197 | $1,059,341,699.00 |
| Housing | 68 | $248,348,173.30 |
| **Total** | **336** | **$1,604,655,362.00** |

Source: NCEM iRisk database

**Table G.6 – UNC-CH North Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 26 | $64,658,546.72 |
| Educational/Extracurricular | 13 | $43,310,075.95 |
| Housing | - | - |
| **Total** | **39** | **$107,968,622.67** |

Source: NCEM iRisk database

**Table G.7 – UNC-CH South Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 12 | $23,872,435.85 |
| Educational/Extracurricular | 49 | $88,550,478.27 |
| Housing | 5 | $9,156,961.21 |
| **Total** | **66** | **$121,579,875.33** |

Source: NCEM iRisk database

**Table G.8 – UNC-CH West Campus Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 1 | $26,168,324.69 |
| Educational/Extracurricular | 11 | $10,548,891.17 |
| Housing | 1 | $286,566.52 |
| **Total** | **13** | **$37,003,782.38** |

Source: NCEM iRisk database

## G.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt campus continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by UNC-CH's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the UNC-CH HMPC updated the list of critical facilities from the previous plan and categorized facilities into two tiers of priority. Factors considered for the selection of critical facilities included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for UNC-CH are listed in Table G.9 and shown in Figure G.10 through Figure G.12.

**Table G.9 – UNC-CH Critical Facilities**

| | Bldg # | Building Name | Building Type | Priority | Generator? |
|---|---|---|---|---|---|
| 1 | 328 | Bingham Facility Building Number 1*** | Laboratory | 2 | Yes |
| 2 | 672 | Bingham Facility Building Number 2*** | Research/Lab | 2 | Yes |
| 3 | 675 | Bingham Facility Building Number 3*** | Research/Lab | 2 | Yes |
| 4 | 229 | Burnett-Womack Building | Lab/Class | 2 | Yes |
| 5 | 663 | Cameron Substation | Electric Distribution | 2 | No |
| 6 | 086 | Caudill, W Lowry and Susan S Labs | Lab/Class | 2 | Yes |
| 7 | 087 | Chapman Hall | Academic/Research | 2 | Yes |

| | Bldg # | Building Name | Building Type | Priority | Generator? |
|---|---|---|---|---|---|
| 8 | 391 | Chase Dining Hall | Food Preparation | 1 | Yes |
| 9 | 647 | Cobb Chilled Water Plant* | Chilled Water System | 2 | Yes |
| 10 | 179 | Cogeneration Facility | Cogen System | 1 | Yes |
| 11 | 013 | Davie Hall | Lab/Class | 2 | Yes |
| 12 | 082 | Dean Smith Center | Athletics / Shelter / POD | 2 | Yes |
| 13 | 463 | Electric Distribution System Ops Center | Electric Distribution | 1 | Yes |
| 14 | 649 | Environment Health & Safety Building | Public Safety | 1 | Yes |
| 15 | 212 | Francis Owen Blood Research Lab | Laboratory | 2 | Yes |
| 16 | 359 | Genetic Medicine Research Building | Academic Research | 2 | Yes |
| 17 | 353 | Hemophilia Research Lab | Research/Lab | 2 | Yes |
| 18 | 358 | Hooker, Michael Research Center | Lab/Class | 2 | Yes |
| 19 | 454 | ITS Franklin | IT Systems | 1 | Yes |
| 20 | 625 | ITS Manning | IT Systems | 1 | Yes |
| 21 | 231 | Jones Building, Dr Mary Ellen | Laboratory | 2 | Yes |
| 22 | 357 | Kerr, Banks Dayton Hall | Lab/Class | 2 | Yes |
| 23 | 210A | Koury Oral Health Sciences Building | Lab/Class | 2 | Yes |
| 24 | 202 | MacNider Hall | Laboratory/IT Systems | 1 | Backup only |
| 25 | 626 | Manning Steam Plant | Cogen System | 2 | ? |
| 26 | 141 | Manning Substation | Electric Distribution | 2 | No |
| 27 | 360 | Marsico Hall | Laboratory | 2 | Yes |
| 28 | 238 | McGavran-Greenberg Hall | Lab/Class | 2 | Yes |
| 29 | 247 | Medical Biomolecular Research Building | Laboratory | 2 | Yes |
| 30 | 245 | NeuroSciences Research Building | Laboratory | 2 | Yes |
| 31 | 227 | North Chilled Water Plant | Chilled Water System | 2 | No |
| 32 | 37 | Peabody Hall | IT Systems | 1 | No |
| 33 | 430 | Public Safety Building | Public Safety | 1 | Yes |
| 34 | 5 | South Building | Historic/Administration | 2 | No |
| 35 | 230 | South Chilled Water Plant | Chilled Water System | 2 | No |
| 36 | 506 | South Substation | Electric Distribution | 2 | No |
| 37 | 217 | Taylor, Isaac M Hall | Laboratory | 2 | Yes |
| 38 | 242 | Thurston-Bowles Building | Laboratory | 2 | Yes |
| 39 | 646 | Tomkins Chilled Plant | Chilled Water System | 2 | No |
| 40 | 46 | Wilson Hall | Lab/Class | 2 | No |
| 41 | 24 | Wilson Library** | Historic Collections | 2 | Yes |
| 43 | 236 | Glaxo Research Building | Research/Lab | 2 | Yes |
| 44 | 094 | IMS Fisheries Research Lab | Academic/Research | 2 | Partial |
| 45 | 069 | Kenan Labs | Research/Lab | 2 | Yes |

*Cobb Chilled water plant has a generator in the structure, but it feeds Cobb Dorm and the Parking Deck either completely or mostly. **Wilson library is fed by the generator in Caudill labs as well as a small generator located in the walled courtyard beside the Stacks entrance. Kenan Labs is fed by the generator in Murray Hall. ***These facilities are located outside of the mapped campus boundaries.

**Figure G.10 – UNC-CH Map of Buildings and Critical Facilities, Central, South, and East Campuses**

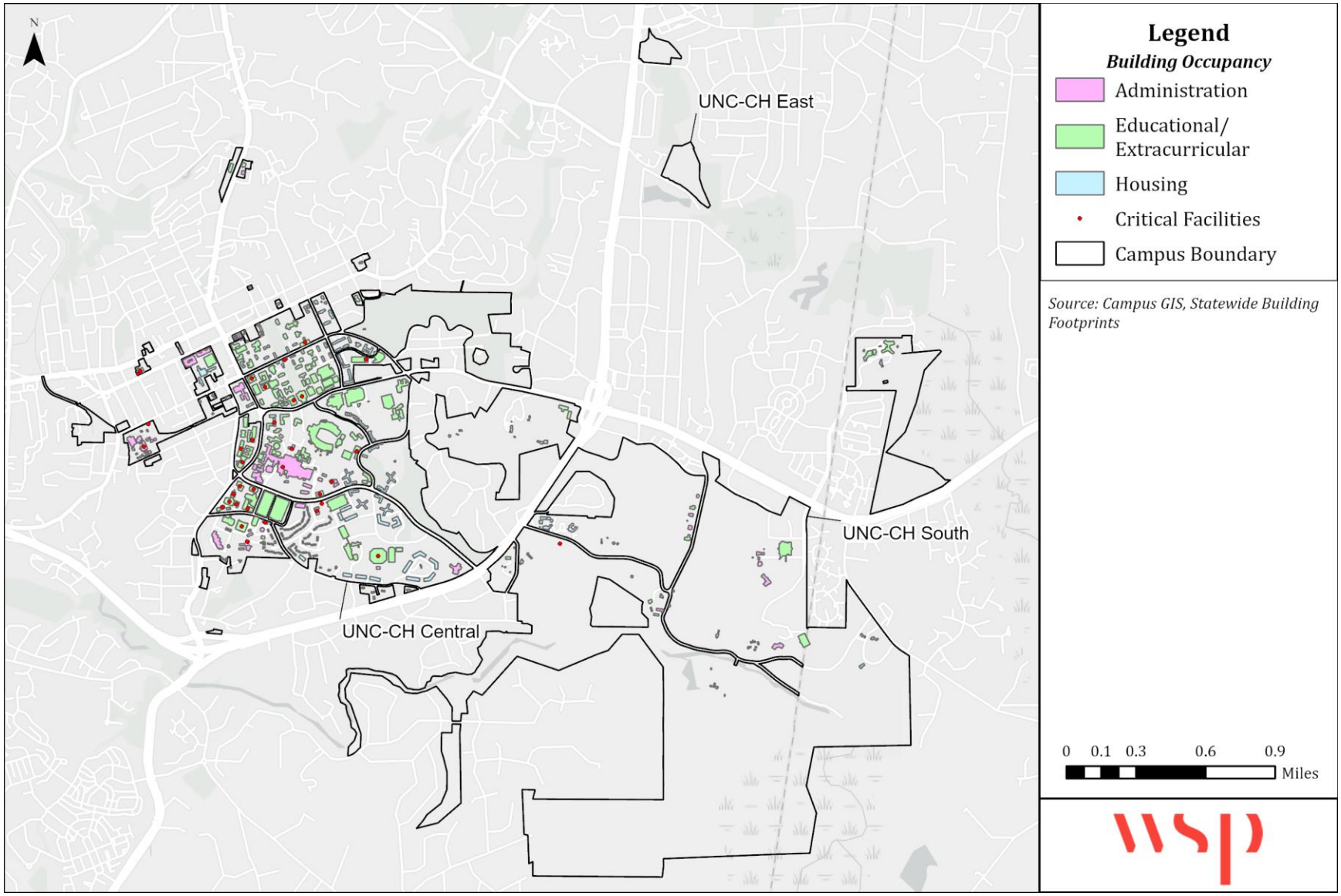


**Figure G.11 – UNC-CH Map of Buildings and Critical Facilities, North Campus**

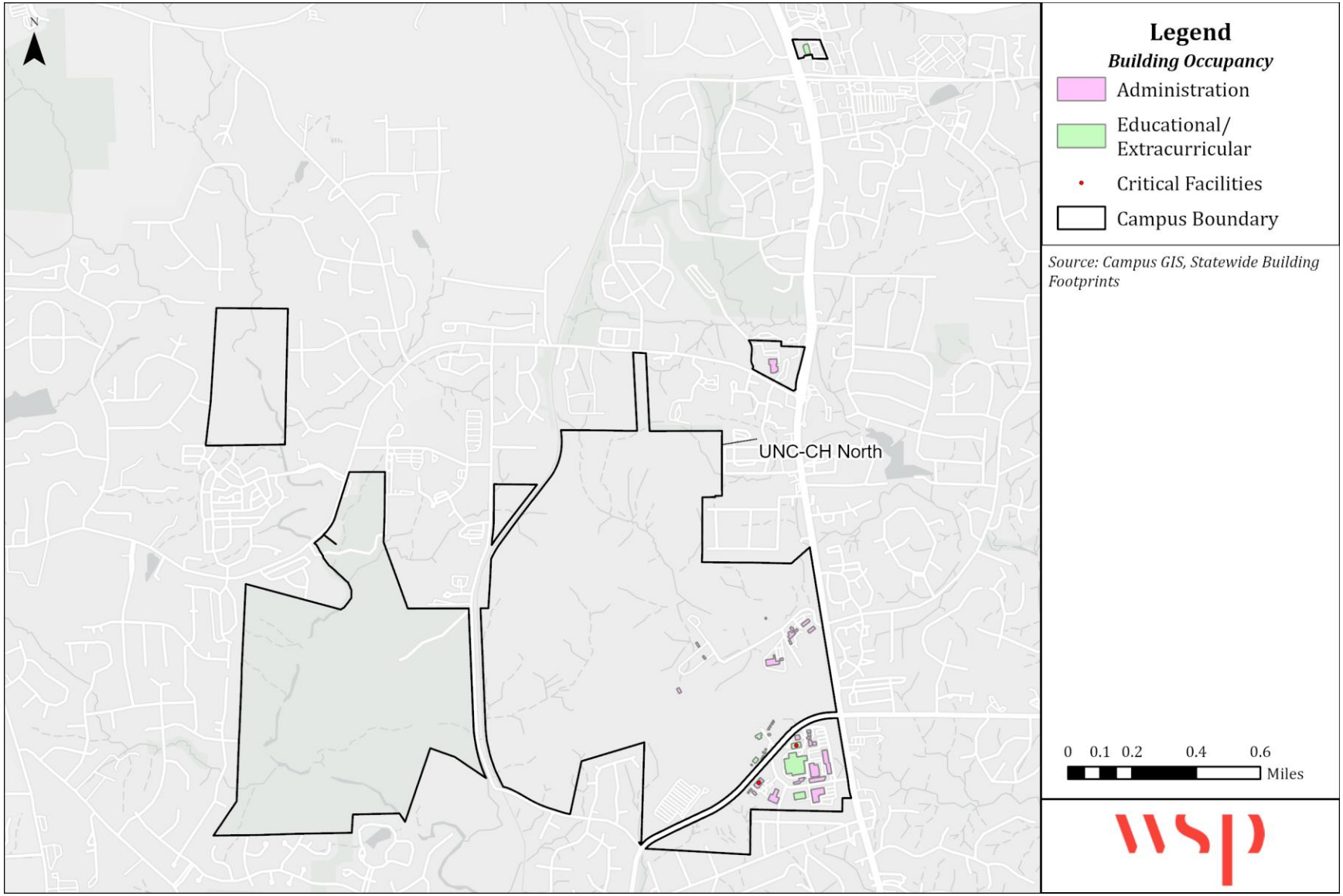
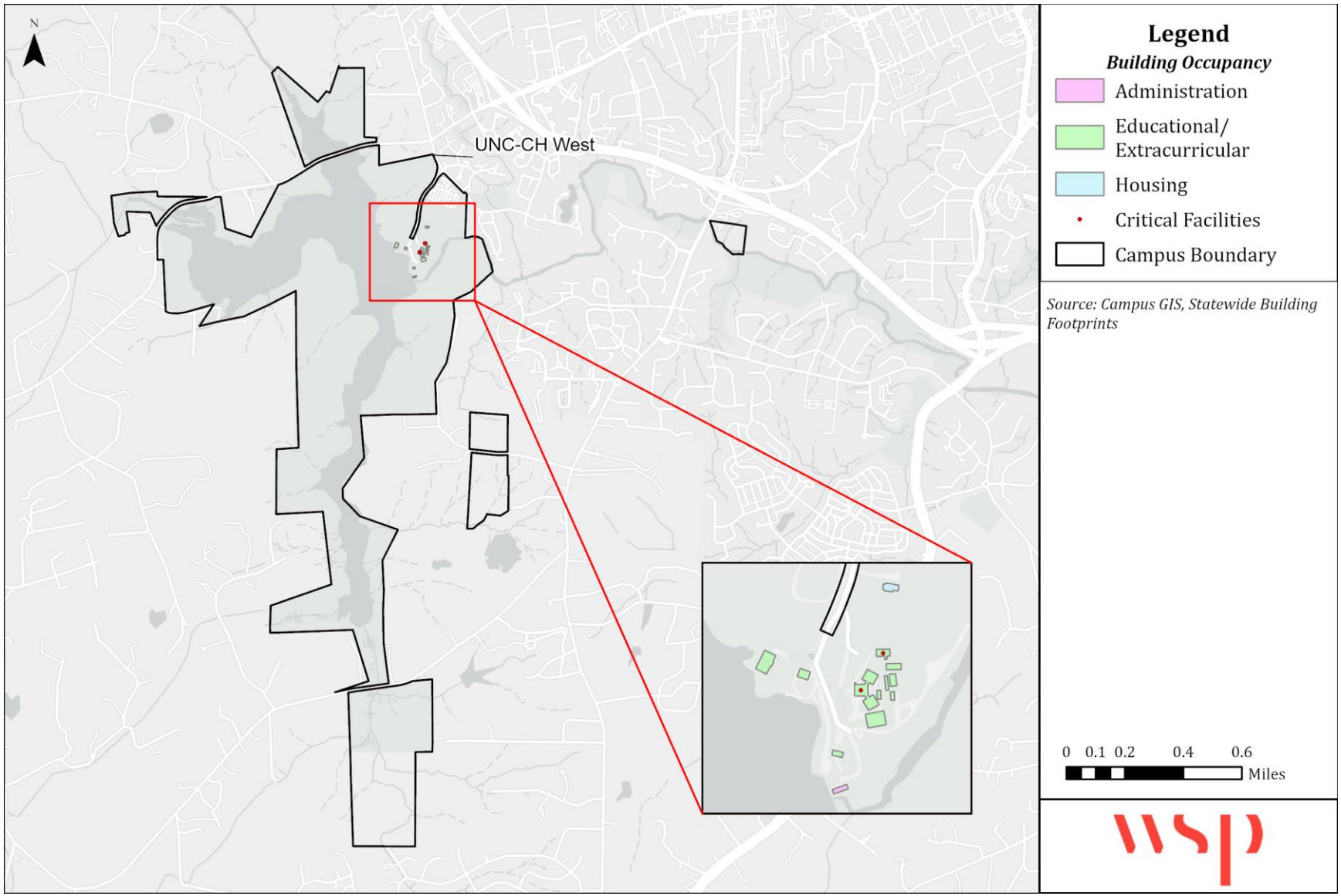


**Figure G.12 – UNC-CH Map of Buildings and Critical Facilities, West Campus**



# G.4 Hazard Identification & Risk Assessment

## G.4.1 Hazard Identification

To identify a full range of hazards relevant to UNC-CH, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the UNC-CH Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table G.10. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table G.10 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP UNC-CH Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Excessive Heat | Yes | No |
| Earthquake | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failure | Yes | Yes |
| Drought | Yes | Yes |
| Tornadoes & Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | No |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | No |

UNC-CH's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Orange County was used to approximate past events that may have affected the UNC-CH campus. The NCEI database contains 417 records of storm events that occurred in Orange County in the 25-year period from 2000 through 2024. Table G.11 summarizes these events.

**Table G.11 – NCEI Severe Weather Data for Orange County, 2000 – 2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Flash Flood | 46 | $10,964,500 | $0 | 0 | 1 |
| Flood | 4 | $26,400,000 | $5,000,000 | 0 | 0 |
| Hail | 44 | $2,500 | $500 | 0 | 0 |
| Heavy Rain | 2 | $0 | $0 | 0 | 0 |
| Heavy Snow | 1 | $0 | $0 | 0 | 0 |
| High Wind | 2 | $1,000 | $0 | 0 | 0 |
| Ice Storm | 1 | $2,700,000 | $0 | 0 | 0 |
| Lightning | 8 | $2,410,000 | $0 | 2 | 0 |
| Strong Wind | 15 | $1,346,500 | $6,000 | 0 | 2 |
| Thunderstorm Wind | 216 | $652,250 | $2,000 | 2 | 3 |
| Tornado | 7 | $2,650,000 | $0 | 0 | 0 |
| Tropical Storm | 2 | $1,250,000 | $0 | 0 | 0 |
| Winter Storm | 31 | $1,000,000 | $0 | 0 | 0 |
| Winter Weather | 38 | $30,000 | $0 | 0 | 0 |
| **Total** | **417** | **$49,406,750** | **$5,008,500** | **4** | **6** |

Source: National Center for Environmental Information Events Database, retrieved October 2025

Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Orange County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance.

Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Orange County has been designated in 18 major disaster declarations, as detailed in Table G.12, and 13 emergency declarations, as detailed in Table G.13.

**Table G.12 – FEMA Major Disaster Declarations, Orange County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-1087-NC | 13-Jan-96 | Snow | Blizzard of 96 | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1312-NC | 31-Jan-00 | Severe Storm(s) | Severe Winter Storm | N/A | N/A | $27,368,108 |
| DR-1448-NC | 12-Dec-02 | Severe Ice Storm | Severe Ice Storm | N/A | N/A | $86,565,180 |
| DR-1457-NC | 27-Mar-03 | Severe Ice Storm | Ice Storm | N/A | N/A | N/A |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 25,950 | $45,380,866 | $70,854,431 |
| DR-4167-NC | 21-Mar-13 | Severe Ice Storm | Severe Winter Storm | N/A | N/A | N/A |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34,713 | $133,948,455 | $632,937,402 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |
| DR-4889-NC | 11-Sep-25 | Tropical Depression | Tropical Depression Chantal | N/A | N/A | N/A |

Source: FEMA Disaster Declarations Summary, October 2025

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table G.13 – FEMA Emergency Declarations, Orange County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3033-NC | 02-Mar-77 | Snow | Drought & Freezing |
| EM-3049-NC | 11-Aug-77 | Drought | Drought |
| EM-3110-NC | 17-Mar-93 | Snow | Severe Snowfall & Winter Storm |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 01-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 06-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sept-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update.

Table G.14 summaries the determination made for each hazard.

### Table G.14 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | Yes | ▪ One high hazard dam is located on UNC-CH campus |
| Drought | Yes | ▪ Over the 25-year (1340 week) period from January 2000 through September 2025, Orange County experienced 661 weeks of drought ranging from abnormally dry conditions to exceptional drought. |
| Earthquake | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ iRisk database enables vulnerability assessment |
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ Orange County has had two disaster declarations related to flooding and eight other disaster declarations for hurricanes which may have involved flooding |
| Geological Hazards (Sinkhole & Landslide) | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ Orange County faces moderate to high susceptibility to landslides in the southeast corner of the County where UNC-CH is located |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Hurricane | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ Orange County has had eight disaster declarations for hurricanes |
| Severe Winter Weather | Yes | ▪ Included in 2021 UNC-CH Annex and rated a high-risk hazard<br>▪ Potential for power outages, freezing temperatures, and dangerous travel conditions presents risk to campus |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ F2 tornado tracks have passed within 10 miles of UNC-CH campus |
| Wildfire | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in 2021 UNC-CH Annex<br>▪ Fixed facility sites and transportation routes with hazardous materials are present in and around the campus |
| Infectious Disease | No | ▪ Not included in 2021 UNC-CH Annex<br>▪ Addressed by state and federal planning and emergency response |
| Cyber Security | No | ▪ Not included in 2021 UNC-CH Annex |
| Terrorism | No | ▪ Not included in 2021 UNC-CH Annex<br>▪ Addressed by state and federal planning and emergency response |

# G.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on UNC-CH's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Orange County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and structure values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;

- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Eno-Haw Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Orange County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table G.15 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Dam Failure** | NC Dam Inventory, NCDEQ | Campus | Qualitative Analysis | Campus |

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Drought** | USDM, NDMC, NCEI | County | Qualitative Analysis | Campus |
| **Earthquake** | USGS, NCEI | County | iRisk | Census Tract |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Geological – Landslide** | USGS | County | Qualitative Analysis | Campus |
| **Hurricane** | NHC | County | iRisk | Census Tract |
| **Landslide** | USGS | County | Qualitative Analysis | Campus |
| **Severe Winter Weather** | NWS, NCEI | County | Statistical Analysis | County |
| **Tornadoes & Thunderstorms** | NWS, NCEI | Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCDEQ = North Carolina Department of Environmental Quality; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NDMC = National Drought Mitigation Center; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDM = United States Drought Monitor; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the UNC-CH planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table G.16.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile. The results of the risk assessment and overall PRI scoring are provided in Section G.5.12 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table G.16 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | 1 | 30% |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | 2 | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | 3 | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | 4 | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | 2 | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | 4 | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | 1 | 20% |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | 2 | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | 3 | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | 4 | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | 1 | 10% |
| | **12 TO 24 HRS** | SELF DEFINED | 2 | |
| | **6 TO 12 HRS** | SELF DEFINED | 3 | |
| | **LESS THAN 6 HRS** | SELF DEFINED | 4 | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | 1 | 10% |
| | **LESS THAN 24 HRS** | SELF DEFINED | 2 | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | 3 | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | 4 | |

## G.5.1 Dam Failure

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Dam Failure | Possible | Critical | Negligible | Less than 6 hours | Less than 1 week | 2.4 |

### Location

The North Carolina Dam Inventory, maintained by North Carolina Department of Environmental Quality, provides a detailed inventory of all dams in the state. As of November 2025, there are 9 dams located on or near campus with inundation areas affecting the UNC-CH campus; 2 of these dams are rated significant hazard while the other 7 dams are all rated high hazard. Of the high hazard dams in the planning area, Only the Spring Valley Dam was given a condition assessment of "poor" on the last inspection. However, 5 of the high hazard dams were given a condition assessment of "fair" on the last inspection. The University Lake Dam is the only dam located within the boundary of a UNC-CH campus and is rated as a high hazard.

Figure G.13 shows all dams located either on or near campus that have inundation areas that intersect the UNC-CH campus boundary. Table G.17 lists all dams located on UNC-CH campus and their current hazard potential and conditions as of last inspection.

*Spatial Extent: 1 – Negligible*

**Table G.17 – Dams Located on UNC-CH Campus**

| Dam Name | NID ID | Hazard Potential | Condition as of Last Inspection | Max Capacity (Ac-Ft) | River/Stream |
|---|---|---|---|---|---|
| University Lake Dam | NC00782 | High | Satisfactory | 4836 | Morgan Creek |

Source: North Carolina Dam Inventory, November 2025

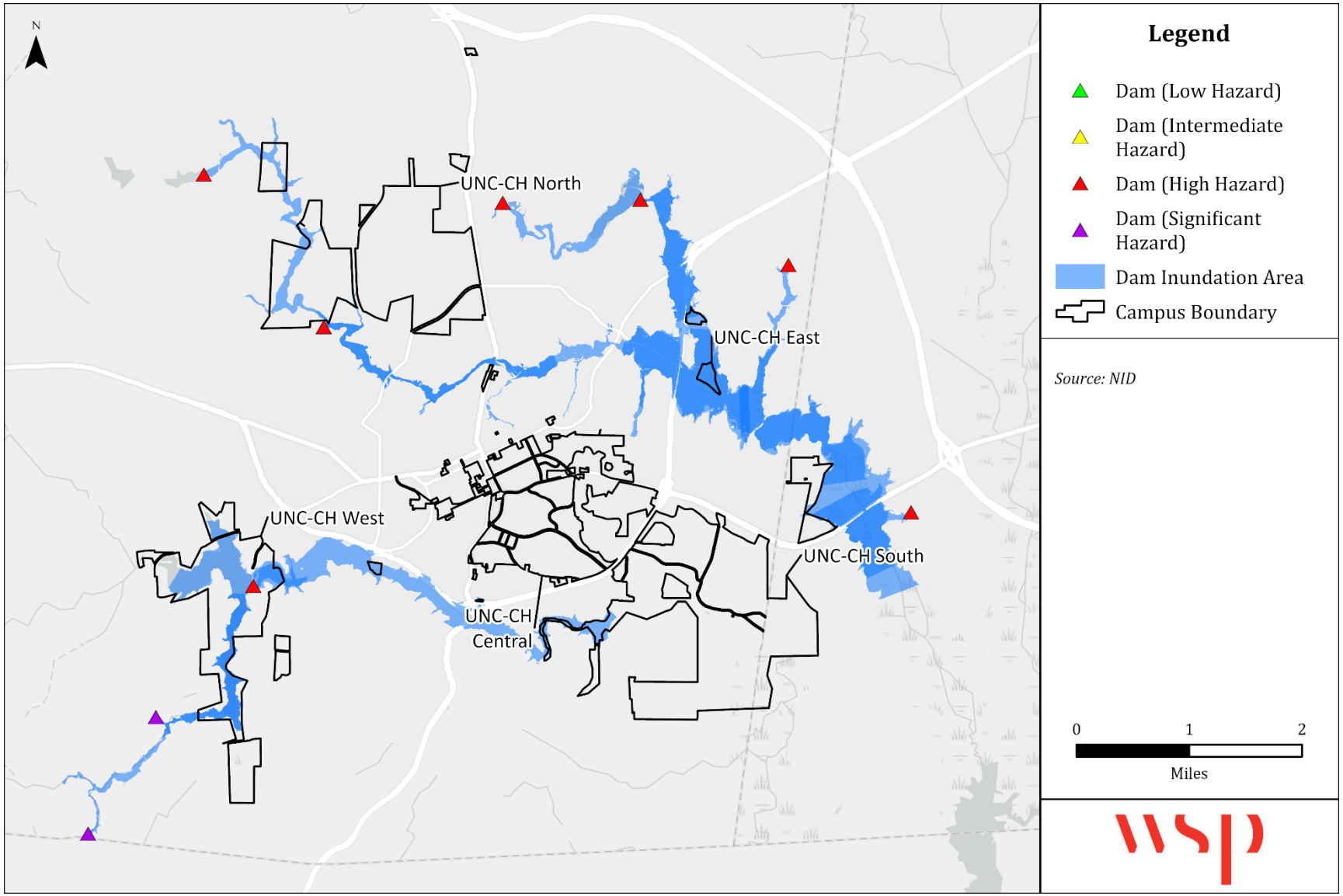
North Carolina Emergency Management contains dam inundation data that shows areas of potential flooding in the event of a dam failure. Table G.18 lists the dams located near campus with inundation areas that may impact UNC-CH's campus.

**Table G.18 – Dams with Inundation Areas that Intersect UNC-CH Campus**

| Dam Name | NID ID | Hazard Potential | Condition as of Last Inspection | Max Capacity (Ac-Ft) | River/Stream |
|---|---|---|---|---|---|
| Colony Lake Dam | NC03671 | High | Fair | 48 | Little Creek |
| Dobson Dam | NC05979 | Significant | Satisfactory | | UT to Prichards Mill Creek |
| Eastwood Lake Dam | NC00781 | High | Fair | 330 | Booker Creek |
| Hogan Farms Dam | NC00770 | High | Fair | 160 | Bolin Creek |
| Jackson Pond Dam | NC04914 | Significant | Fair | 10 | Cumbo Branch |
| Lake Ellen Dam | NC01537 | High | Fair | 81 | Booker Creek |
| Spring Valley Dam | NC04994 | High | Poor | 22 | Bolin Creek |
| Thompson Lake Dam | NC01047 | High | Fair | 60 | UT to Little Creek |

Source: North Carolina Dam Inventory, November 2025

**Figure G.13 – Dam Locations with Inundation Areas on UNC Chapel Hill Campus**



## Extent

Each state has definitions and methods to determine the hazard potential of a dam. In North Carolina, dams are regulated by the state if they are 25 feet or more in height and impound 50 acre-feet or more. Dams and impoundments smaller than that may fall under state regulation if it is determined that failure of the dam could result in loss of human life or significant damage to property. The height of a dam is from the highest point on the crest of the dam to the lowest point on the downstream toe, and the storage capacity is the volume impounded at the elevation of the highest point on the crest of the dam.

Dam Safety Program engineers determine the "hazard potential" of a dam, meaning the probable damage that would occur if the structure failed, in terms of loss of human life and economic loss or environmental damage. Dams are assigned one of three classes based on the nature of their hazard potential:

- Class A (Low Hazard) includes dams located where failure may damage uninhabited low value non-residential buildings, agricultural land, or low volume roads.
- Class B (Intermediate Hazard) includes dams located where failure may damage highways or secondary railroads, cause interruption of use or service of public utilities, cause minor damage to isolated homes, or cause minor damage to commercial and industrial buildings. Damage to these structures will be considered minor only when they are located in backwater areas not subjected to the direct path of the breach flood wave; and they will experience no more than 1.5 feet of flood rise due to breaching above the lowest ground elevation adjacent to the outside foundation walls or no more than 1.5 feet of flood rise due to breaching above the lowest floor elevation of the structure.
- Class C (High Hazard) includes dams located where failure will likely cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, primary highways, or major railroads.

### Table G.19 – Dam Hazard Classifications

| Hazard Classification | Description | Quantitative Guidelines |
|---|---|---|
| **Low** | Interruption of road service, low volume roads | Less than 25 vehicles per day |
| | Economic damage | Less than $30,000 |
| **Intermediate** | Damage to highways, interruption of service | 25 to less than 250 vehicles per day |
| | Economic damage | $30,000 to less than $200,000 |
| | Loss of human life* | Probable loss of 1 or more human lives |
| **High** | Economic damage | More than $200,000 |
| | *Probable loss of human life due to breached roadway or bridge on or below the dam | 250 or more vehicles per day |

Source: NCDEQ

Based on classification criteria, a high hazard dam failure could cause death and/or injury as well as severe property damage and economic impacts within the affected area. Therefore, though the affected area would be negligible in size relative to the entire planning area, the potential impact of a high hazard dam failure is critical.

*Impact: 3 – Critical*

## Historical Occurrences

According to the current Eno-Haw Regional Hazard Mitigation Plan, which includes Orange County, and anecdotal evidence, there are no records of historical dam failures occurrences in or affecting the UNC-CH campus or the surrounding area.

## Probability of Future Occurrence

Given the presence of high hazard dams in Orange County, failure of a dam is possible. Dam failure has not occurred in the area; however historical events alone do not provide an adequate estimate of potential future occurrence. With heavy rain events becoming more frequent and intense, conditions conducive to dam failure may occur more frequently as well.

*Probability: 2 – Possible*

## Vulnerability Assessment

### Methodology & Assumptions

Developed by North Carolina Emergency Management (NCEM), the Statewide Emergency Response Analysis (SERA) provides standardized inundation modeling to support emergency preparedness. SERA data uses the 100-year storm event and assumes a full pond overtopping failure. This modeling approach is intentionally conservative and does not reflect the operational design of individual dams, many of which are engineered to avoid overtopping during such events. However, it provides a useful starting point to understand potential downstream risk. Based on a visual assessment of the inundation areas provided by SERA, the UNC-CH campus could be impacted by the failure of dams with high hazard potential: University Lake Dam, Colony Lake Dam, Eastwood Lake Dam, Hogan Farms Dam, Lake Ellen Dam, Spring Valley Dam, and Thompson Lake Dam.

### People

There are seven high hazard dams in the planning area, which by definition would cause probable loss of life in the event of a failure. A person’s immediate vulnerability to a dam failure is directly associated with the person’s distance downstream of the dam as well as proximity to the stream carrying the floodwater from the failure. For dams that have an Emergency Action Plan (EAP), the vulnerability of loss of life for persons in their homes or on their property may be mitigated by following the EAP evacuation procedures; however, the displaced persons may still incur sheltering costs. Additionally, even if they are able to evacuate in time, displaced people

may still incur sheltering costs. According to NID records, all but one of the high hazard dams on or near UNC-CH campus have an Emergency Action Plan.

For people located on the river (e.g. for recreation) the vulnerability of loss of life is significant. People are also vulnerable to the loss of the uses of the lake upstream of a dam following failure. Several uses are minor, such as aesthetics or recreational use. However, some lakes serve as drinking water supplies and their loss could disrupt the drinking water supply and present a public health problem.

### Property

Vulnerability of the built environment includes damage to the dam itself and any man-made feature located within the inundation area caused by the dam failure. Downstream of the dam, vulnerability includes potential damage to homes, personal property, commercial buildings and property, and government owned buildings and property; destruction of bridge or culvert crossings; weakening of bridge supports through scour; and damage or destruction of public or private infrastructure that cross the stream such as water and sewer lines, gas lines and power lines. Water dependent structures on the lake upstream of the dam, such as docks/piers, floating structures or water intake structures, may be damaged by the rapid reduction in water level during the failure.

### Environment

Aquatic species within the lake will either be displaced or destroyed. The velocity of the flood wave will likely destroy riparian and instream vegetation and destroy wetland function. The flood wave will like cause erosion within and adjacent to the stream. Deposition of eroded deposits may choke instream habitat or disrupt riparian areas. Sediments within the lake bottom and any low oxygen water from within the lake will be dispersed, potentially causing fish kills or releasing heavy metals found in the lake sediment layers.

## Changes in Development

Increased development downstream from dams generally increases exposure. Such development may necessitate upgrading the rating based on the guidelines in Table G.19.

## Problem Statements

- While a dam failure has not occurred in the County to date, failure in the future is still possible. There is one high hazard dam located on UNC-CH campus.
- There are 6 high hazard dams located near campus with inundation areas that could impact campus in the event of a dam failure.

## G.5.2 Drought

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Drought | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |

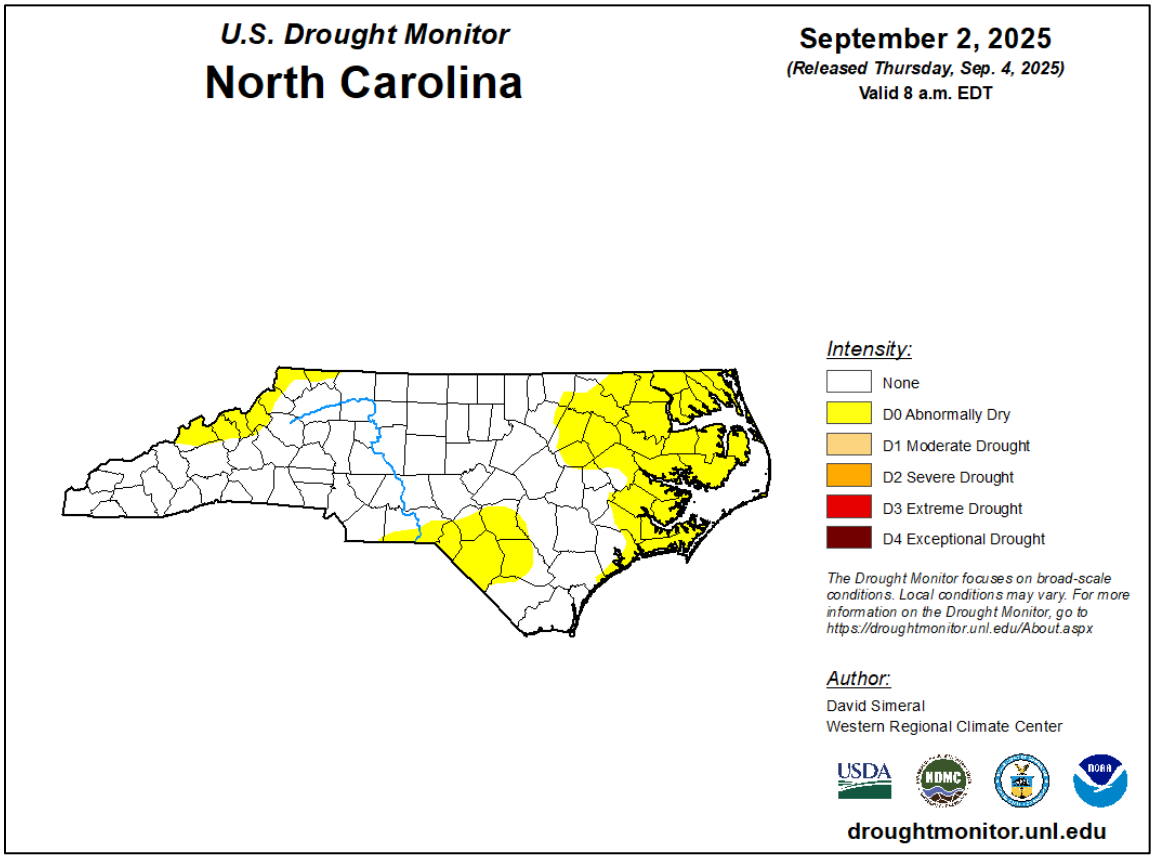
### Location

Drought is a regional hazard that can cover the entire planning area, and in some cases the entire state. The National Weather Service views drought and extreme heat as a phenomenon affecting broad forecast "zones", making it uncommon to pinpoint locations within planning areas that are more vulnerable to these hazards than others. Historically, the Eastern United Staes has experienced fewer significant long-term droughts compared to the Central and Western regions of the county.

The figure below illustrates the U.S. Drought Monitor's drought ratings for North Carolina as of September 2, 2025; as of that date, Orange County was experiencing no impacts of drought.

*Spatial Extent: 4 – Large*

**Figure G.14 – US Drought Monitor for Week of September 2, 2025**




Source: U.S. Drought Monitor

## Extent

The most significant impacts of drought are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Drought conditions can cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Drought extent can be defined in terms of intensity, using the U.S. Drought Monitor scale. The Drought Monitor Scale measures drought episodes with input from the Palmer Drought Severity Index, the Standardized Precipitation Index, the Keetch-Byram Drought Index, soil moisture indicators, and other inputs as well as information on how drought is affecting people. Figure G.15 details the classifications used by the U.S. Drought Monitor. A category of D2 (severe) or higher on the U.S. Drought Monitor Scale can typically result in crop or pasture losses, water shortages, and the need to institute water restrictions.

**Figure G.15 – US Drought Monitor Classifications**

| | | | 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:<br>▪ short-term dryness slowing planting, growth of crops or pastures<br>Coming out of drought:<br>▪ some lingering water deficits<br>▪ 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<br>▪ Streams, reservoirs, or wells low, some water shortages developing or imminent<br>▪ 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<br>▪ Water shortages common<br>▪ 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<br>▪ 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<br>▪ 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: US Drought Monitor

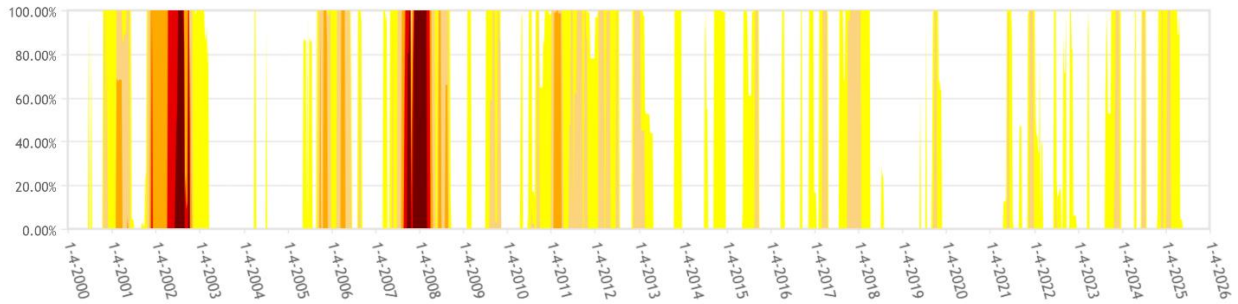
From late 2007 through mid-2008, North Carolina experienced the worst drought in state history. During this time, portions of Orange County experienced exceptional drought conditions.

*Impact: 1 – Minor*

## Historical Occurrences

Between 2000 and 2025, Orange County was in some level of drought 49% of the time. The County recorded 34 weeks in “extreme” drought or worse during this timeframe. Figure G.16 shows the historical periods where Orange County was considered in some level of drought conditions. The color key shown in Figure G.15 indicates the intensity of the drought.

**Figure G.16 – US Drought Monitor Historical Trends – Orange County 2000-2025**




Source: US Drought Monitor

The National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln, provides a clearinghouse for information on the effects of drought, based on reports from media, observers, impact records, and other sources.

According to the National Drought Mitigation Center's Drought Impact Reporter, during the 10-year period from January 2015 through September 2025, 1,447 drought impacts were noted for the State of North Carolina, of which 8 were reported to affect Orange County. Table G.20 summarizes the number of impacts reported by category and the years impacts were reported for each category. Note that the Drought Impact Reporter assigns multiple categories to each impact.

**Table G.20 – Drought Impacts Reported for Orange County, January 2015 through September 2025**

| Category | Impacts | Years Reported |
|---|---|---|
| Agriculture | 2 | 2024 |
| Fire | 5 | 2019, 2021, 2024 |
| Relief, Response & Restrictions | 7 | 2017, 2019, 2021, 2024 |
| Society & Public Health | 1 | 2024 |
| Water Supply & Quality | 2 | 2017 |

Source: Drought Impact Reporter, http://droughtreporter.unl.edu

## Probability of Future Occurrence

Over the 25-year (1,340 week) period from January 2000 through September 2025, Orange County experienced 661 weeks of drought ranging from abnormally dry conditions to exceptional drought. This equates to a 49 percent chance of drought in any given week. During this time, 121 weeks were categorized as a severe (D2) drought or greater; which equates to a 9 percent chance of severe drought in any given week.

*Probability: 3 – Likely*

## Vulnerability Assessment

### People

Drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Drought can also contribute to health issues by compromising water quality due to decreased water levels. Additionally, when coupled with extreme heat, droughts can lead to an increase in heat-related illnesses such heat-stroke, potentially resulting in loss of life.

The historical and potential impacts of drought on populations include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased costs to local and state government for large-scale water acquisitions and delivery, water rationing, and water wells running dry for individuals and families.

### Property

Direct structural damage from drought is rare, though it can happen. Droughts can disrupt soil cycles, leading to soil shrinking and swelling, potentially causing cracks in foundations and damaging infrastructure. It can also profoundly impact landscapes, posing financial burdens on property owners. Drought is unlikely to cause damage to the built environment. However, in areas with shrinking and expansive soil, drought may lead to structural damage.

### Environment

Environmental losses from drought are associated with damage to plants, animals, wildfire, and air and water quality, forest and range fires, landscape degradation, biodiversity loss, and soil erosion. While some impacts are transient, resolving once the drought subsides, others endure or may become irreversible. For instance, wildlife habitats may suffer from the loss of wetlands, lakes, and vegetation, yet many species can eventually rebound. Landscape degradation and heightened soil erosion may lead to lasting declines in biological productivity. Despite the challenges in quantifying environmental losses, heightened public awareness and concern for environmental well-being have prompted public officials to allocate greater attention and resources to mitigate these effects. Moreover, if climate change forecasts of prolonged drought followed by intense rainfall events hold true, the risk of flash flooding also escalates under such conditions.

## Changes in Development

As new development on campus occurs and population rises, water demand will likely increase, which could lower the threshold for socioeconomic drought in terms of inability of water supply to meet water demand on campus and in the larger Chapel Hill and Orange County communities.

Following the drought in 2009, UNC-CH developed a reclaimed water system to provide cooling tower make-up water for the University's chilled water plants, the largest water use on campus,

and for athletic field irrigation. Reclaimed water is also used to flush toilets in buildings on campus.

## Problem Statements

- Orange County experienced drought periods of 100 weeks or longer three times between 2000-2025: 100 weeks from August 2010 through July 2012 – 18 weeks at D2 level; 150 weeks from May 2007 through September 2008 – 42 weeks at D2 or higher; and October 2001 through March 2003 – 48 weeks at D2 or higher.
- Critical functions at UNC-CH rely on a chilled water system; UNC-CH has attempted to mitigate impacts to these functions during periods of drought by integrating the use of reclaimed water systems.

## G.5.3 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

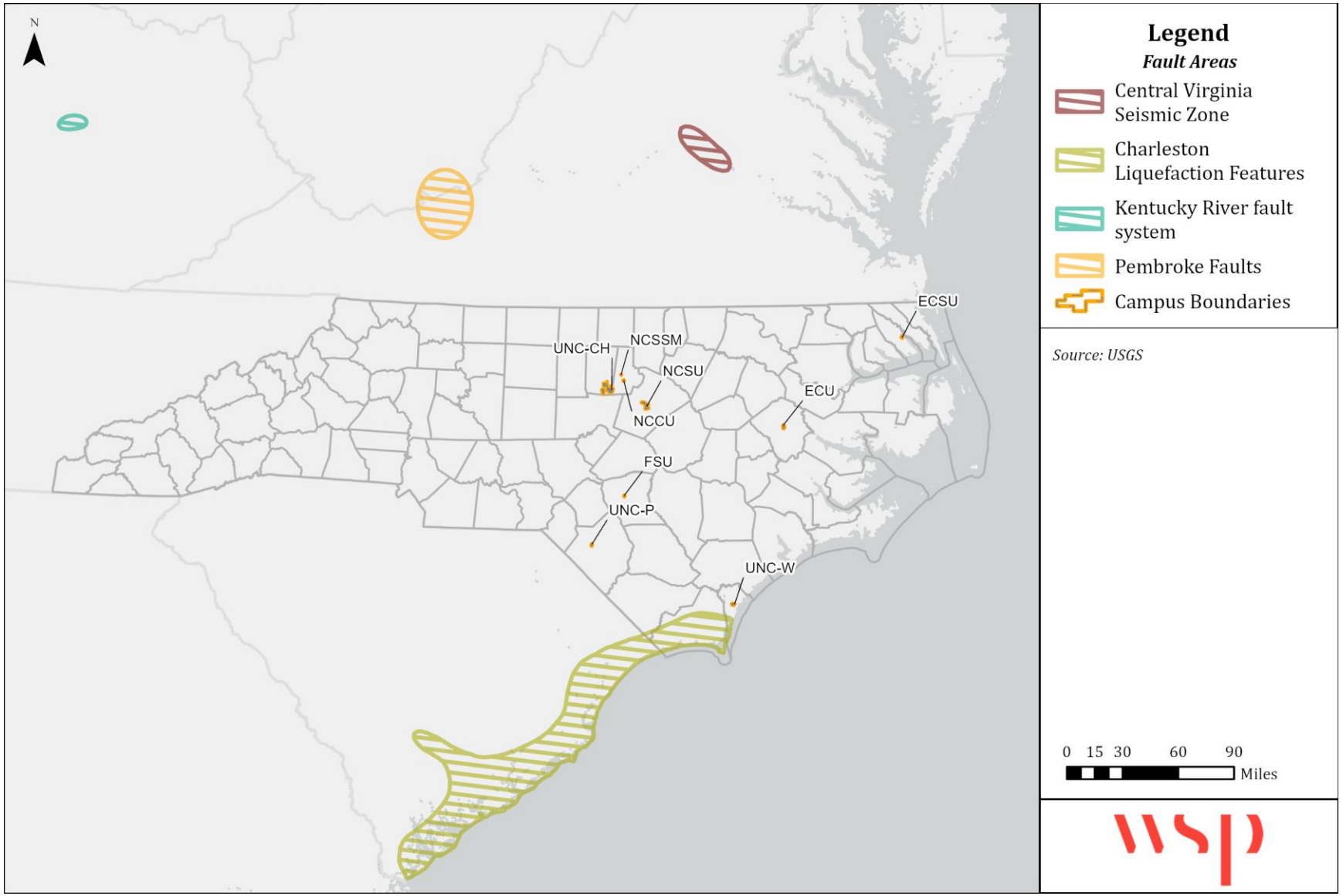
Figure G.17 reflects the quaternary faults that present an earthquake hazard for the UNC-CH planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. No active faults were noted in Orange County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Orange County is likely to be felt across most if not all of the planning area.

*Spatial Extent: 4 – Large*

**Figure G.17 – U.S. Quaternary Faults**



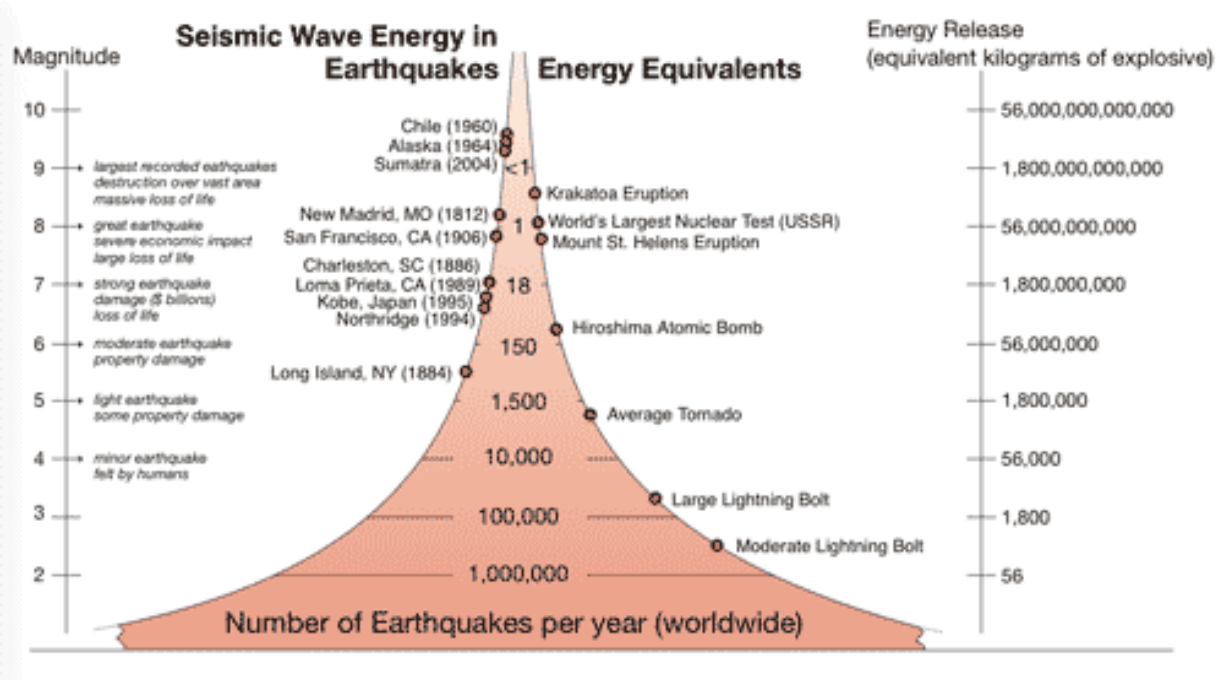
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure G.18.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table G.21 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure G.18 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table G.21 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |

| MMI | Shaking | Description/Damage |
|---|---|---|
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater from 1900 to 2024. Earthquake events that occurred within 100 miles of the UNC-CH campus are presented in Table G.22, and Figure G.19 shows the epicenter of these events.

### Table G.22 – Historical Earthquakes within 100 Miles of UNC-CH, 1900-2024

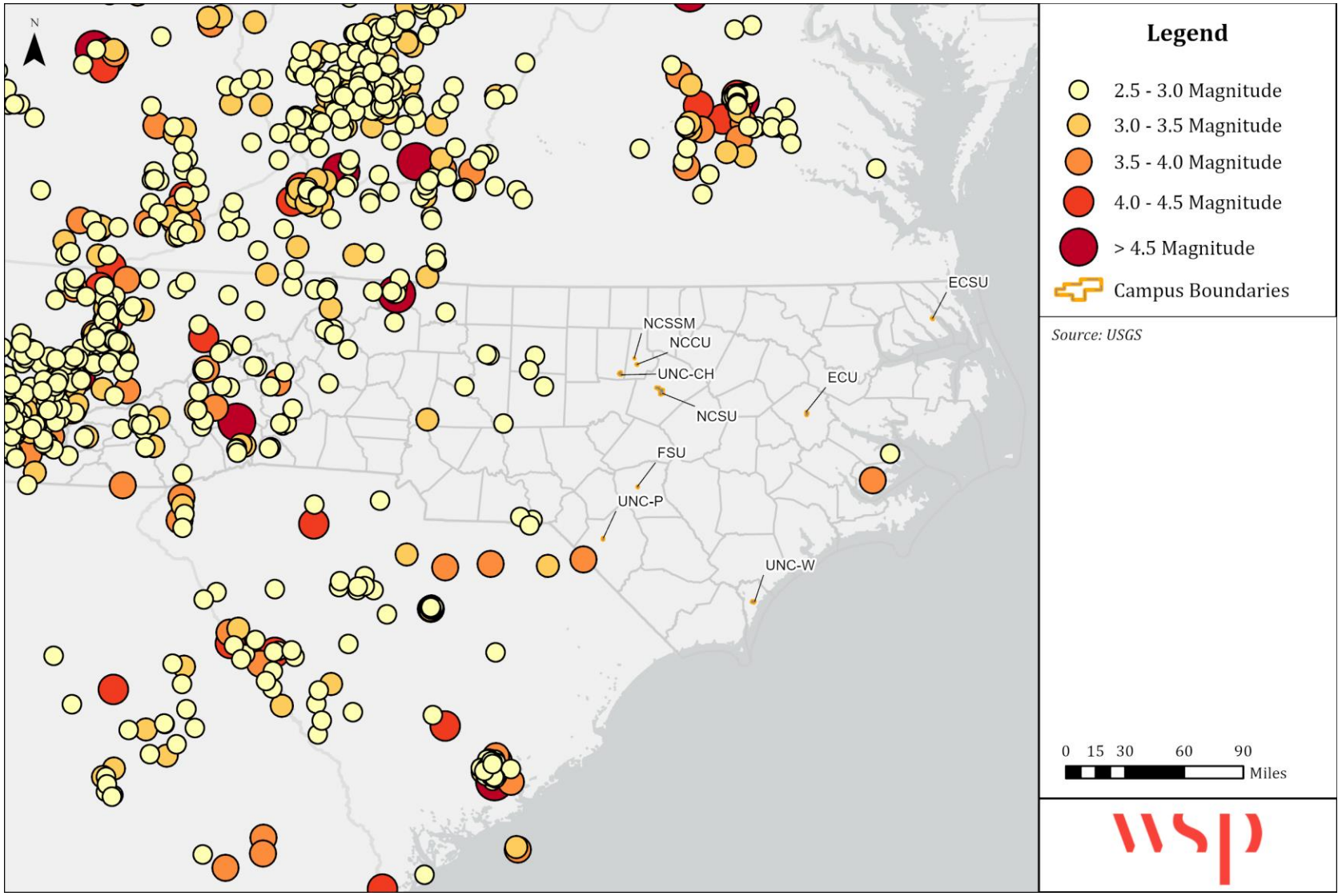
| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 9/13/1976 | 3.3 | 10 km NNE of Lowgap, North Carolina |
| 3/17/1978 | 2.8 | 1 km N of Hillsville, Virginia |
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 4/22/1980 | 2.8 | 9 km SE of Dobson, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 6/10/1985 | 3.2 | 4 km N of Prices Fork, Virginia |
| 3/26/1986 | 2.9 | 3 km N of Prices Fork, Virginia |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 6/4/1989 | 2.8 | 9 km WNW of Burkeville, Virginia |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 6/5/1998 | 3.2 | 4 km SSE of Mooresville, North Carolina |
| 10/21/1998 | 3.8 | 13 km S of Dillwyn, Virginia |
| 8/18/2000 | 2.7 | 2 km SSE of Narrows, Virginia |
| 9/3/2001 | 2.5 | Virginia |
| 9/22/2006 | 3.4 | 4 km WSW of Blenheim, South Carolina |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |
| 11/3/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 5/16/2009 | 3 | 2 km NNE of Cave Spring, Virginia |
| 11/25/2009 | 2.7 | 14 km S of Arrington, Virginia |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |
| 5/22/2014 | 3.1 | 15 km ENE of Cumberland, Virginia |
| 11/4/2015 | 2.67 | 3 km NE of Dillwyn, Virginia |
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |
| 9/27/2021 | 2.56 | 4 km N of Lafayette, Virginia |
| 7/6/2023 | 2.71 | 5 km S of Hillsville, Virginia |
| 7/8/2023 | 2.57 | Virginia-North Carolina border region |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there were two earthquakes felt in and around Chapel Hill: on September 1, 1886 with an epicenter approximately 345 miles from Chapel Hill; and on March 3, 1925 a 7 magnitude with an epicenter approximately over 1500 miles from Chapel Hill.

**Figure G.19 – Historical Earthquakes by Magnitude, 1900-2024**




Source: USGS

## Probability of Future Occurrence

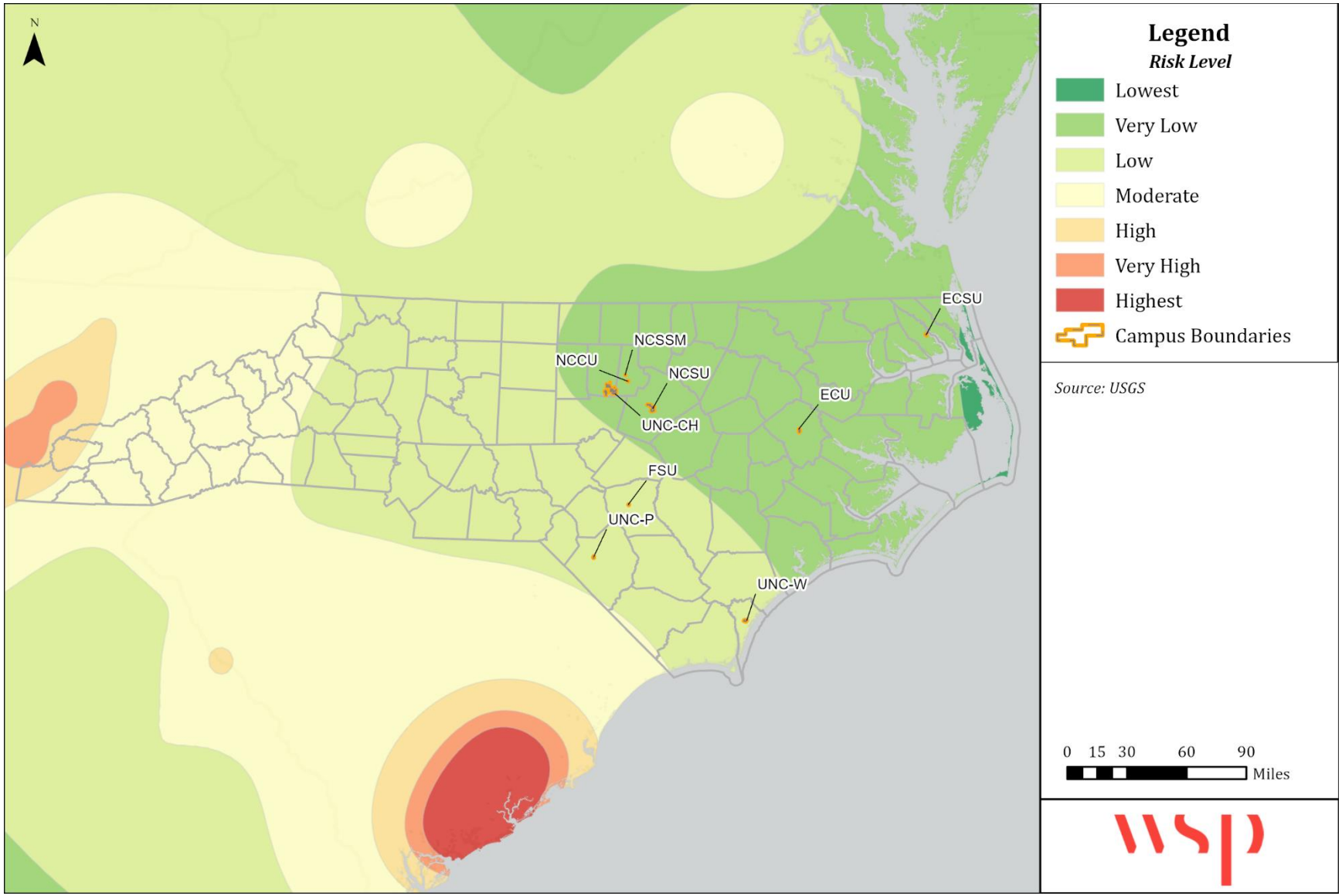
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure G.20 on the following page reflects the seismic hazard for Orange County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Orange County is located within the dark green zone which represents "very low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting UNC-CH is unlikely.

*Probability: 1 – Unlikely*

**Figure G.20 – Seismic Hazard Information for Orange County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on UNC-CH's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damage to infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause over $2.2 million of estimated total damage across all UNC-CH campuses.

Orange County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. Table G.23 through Table G.26 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table G.23 – Estimated Building Damage by Earthquake Event, UNC-CH Central Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $42,453.13 | $13,582.52 | $56,035.65 |
| Educational | $47,219.89 | $72,242.56 | $119,462.45 |
| Housing | $8,818.75 | $13,791.07 | $22,609.82 |
| **Total** | **$98,491.77** | **$99,616.15** | **$198,107.92** |
| **500-Year Earthquake Event** | | | |
| Administration | $250,402.12 | $113,973.75 | $364,375.87 |
| Educational | $462,107.18 | $874,292.65 | $1,336,399.83 |
| Housing | $103,569.46 | $154,708.87 | $258,278.33 |
| **Total** | **$816,078.76** | **$1,142,975.27** | **$1,959,054.03** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $897,223.50 | $330,697.46 | $1,227,920.96 |
| Educational | $1,961,030.76 | $3,139,983.71 | $5,101,014.47 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Housing | $454,358.64 | $527,130.00 | $981,488.64 |
| **Total** | **$3,312,612.90** | **$3,997,811.17** | **$7,310,424.07** |

Source: NCEM iRISK Database

### Table G.24 – Estimated Building Damage by Earthquake Event, UNC-CH North Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $2,977.26 | $4,137.76 | $7,115.02 |
| Educational | $1,323.86 | $1,919.02 | $3,242.88 |
| **Total** | **$4,301.12** | **$6,056.78** | **$10,357.90** |
| **500-Year Earthquake Event** | | | |
| Administration | $27,520.64 | $54,854.54 | $82,375.18 |
| Educational | $17,019.05 | $33,622.01 | $50,641.06 |
| **Total** | **$44,539.69** | **$88,476.55** | **$133,016.24** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $102,065.15 | $182,564.39 | $284,629.54 |
| Educational | $61,547.10 | $116,264.20 | $177,811.30 |
| **Total** | **$163,612.25** | **$298,828.59** | **$462,440.84** |

Source: NCEM iRISK Database

### Table G.25 – Estimated Building Damage by Earthquake Event, UNC-CH South Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $943.12 | $1,397.09 | $2,340.21 |
| Educational | $3,940.36 | $3,917.13 | $7,857.49 |
| Housing | $192.36 | $195.24 | $387.60 |
| **Total** | **$5,075.84** | **$5,509.46** | **$10,585.30** |
| **500-Year Earthquake Event** | | | |
| Administration | $8,530.10 | $11,636.20 | $20,166.30 |
| Educational | $41,662.27 | $44,793.58 | $86,455.85 |
| Housing | $2,278.10 | $2,102.30 | $4,380.40 |
| **Total** | **$52,470.47** | **$58,532.08** | **$111,002.55** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $37,386.71 | $39,194.21 | $76,580.92 |
| Educational | $177,988.93 | $149,257.41 | $327,246.34 |
| Housing | $10,109.39 | $7,334.92 | $17,444.31 |
| **Total** | **$225,485.03** | **$195,786.54** | **$421,271.57** |

Source: NCEM iRISK Database

**Table G.26 – Estimated Building Damage by Earthquake Event, UNC-CH West Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $2,840.00 | $0.00 | $2,840.00 |
| Educational | $387.84 | $138.83 | $526.67 |
| Housing | $17.36 | $8.99 | $26.35 |
| **Total** | **$3,245.20** | **$147.82** | **$3,393.02** |
| **500-Year Earthquake Event** | | | |
| Administration | $25,360.00 | $0.00 | $25,360.00 |
| Educational | $5,526.86 | $1,987.58 | $7,514.44 |
| Housing | $201.49 | $117.00 | $318.49 |
| **Total** | **$31,088.35** | **$2,104.58** | **$33,192.93** |
| **1,000-Year Earthquake Event** | | | |
| Administration | $119,840.00 | $0.00 | $119,840.00 |
| Educational | $27,844.08 | $5,506.17 | $33,350.25 |
| Housing | $577.29 | $328.09 | $905.38 |
| **Total** | **$148,261.37** | **$5,834.26** | **$154,095.63** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Orange County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the UNC-CH campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at UNC-CH have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statements

- While earthquakes are an unlikely hazard event for the UNC-CH campus, an estimate of over $2.2 million of total damage across all UNC-CH campuses could occur in the case of a 500-year earthquake event.

## G.5.4 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of extreme heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The NWS Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

The extent of extreme heat can be defined by the maximum temperature reached and is based on the heat index. Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures at or above 100°F. Table G.27 provides counts of heat index values by threshold recorded from 2009-2024 at the North Durham Water Reclamation Facility in Durham County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F.

Chapel Hill sits in both Durham and Orange counties. Data for Durham County was used as an indicator for UNC-CH because the North Durham Reclamation Facility contained a more consistent period of record compared to weather stations in Chapel Hill and Orange County.

*Impact: 2 – Limited*

**Table G.27 – Historic Heat Index, North Durham Reclamation Facility, Durham County, NC, 2009-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2009 | 8 | 0 | 0 | 0 | 8 |
| 2010 | 98 | 24 | 0 | 0 | 122 |
| 2011 | 70 | 16 | 0 | 0 | 86 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2012 | 58 | 22 | 1 | 0 | 81 |
| 2013 | 59 | 17 | 0 | 0 | 76 |
| 2014 | 14 | 0 | 0 | 0 | 14 |
| 2015 | 26 | 1 | 0 | 0 | 27 |
| 2016 | 76 | 6 | 0 | 0 | 82 |
| 2017 | 36 | 0 | 0 | 0 | 36 |
| 2018 | 44 | 2 | 0 | 0 | 46 |
| 2019 | 119 | 13 | 0 | 0 | 132 |
| 2020 | 74 | 16 | 0 | 0 | 90 |
| 2021 | 60 | 16 | 0 | 0 | 76 |
| 2022 | 83 | 15 | 0 | 0 | 98 |
| 2023 | 69 | 17 | 0 | 0 | 86 |
| 2024 | 77 | 30 | 7 | 61 | 175 |
| **Sum** | **971** | **195** | **8** | **61** | **1,235** |
| **Average** | **61** | **12** | **1** | **4** | **77** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

NCEI records did not include a heat-related incident for Durham and Orange counties between 2000 and 2024. The most recent heat-related incident on record occurred in 1998 and is summarized below. It should be noted that extreme heat did occur in Durham and Orange counties during this period, as indicated in Table G.27, but incidents were not captured by NCEI.

- **July 22, 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.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the North Durham Water Reclamation Facility in Durham County, NC. Based on 16 years of data (2009-2024), Durham station averaged 19 days per year with a heat index of 100 degrees or higher.

*Probability: 4 – Highly Likely*

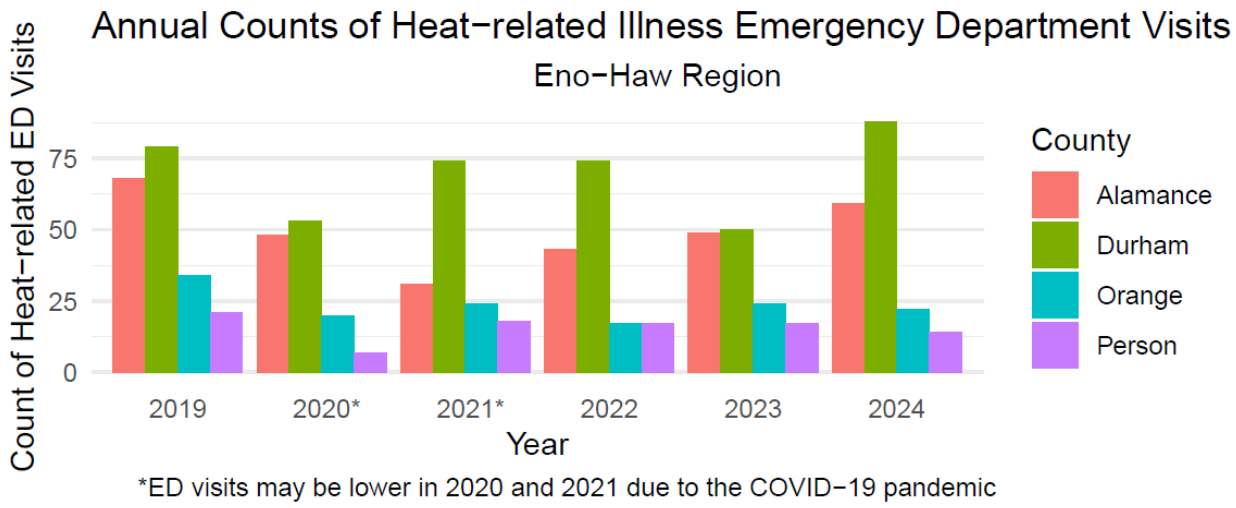
## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

Emergency department visits for heat related illnesses notably increase when heat index temperatures exceed 100°F. Using public health syndromic surveillance system data from NC DETECT, Figure G.21 from the Eno-Haw Regional Hazard Mitigation Plan shows the annual count of emergency department visits for heat-related illness in Orange County and Durham County. Counts of emergency department visits for heat-related illness in Orange County ranged from 14 in 2023 to 34 in 2019. Durham County experienced much higher rates of heat-related illness, ranging from 50 in 2023 to 88 in 2024.

**Figure G.21 – Annual Heat-Related Illness Emergency Department Visits in Eno-Haw Region**




Source: North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT)

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made

with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized “heat islands.” Information is not available on the extent to which impervious surface coverage has changed since the adoption of the previous hazard mitigation plan, but it is possible that as greenfield development has occurred, this process has and may continue to exacerbate heat hazards in some areas of the county.

### Problem Statements

- UNC-CH is located in Durham and Orange counties currently averages 61 hours per year with heat at or above 100°F and there is a 100% annual chance of heat index values of 100°F or higher in any given year.

# G.5.5 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Limited | Moderate | 6 to 12 hrs | Less than 1 week | 3.0 |

## Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the UNC-CH campus using the FIRM dated October 19, 2018. Figure G.22 through Figure G.26 reflect the 2018 mapped flood insurance zones. Table G.28 summarizes some of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table G.28 intersect the UNC-CH campus.

The primary sources of flooding on the north campus include Jolly Branch and Crow Branch, and the primary sources on the west campus include Neville Creek, East Branch Price Creek, Pritchard Mill Creek, and Morgan Creek. The primary sources of flooding on the east, central, and south campuses include Bolin Creek, Booker Creek, Chapel Creek, Meeting of the Waters, Morgan Creek, and Wilson Creek.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the Town of Chapel Hill and the UNC-CH campus. Flood risk is not limited to the 1%-annual-chance floodplain. Although no detailed studies were completed by FEMA for several smaller tributaries that run through campus, it should be noted that these waterways could be a source of flooding.

*Spatial Extent: 1 – Moderate*

**Table G.28 – Mapped Flood Insurance Zones**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with |

| Zone | Description |
|---|---|
| | possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure G.22 – FEMA Flood Hazard Areas in UNC-CH, Central Campus**

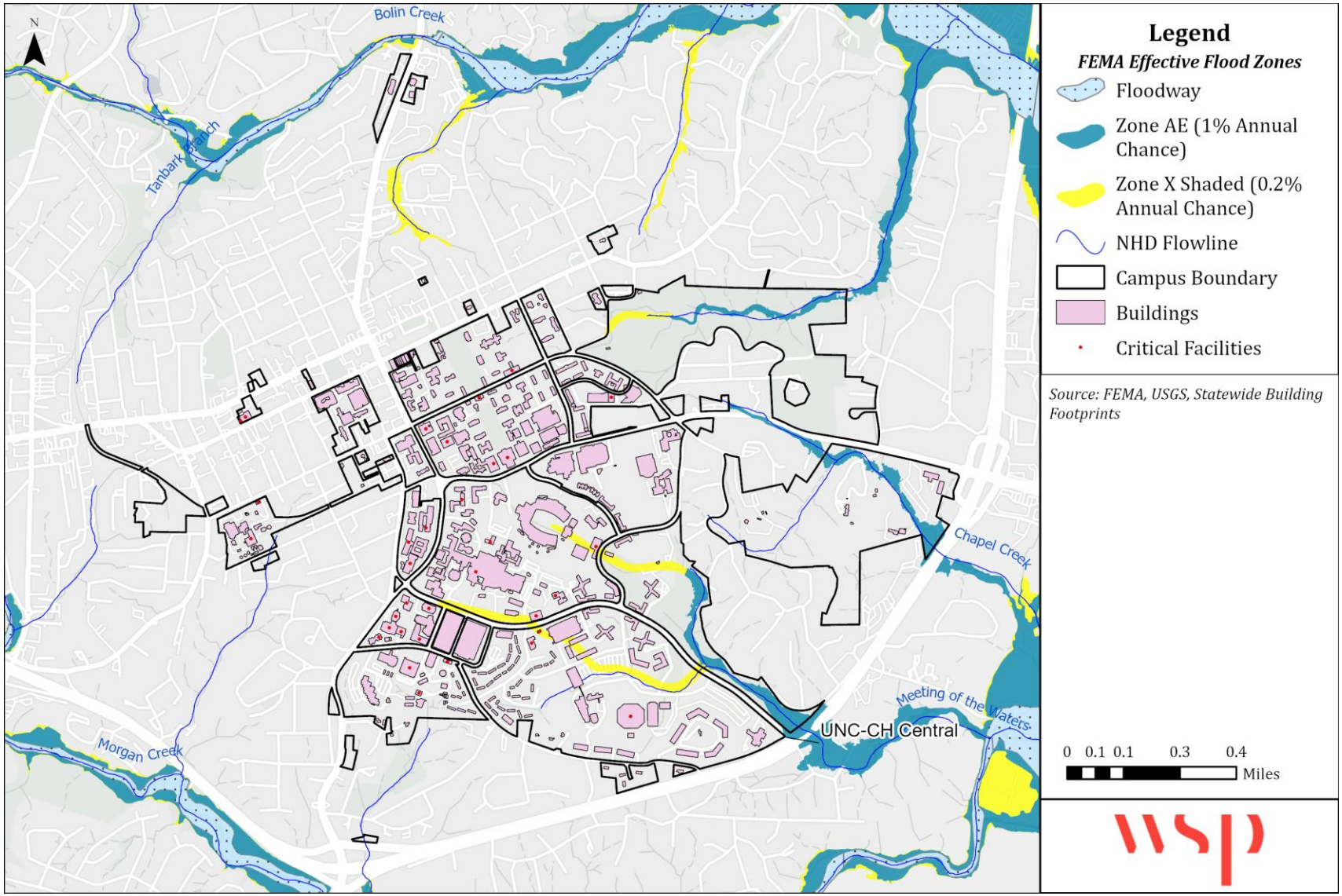


**Figure G.23 – FEMA Flood Hazard Areas in UNC-CH, East Campus**

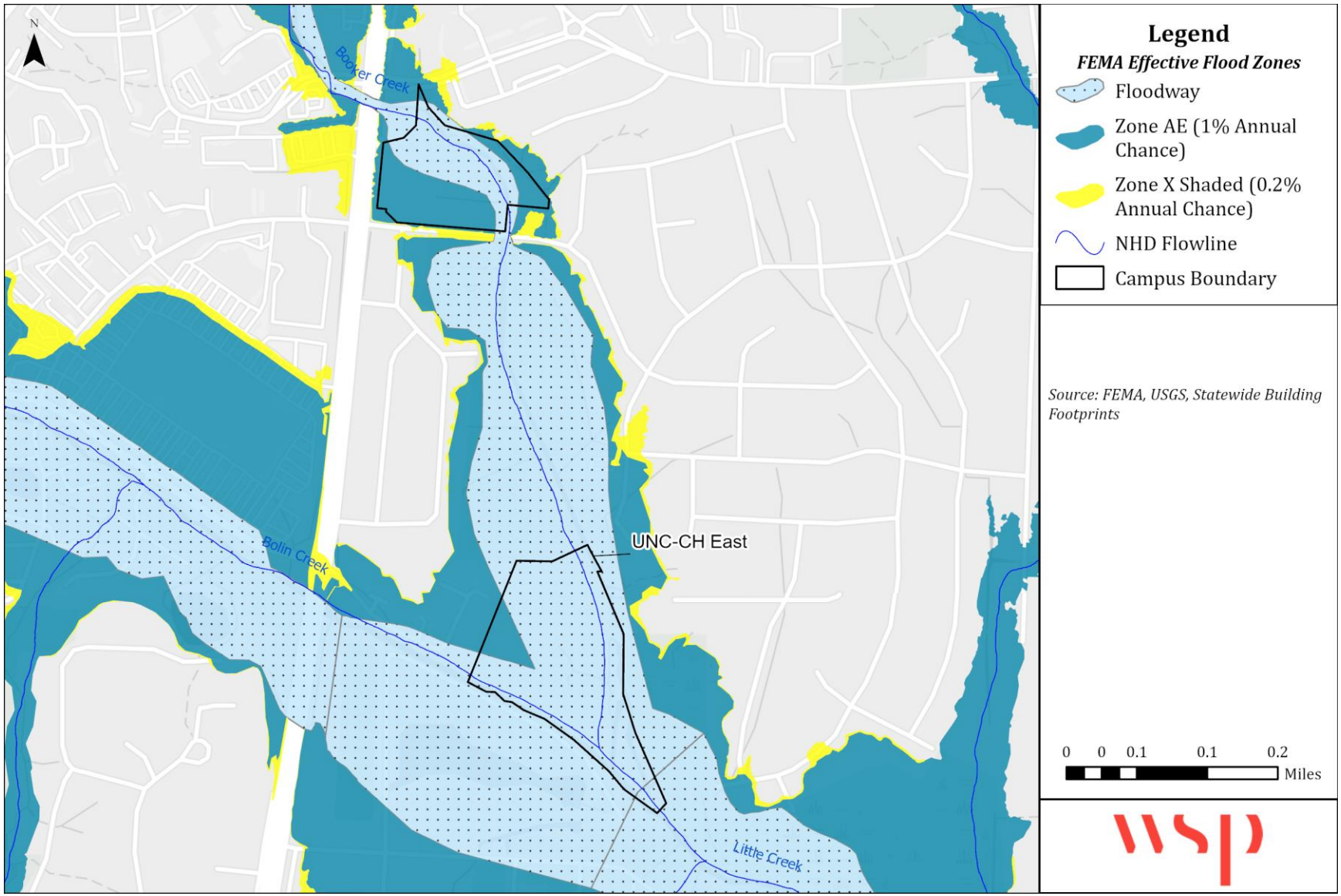


**Figure G.24 – FEMA Flood Hazard Areas in UNC-CH, North Campus**

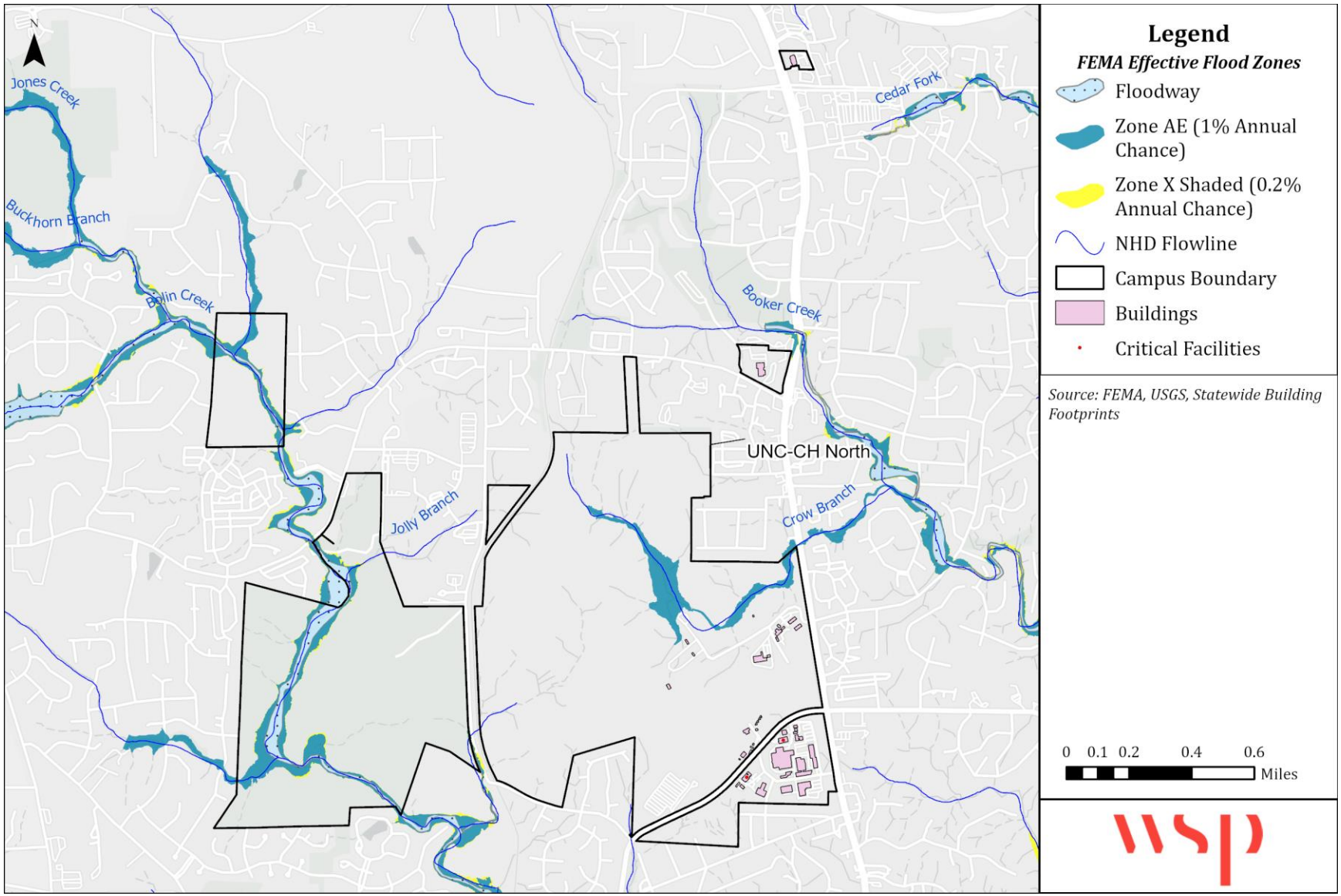


**Figure G.25 – FEMA Flood Hazard Areas in UNC-CH, South Campus**

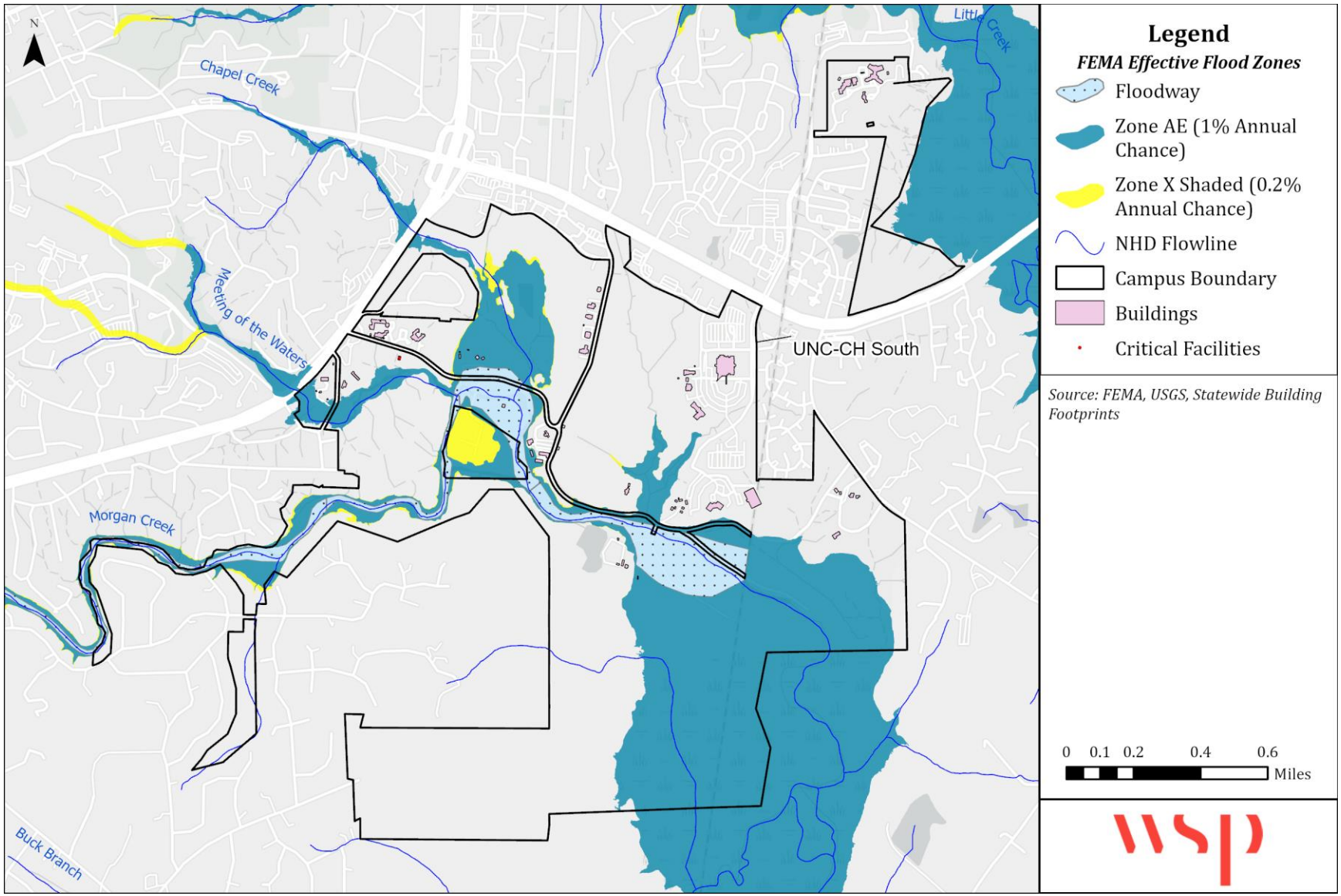
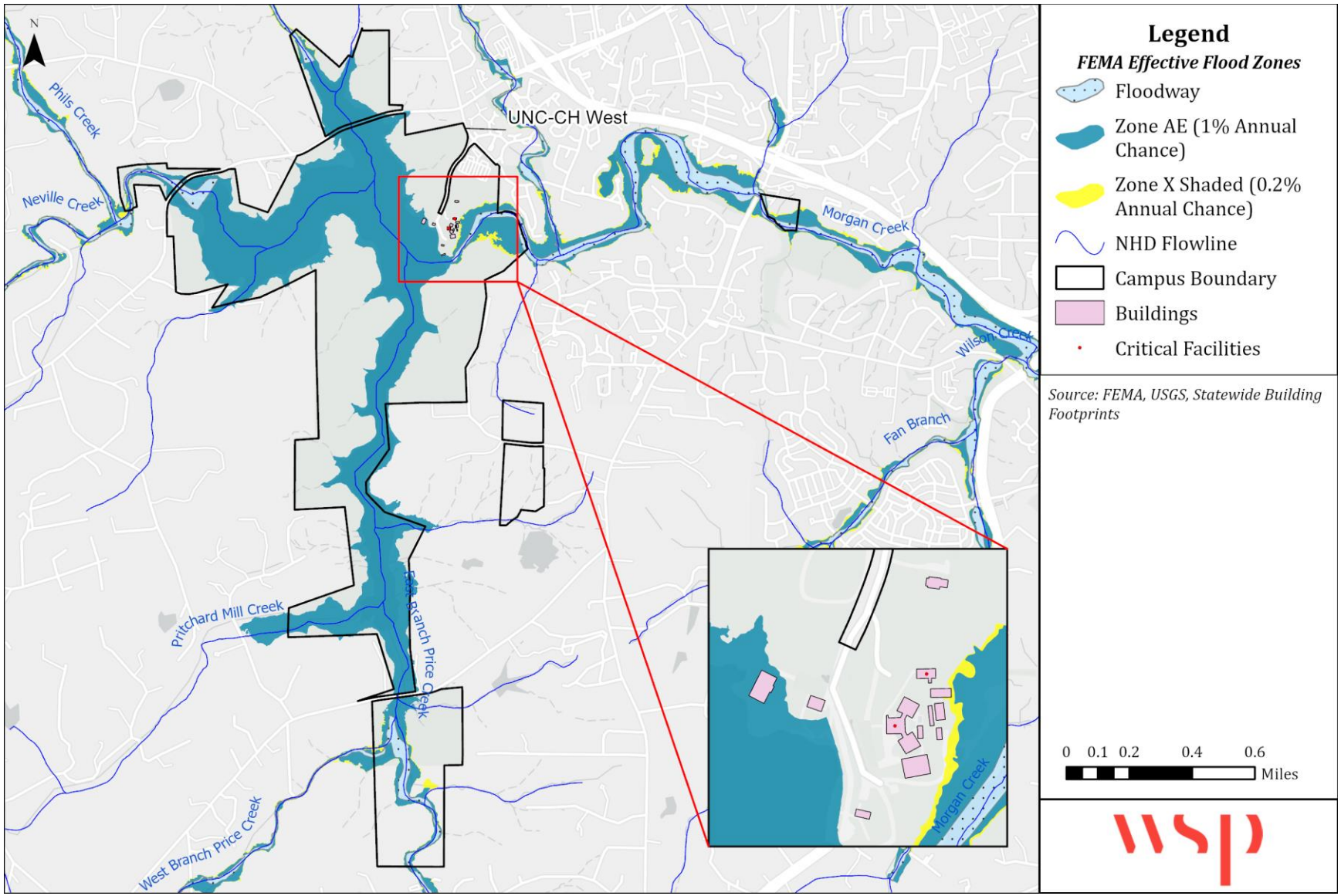


**Figure G.26 – FEMA Flood Hazard Areas in UNC-CH, West Campus**



This assessment focuses on riverine flooding; however, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. UNC-CH has a stormwater engineering team that manages stormwater drainage issues on campus. The buildings and storm structures listed in Table G.29 and Table G.30 were identified by UNC-CH's stormwater engineers as flooding problem areas on campus. These locations flooded during two primary events that affected campus, a 2013 storm, Tropical Storm Debby in 2024, and Tropical Storm Chantal in 2025.

**Table G.29 – Flood Prone Buildings, UNC-CH**

| Building | Location | Issue |
|---|---|---|
| Morehead Chemistry | West side | Insufficient drainage & undersized pipes |
| Valet Lot | | Drains clog easily |
| Skipper Bowles Lot | | Suspect not enough drain inlets |
| Ackland Art | North side exterior stairwell pit | Insufficient drainage |
| Carroll Hall | Northwest corner exterior stairwell pit and window wells | Insufficient drainage |
| Kennan Labs | West side 'A' tower ground floor exterior entrance. | Insufficient drainage & undersized pipes |
| Manning Hall | | Insufficient drainage |
| McIver | West side exterior stairwell pit | Insufficient drainage |
| Med D | North and South end | Insufficient drainage |
| Kennan Stadium | West end | Insufficient drainage |
| Murry Hall | Northeast entrance | Insufficient drainage |
| Murry Hall | West side exterior entrance at loading dock | Insufficient drainage |
| Student Rec (SRC) | Northwest entrance | Insufficient drainage |
| Saunders Hall | South side exterior stairwell pit | Insufficient drainage |
| Taylor Student Health | West side exterior stairwell pit | Insufficient drainage |
| Venable | Northeast entrance | Insufficient drainage |
| Memorial Hall | Southwest entrance | Undersized piping |
| FOBRL | east side | Grading |
| Ronald McDonald House | North side | Undersized piping |
| Ronald McDonald House | Garage | Undersized piping |
| Student Recreation Center | North side | Trench Drains clog easily |
| FOBRRL | Creekside | Risk from stream flooding |
| Frank Porter Graham Child Development Center | Creekside | Risk from stream flooding |
| Carroll Hall | North side/Main entrance | Insufficient drainage |

**Table G.30 – Flood Prone Storm Structures, UNC-CH**

| ID Number | General Location | Location Description | Problem Description |
|---|---|---|---|
| 141-D-005 | General Storeroom | Next to diesel tank | Pine needles block drain |
| 141-A-003 | General Storeroom | Along fence between EHS and Facilities Warehouse | Pine needles block drain |
| 311-B-215 | South Road and Columbia St. Intersection | Along fence at EHS | Pine needles block drain |
| 311-B-443 | Kennan Science Complex Loading Dock | Middle of loading dock | Debris filling and blocking drain |
| 311-B-127 | Kennan Labs | South Road on Kennan side at crosswalk to Coker near pedestrian triangle | Debris blocking grate |
| 311-B-126 | South Road and Bell Tower Dr. intersection | South Road and Bell Tower Dr. intersection | Debris blocking grate |
| 221-C-158 | Rams Head | Trench drain at Ridge Road entrance to Rams Head Tunnel | Debris filling and blocking drain |
| 221-C-164 | Ridge Road at Rams head | Crosswalk on Ridge Road at Rams Head | Basket fills with debris |
| 211-D-286 | South Building Parking Lot | South Building Parking Lot in corner | Debris covering drain |
| 211-D-123 | South Building Parking Lot | South Building bottom rear entrance | Small drain covered easily by leaves |
| 221-C-104 | SASB | SASB Courtyard | Debris |
| 211-C-099 | Fetzer Gym | Trench drain subject to clogging | Debris |

UNC-CH also has a 2011 Stormwater Master Plan, which includes an inventory of the stormwater system and modeling and surface flow analysis of problem areas in order to develop a Capital Improvement Plan (CIP) to address stormwater system infrastructure needs. CIP projects are intended to achieve both flood reduction and water quality goals.

## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

Approximately 22 percent of the combined UNC-CH campuses falls within the SFHA. Table G.31 provides a summary of the UNC-CH Campus' total area by flood zone on the 2018 effective DFIRM. Figure G.27 through Figure G.31 shows the depth of flooding predicted from a 1% annual chance flood. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

*Impact: 2 – Limited*

### Table G.31 – Flood Zone Acreage on UNC-CH Campus

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| **North Campus** | | |
| AE | 72.6 | 6.5% |
| Floodway* | 19.3 | 2% |
| 0.2% annual-chance | 3.7 | 0.3% |
| Unshaded X | 1,032.8 | 93.1% |
| **Total** | 1,109.1 | **--** |
| **SFHA Total** | **72.6** | **6.5%** |
| **Central Campus** | | |
| AE | 22.4 | 2.8% |
| Floodway* | 0.0 | 0.0% |
| 0.2% annual-chance | 17.8 | 2.2% |
| Unshaded X | 762.6 | 95.0% |
| **Total** | **802.8** | **--** |
| **SFHA Total** | **22.4** | **2.8%** |
| **East Campus** | | |
| AE | 27.3 | 100.0% |
| Floodway* | 21.0 | 77.7% |
| 0.2% annual-chance | 0.0 | 0.0% |
| Unshaded X | 0.0 | 0.0% |
| **Total** | **27.3** | **--** |
| **SFHA Total** | **27.3** | **100%** |
| **West Campus** | | |
| AE | 315.5 | 44% |
| Floodway* | 21.2 | 0.3% |
| 0.2% annual-chance | 4.8 | 0.7% |
| Unshaded X | 396.9 | 55.3% |
| **Total** | **717.1** | **--** |
| **SFHA Total** | **315.5** | **44%** |
| **South Campus** | | |
| AE | 440.9 | 33.1% |
| Floodway* | 82.0 | 6.0% |
| 0.2% annual-chance | 10.0 | 0.8% |
| Unshaded X | 882.4 | 66.2% |
| **Total** | **1,333.4** | **--** |
| **SFHA Total** | **440.9** | **33.1%** |

Source: FEMA 2018 DFIRM

*Floodway is part of the AE zone. Floodway acreage is accounted for in AE totals.

**Figure G.27 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-CH Central Campus**

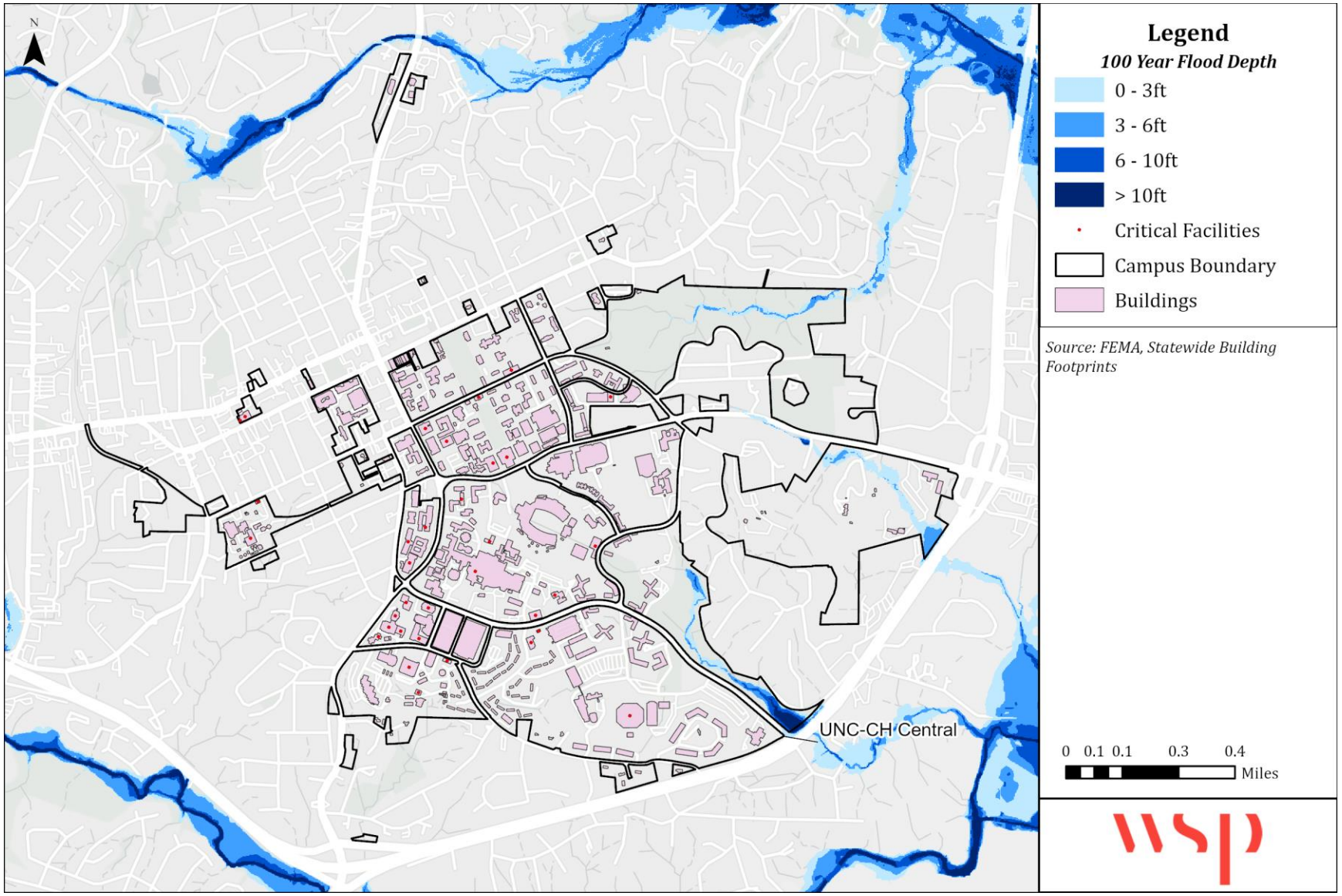


**Figure G.28 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-CH East Campus**

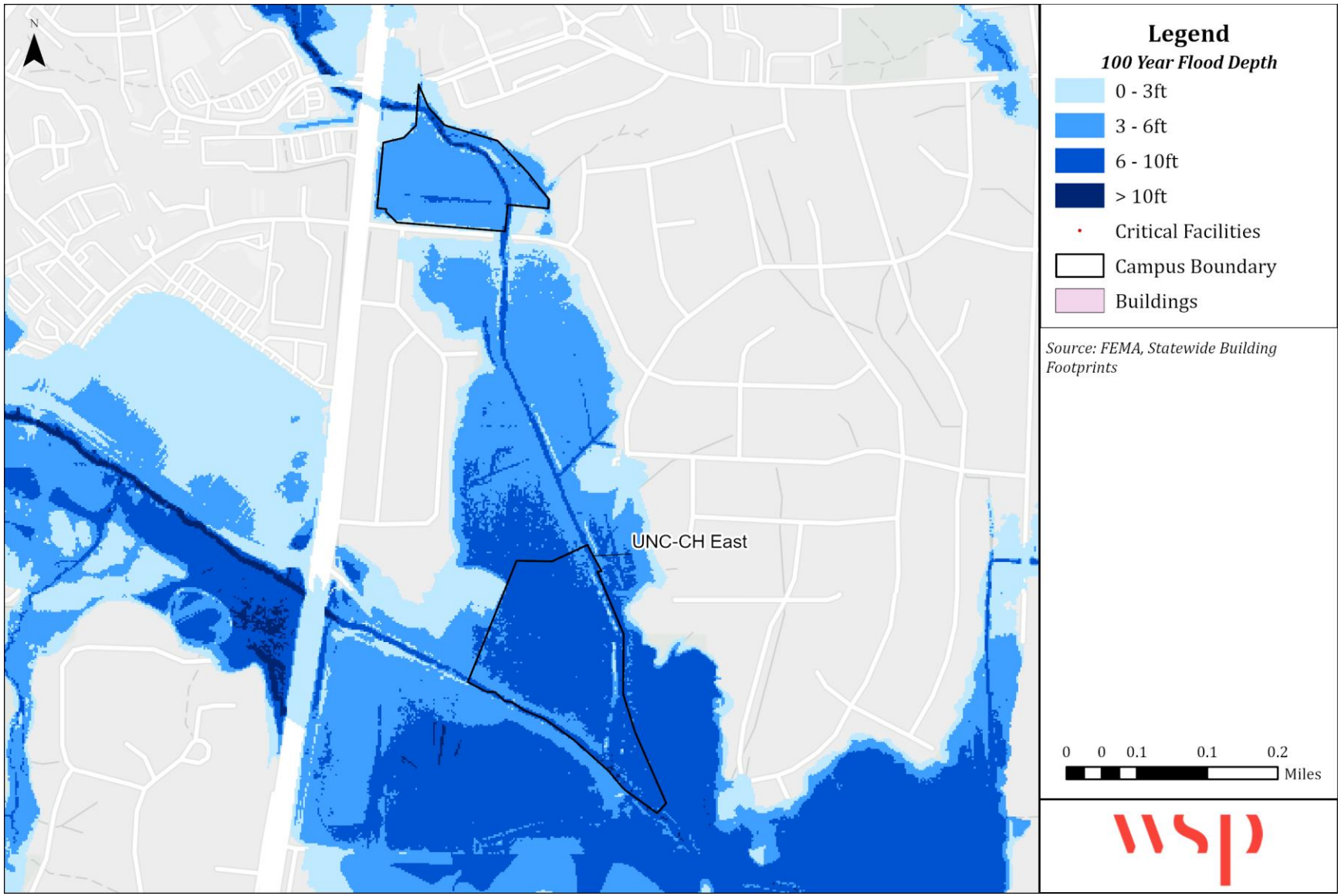


**Figure G.29 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-CH North Campus**

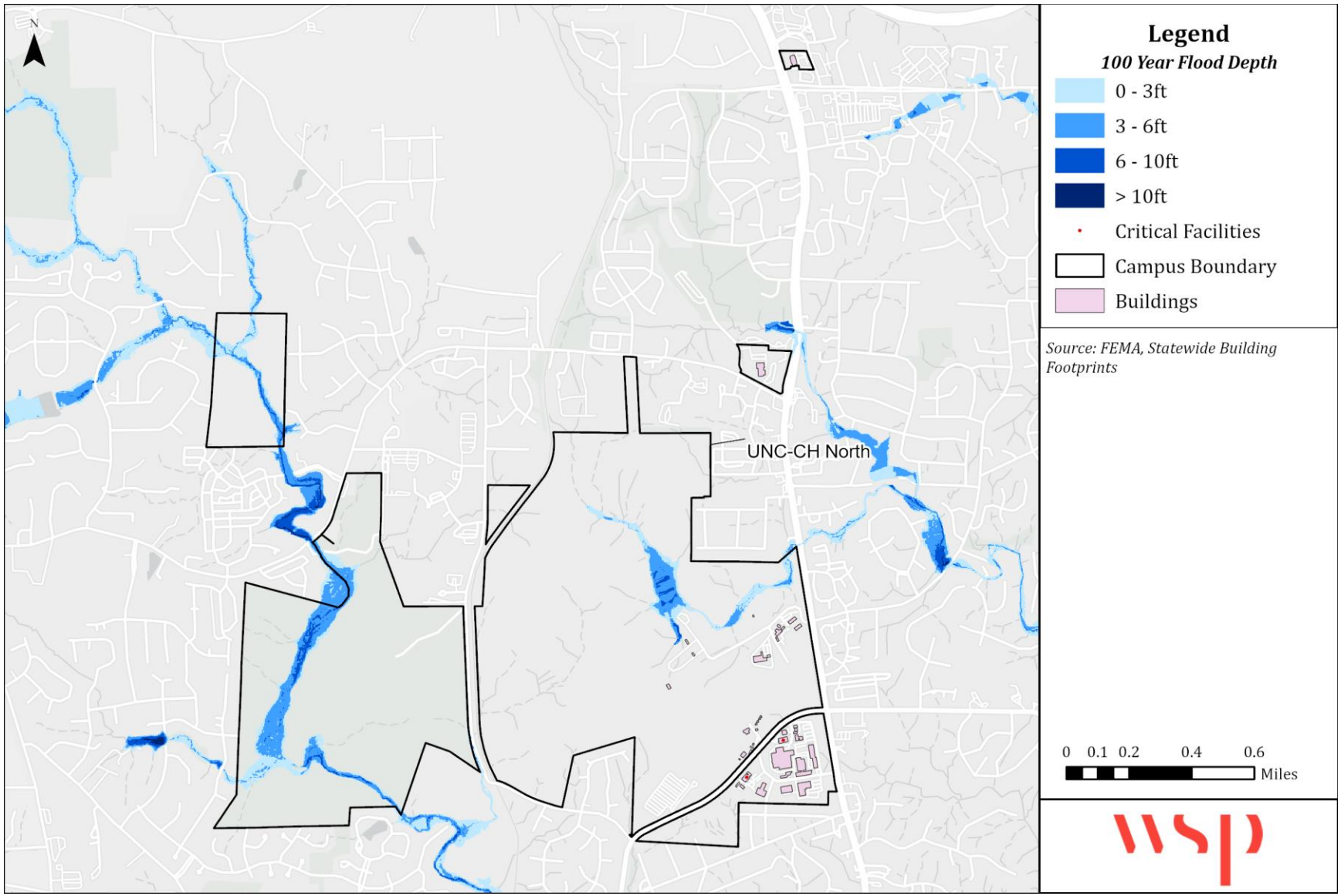


**Figure G.30 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-CH South Campus**

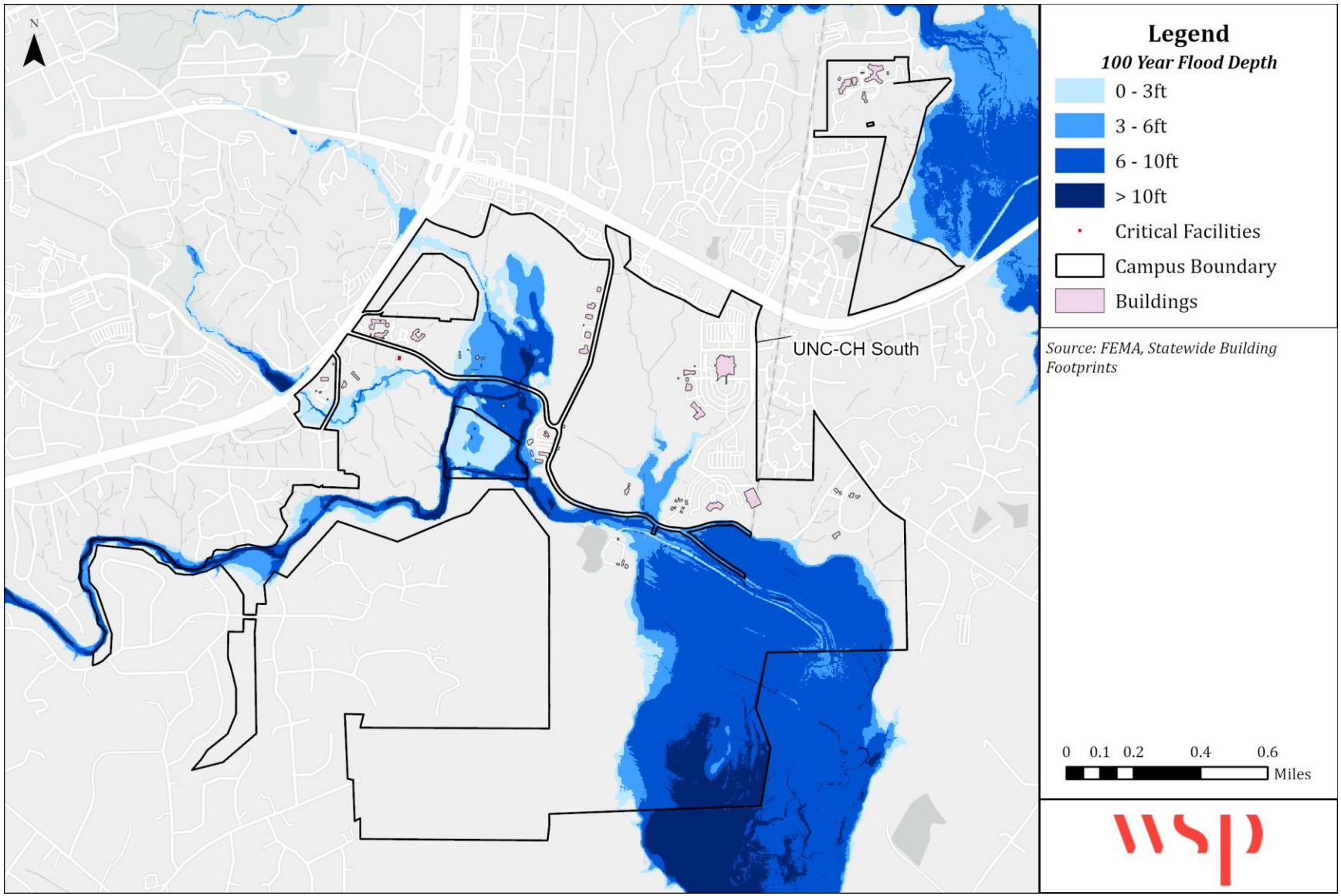
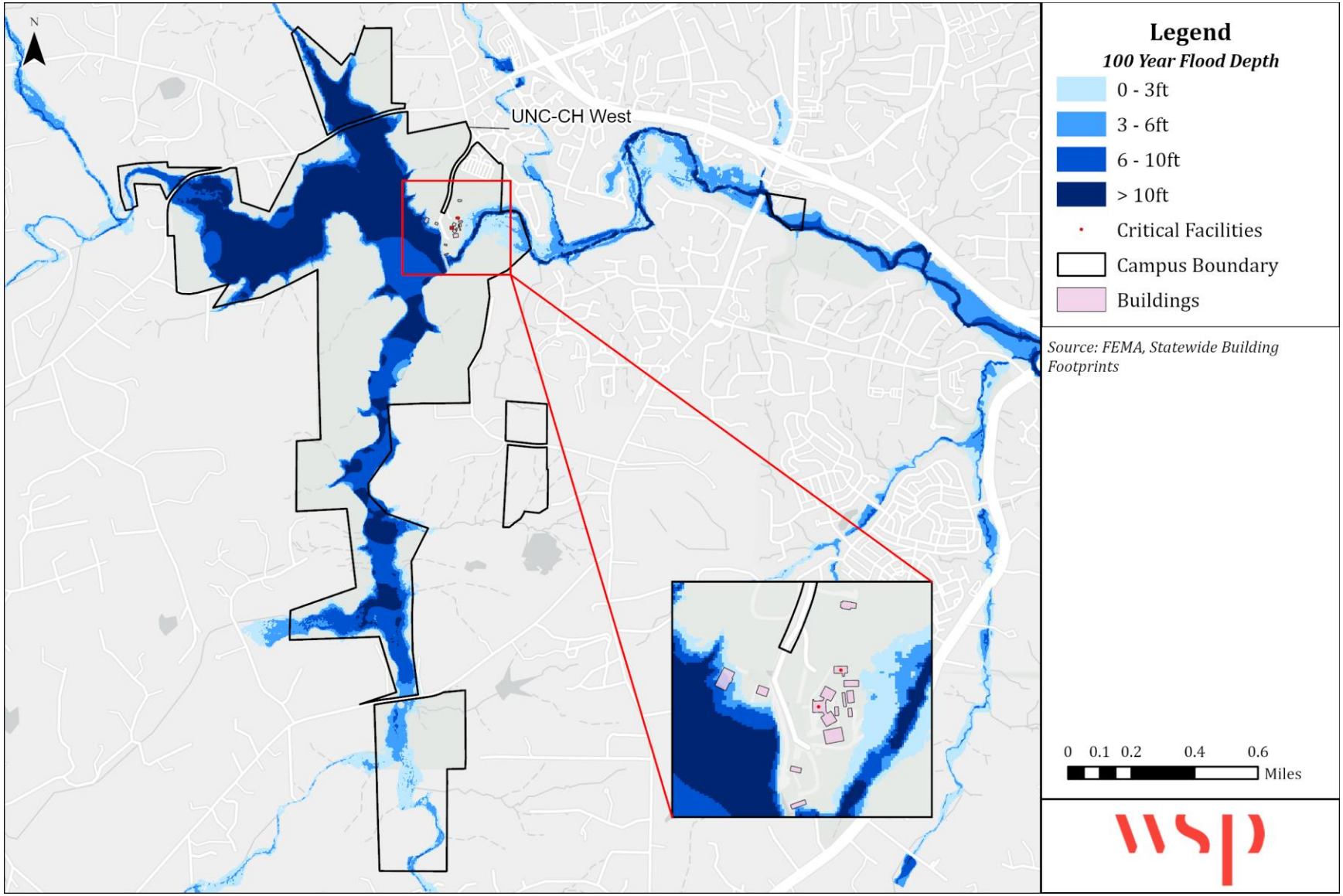


**Figure G.31 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-CH West Campus**



## Historical Occurrences

Table G.32 details the historical occurrences of flooding for Chapel Hill identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 28 recorded flood-related events occurred on 19 separate days in Chapel Hill and Orange County from 2000 to 2024 causing $10,791,500 in property damage, 1 injury, and no fatalities, or crop damage. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table G.32 – NCEI Records of Flooding for the Town of Chapel Hill, 2000-2024**

| Location | Date | Deaths/Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Chapel Hill | 7/23/2000 | 0/0 | $6,400,000 | $0 |
| Chapel Hill | 7/25/2006 | 0/0 | $0 | $0 |
| Chapel Hill | 5/27/2011 | 0/0 | $0 | $0 |
| Chapel Hill | 9/6/2012 | 0/0 | $0 | $0 |
| Chapel Hill | 6/30/2013* | 0/0 | $4,100,000 | $0 |
| Chapel Hill | 5/15/2014 | 0/0 | $0 | $0 |
| Chapel Hill | 12/23/2015 | 0/0 | $0 | $0 |
| Chapel Hill | 12/30/2015 | 0/0 | $5,000 | $0 |
| Etland | 10/8/2016 | 0/0 | $250,000 | $0 |
| Carr | 9/16/2018 | 0/0 | $0 | $0 |
| Carrboro | 11/12/2018 | 0/0 | $10,000 | $0 |
| Chapel Hill | 1/3/2022* | 0/0 | $0 | $0 |
| Chapel Hill | 7/9/2022 | 0/1 | $1,500 | $0 |
| Chapel Hill | 7/13/2022* | 0/0 | $0 | $0 |
| Chapel Hill | 6/23/2023* | 0/0 | $0 | $0 |
| Chapel Hill | 1/9/2024 | 0/0 | $5,000 | $0 |
| Chapel Hill | 7/12/2024 | 0/0 | $15,000 | $0 |
| Chapel Hill | 8/8/2024 | 0/0 | $5,000 | $0 |
| **Flood** | | | | |
| Chapel Hill | 4/7/2023* | 0/0 | $0 | $0 |
| **Total** | | **0/1** | **$10,791,500** | **$0** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events in Orange County:

- **July 23, 2000** – Flooding of streets and buildings was reported countywide, especially in Chapel Hill and Carrboro. The Eastgate Shopping center was damaged, as well as several apartments and homes. A bridge was washed out on Piney Mountain Rd.

- **July 25, 2006** – Ten residents were forced to be temporarily evacuated from a Carrboro mobile home park. Several streets in downtown Chapel Hill were flooded with water rising to the top of the cars window.
- **September 6, 2012** – An upper level disturbance and low level trough combined with a very moist air mass to produce scattered thunderstorms which resulted in 2 to 3 inches of rainfall and minor flash flooding. Several road closures were reported, including Piney Mountain Road, MLK Jr. Boulevard, Carol Street, Hollow Street, Hillsborough Street, and Umstead Drive and Bradley Road.
- **June 30, 2013** – Two rounds of heavy rain (4-5 inches) resulted in already saturated sails resulted in flash flooding. Chapel Hill and Carrboro experienced the most significant flooding, with substantial property damage occurring. The first floor of the Town Hall flooded. Franklin Street saw widespread flooding, with water above the windows of cars in several locations (Estes Drive). Some businesses were also impacted. In addition, high water began to encroach on the Camelot Village apartments that are located on Estes Street. Several buildings at the University of North Carolina had water in them, including the bottom floor of Granville Tower. East Gate Shopping Center experienced flooding with water in several businesses and stranded many cars in the parking lot. One hard hit residential area was along Estes Drive near Highway 15-501, where the Camelot Village Condominiums experienced extensive flooding - 76 out of 116 units flooded. Airport Gardens Public Housing Neighborhood was flooded– 18 out of the 26 units flooded. Several areas of Carrboro experienced flooding, including the Rocky Brook Mobile Home Park on Greensboro Street, where residents had to be evacuated due to high water – 20 out of 31 homes were eventually condemned. Due to the flooding, the county qualified for state and federal aid.
- **October 8, 2016** – Heavy rainfall of 4 to 5 inches caused widespread flash flooding across the county, with numerous road closures. Flooding damaged the first floor of 5 buildings in Chapel Hill.
- **November 12, 2018** – Heavy rain resulted in flash flooding throughout the city of Chapel Hill. Multiple roads were flooded, including Umstead Road, Estes Drive, Cleland Road and Old Mason Farm Road.
- **January 3, 2022** – Flash flooding was reported along Umstead Drive in between Pritchard Ave and Martin Luther King Junior Blvd, Oakwood Dr, Cleland Dr, and Old Mason Farm Rd.
- **July 13, 2022** – Storms over Orange and Durham Counties produced flash flooding around Chapel Hill and Durham. Flash flooding was reported along Fordham Blvd between south Estes Dr and Ephesus Church Rd, West Franklin St between Kenan St and Mallette St, and near the intersection of Martin Luther King Jr. Blvd and Estes Dr.
- **July 12, 2024** – Ongoing showers and storms become numerous particularly across Wake and Orange Counties, leading to isolated flash flooding. Flooding occurred at Raleigh Road and Fordham Boulevard. A car was stuck in high water.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which

have also included damages associated with flooding. Orange County has received six Major Disaster Declarations for Hurricanes and Tropical Storms in 1996, 1999, 2003, 2018, 2019, 2025 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year floodplain is those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The UNC-CH campus has some area of land in FEMA-mapped flood hazard areas. This delineation is a useful way to identify the most at-risk areas, but the Town of Chapel Hill and the UNC-CH campus are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Orange County and Chapel Hill and impacts from past flood events have been noted by NCEI. NCEI reports 28 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability over 100%. Therefore, the probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. In total, there are 453 buildings across all UNC-CH's campuses; of these, 2 buildings are located within the SFHA on UNC-CH West campus and 9 on UNC-CH South campus. Additionally, there are a total of 13 buildings located within the 0.2 % annual chance floodplain which are moderate risk areas to flooding on campus. These were the buildings evaluated as part of this analysis.

Flood damage is directly related to the depth of flooding by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a specific percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure G.27 through Figure G.31 depict the depth of flooding that can be expected within the UNC-CH campus during the 1-percent-annual-chance flood event.

The 24 exposed buildings are shown in Figure G.32 and Figure G.33 on the following pages.

**Figure G.32 – Buildings Exposed to Flood Risk on UNC-CH Central, East, and South Campus**

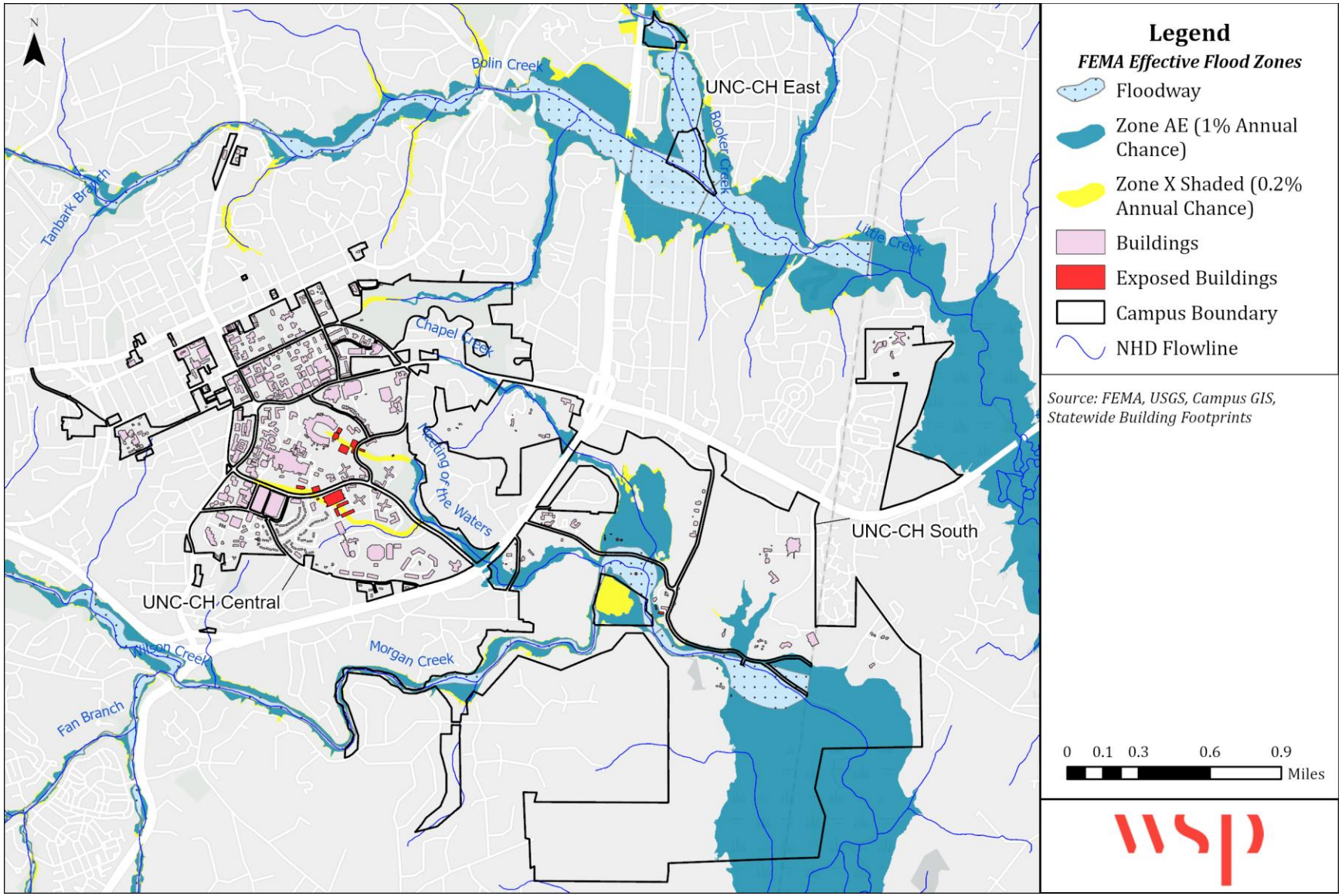
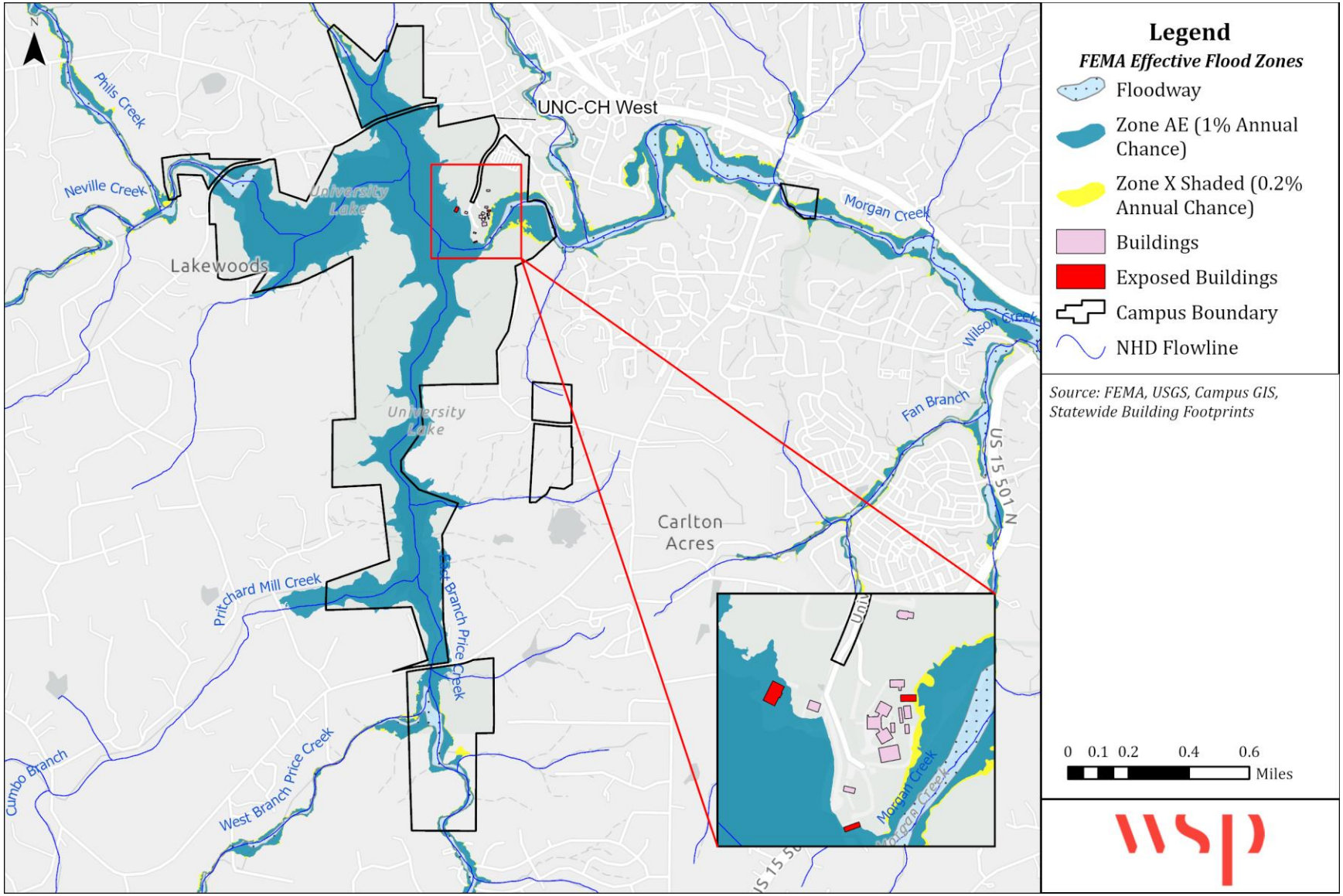


**Figure G.33 – Buildings Exposed to Flood Risk on UNC-CH West Campus**



## People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.

- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths caused by flood events in Chapel Hill.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems have the potential to be damaged or destroyed by flood waters.

Using the methodology described above, G.33 details estimated losses for eight structures that are expected to be impacted by the 1%-annual-chance flood event.

**Table G.33 – Estimated Structure Damage and Content Loss for 1% Annual Chance Flood**

| Building | Occupancy Type | Campus | Structure Loss | Content Loss | Total Loss |
|---|---|---|---|---|---|
| Nicholls, Michael Crew Club Boathouse | Educational/ Extracurricular | West | $3,320.17 | $8,964.45 | $12,284.62 |
| Finley Fields Sheds | Educational/ Extracurricular | South | $1,903.49 | $10,278.86 | $12,182.35 |
| Finley Fields North Bathroom Building | Educational/ Extracurricular | South | $709.55 | $3,831.59 | $4,541.15 |
| Finley Fields Spectator Shelter | Educational/ Extracurricular | South | $8,959.62 | $48,381.94 | $57,341.55 |
| Finley Storage B | Educational/ Extracurricular | South | $31,355.75 | $170,178.53 | $201,534.29 |
| Finley Storage A | Educational/ Extracurricular | South | $39,227.66 | $220,164.30 | $259,391.96 |
| UNC-CH South Unknown | Educational/ Extracurricular | South | $40,555.77 | $230,384.52 | $270,940.29 |
| Biology Trailer | Educational/ Extracurricular | South | $5,813.54 | $20,272.21 | $26,085.75 |
| | | **Total** | **$131,845.55** | **$712,456.40** | **$844,301.96** |

Source: NCEM iRisk database

Three additional structures intersect the SFHA, however, the first floor elevation (FFE) of these structures is higher than the flood elevation of the 1%-annual-chance flood zone, so no loss estimates were generated for these buildings.

None of the critical facilities identified for UNC-CH are located within the 1%-annual-chance floodplain, therefore there is no estimated damage to critical facilities from this flood event. However, the following three critical facilities are located within the 0.2% annual chance flood zone and therefore may have moderate risk of flooding: Chase Dining Hall, Manning Substation, and Information Technology Services Building – Manning.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the UNC-CH Facilities Management works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statements

- The 1%- annual-chance floodplain extends onto almost 22 percent of the UNC-CH campus.
- There are no critical facilities within the SFHA; however, 11 buildings on the UNC-CH campus are located within the 1% annual chance floodplain and one of these buildings is located within the floodway.
- Eight structures within the SFHA are estimated to sustain structure and content loss of $844,301 from the 1% annual chance flood event. Seven of these structures are located on South Campus.
- Flooding is not limited to the SFHA. Localized flooding can still impact facilities, roadways, and other locations on campus. Problem locations are tracked by Building Services and staff stormwater engineers.
- In 2013, a flash flood event impacted several buildings on the UNC Chapel Hill campus. Tropical Storm Chantal in 2025 also caused flooding on campus.

## G.5.6 Geological – Landslide

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Landslide | Possible | Minor | Small | 6 to 12 hrs | Less than 6 hrs | 1.7 |

### Location

Orange County is located within the Piedmont region of North Carolina. The Piedmont lies between the Coastal Plain and the Blue Ridge Mountains and encompasses approximately 45 percent of the area of the state. The Piedmont is characterized by gently rolling, well-rounded hills and long low ridges with a few hundred feet of elevation difference between the hills and valleys.

The U.S. Geological Survey (USGS) has produced landslide susceptibility and incidence mapping of the U.S., as shown in Figure G.34. The USGS determines susceptibility based on the probable degree of response to cutting or loading of slopes or to anomalously high precipitation. Incidence is measured by the rate of past occurrences. According to the USGS definition and mapping, Orange County faces primarily moderate susceptibility and low incidence of landslides, with some areas of high susceptibility in the southeast corner of the County where UNC-CH is located.

*Spatial Extent: 2 – Small*

### Extent

In low-relief areas, such as the Orange County area, landslides may occur as cut-and fill failures (roadway and building excavations), river bluff failures, lateral spreading landslides, collapse of mine-waste piles (especially coal), and a wide variety of slope failures associated with quarries and open-pit mines. In these instances, impacts are limited to the defined area. Event magnitude is also dependent on topography; landslide risk is higher in areas with steeper slopes. Given the gentle topography the county, the magnitude of any landslides on UNC-CH's campus would be minor.

*Impact: 1 – Minor*

### Historical Occurrences

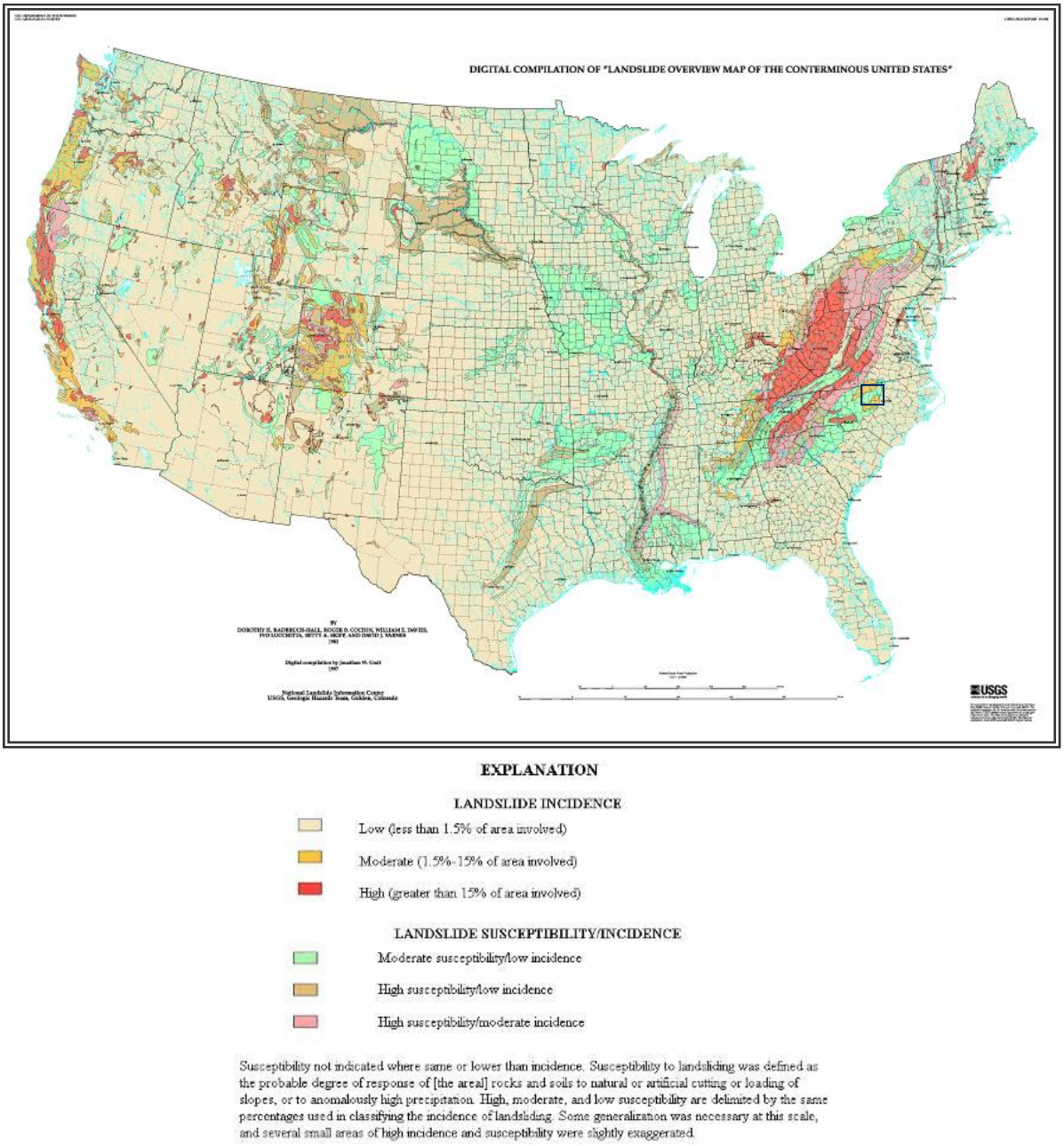
The North Carolina Geologic Survey landslide geodatabase contains records of three landslide occurrences in Orange County between 1990 and 2024. These events occurred in central and western Orange County, and only one event, at Occoneechee Mountain, required an urgent response. Additionally, per information reported by the planning committee for the Eno-Haw Regional Hazard Mitigation Plan, a landslide occurred on September 17, 2018 during Hurricane Florence; an embankment off East Franklin Street in Chapel Hill spilled significant debris onto the Bolin Creek Trail.

## Probability of Future Occurrence

As discussed above, four known landslide events occurred in Orange County between 1990 and 2024. Based on these historical occurrences, it is possible to experience a landslide event in the future; however, such an event is unlikely to have a severe impact.

*Probability: 2 – Possible*

### Figure G.34 – Landslide Incidence and Susceptibility




Source: USGS

## Vulnerability Assessment

### People

People are unlikely to sustain serious physical harm as a result of landslides in Orange County. Impacts would be relatively minor and highly localized. An individual using an impacted structure or infrastructure at the time of a landslide event may sustain minor injuries.

### Property

Landslides are infrequent in Orange County and occur in small, highly localized instances relative to the general area of risk. Additionally, these events are generally small scale in terms of the magnitude of impacts. As a result, it is difficult to estimate the property at risk to landslide. On average, a landslide event in the planning area may cause minor to moderate property damage to one or more buildings or cause localized damage to infrastructure. A landslide event may also result in the need for debris removal.

### Environment

Because landslides are essentially a mass movement of sediment, they may result in changes to terrain, damage to trees in the slide area, changes to drainage patterns, and increases in sediment loads in nearby waterways. Landslides in Orange County are unlikely to cause any more severe impacts.

## Changes in Development

Development on steep slopes or hillsides should contain mitigation measures to reduce the likelihood of landslides. However, this is not particularly relevant to the UNC-CH's campus given its gentle topography.

## Problem Statements

- Based on available data, four minor landslide events occurred in Orange County between 1990-2024. None of these events resulted in significant damage.

## G.5.7 Hurricane

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricane | Possible | Limited | Large | More than 24 hrs | Less than 24 hrs | 2.3 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. Hurricanes and tropical storms can occur anywhere within Orange County and affect the entire UNC-CH campus.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Table G.34), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

**Table G.34 – Saffir-Simpson Scale**

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as "major" hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table G.35 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table G.35 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| 1 | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| 2 | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| 3 | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| 4 | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| 5 | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Tropical cyclones weaken relatively quickly after making landfall; therefore, Orange County will not typically experience major hurricane force winds, though these occurrences are possible. Hurricane Michael passed within 10 miles of UNC-CH's campus as a Tropical Storm with wind speeds around 45 mph in 2018.

*Impact: 2 – Limited*

## Historical Occurrences

According to NCEI, two recorded hurricane-related events affected Orange County from 2000 to 2024 causing an estimated $1,250,000 in property damage. There were no injuries or fatalities recorded for either of these events.

**Table G.36 – Recorded Hurricane and Tropical Storm Events in Orange County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 10/11/2018 | Tropical Storm | Tropical Storm Michael | 0/0 | $500,000 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $750,000 | $0 |
| **Total** | | | **0/0** | **$1,250,000** | **$0** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Michael (2018**) – Tropical Storm Michael moved through North Carolina on Thursday, October 11th. Michael brought heavy rain and strong damaging winds to central North Carolina. While heavy rainfall of 3 to 6 inches produced minor flash flooding across the area, it was high wind gusts of 40 to 60 mph that caused the biggest problems, knocking down score of trees, leading to blocked roadways and thousands without power.
- **Hurricane Ian (2022)** – Hurricane Ian made landfall along the South Carolina coast near Georgetown during the early afternoon hours of September 30, 2022. Widespread wind gusts over tropical storm force and heavy rainfall occurred across much of central North Carolina through the afternoon and evening hours. There were numerous reports of wind damage and power outages as a result of the storm.

According to the NOAA Historical Hurricane Tracks dataset, 15 hurricanes or tropical storms passed within 25 miles of UNC-CH since 1900. These events are listed in Table G.37, and storm tracks are mapped in Figure G.35.

**Table G.37 – Hurricane Tracks within 25 miles of UNC-CH, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 6/17/1902 | Unnamed | Tropical Storm |
| 9/1/1911 | Unnamed | Tropical Depression |
| 10/3/1929 | Unnamed | Tropical Storm |
| 10/20/1944 | Unnamed | Tropical Storm |
| 9/19/1945 | Unnamed | Tropical Storm |
| 8/18/1955 | Diane | Tropical Storm |
| 9/1/1964 | Cleo | Tropical Depression |
| 6/11/1968 | Abby | Tropical Depression |
| 9/17/1976 | Unnamed | Tropical Depression |

| Date | Storm Name | Storm Category |
|---|---|---|
| 8/19/1985 | Danny | Tropical Depression |
| 9/7/1996 | Fran | Category 1 |
| 9/6/1999 | Dennis | Tropical Depression |
| 9/20/2000 | Gordon | Tropical Depression |
| 10/12/2018 | Michael | Tropical Storm |
| 7/9/2021 | Elsa | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

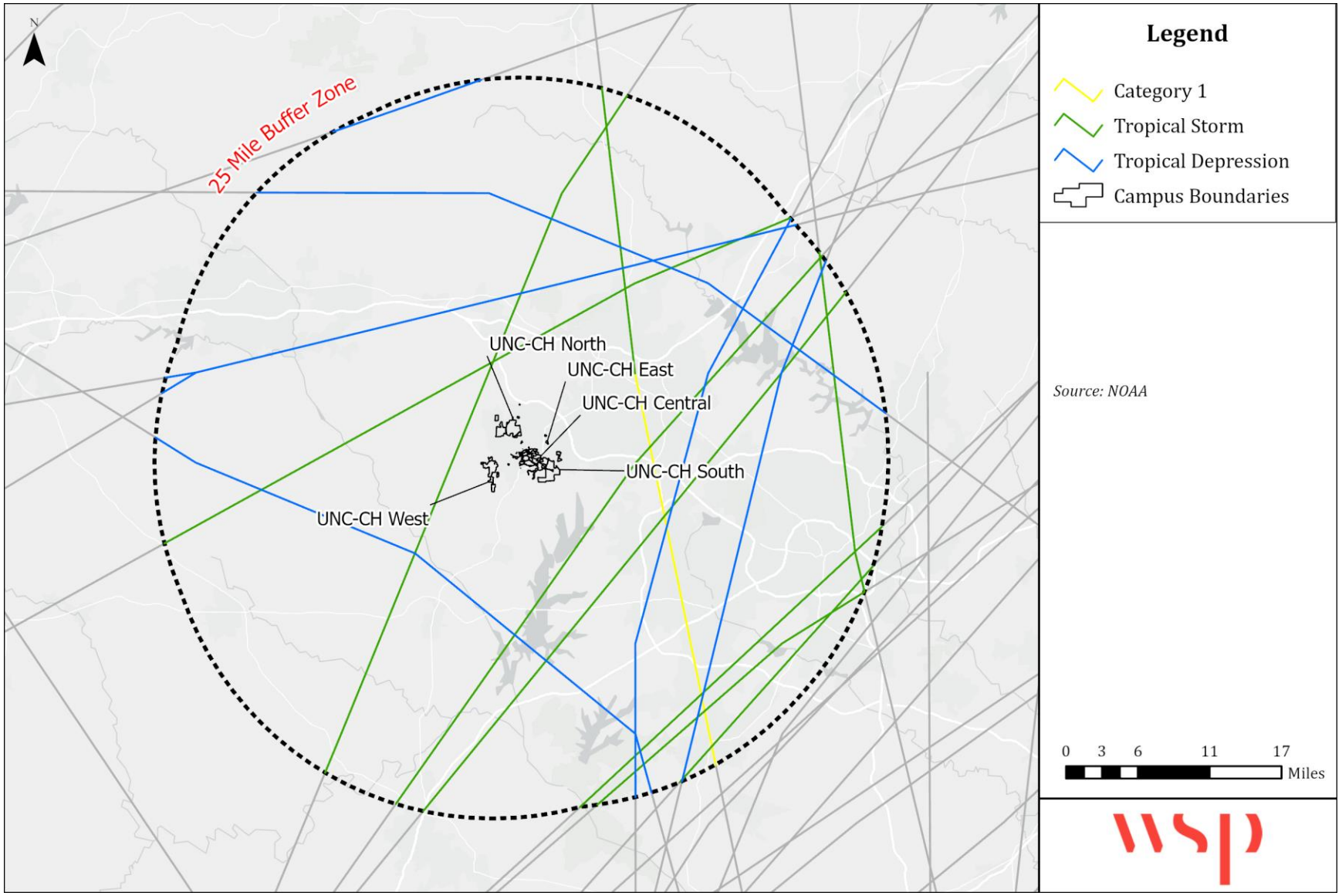
Orange County has received five major disaster declarations and seven emergency declarations for hurricane and tropical storm events, as summarized in Table G.38.

**Table G.38 – Hurricane-Related Disaster Declarations & Emergency Declarations**

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd Emergency Declarations |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 10/7/2016 | EM-3380-NC | Hurricane Matthew |
| 9/14/2018 | DR-4393-NC & EM-3401-NC | Hurricane Florence |
| 1/31/2019 | DR-4412 | Tropical Storm Michael |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

Source: OpenFEMA, 2025

**Figure G.35 – Historical Hurricane and Tropical Storm Tracks within 25 miles of UNC-CH, 1990-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, two tropical storms impacted Orange County, which equates to an 8 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting the County is possible.

*Probability: 2 – Possible*

## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. On-campus students may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause over $2.5 million of estimated total building damage across all UNC-CH's campuses.

Table G.39 through Table G.42 detail the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

### Table G.39 – Estimated Building Damage by Hurricane Winds, UNC-CH Central Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $278,602.97 | $63,927.59 | $342,530.56 |
| Educational | $1,187,853.70 | $201,479.41 | $1,389,333.11 |
| Housing | $226,330.50 | $15,066.11 | $241,396.61 |
| **Total** | **$1,692,787.17** | **$280,473.11** | **$1,973,260.28** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $857,603.97 | $208,721.91 | $1,066,325.88 |
| Educational | $3,956,193.51 | $1,137,585.15 | $5,093,778.66 |
| Housing | $714,403.08 | $134,873.11 | $849,276.19 |
| **Total** | **$5,528,200.56** | **$1,481,180.17** | **$7,009,380.73** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $2,647,257.67 | $658,339.06 | $3,305,596.73 |
| Educational | $11,583,901.90 | $5,318,721.47 | $16,902,623.37 |
| Housing | $2,197,736.55 | $837,013.66 | $3,034,750.21 |
| **Total** | **$16,428,896.12** | **$6,814,074.19** | **$23,242,970.31** |

Source: NCEM iRISK Database

### Table G.40 – Estimated Building Damage by Hurricane Winds, UNC-CH North Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $195,895.54 | $75,229.17 | $271,124.71 |
| Educational | $52,726.56 | $9,663.78 | $62,390.34 |
| **Total** | **$248,622.10** | **$84,892.95** | **$333,515.05** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $475,388.39 | $214,598.57 | $689,986.96 |
| Educational | $152,170.62 | $44,396.41 | $196,567.03 |
| **Total** | **$627,559.01** | **$258,994.98** | **$886,553.99** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $1,077,851.46 | $636,932.70 | $1,714,784.16 |
| Educational | $441,549.48 | $217,312.98 | $658,862.46 |
| **Total** | **$1,519,400.94** | **$854,245.68** | **$2,373,646.62** |

Source: NCEM iRISK Database

### Table G.41 – Estimated Building Damage by Hurricane Winds, UNC-CH South Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $35,226.70 | $874.32 | $36,101.02 |
| Educational | $112,525.36 | $6,332.53 | $118,857.89 |
| Housing | $3,527.00 | $168.87 | $3,695.87 |
| **Total** | **$151,279.06** | **$7,375.72** | **$158,654.78** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **300-Year Hurricane Wind Event** | | | |
| Administration | $93,115.84 | $12,272.04 | $105,387.88 |
| Educational | $322,742.96 | $81,805.35 | $404,548.31 |
| Housing | $12,414.84 | $1,487.05 | $13,901.89 |
| **Total** | **$428,273.64** | **$95,564.44** | **$523,838.08** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $249,784.79 | $102,089.92 | $351,874.71 |
| Educational | $998,904.27 | $626,282.22 | $1,625,186.49 |
| Housing | $35,950.14 | $7,794.42 | $43,744.56 |
| **Total** | **$1,284,639.20** | **$736,166.56** | **$2,020,805.76** |

Source: NCEM iRISK Database

**Table G.42 – Estimated Building Damage by Hurricane Winds, UNC-CH West Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $10,243.31 | - | $10,243.31 |
| Educational | $40,034.24 | $17.17 | $40,051.41 |
| Housing | $92.13 | $8.06 | $100.19 |
| **Total** | **$50,369.68** | **$25.23** | **$50,394.91** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $41,516.80 | - | $41,516.80 |
| Educational | $66,553.56 | $145.04 | $66,698.60 |
| Housing | $336.24 | $59.37 | $395.61 |
| **Total** | **$108,406.60** | **$204.41** | **$108,611.01** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $197,467.39 | - | $197,467.39 |
| Educational | $90,450.75 | $1,103.90 | $91,554.65 |
| Housing | $1,525.09 | $442.83 | $1,967.92 |
| **Total** | **$289,443.23** | **$1,546.73** | **$290,989.96** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statements

- Historical tracks of multiple hurricane events have passed within 25-miles of the UNC-CH Campus.
- For the 25-year period from 2000 through 2024, there were two hurricane wind events that caused $1,250,000 in damage in Orange County.

## G.5.8 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Orange County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI) shown in Table G.43 for the Orange County area, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. The county may experience any level on the RSI scale. Orange County receives an average of 4 to 6 inches of snowfall per year. According to NCEI records since 1996, the greatest snowfall amounts to impact Orange County have been between 7-12 inches. During the snowstorm of January 25, 2000, 11.8 inches of snow were recorded in Chapel Hill, the third greatest one-day snowfall in the county. It is possible that more severe events and impacts could be felt in the future.

**Table G.43 – Regional Snowfall Index (RSI) Values**

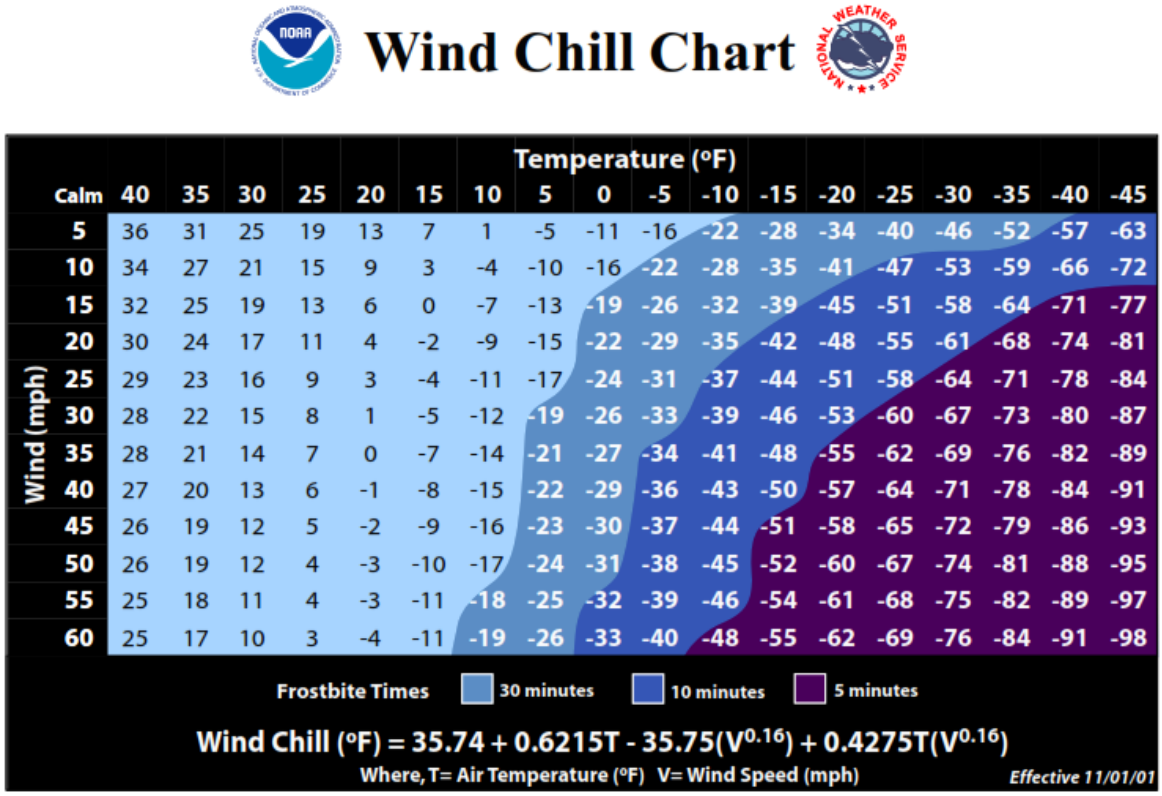
| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including

precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure G.36, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure G.36 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Orange County took place December 17th, 1930, with a recorded depth of 12 inches of snow occurring in the Town of Chapel Hill.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24 hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements. Defined by NWS Pembroke Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there was one heavy snow event, one ice storm, and 71 combined winter storm/winter weather events in Orange County during the 25-year period from 2000 through 2024. These events caused $3,730,000 in property damage, but they did not cause any fatalities, injuries, or crop damage, though these types of impacts may not have been reported and are possible in future events. Events in Orange County by type are recorded in Table G.44.

**Table G.44 – Recorded Severe Winter Weather Events in Orange County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Heavy Snow | 1 | 0 | 0 | $0 | $0 |
| Ice Storm | 1 | 0 | 0 | $2,700,000 | $0 |

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Winter Storm | 31 | 0 | 0 | $1,000,000 | $0 |
| Winter Weather | 38 | 0 | 0 | $30,000 | $0 |
| **Total** | **71** | **0** | **0** | **$3,730,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **December 7, 2007** – A brief period of light freezing rain fell across Central North Carolina from the Triad east to portions of the Triangle and over the Coastal Plain. Most of the freezing rain accumulation of up to sixteenth of an inch occurred from southern Wake county east to Smithfield and north to Wilson, Rocky Mount and Roanoke Rapids. Portions of Interstate 40 and Highway 70 in Johnston County were closed due to numerous accidents. Over 150 automobile accidents were reported across Central North Carolina due to icy bridges. In Orange County, Light freezing rain during the early morning hours just prior to sunrise resulted in several automobile accidents from black ice on numerous bridges.
- **March 6, 2014 –** One quarter of an inch of ice from freezing rain resulted in widespread downed trees and powerlines. Additionally, 1 to 1.5 inches of snow fell across the county. A strong surface low deepening off the Carolina coast brought a wintry mix of snow, sleet, and freezing rain to the northern-northwestern Piedmont counties. Snowfall amounts of 4 to 7 inches fell Forsyth, Person and Guilford counties. Just to the south and east of this area, a corridor of mainly sleet mixed with freezing rain produced significant icing of a quarter to half inch. This icing produced widespread downed trees and power outages over the northwest Piedmont. At the peak of the storm, over 400,000 customers were without power. A natural disaster was declared in 7 counties across the Raleigh CWA that were impacted by this storm.
- **February 25, 2015 –** As a low-pressure system tracked along the southeast coast, wintry precipitation spread into Central North Carolina. A winter storm warning was issued for the majority of the area, with the exception of a few counties in the extreme southeast where a winter weather advisory was needed. Snowfall/sleet amounts of 5 to 8 inches fell across the county. The heavy wet snow caused widespread power outages from falling trees and power lines. At the peak of the storm, over 7,000 customers were without power in the county.
- **December 9, 2018 –** Strong Cold Air Damming and a Miller-A storm track from the northern Gulf of Mexico to off the NC coast brought record early heavy snowfall to parts of central NC on December 9th and 10th. There was also a narrow swath of 0.1 to 0.2 inches of freezing rain across portions of the western Piedmont counties. In Orange County, snowfall amounts ranged from 7 inches across southern portions of the county to 11 inches across northern portions of the county. A thin glaze of ice from freezing rain was also reported.
- **February 7, 2022 –** A hybrid cold air damming event developed across the area during the early morning hours of the 7th. With light precipitation overspreading the area during this time and cold surface high pressure initially extending into the area form the north, initial rainfall evaporatively cooled surface temps to below freezing, before rising back above freezing by late morning into the afternoon as the surface high to the north shifted offshore.

Freezing rain amounts ranged from a trace up to one tenth of an inch across the northwest Piedmont. Impacts were generally limited, with scattered reports of traffic accidents the main impact.

Orange County has received seven FEMA Major Disaster Declarations for a snowstorm in 1977, 1993, blizzard in 1996 and severe winter storms or ice storms in 2000, 2002, 2003, and 2014.

## Probability of Future Occurrence

NCEI records 71 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $726,117, which assumes that 10% of the on-campus population is impacted.

**Table G.45 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 34,099 | 3,409 | $726,117 |

### Property

The NCEI reported $3,730,000 of property damage in association with any winter weather events between 2000 and 2024 for Orange County. Based on these records, the County experiences an estimated annualized loss of $149,200 in property damage. The average impact from winter weather events per incident in Orange County is $52,535.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is out driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on utilities and increasing the exposure of infrastructure networks. UNC-CH may wish to consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statements

- Severe winter weather events are highly likely for Orange County and the UNC-CH campus. The events have also resulted in four presidential disaster declarations for the County.

# G.5.9 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornado & Thunderstorm | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Tornadoes, thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally confined to the footprint of its associated thunderstorm. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas.

*Spatial Extent: 4 – Large*

### TORNADO

Tornados can occur anywhere on UNC-CH's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado damage isn't increased in one area of the campus versus another. All of UNC-CH is exposed to this hazard.

### THUNDERSTORM WINDS

The entirety of UNC-CH's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of UNC-CH is exposed to lightning.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates

(not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table G.46 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table G.46 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

The most intense tornado to pass through Orange County in the past 75 years was an F3 on November 23, 1992 and resulted in 2 fatalities, 10 injuries, and $250,000 in damages.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm can be defined by the storm's maximum wind speed and its impacts. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Chapel Hill since 2000 occurred on June 13, 2013 and had a measured wind speed of 70.2 mph. The event reportedly resulted in $3,000 in property damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table G.47, is a common parameter that is part of fire weather forecasts nationwide.

**Table G.47 – Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

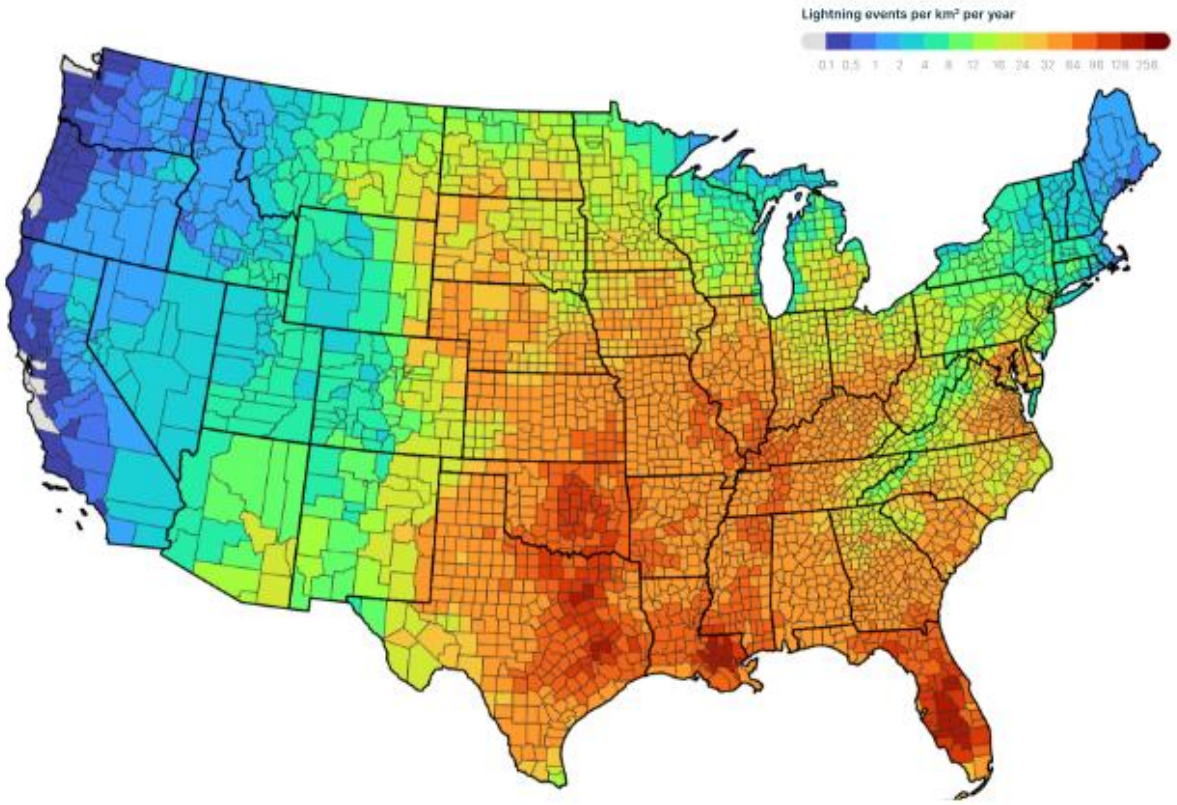
Source: National Weather Service

With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption to quality of life.

According to the Vaisala flash density map, Orange County experiences 16 to 24 lightning events per kilometer per year.

*Impact: 1 – Minor*

**Table G.48 – Lightning Density in the U.S. (2024)**




## HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table G.49 indicates the hailstone measurements utilized by the National Weather Service.

**Table G.49 – Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table G.50 describes typical intensity and damage impacts of the various sizes of hail.

**Table G.50 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls Durhamed |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Chapel Hill was a little over 1" in diameter; the largest hailstone recorded was 1.75", recorded on March 8, 2005, April 8, 2006, June 4, 2007, May 9, 2008, June 25, 2015 and April 28, 2016. The largest hailstone recorded in NCEI's full records was 2.75" on May 14, 1967.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Orange County has 11 recorded tornadoes between 1950 and 2024. These tornado events reported $2,902,500 in property

damage, 11 injuries, and 2 deaths. Table G.51 shows historical tornadoes in Orange County recorded in NCEI between 1950 and 2024.

**Table G.51 – Recorded Tornadoes in Orange County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 7/13/1975 | 1400 | F1 | 0 | 1 | $2,500 |
| - | 3/29/1991 | 1510 | F2 | 0 | 0 | $0 |
| - | 11/23/1992 | 120 | F3 | 2 | 10 | $250,000 |
| - | 1/28/1994 | 955 | F0 | 0 | 0 | $0 |
| CARRBORO | 6/19/2000 | 1305 | F0 | 0 | 0 | $0 |
| CARRBORO | 9/8/2004 | 1145 | F0 | 0 | 0 | $0 |
| SCHLEY | 1/14/2005 | 445 | F0 | 0 | 0 | $0 |
| CARR | 10/27/2010 | 1630 | EF1 | 0 | 0 | $250,000 |
| TEER | 4/19/2019 | 1500 | EF2 | 0 | 0 | $2,000,000 |
| CARR | 3/18/2021 | 1704 | EF1 | 0 | 0 | $150,000 |
| MILES | 5/6/2022 | 1608 | EF1 | 0 | 0 | $250,000 |
| **Total** | | | | **2** | **11** | **$2,902,500** |

Source: NCEI

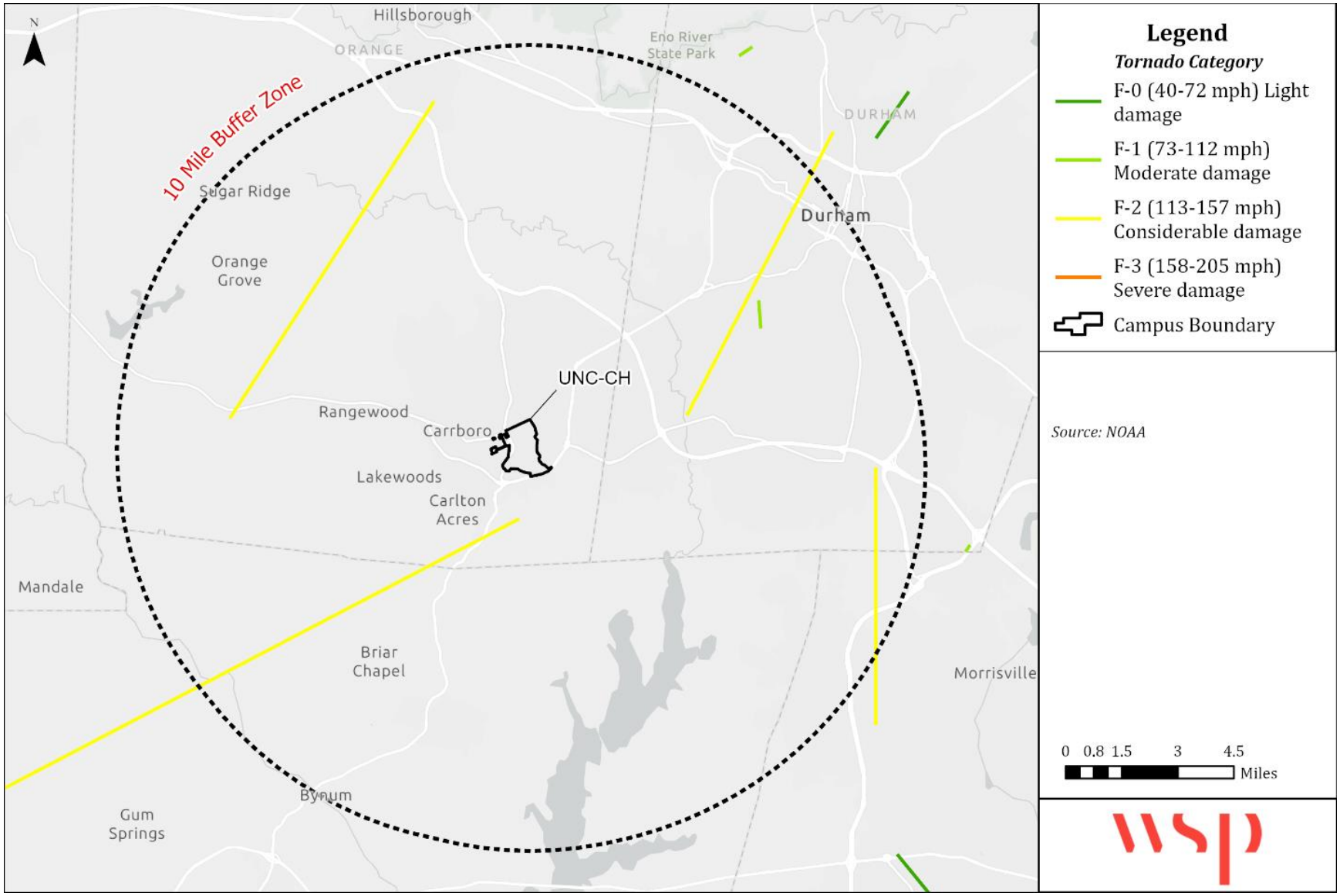
Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **November 23, 1992** – This violent tornado ripped through western and northern sections of Hillsborough, including the more densely populated Fairview subdivision. The tornado reached its greatest intensity with damage path nearly .75 mile wide along Highway 70 west of the city. Here, a two-year-old and 53-year old man died. The damage path then narrowed to about 200 yards in Fairview. Ten other people were injured with 53 homes and one business destroyed, 109 homes and another business damaged. Property damage was estimated at $2 million dollars.
- **January 14, 2005 –** A tornado touched down in northeast Hillsborough along St. Mary's Road and damaged two properties. The east wall of a home was almost completely blown out, and on an adjacent property a metal equipment shed was destroyed with some of the debris carried into nearby trees. A small outbuilding was pushed a short distance off its foundation wall, as well.
- **October 27, 2010 –** A supercell thunderstorm produced a series of tornadoes across portions of Orange, Granville, and Vance counties in central North Carolina. The first tornado produced EF-1 damage with winds between 90 to 95 mph along Carr Store Road near Allie Mae Road in northern Orange County. At this location a church sustained significant damage, with two walls made of cinder blocks blown down. Numerous hard and soft wood trees were also snapped off and uprooted at this location. The tornado continued to track east northeast and damaged two homes along Pentecost Road. Both homes sustained roof damage, including a partially collapsed chimney. Two individuals were home at the time of the tornado and were not injured. Numerous trees where snapped off and uprooted at this location as well. Winds were estimated to range from 86 to 90 mph. The

tornado weakened as it continued to track east north-east across Mcdade Store Road and Efland-Cedar Grove Road before lifting. Numerous trees were either damaged or downed during this area.

- **April 19, 2019 –** A tornado initially touched down in the White Cross area and Leslie Drive area of southwest Orange County. Considerable tree damage occurred in this area, including the snapping and splitting of healthy large-trunk trees. Subsequent damage to vehicles and homes occurred as the trees fell. Given the magnitude and nature of the damage, wind speeds were estimated at 110 mph. The tornado then tracked north-northeast eventually crossing Dodsons Cross Road, Dairyland Road, Arthur Minnis Road, and Borland Roads, all while producing similar tree damage. The tornado finally began to lift and/or dissipate near Hillsborough just north of I-40 near exit 261, but not before producing considerable damage to several homes just south of exit 261. The roof and several exterior walls of one home were completely destroyed. Damage at this location was estimated at 115 mph, making this tornado a low-end EF-2 on the EF scale.

**Figure G.37 – Tornado Paths within 10 Miles of UNC-CH, 1950-2024**



### THUNDERSTORM WINDS

Between 2000 and 2024, the NCEI recorded wind speeds for 57 separate incidents of thunderstorm winds, occurring on 45 separate days, for Chapel Hill. These events caused $263,500 in recorded property damage, two injuries, and two fatalities. The recorded gusts averaged 58.1 miles per hour, with the highest gusts recorded at 70.2 mph on June 13, 2013. Of these events, 24 caused property damage. Wind gusts with property damage recorded averaged $9,086 in damage, with the highest reported damage being a total of $40,000 across two events on February 6, 2020. These incidents are aggregated by the date the events occurred and are recorded in Table G.52. These records specifically note thunderstorm wind impacts for Chapel Hill.

**Table G.52 – Recorded Thunderstorm Winds, Chapel Hill, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Countywide | 5/20/2000 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 5/25/2000 | 69.1 | 0 | 2 | $0 |
| Chapel Hill | 8/18/2000 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 2/22/2003 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 7/22/2003 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 10/14/2003 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 7/28/2005 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 4/3/2006 | 57.6 | 0 | 0 | $0 |
| Chapel Hill Wllms Ar | 3/4/2008 | 63.3 | 0 | 0 | $0 |
| Chapel Hill Wllms Ar | 5/9/2008 | 59.9 | 0 | 0 | $0 |
| Chapel Hill | 7/4/2008 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 5/9/2009* | 57.6 | 0 | 0 | $0 |
| Chapel Hill Wllms Ar | 9/28/2009 | 57.6 | 0 | 0 | $0 |
| Chapel Hill Wllms Ar | 5/27/2011 | 57.6 | 0 | 0 | $0 |
| Chapel Hill Wllms Ar | 6/18/2011 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 8/14/2011 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 5/9/2012* | 57.6 | 0 | 0 | $2,500 |
| Chapel Hill | 7/19/2012 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 7/24/2012* | 57.6 | 0 | 0 | $34,000 |
| Chapel Hill | 6/13/2013 | 70.2 | 1 | 0 | $3,000 |
| Chapel Hill | 6/30/2013 | 57.6 | 0 | 0 | $5,000 |
| Chapel Hill Wllms Ar | 1/11/2014 | 57.6 | 0 | 0 | $1,000 |
| Chapel Hill | 6/18/2015 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 6/26/2015 | 57.6 | 0 | 0 | $2,000 |
| Chapel Hill Wllms Ar | 7/21/2015 | 57.6 | 0 | 0 | $5,000 |
| Chapel Hill Wllms Ar | 2/24/2016* | 57.6 | 0 | 0 | $3,000 |
| Chapel Hill Wllms Ar | 6/16/2017 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 7/23/2017 | 57.6 | 0 | 0 | $3,000 |
| Chapel Hill | 4/15/2018 | 57.6 | 0 | 0 | $1,000 |
| Chapel Hill | 7/4/2018* | 57.6 | 0 | 0 | $1,500 |
| Chapel Hill | 4/12/2019* | 57.6 | 0 | 0 | $6,000 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Chapel Hill | 6/20/2019* | 57.6 | 0 | 0 | $15,000 |
| Chapel Hill | 2/6/2020* | 57.6 | 0 | 0 | $40,000 |
| Chapel Hill | 4/26/2020 | 57.6 | 0 | 0 | $25,000 |
| Chapel Hill | 6/11/2020 | 57.6 | 0 | 0 | $10,000 |
| Chapel Hill Wllms Ar | 6/28/2020 | 57.6 | 1 | 0 | $50,000 |
| Chapel Hill | 5/4/2021 | 57.6 | 0 | 0 | $1,500 |
| Chapel Hill | 7/9/2021 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 5/19/2022 | 57.6 | 0 | 0 | $0 |
| Chapel Hill | 5/27/2022 | 57.6 | 0 | 0 | $5,000 |
| Chapel Hill Wllms Ar | 7/26/2022 | 57.6 | 0 | 0 | $10,000 |
| Chapel Hill | 1/12/2023 | 57.6 | 0 | 0 | $20,000 |
| Chapel Hill Wllms Ar | 6/23/2023 | 57.6 | 0 | 0 | $10,000 |
| Chapel Hill | 6/30/2023 | 57.6 | 0 | 0 | $5,000 |
| Chapel Hill Wllms Ar | 7/23/2024 | 57.6 | 0 | 0 | $5,000 |
| | | **Total** | **2** | **2** | **$263,500** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **May 25, 2000** – A Piper Cherokee crashed while trying to land at the Horace Williams Airport due to strong winds.
- **March 4, 2008** – Numerous trees were blown down from Chapel Hill east to the Durham County line.
- **May 27, 2011** – Several power-lines were blown down across Chapel Hill.
- **May 9, 2012** – A cold front moved into central North Carolina and interacted with an unstable air mass to produce scattered showers and thunderstorms. Some of these storms became strong to severe across portions of the Piedmont and Coastal Plain of Central North Carolina. Several trees were reported down in Chapel Hill; one 4-inch diameter tree was snapped in half and partially blocking Manning Drive.
- **July 24, 2012** – A very unstable airmass and deep dry sub cloud layer coupled with a disturbance which moved across the area during peak heating caused scattered to numerous showers and thunderstorms to develop in the afternoon into the evening. Many of these storms became severe and produced damaging wind events. More than a dozen trees and power lines were reported down across the Town of Chapel Hill; one tree was blown down onto a car on South Columbia Street at the UNC-CH campus. One adult and two high school students were inside the car at the time but escaped without injuries.
- **June 13, 2013** – A ferocious line of strong to severe thunderstorms raced through central North Carolina during the afternoon and into the early evening, uprooting trees and snapping power lines with straight-line wind gusts up to 80 mph. Damage was widespread with numerous trees falling on homes throughout the County warning area. A large tree was blown down on the 300 Block of East Franklin Street killing a 20 year old UNC-CH student.
- **June 30, 2013** – The forecast area remained sandwiched between an unseasonably deep trough aloft to the west and a ridge to the east. This resulted in a persistent very moist air

mass and with soils already saturated., two rounds of heavy rain resulting in flash flooding, first in the early morning hours across Durham and Orange counties and later in the day across the same area. Chapel Hill and Carrboro experienced the most significant flooding, with substantial property damage occurring. As afternoon destabilization occurred, a couple of storms became severe and produced some isolated wind damage. A tree was blown down on the UNC-CH campus, damaging a couple of cars.

- **June 28, 2020** - One tree fell on a mobile home in the 1200 block of Martin Luther King Boulevard, resulting in a fatality.

### LIGHTNING

According to NCEI data, there were 2 lightning strikes reported between 2000 and 2024 in Chapel Hill. These lightning strike events recorded an estimated $2,380,000 worth of property damage. No crop damage, injuries, fatalities were reportedly caused by these strikes; however, two fatalities were recorded due to lightning strikes elsewhere in Orange County. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table G.53 details NCEI-recorded lightning strikes from 2000 through 2024 for Chapel Hill.

**Table G.53 – Recorded Lightning Strikes in Chapel Hill, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| CHAPEL HILL | 7/2/2002 | 1515 | 0 | 0 | $880,000 |
| CHAPEL HILL | 12/11/2008 | 1205 | 0 | 0 | $1,500,000 |
| | | **Total** | **0** | **0** | **$2,380,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Chapel Hill:

- **July 2, 2002** – Lightning started at least three house fires around Chapel Hill. The worst damage was sustained at a condominium complex on Copperline Drive.
- **December 11, 2008** – A powerful upper level disturbance with associated cold front pushed across the region the afternoon and evening of December 11. Over 2 inches of rain fell in many locations with several reports of minor urban flooding. Lightning struck a home in Chapel Hill and it caught fire; the house burned to the ground when the lightning got into the gas lines of the home.

### HAIL

NCEI records 8 hail incidents across 7 days between 2000 and 2024 in Chapel Hill. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the City was 1.75 inches, which occurred on three different occasions in 2005, 2008, and 2015. The average hail size of all events in Chapel Hill was approximately 1.2 inches in diameter. Table G.54 summarizes hail events for Chapel Hill. In some cases, hail was reported for multiple locations on the same day.

**Table G.54 – Summary of Hail Occurrences in Chapel Hill**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| CHAPEL HILL | 3/8/2005 | 1.75 |
| CHAPEL HILL | 5/25/2006 | 1 |
| CHAPEL HILL WLLMS AR | 5/9/2008 | 0.75 |
| CHAPEL HILL | 5/9/2008 | 1.75 |
| CHAPEL HILL WLLMS AR | 5/27/2011 | 1 |
| CHAPEL HILL WLLMS AR | 4/25/2014 | 1 |
| CHAPEL HILL WLLMS AR | 6/25/2015 | 1.75 |
| CHAPEL HILL | 5/21/2018 | 0.75 |

Source: NCEI

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **May 9, 2008** – Penny sized hail was reported at the intersection of Allard and Lyon Roads.
- **June 25, 2015** – Golf ball sized hail was reported near Fordham Boulevard and East Franklin Street.
- **May 21, 2018** – Dime sized hail reported at UNC Chapel Hill Medical Center.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Chapel Hill averages 1.8 days with thunderstorm wind events per year. Over this same period, two lightning events were reported as having caused property damage, which equates to an 8% likelihood of experiencing a damaging lightning strike annually.

The average hailstorm in Chapel Hill occurs in the afternoon or evening and has a hail stone with a diameter of around 1.2 inches. Over the 25-year period from 2000 through 2024, Chapel Hill experienced 8 days with reported hail incidents: this averages to 0.32 days per year with reported incidents somewhere in the town.

Probability of future occurrence was calculated based on past occurrences and was assumed to be uniform across the county.

In a 75-year span between 2000 and 2024, Orange County experienced 11 recorded tornado incidents over 11 separate days. This correlates to a 15 percent annual probability that the County will experience a tornado somewhere in its boundaries. Most of these events were magnitude EF0 or EF1. However, two of these past tornado events were magnitude EF2, and one was magnitude EF3. Therefore, the annual probability of a significant tornado event is less than 5% annually.

Based on these historical occurrences, there is between a 10% to 100% chance that Chapel Hill will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on UNC-CH's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Between 2000 and 2024, falling trees due to thunderstorm winds resulted in two fatalities. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $726,117, which assumes that 10% of the on-campus population is impacted.

**Table G.55– Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 34,099 | 3,409 | $726,117 |

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Since 1950, tornadoes have resulted in 2 fatalities and 11 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Chapel Hill, most property damage caused by lightning was due to structural fires.

NCEI records lightning impacts over 20 years (2000-2024), with $2,380,000 in property damage recorded during two events. Based on these records, the planning area experiences an annualized loss of $95,200 in property damage.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2025 in Chapel Hill, NCEI did not report any property damage as a direct result of hail.

It should be noted that property damage due to hail is usually insured loss, with damage covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damage in Chapel Hill, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $263,500 in property damage, which equates to an annualized loss of $9,086 across Chapel Hill.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damage and losses attributed to secondary hazards spawned by the tornado, or due to the damage caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in Orange County are directly responsible for $2,902,500 worth of damage to property according to NCEI data. This equates to an annualized loss of $38,700. Per the iRisk analysis, an F2 tornado event could cause over $1.5 billion of estimated total building damage across all UNC-CH campuses.

Table G.56 through Table G.59 detail the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

### Table G.56 – Estimated Building Damage by Tornado Events, UNC-CH Central Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $6,916,217.61 | $2,412,235.97 | $9,328,453.58 |
| Educational | $14,489,676.03 | $20,196,569.55 | $34,686,245.58 |
| Housing | $2,892,290.19 | $3,005,841.28 | $5,898,131.47 |
| **Total** | **$24,298,183.83** | **$25,614,646.80** | **$49,912,830.63** |
| **F1 Tornado Event** | | | |
| Administration | $48,735,399.22 | $16,892,740.84 | $65,628,140.06 |
| Educational | $109,891,360.63 | $154,213,412.37 | $264,104,773.00 |
| Housing | $22,707,666.50 | $23,931,106.05 | $46,638,772.55 |
| **Total** | **$181,334,426.35** | **$195,037,259.26** | **$376,371,685.61** |
| **F2 Tornado Event** | | | |
| Administration | $125,452,426.18 | $58,979,025.84 | $184,431,452.02 |
| Educational | $371,513,578.00 | $530,271,259.13 | $901,784,837.13 |
| Housing | $78,305,294.39 | $85,061,514.99 | $163,366,809.38 |
| **Total** | **$575,271,298.57** | **$674,311,799.96** | **$1,249,583,098.53** |
| **F3 Tornado Event** | | | |
| Administration | $156,474,309.33 | $92,129,589.66 | $248,603,898.99 |
| Educational | $580,137,960.07 | $832,236,007.79 | $1,412,373,967.86 |
| Housing | $124,632,955.25 | $135,524,345.14 | $260,157,300.39 |
| **Total** | **$861,245,224.65** | **$1,059,889,942.59** | **$1,921,135,167.24** |
| **F4 Tornado Event** | | | |
| Administration | $160,097,327.84 | $96,433,190.92 | $256,530,518.76 |
| Educational | $601,787,004.68 | $862,855,256.80 | $1,464,642,261.48 |
| Housing | $129,402,687.44 | $140,554,684.21 | $269,957,371.65 |
| **Total** | **$891,287,019.96** | **$1,099,843,131.93** | **$1,991,130,151.89** |

Source: NCEM iRISK Database

### Table G.57 – Estimated Building Damage by Tornado Events, UNC-CH North Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $924,545.08 | $1,301,401.63 | $2,225,946.71 |
| Educational | $818,908.92 | $1,174,902.71 | $1,993,811.63 |
| **Total** | **$1,743,454.00** | **$2,476,304.34** | **$4,219,758.34** |
| **F1 Tornado Event** | | | |
| Administration | $7,215,749.52 | $10,252,191.07 | $17,467,940.59 |
| Educational | $5,325,357.77 | $7,589,163.22 | $12,914,520.99 |
| **Total** | **$12,541,107.29** | **$17,841,354.29** | **$30,382,461.58** |
| **F2 Tornado Event** | | | |
| Administration | $25,214,024.57 | $36,249,716.60 | $61,463,741.17 |
| Educational | $16,896,333.32 | $24,101,651.72 | $40,997,985.04 |
| **Total** | **$42,110,357.89** | **$60,351,368.32** | **$102,461,726.21** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F3 Tornado Event** | | | |
| Administration | $39,921,296.63 | $57,497,173.01 | $97,418,469.64 |
| Educational | $26,004,984.89 | $37,131,153.90 | $63,136,138.79 |
| **Total** | **$65,926,281.52** | **$94,628,326.91** | **$160,554,608.43** |
| **F4 Tornado Event** | | | |
| Administration | $41,361,078.39 | $59,569,900.80 | $100,930,979.19 |
| Educational | $26,946,145.51 | $38,475,192.15 | $65,421,337.66 |
| **Total** | **$68,307,223.90** | **$98,045,092.95** | **$166,352,316.85** |

Source: NCEM iRISK Database

### Table G.58 – Estimated Building Damage by Tornado Events, UNC-CH South Campus

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $498,934.70 | $474,930.61 | $973,865.31 |
| Educational | $1,383,780.84 | $1,787,903.56 | $3,171,684.40 |
| Housing | $135,516.12 | $110,822.74 | $246,338.86 |
| **Total** | **$2,018,231.66** | **$2,373,656.91** | **$4,391,888.57** |
| **F1 Tornado Event** | | | |
| Administration | $3,792,400.08 | $3,652,100.56 | $7,444,500.64 |
| Educational | $10,770,894.05 | $13,979,859.43 | $24,750,753.48 |
| Housing | $876,113.96 | $703,694.79 | $1,579,808.75 |
| **Total** | **$15,439,408.09** | **$18,335,654.78** | **$33,775,062.87** |
| **F2 Tornado Event** | | | |
| Administration | $10,275,099.06 | $11,411,898.77 | $21,686,997.83 |
| Educational | $43,873,334.01 | $59,312,878.83 | $103,186,212.84 |
| Housing | $2,001,157.50 | $1,670,043.24 | $3,671,200.74 |
| **Total** | **$56,149,590.57** | **$72,394,820.84** | **$128,544,411.41** |
| **F3 Tornado Event** | | | |
| Administration | $12,507,964.37 | $13,837,809.02 | $26,345,773.39 |
| Educational | $50,961,766.59 | $69,092,953.87 | $120,054,720.46 |
| Housing | $2,996,430.43 | $2,512,167.88 | $5,508,598.31 |
| **Total** | **$66,466,161.39** | **$85,442,930.77** | **$151,909,092.16** |
| **F4 Tornado Event** | | | |
| Administration | $12,701,522.21 | $14,068,235.31 | $26,769,757.52 |
| Educational | $51,648,209.92 | $70,052,918.91 | $121,701,128.83 |
| Housing | $3,104,060.33 | $2,606,609.75 | $5,710,670.08 |
| **Total** | **$67,453,792.46** | **$86,727,763.97** | **$154,181,556.43** |

Source: NCEM iRISK Database

**Table G.59 – Estimated Building Damage by Tornado Events, UNC-CH West Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $1,143,714.29 | - | $1,143,714.29 |
| Educational | $304,153.75 | $426,046.93 | $730,200.68 |
| Housing | $4,285.07 | $2,142.53 | $6,427.60 |
| **Total** | **$1,452,153.11** | **$428,189.46** | **$1,880,342.57** |
| **F1 Tornado Event** | | | |
| Administration | $8,255,461.82 | - | $8,255,461.82 |
| Educational | $2,303,628.58 | $3,252,207.10 | $5,555,835.68 |
| Housing | $25,766.03 | $12,883.01 | $38,649.04 |
| **Total** | **$10,584,856.43** | **$3,265,090.11** | **$13,849,946.54** |
| **F2 Tornado Event** | | | |
| Administration | $18,655,018.18 | - | $18,655,018.18 |
| Educational | $7,877,715.55 | $11,351,972.33 | $19,229,687.88 |
| Housing | $72,472.27 | $36,236.13 | $108,708.40 |
| **Total** | **$26,605,206.00** | **$11,388,208.46** | **$37,993,414.46** |
| **F3 Tornado Event** | | | |
| Administration | $20,000,000.00 | - | $20,000,000.00 |
| Educational | $12,466,949.58 | $17,959,255.94 | $30,426,205.52 |
| Housing | $143,881.13 | $71,940.56 | $215,821.69 |
| **Total** | **$32,610,830.71** | **$18,031,196.50** | **$50,642,027.21** |
| **F4 Tornado Event** | | | |
| Administration | $20,000,000.00 | - | $20,000,000.00 |
| Educational | $12,934,169.61 | $18,613,523.76 | $31,547,693.37 |
| Housing | $157,786.64 | $78,893.32 | $236,679.96 |
| **Total** | **$33,091,956.25** | **$18,692,417.08** | **$51,784,373.33** |

Source: NCEM iRISK Database

## Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statements

- The most intense tornado to pass through Orange County in the past 75 years was an F3 magnitude that resulted in 2 deaths, 10 injuries, and $250,000 in property damage.
- The strongest recorded thunderstorm wind event for Orange County in the past 25 years occurred in June 2013 and had a measured gust of 70.2 mph.
- Thunderstorms and tornadoes are frequent hazard events in Orange County and around the UNC-CH campus. Reported damages for the 25-year period from 2000-2024 include $263, 500 for thunderstorm winds and $2,380,000 for lightning strikes.
- Between 1950 and 2024, tornadoes caused $2,902,500 in damage.
- One Chapel Hill student died due to injuries sustained from a downed tree during a thunderstorm wind event.

## G.5.10 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |

### Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 13 percent of the combined UNC-CH campuses are within the primary exposure category. A third of the east campus is within the primary exposure zone. Around 17 percent is within the secondary exposure category of the Functional WUI. While only a small percentage of each campus falls within the secondary exposure category, around 60 percent of the central campus is categorized as secondary exposure. Table G.60 through Table G.64 details the Functional WUI acreage in the UNC-CH

campus, and Figure G.38 through Figure G.40 below shows the Functional WUI areas. On a county level, the majority of Orange County is classified as sources of ember load to buildings with pockets of primary exposure integrated within these areas. Spread between areas of primary exposure and sources of ember load are contiguous areas of wildfire transmission zone – concentrated in areas with less housing density. Hillsborough and Chapel Hill have higher concentrations of secondary exposure.

The expansion of residential development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

*Spatial Extent: 4 – Large*

**Table G.60 – Functional Wildland Urban Interface, UNC-CH North Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 120 | 11% |
| | Secondary Exposure | 79 | 7% |
| | Sources of Ember Load to Buildings | 616 | 56% |
| | Wildfire Transmission Zone | 291 | 26% |
| | Low to No Exposure | 0 | 0% |
| | Water | 4 | 0% |
| | **Total** | **1,109** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table G.61 – Functional Wildland Urban Interface, UNC-CH Central Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 172 | 21% |
| | Secondary Exposure | 486 | 60% |
| | Sources of Ember Load to Buildings | 85 | 11% |
| | Wildfire Transmission Zone | 61 | 8% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **803** | **100%** |

Source: Southern Wildfire Risk Assessment

**Table G.62 – Functional Wildland Urban Interface, UNC-CH East Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 9 | 33% |
| | Secondary Exposure | 1 | 3% |
| | Sources of Ember Load to Buildings | 15 | 57% |
| | Wildfire Transmission Zone | 2 | 7% |
| | Low to No Exposure | 0 | 0% |

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Water | 0 | 0% |
| | **Total** | **27** | **100%** |

Source: Southern Wildfire Risk Assessment

### Table G.63 – Functional Wildland Urban Interface, UNC-CH West Campus

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 57 | 8% |
| | Secondary Exposure | 7 | 1% |
| | Sources of Ember Load to Buildings | 326 | 45% |
| | Wildfire Transmission Zone | 191 | 27% |
| | Low to No Exposure | 0 | 0% |
| | Water | 137 | 19% |
| | **Total** | **717** | **100%** |

Source: Southern Wildfire Risk Assessment

### Table G.64 – Functional Wildland Urban Interface, UNC-CH South Campus

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 175 | 13% |
| | Secondary Exposure | 115 | 9% |
| | Sources of Ember Load to Buildings | 914 | 69% |
| | Wildfire Transmission Zone | 124 | 9% |
| | Low to No Exposure | 0 | 0% |
| | Water | 5 | 0% |
| | **Total** | **1,334** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure G.38 – Functional Wildland Urban Interface, UNC-CH North Campus**

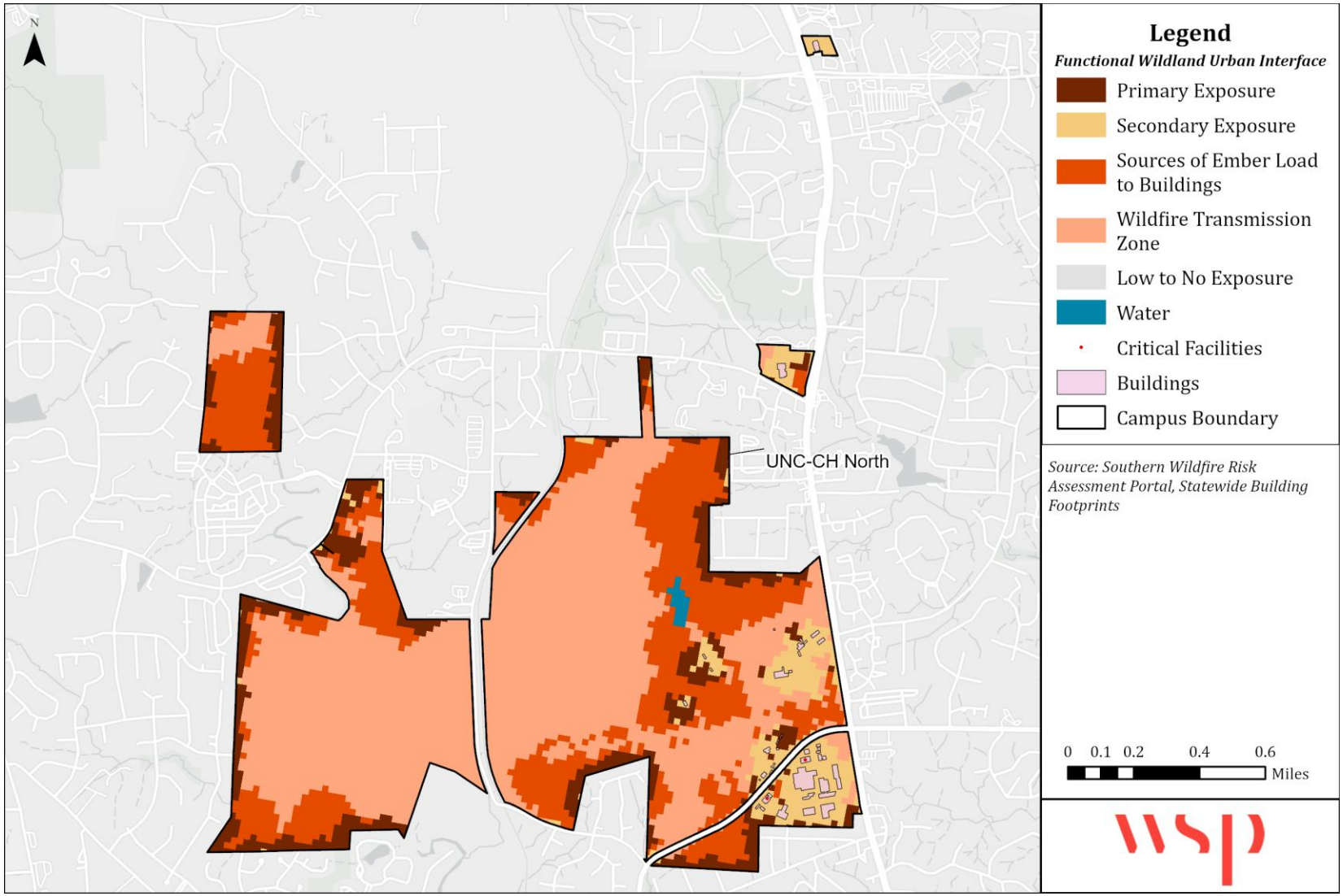


**Figure G.39 – Functional Wildland Urban Interface, UNC-CH East, Central, and South Campus**

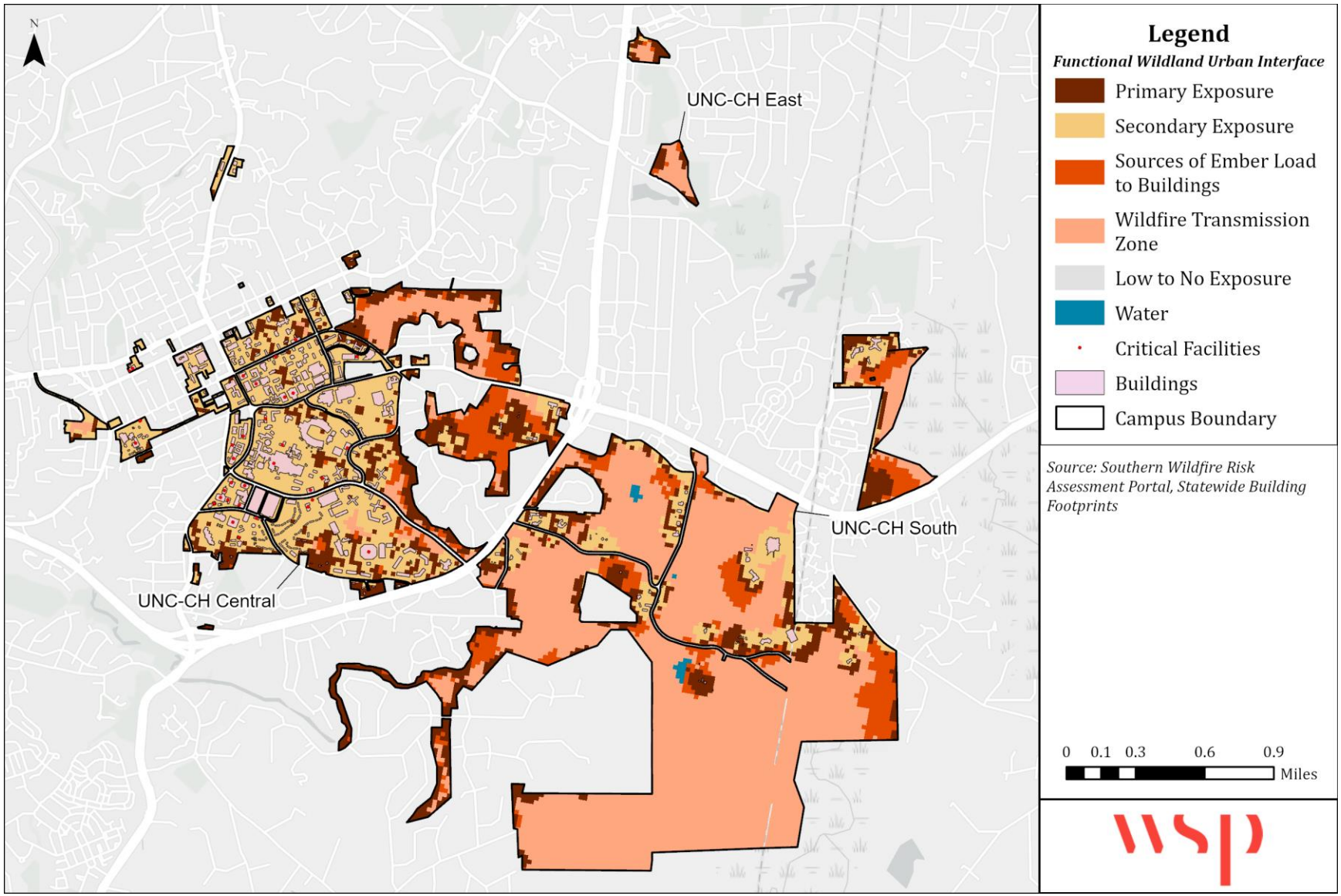
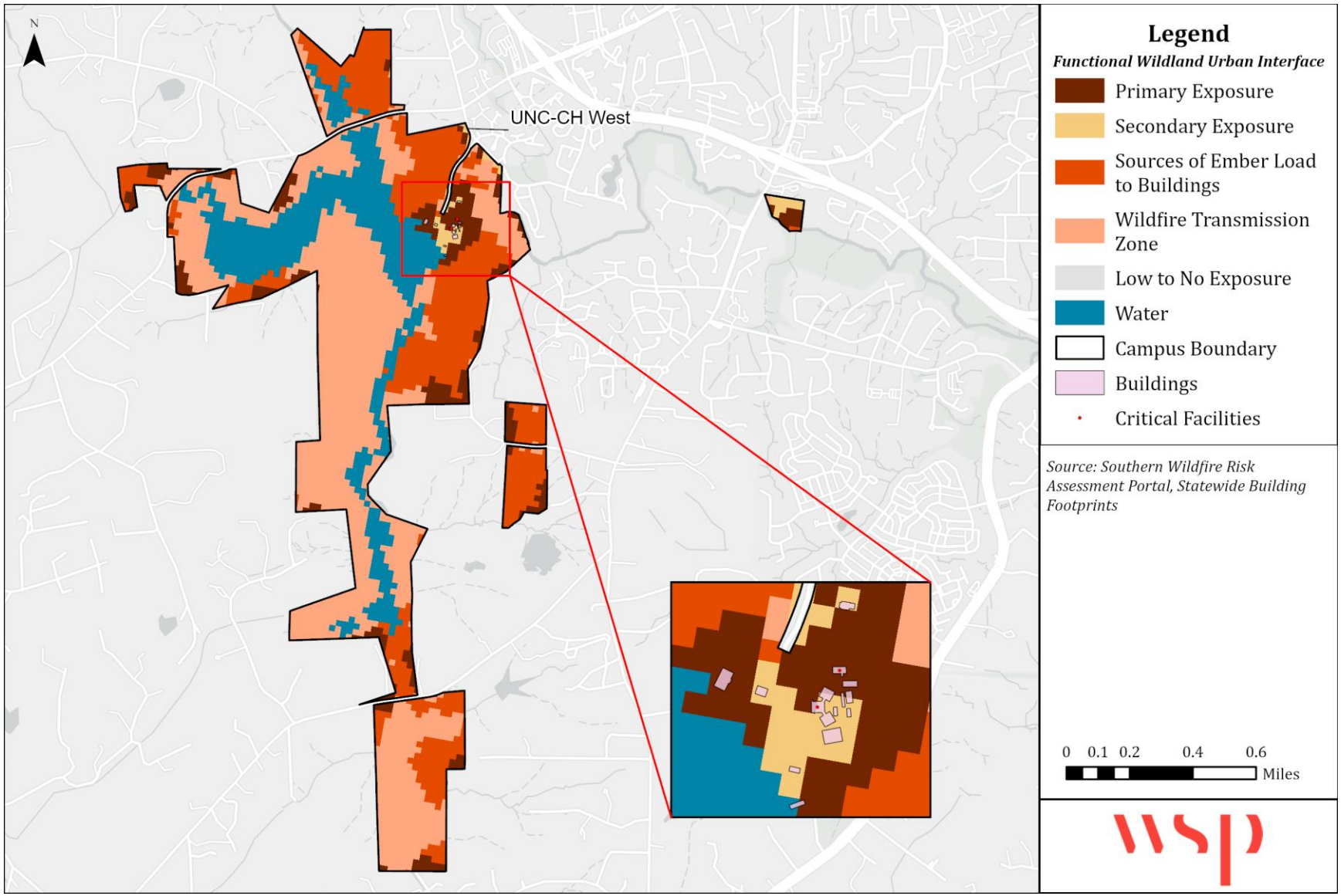


**Figure G.40 – Functional Wildland Urban Interface, UNC-CH West Campus**



## Extent

The entire state is at risk to a wildfire occurrence. 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.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table G.65, consists of five classes, as defined by SWRA. Table G.66 through Table G.70 and Figure G.41 through Figure G.43 detail the characteristic fire intensity scale across the UNC-CH campus.

### Table G.65 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

### Table G.66 – Characteristic Fire Intensity, UNC-CH North Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 145 | 13% |
| | 1 - Very Low | 53 | 5% |
| | 1.5 | 524 | 47% |
| | 2 - Low | 107 | 10% |
| | 2.5 | 2 | 0% |
| | 3 - Moderate | 61 | 6% |
| | 3.5 | 217 | 20% |
| | 4 - High | 1 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **1,109** | **100%** |

### Table G.67 – Characteristic Fire Intensity, UNC-CH Central Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 505 | 63% |
| | 1 - Very Low | 103 | 13% |
| | 1.5 | 132 | 16% |
| | 2 - Low | 42 | 5% |
| | 2.5 | 11 | 1% |
| | 3 - Moderate | 8 | 1% |
| | 3.5 | 3 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **803** | **100%** |

### Table G.68 – Characteristic Fire Intensity, UNC-CH East Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 1 | 5% |
| | 1 - Very Low | 20 | 72% |
| | 1.5 | 6 | 22% |
| | 2 - Low | 0 | 1% |
| | 2.5 | 0 | 0% |
| | 3 - Moderate | 0 | 0% |
| | 3.5 | 0 | 0% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **27** | **100%** |

### Table G.69 – Characteristic Fire Intensity, UNC-CH West Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 157 | 22% |
| | 1 - Very Low | 72 | 10% |
| | 1.5 | 356 | 50% |
| | 2 - Low | 63 | 9% |
| | 2.5 | 1 | 0% |
| | 3 - Moderate | 15 | 2% |
| | 3.5 | 54 | 7% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **717** | **100%** |

**Table G.70 – Characteristic Fire Intensity, UNC-CH South Campus**

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 255 | 19% |
| | 1 - Very Low | 350 | 26% |
| | 1.5 | 532 | 40% |
| | 2 - Low | 130 | 10% |
| | 2.5 | 21 | 2% |
| | 3 - Moderate | 29 | 2% |
| | 3.5 | 17 | 1% |
| | 4 - High | 0 | 0% |
| | 4.5 | 0 | 0% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **1,334** | **100%** |

Around 26 percent of the combined campuses are rated non-burnable. The majority of central campus (63%) and just under a quarter (22%) of west campus is non-burnable. Class 3.5, moderate fire intensity, is the highest category that the campus is exposed to, except 1 acre of north campus falls within category 4 (high fire intensity). Only 7 percent of the total combined campus acreage has class 3.5 fire intensity, however around 20 percent of north campus falls within the 3.5 category. Class 3 has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the campus (63%) have Class 1 to 2.5 fire intensity, which is easily suppressed and classified as very low to low fire intensity.

*Impact: 2 – Limited*

**Figure G.41 – WUI Characteristic Fire Intensity, UNC-CH North Campus**

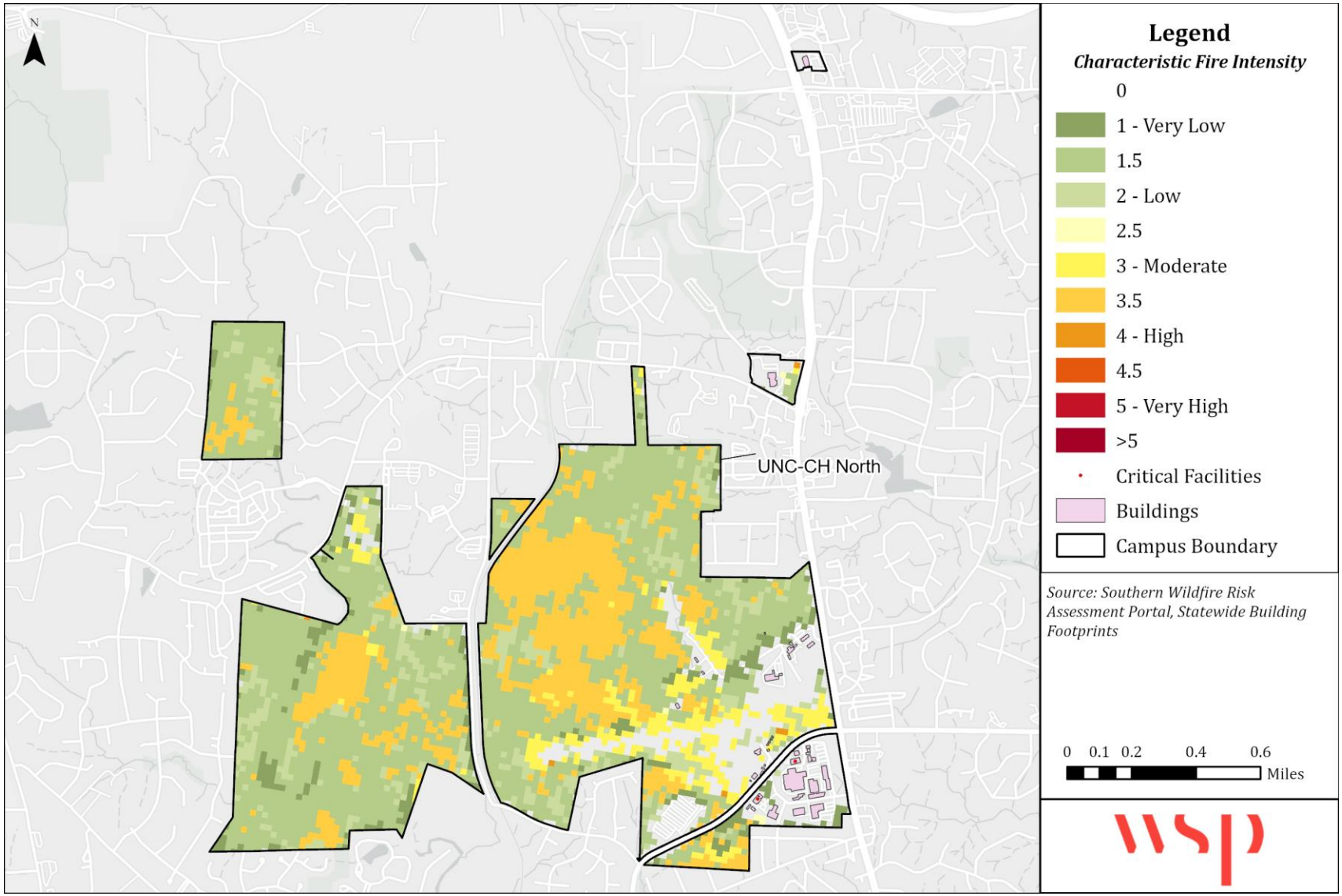


**Figure G.42 – WUI Characteristic Fire Intensity, UNC-CH Central, East, South Campus**

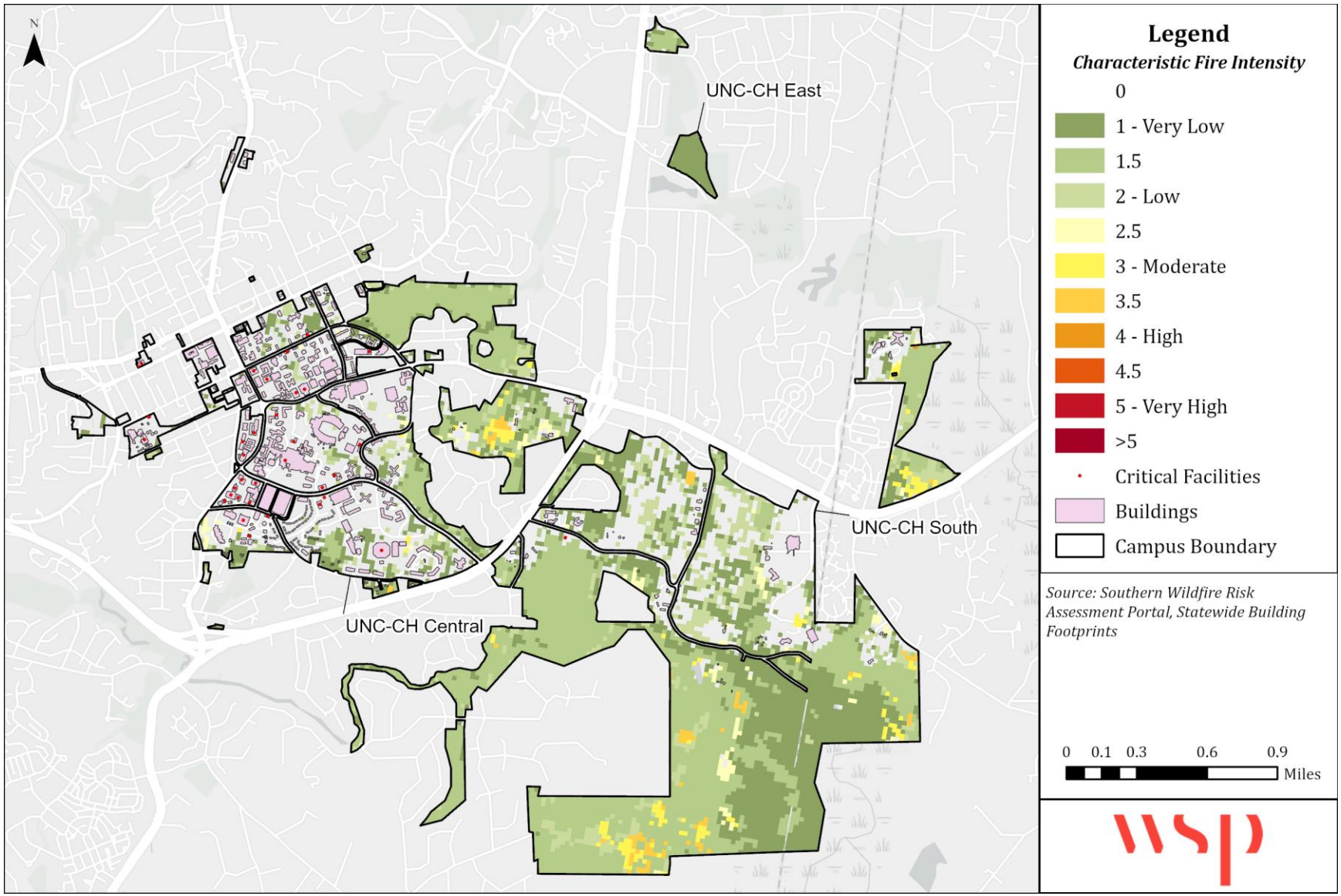
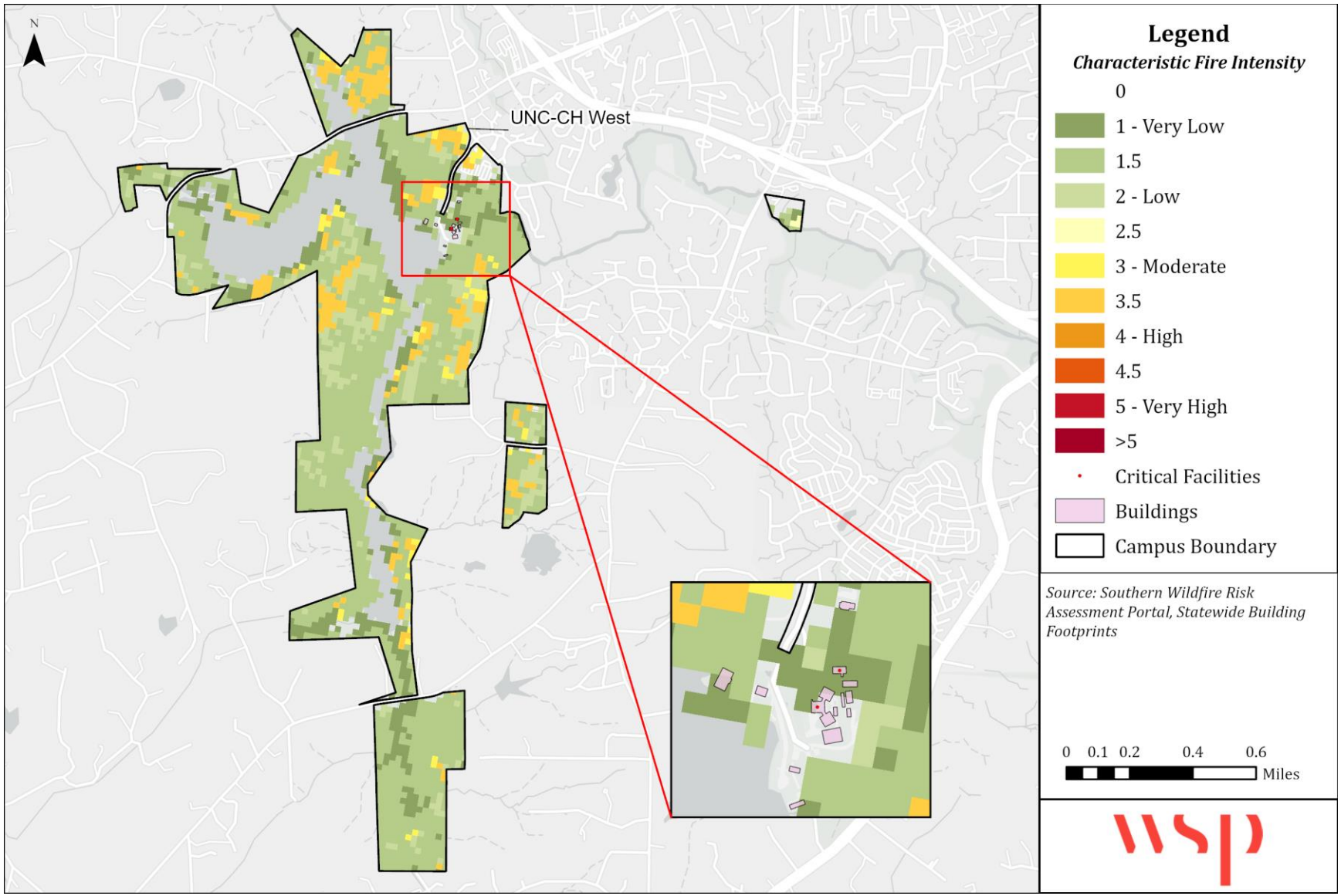


**Figure G.43 – WUI Characteristic Fire Intensity, UNC-CH West Campus**



## Historical Occurrences

Table G.71 lists past occurrences of wildfire in Orange County from 2000-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 1,012 noted wildfires within Orange County between 2000 and 2024. The total acreage burned during this period was 1,340 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Orange County experiences 40.5 fires and 53.6 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 1.32 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table G.71 – Records of Wildfire in Orange County, 2000-2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 2000 | 55 | 43.50 | 0.79 |
| 2001 | 113 | 117.90 | 1.04 |
| 2002 | 85 | 55.60 | 0.65 |
| 2003 | 37 | 28.20 | 0.76 |
| 2004 | 41 | 54.00 | 1.32 |
| 2005 | 40 | 39.20 | 0.98 |
| 2006 | 50 | 73.60 | 1.47 |
| 2007 | 37 | 352.10 | 9.52 |
| 2008 | 22 | 18.30 | 0.83 |
| 2009 | 18 | 46.60 | 2.59 |
| 2010 | 31 | 42.30 | 1.36 |
| 2011 | 35 | 47.50 | 1.36 |
| 2012 | 13 | 31.50 | 2.42 |
| 2013 | 16 | 43.60 | 2.73 |
| 2014 | 23 | 33.50 | 1.46 |
| 2015 | 35 | 46.98 | 1.34 |
| 2016 | 62 | 44.34 | 0.72 |
| 2017 | 74 | 80.81 | 1.09 |
| 2018 | 35 | 21.76 | 0.62 |
| 2019 | 38 | 19.99 | 0.53 |
| 2020 | 27 | 22.90 | 0.85 |
| 2021 | 30 | 35.91 | 1.20 |
| 2022 | 36 | 26.44 | 0.73 |
| 2023 | 37 | 9.38 | 0.25 |
| 2024 | 22 | 4.61 | 0.21 |
| **Total** | **1,012** | **1,340.52** | **1.32** |

Source: North Carolina Forest Service

## Probability of Future Occurrence

The Southern Wildfire Risk Assessment provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the UNC-CH campuses are presented in Table G.72 through Table G.76 and illustrated in Figure G.44 through Figure G.46.

**Table G.72 – Burn Probability, UNC-CH North Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 4 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 101 | 9% |
| | 2/10 | 0.0001000 - 0.0002154 | 358 | 32% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 647 | 58% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **1,109** | **100%** |

**Table G.73 – Burn Probability, UNC-CH Central Campus**

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 647 | 81% |
| | 2/10 | 0.0001000 - 0.0002154 | 156 | 19% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **803** | **100%** |

### Table G.74 – Burn Probability, UNC-CH East Campus

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 1 | 5% |
| | 2/10 | 0.0001000 - 0.0002154 | 26 | 95% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 0 | 0% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **27** | **100%** |

### Table G.75 – Burn Probability, UNC-CH West Campus

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 137 | 19% |
| | 1/10 - Very Low | >0 - 0.0001000 | 70 | 10% |
| | 2/10 | 0.0001000 - 0.0002154 | 392 | 55% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 118 | 17% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **717** | **100%** |

### Table G.76 – Burn Probability, UNC-CH South Campus

| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 5 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 330 | 25% |
| | 2/10 | 0.0001000 - 0.0002154 | 945 | 71% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 53 | 4% |
| | 4/10 | 0.0004642 - 0.0010000 | 0 | 0% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **1,334** | **100%** |

The UNC-CH campuses have very low to low burn probability. Approximately 76 percent of the combined campus has a burn probability of 1 or 2 and around 20 percent has a burn probability of 3. The remaining acreage has little to no burn probability. It should be noted that almost 20 percent of West campus has no burn probability. Based on the SWRA results, the probability of wildfire across the campus is considered unlikely.

*Probability: 2 – Unlikely*

**Figure G.44 – Burn Probability, UNC-CH North Campus**

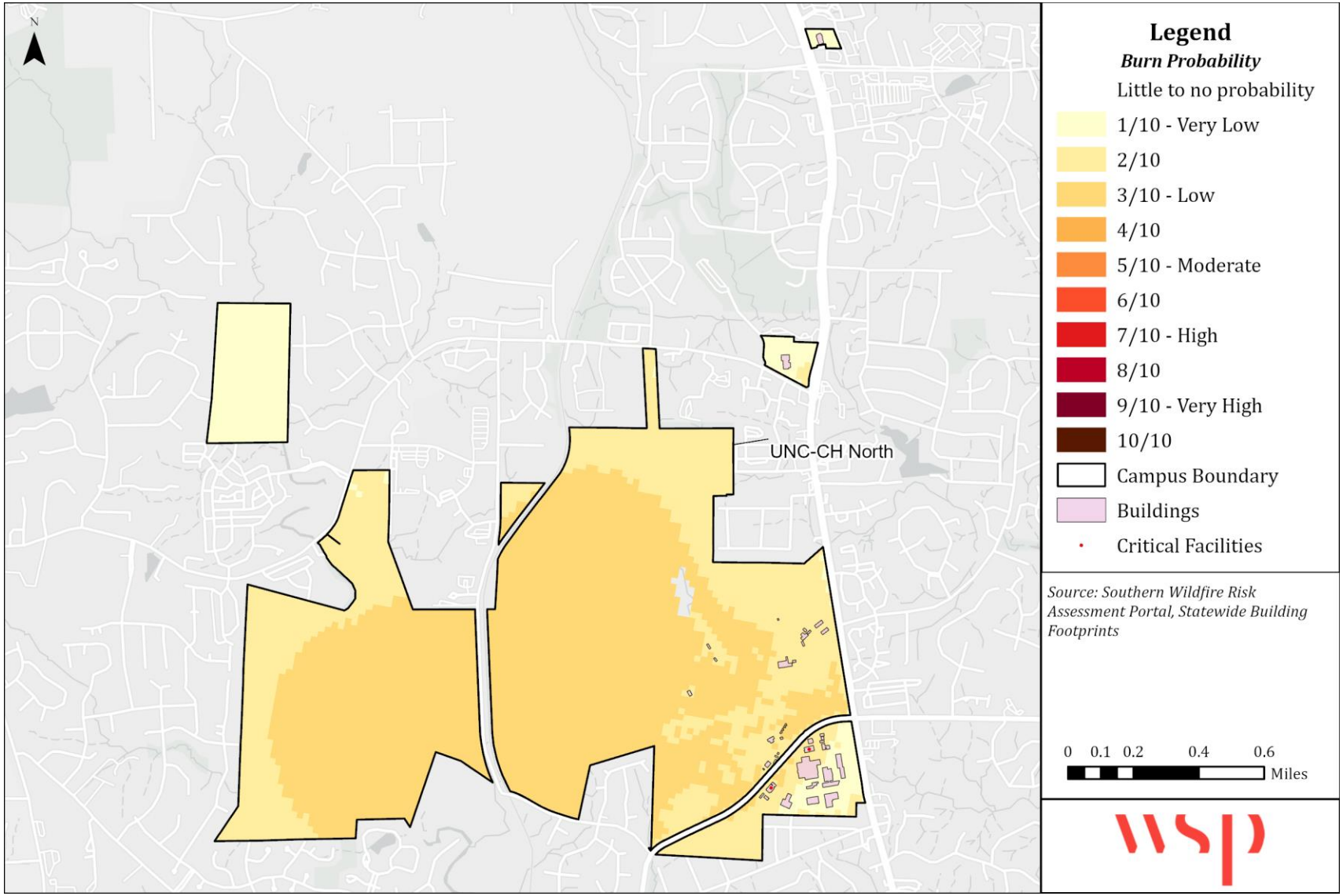


**Figure G.45 – Burn Probability, UNC-CH Central, East, South Campus**

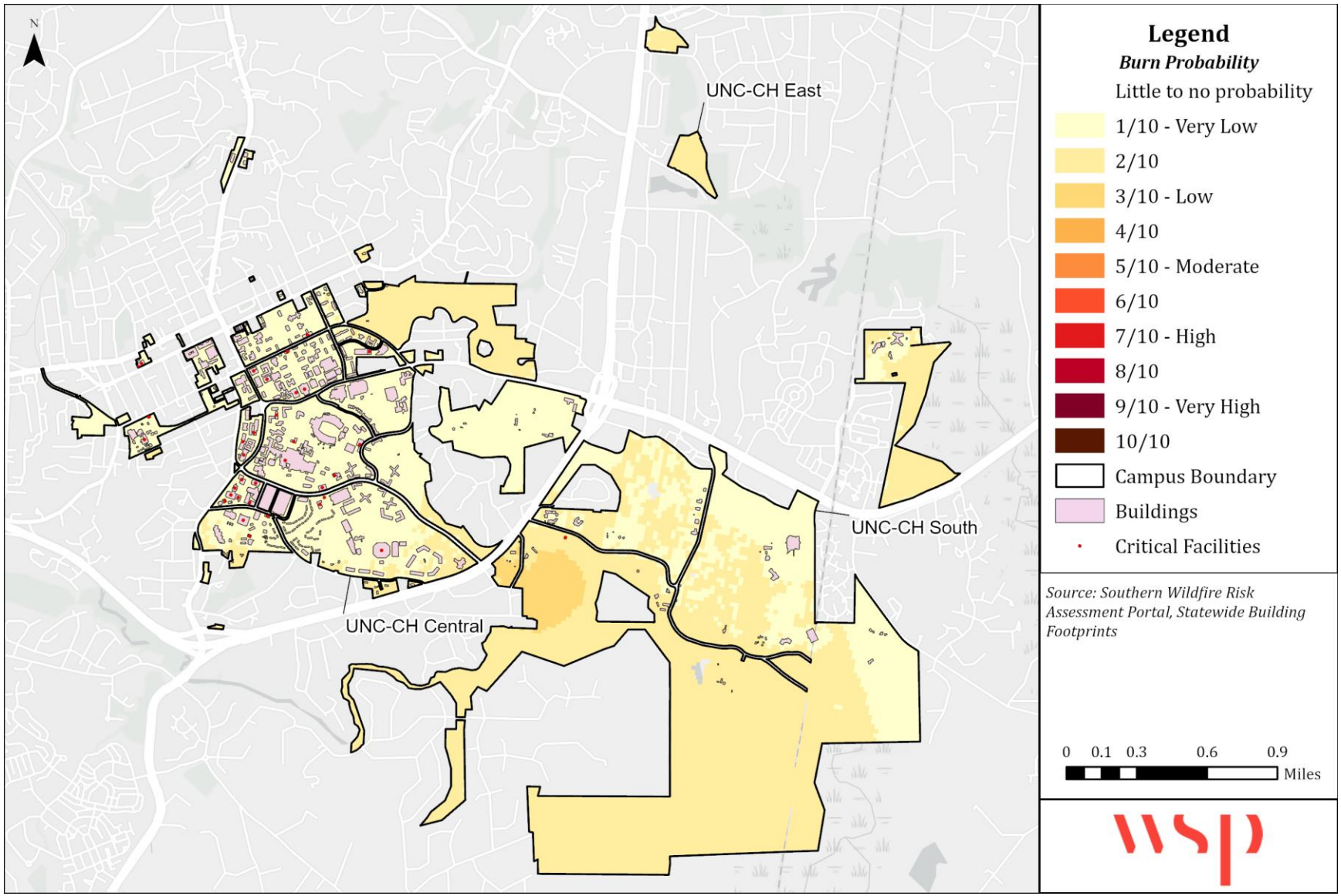
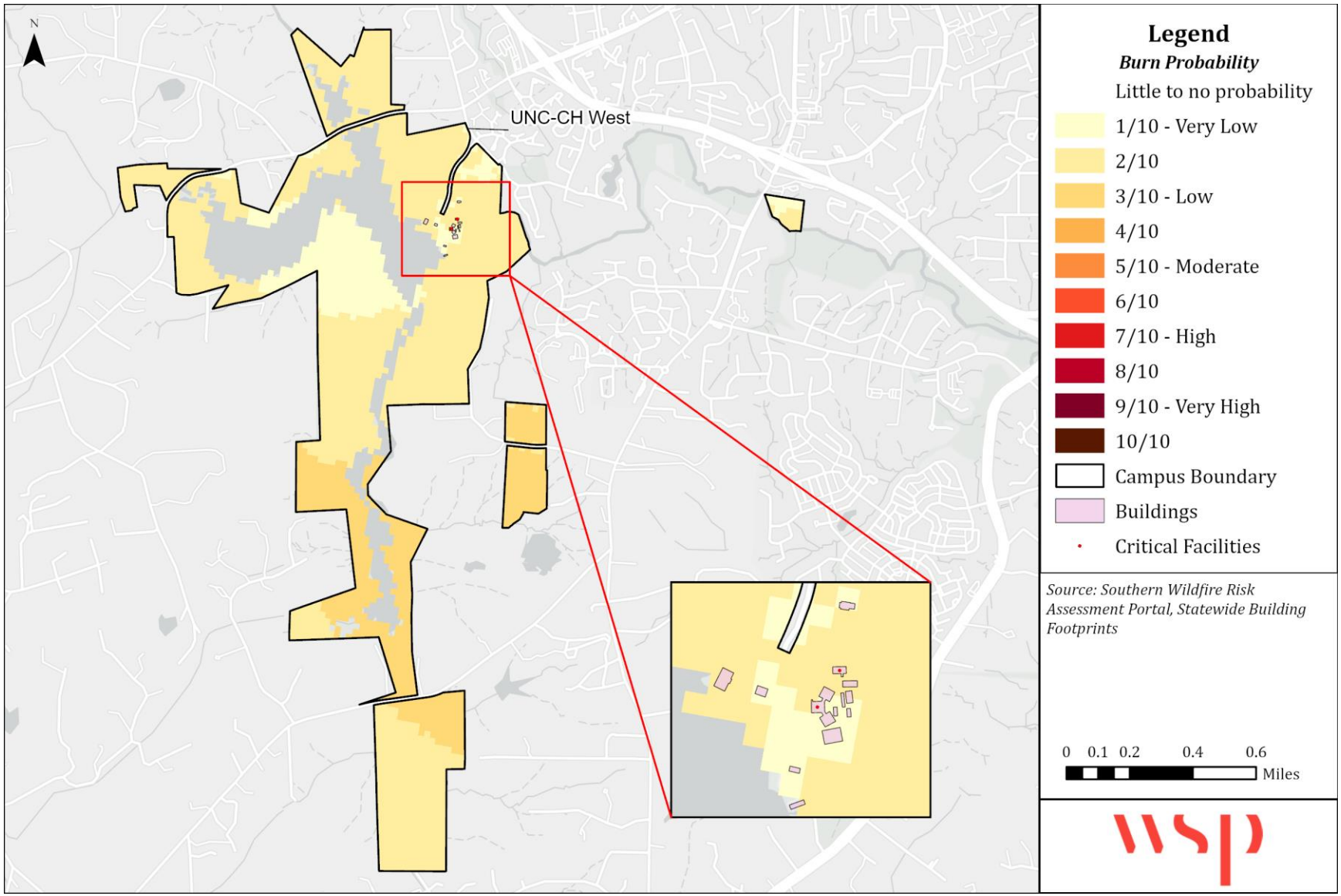


**Figure G.46 – Burn Probability, UNC-CH West Campus**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10.

All of the 454 structures assessed on the UNC-CH campus have a wildfire exposure score of either 1/10, 2/10, or 3/10 which equates to relatively low vulnerability. Table G.77 shows the number and value of campus buildings by occupancy type that fall within Wildfire Exposure Scores 1, 2, and 3.

**Table G.77 – Building Counts and Values within the Wildfire Exposure Score**

| Occupancy | Wildfire Exposure Score 1 | | Wildfire Exposure Score 2 | | Wildfire Exposure Score 3 | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 1 | $26,168,325 | 103 | $588,980,298 | 6 | $5,776,956 |
| Extracurricular/ Educational | 0 | $0 | 245 | $954,429,373 | 25 | $11,654,972 |
| Housing | 0 | $0 | 69 | $224,219,978 | 5 | $1,432,229 |
| **Total** | **1** | **$26,168,325** | **417** | **$1,767,629,649** | **36** | **$18,864,157** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the UNC-CH campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. To reduce wildfire impacts, the University can work with the City and/or County to coordinate fuel reduction efforts, educate residents and campus population, train firefighters, and establish local wildfire management plans. The Orange County Fire & Life Safety Division is responsible for enforcement of the North Carolina fire code which includes fire inspections and permitting, public fire education and community outreach, County fire department coordination, fire investigations, hazardous materials response, and reviewing plans for new building construction. Permits, under the authority of the North Carolina Fire Code, are applied for and issued by Orange County Fire & Life Safety Division.

Although a wildfire community protection plan exists for the state of North Carolina, there are no community wildfire protection plans and no wildfire-specific mitigation review requirements or regulations for development in the wildland-urban interface in Orange County.

## Problem Statements

- The entire UNC-CH campus is located within an identified functional WUI area but has very low fire intensity and burn probability.
- Orange County experiences wildfires on an annual basis with 40.5 fires and 53.6 acres burned annually, as reported by the NCFS. The actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire department.
- Coordination with the Town and County is recommended to reduce fuel efforts and establish a local wildfire management plan.

## G.5.11 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Materials Incident | Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.0 |

### Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of UNC-CH's campus. This site is the Argos Chapel Hill Concrete Plan which is in the Nonmetallic Mineral Product sector. Additionally, the HMPC identified the following critical facilities on UNC-CH's campus with hazardous materials stored on site:

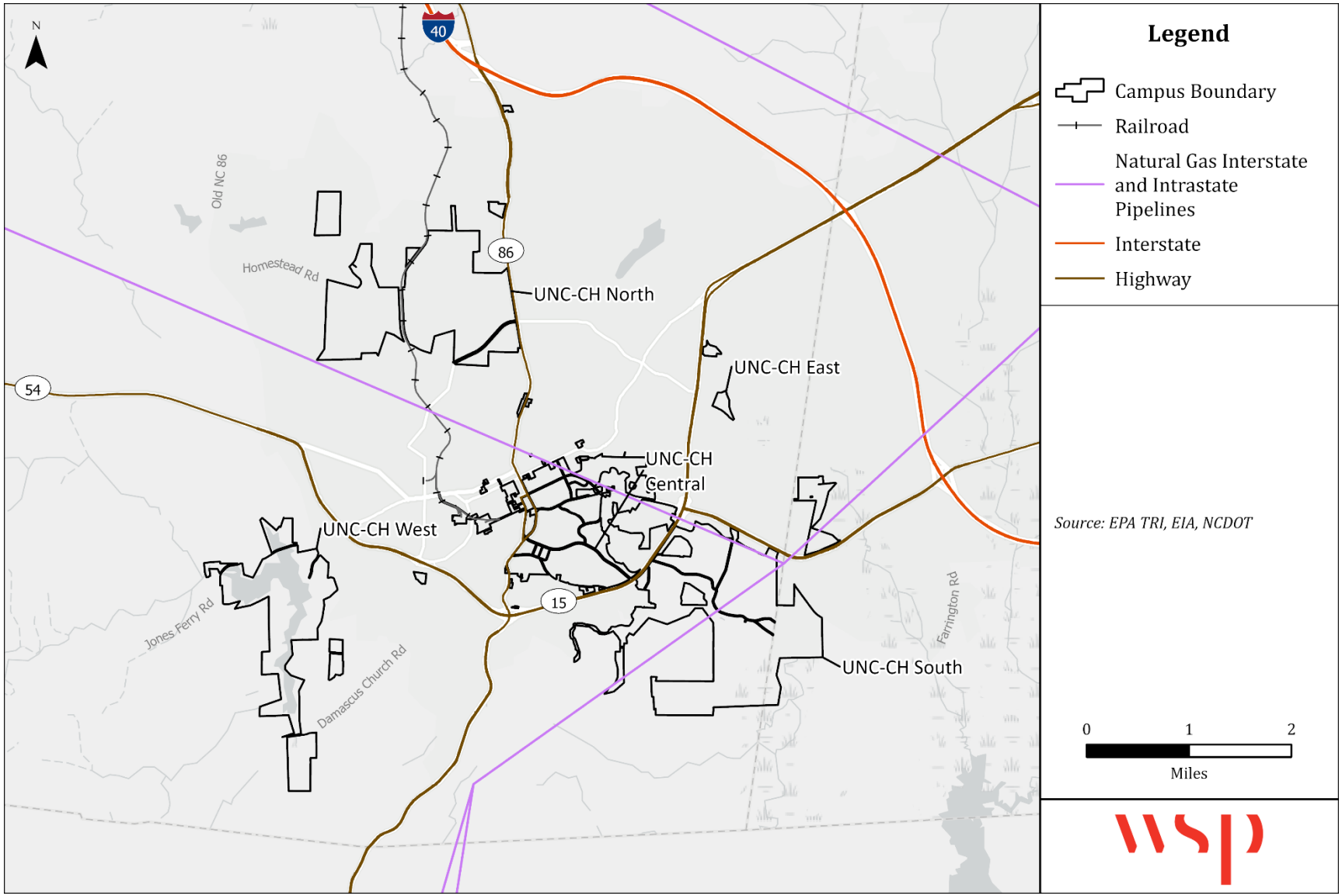
- Bingham Facility Building #1
- Bingham Facility Building #2
- Bingham Facility Building #3
- Burnett-Womack Building
- Caudill, W Lowry, and Susan S Labs
- Chapman Hall
- Davie Hall
- Francis Owen Blood Research Lab
- Genetic Medicine Research Lab
- Hemophilia Research Lab
- Hooker, Michael Research Center
- Jones Building, Dr. Mary Ellen
- Kerr, Banks Dayton Hall
- Koury Oral Health Sciences Building
- Marsico Hall
- McGavran-Greenberg Hall
- Medical Biomolecular Research Building
- Neurosciences Research Building
- Taylor, Isaac M Hall
- Thurston Bowles Building
- Wilson Hall
- Treatment Storage and Disposal Facility in buildings 531 and 488 behind EHS building

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal.

Pipelines exist throughout the state of North Carolina and the planning area and are most commonly used to transport energy sources such as natural gas and petroleum products but are also often used in the transportation of other hazardous liquids. Generally, pipelines are safe and effective, transporting materials where they are needed without incident. Figure G.47 below shows the location of major pipelines and the modes of transportation for hazardous materials adjacent to or through UNC-CH's campus.

*Spatial Extent: 1 – Negligible*

**Figure G.47 – Major Transportation Routes and Pipelines, UNC-CH**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 17 recorded releases in Chapel Hill from 2000 through 2024. Of these events, none were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $21,785 in damage with all incidents occurring on highways and roads. The most common materials spilled in the town of Chapel Hill were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure G.48 describes all nine hazard classes.

**Figure G.48 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 17 incidents of hazardous materials release in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is a 68 percent annual probability of a hazardous materials incident occurring throughout the Town of Chapel Hill.

Although no serious incidents were reported in the Town of Chapel Hill, there is still a small chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 3 – Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However, there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause major long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $21,785 in damage, which equates to an annualized loss of $871 across Chapel Hill.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statements

- Transportation routes for hazardous materials are located adjacent to the UNC-CH campus.
- The number of reported incidents within Chapel Hill can be approximated to 68 percent annual probability.

# G.5.12 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section G.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below. Table G.78 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table G.78 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Dam Failure | Possible | Critical | Negligible | Less than 6 hours | Less than 1 week | 2.4 |
| Drought | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Limited | Moderate | 6 to 12 hrs | Less than 1 week | 3.0 |
| Geological – Landslide | Possible | Minor | Small | 6 to 12 hrs | Less than 6 hrs | 1.7 |
| Hurricane | Possible | Limited | Large | More than 24 hrs | Less than 24 hrs | 2.3 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Unlikely | Limited | Large | More than 24 hrs | More than 1 week | 2.2 |
| Hazardous Substances | Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.0 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table G.79:

- High Risk – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- Moderate Risk – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- Low Risk – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal. This is not a priority hazard.

**Table G.79 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Flooding<br>Severe Winter Weather<br>Tornado & Thunderstorm |
| **Moderate Risk (2.0 – 2.9)** | Dam Failure<br>Drought<br>Hurricane<br>Wildfire<br>Hazardous Substances |
| **Low Risk (< 2.0)** | Earthquake<br>Geological – Landslide |

# G.6 Capability Assessment

This section discusses mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- G.6.1 Overview of Capability Assessment
- G.6.2 Planning and Regulatory Capability
- G.6.3 Administrative and Technical Capability
- G.6.4 Fiscal Capability

## G.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## G.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. Table G.80 lists local plans, ordinances, policies and programs currently in place at UNC-CH.

**Table G.80 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | Carolina Next: Innovations for Public Good |
| Master Plan | Y | UNC-CH Master Plan, 2019 |
| Site plan review requirements | Y | Design Review and Checking System (DrChecks) |
| Capital improvements plan | Y | Facilities Planning and Design; 6yr Capital Plan, Stormwater Master Plan; capital improvement plans for libraries, residence halls, athletic facilities, etc. |
| Local emergency operations plan | Y | Emergency Operations Plan |

More details on several relevant tools are provided below:

- **Strategic Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The UNCH CH 2019 Master Plan informs investments on all university land holdings over a 15-year horizon.
- **Capital Improvement Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC Campus creates and maintains a 6-year CIP, which helps inform the University of North Carolina System's CIP.
- **Stormwater Management Program** seeks to prevent flooding problems caused by stormwater runoff. UNC-CH maintains a Stormwater Master Plan and operates its own stormwater system under the EPA's National Pollutant Discharge Elimination System (NPDES) Phase II Program.
- **Emergency Operations Plan** outlines responsibilities and how resources are deployed during and following an emergency or disaster.

## G.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table G.81 provides a summary of the administrative and technical capabilities for UNC-CH.

**Table G.81 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Facilities Planning and Design |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Engineering Services, Energy Services, Facilities Planning and Design |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Energy Services, Facilities Technology Group, Engineering Services |
| Personnel skilled in GIS | Yes | Facilities Technology Group |
| Emergency Manager | Yes | Emergency Management and Planning |
| Grant Writer | Yes | Various Faculty |
| Public Information Officer | Yes | Communications Department |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | Campus Outdoor Alert System and Electronic Communications |

Additional resources and departments that may support administrative capabilities include the following:

- **Emergency Management and Planning** is housed under the Campus Safety umbrella and plans for emergencies such as pandemics, natural hazards, and other threats to the health and safety of the University
- **Facilities Services** is responsible for maintaining all facilities located on the campus of UNC-CH.
- **Energy Services** oversees all power generation and distribution on campus, as well as water, wastewater and storm water services. The Power Services Office plans for redundancies and power allocation during shortages or outages.
- **Facilities Planning and Design** is comprised of design professionals who are responsible for planning, design and management of all capital improvement projects; campus master planning; and mapping and geographical information.
- **Grounds Services** is in in charge of maintaining all university acreage, including planting, pruning, watering and routine maintenance. The Grounds Services Division is also responsible for snow and ice removal, as well as debris removal following a hazard event.
- **UNC Property Office** manages the real property of the University including endowment properties and properties owned by the University or University's foundation.
- **Information Technologies Services** (ITS) is the central organization providing all members of the UNC-CH community with telecommunications, computer support, networking, applications development, and other computing services for academic and administrative endeavors.
- **Risk Management Services** oversees all insurance policies for university property.
- **UNC Police Department** serve as first responders to any emergency situation on campus which requires recognition and initial assessment of potential hazards in order to activate the UNC-CH Emergency Action Plan.
- **Environmental Health and Safety (EHS)** seeks to maintain a safe environment on campus, ensure regulatory compliance for all campus activities, recognize and control health and safety hazards on campus, and provide education through training and consultation.

## G.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table G.82 provides a summary of the fiscal resources at UNC-CH.

**Table G.82 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y; UNC-CH receives funding from Contracts and Grants, and other income from Interest and Fees |

# G.7 Mitigation Strategy

## G.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is also documented in this plan update. Table G.83 summarizes the status of mitigation actions from the previous plan. Table G.84 on the following pages details all completed and deleted actions from the 2021 plan. More information on the actions being carried forward is provided in the Mitigation Action Plan.

**Table G.83 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| UNC-CH | 1 | 46 | 16 |

## Table G.84 – Completed and Deleted Actions from the 2021 Plan

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: CoGen; Lenoir; Woollen Gym; Kenan Labs Building; Thurston-Bowles Bldg; and MBR Bldg. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC2 | Campus-Wide – Upgrade back-up power capabilities to critical facilities including, but not limited to: Woollen Gym. | Delete | Duplicate with UNC60 |
| UNC3 | CoGen - Five aerials and two small monitoring units are mounted to the roof-edge handrails with inadequate or corroded mounts. High winds will detach this equipment. Upgrade mounts at aerials and small equipment that is mounted to rails. | Completed | |
| UNC4 | CoGen - The guyed stack is missing a guy wire on the west side, making it vulnerable to high winds from the west. Install an additional guy wire and guy anchor at west side of stack. Installation will require new framing for guy anchor. | Delete | No longer a priority |
| UNC7 | CoGen - The loose roof ballast at the Boiler 8 building may be blown off during very high winds and break glass curtain wall panels at the new Boiler and Turbine buildings. During next re-roof, use roof system that does not require loose ballast rock. | Delete | Action is a maintenance activity |
| UNC8 | CoGen - The white metal wall panels at penthouse and at south addition have insufficient fasteners attaching the panels to the girts. Many girts have been weakened by notch cuts to accommodate the cross- bracing. The wall panels are vulnerable to tear-off in high winds. Repair existing notched girts and add additional girts and fasteners at metal wall panel assemblies. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC9 | Lenoir - Gaps between slate and coping at gable details make perimeter slate vulnerable to water infiltration and loss of slates during high winds. Rework perimeter detail to include flashing under edge slates. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC10 | Smith Arena - Loose and corroded fasteners at metal roof eaves, swege laps, and transition flashings reduce security of roof panels, making them vulnerable to leaks and tear-off during high winds. Walk every screw-fastened seam. Tighten loose screws, replace rusty or missing screws. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC11 | Smith Arena - Connections at lower chords of pipe arches are improperly built and have less strength and stability than intended by the design. Design upgrade to existing sleeve connections. Fabricate and install new connection parts at eight lower-chord supports for pipe arches. | Delete | Building does not/no longer meets Critical Facility criteria |

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC12 | Smith Arena - Fabric panel edges are tied to steel cables with thousands of plastic wire ties. Wire ties are not reliable over the long term and increase the vulnerability of the fabric roof to wind damage. Procure and install proper connection ties between fabric panel grommets and adjacent catenary cables. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC13 | Smith Arena - Due to the age of the fabric roof, the system requires specialty inspection to ensure that the fabric, seams, and detailing remain in adequate condition to resist high wind loads. Degradation of the fabric roof components will result in vulnerability to failure during high winds. Specialty inspection of fabric roof panels, sleeves, seams, and grommets for material degradation by age and sunlight. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC14 | Smith Arena - No secondary drains. If primary drains are blocked or overwhelmed, water will back up in gutters and leak into the building at the parapet flashings. Water damage will reduce the uplift resistance of the single-ply. Install secondary drain system or scuppers at parapet walls. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC15 | Smith Arena - 12'-3" by 4'-5" windows of 5/16" plate glass likely do not meet current Code requirements for wind loading, and may blow out during a Code wind event. Progressive loss of windows is a possibility. Study: Perform engineering study on wind loading capacity for existing windows. Determine failure windspeed. Compile costs for window upgrade options. Determine cost/benefit for installing stronger window assemblies. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC16 | Smith Arena - Steel fuel lines are elevated above tank and are exposed to damage by wind-driven debris. Install protective guard around exposed section of fuel line. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC17 | Woollen Gym - Trusses have slender members and long spans with minimal bracing and may fail under high wind loads. Structural analysis of barrel roof trusses, to determine factor of safety under Code-mandated wind loads. Design of structural upgrades for trusses. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC18 | Woollen Gym - Age and condition of metal roof panels and deck makes roof vulnerable to damage and blow-off during high wind leading to water entry, damage, and possible ceiling collapse. Replace roof system at main gym high-house and natatorium high-house. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC19 | Woollen Gym - Large expanse of glass is vulnerable to wind blown debris from adjacent roofs and buildings during high winds and exposes the building interior to water entry and damage. Architectural study for upgrading or replacing glass roof skylight at natatorium. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC20 | Woollen Gym - Unreinforced, 71-year-old brick masonry wall with unbraced vertical span of 31'. Vulnerable to blow- in from wind pressure during severe windstorm. Structural analysis of masonry wall to determine factor of safety under Code wind level. Design of repairs or upgrades as required. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC21 | Woollen Gym - Unreinforced, 66-year-old brick masonry wall with unbraced vertical span of 24'. Vulnerable to blow- in from wind pressure during severe windstorm. Structural analysis of masonry wall to determine factor of safety under Code wind level. Design of repairs or upgrades as required. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC22 | Woollen Gym - Large satellite dish has undersized and corroded mounts. Failure of the mounts during high winds would cause damage to both the roof system and the dish. Install new dish mounts. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC23 | Woollen Gym - Unreinforced, 71-year-old brick masonry wall with no bracing. Mortar deteriorated on both sides. Vulnerable to push-over in severe windstorm. Failure of parapet could lead to failure of south wall and hole in barrel roof. Repair face brick and repoint mortar. Install parapet bracing. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |
| UNC24 | Woollen Gym - Large fragile 54-pane frames with swing-sashes. Vulnerable to breakage by flying slate from Women's Gym, glass panes from pool roof, and roof gravel from Fetzer. Vulnerable to blow-in from wind pressure during severe windstorm. Architectural study for replacing window frames and glazing. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC25 | Woollen Gym - Large 9-pane frames positioned just above grade. Vulnerable to breakage by debris blowing across ground. Architectural study for replacing window frames and glazing. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC26 | Woollen Gym - Large fragile 48-pane frames positioned just above grade. Vulnerable to breakage by debris blowing across parking lot. Architectural study for replacing window frames and glazing. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC27 | Woollen Gym - Several windows within range of tree branches. Vulnerable to breakage by tree damage during high winds. Architectural study for replacing window frames and glazing. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC28 | Woollen Gym - West wall of main gym includes 12 large, fragile windows assemblies, each with 54 panes. Broken glass during severe windstorm will hamper use of exits at this wall. Architectural study for replacing window frames and glazing. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC29 | Woollen Gym - Six exits from main gym empty into narrow alley. Exit path is below large windows at main gym's west wall, and adjacent to glass roof and ridge monitor at natatorium. Alley may be strewn with broken glass during a severe windstorm and be impassable, blocking exit and emergency access for main gym. Architectural study for proving overhead protection for alley. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC33 | Thurston-Bowles Bldg - Unanchored metal tables could shift and topple in high winds, blocking exit routes along the east side of the building. Mitigate by anchoring tables to plaza. As described for UNC50 | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC34 | Thurston-Bowles Bldg - Inadequate bolts at base. Crane is corroded and in poor condition. Unit and/or crane could blow off during high winds damaging unit, roof, and penthouse. Remove crane and discard. Install additional mounting fasteners and hardware to secure blower to penthouse roof. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC35 | Thurston-Bowles Bldg - Loose and missing fasteners at inside face of coping. Coping could blow off allowing water entry into masonry wall. Install additional fasteners. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC36 | Thurston-Bowles Bldg - Damaged counterflashing and fastener spacing at termination bar and counterflashing in excess of 8”. Flashings could blow off causing water entry and damage to roof system. Replace damaged counterflashing and add fasteners where spacing exceeds 8". | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC37 | Thurston-Bowles Bldg - Raised edge detail is canted inward increasing vulnerability of detail to wind loads and water entry. Refasten and seal canted edge. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC38 | Thurston-Bowles Bldg - Metal tables with rigid umbrellas are unanchored, and high winds could drive the tables into the storefront windows and doors at the cafeteria. Anchoring the tables would mitigate this hazard. Secure metal tables to plaza deck. Replace metal umbrellas with lighter, foldable fabric umbrellas. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC39 | Thurston-Bowles Bldg - Corroded cabinet and mounting screws. Cabinets could overturn or come loose during high winds, damaging the cabinet, roof, and electrical connections within. Clean and coat corroded steel panels. Install additional fasteners at base. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC40 | Thurston-Bowles Bldg - Corroded isolators and fasteners at mounts. Units could become dismounted during high winds, damaging the units, roof, and support frames. Clean and coat mounting frames. Replace isolators. Replace all fasteners with stainless. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC45 | MBR Bldg - Areas of main roof show wind scour of ballast, reducing wind uplift resistance, exposing geotextile fabric to UV, and allowing displacement of protective insulation. Redistribute existing ballast over bare areas. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC46 | MBR Bldg - Infill stud walls are not reliably attached to steel framing at penthouse. Stud walls are vulnerable to blow-in during high winds, with resulting equipment and water damage within penthouse. Add fasteners between bottom plate of stud wall and support curb, and between top plate and spandrel beam. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC47 | MBR Bldg - Need for proactive inspection, maintenance, repair, and replacement program. Perform regular roof inspection and maintenance, and replace roof on schedule. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC50 | MBR Bldg - Downspouts are minimally secured to the adjacent penthouse walls and could come loose in high wind events causing damage to adjacent roof system and pedestrians below. Install additional downspout mounts. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC51 | MBR Bldg - Wood fins and metal parts could be dislodged by high winds, producing wind-blown debris at main exit area. The pergola and its parts should be inspected for proper connections and sound parts. Inspect decorative hardware at top of pergola. Improve connections as required to make parts secure. | Delete | Project Work Not Started Due to Inadequate Funding; Action is maintenance |
| UNC53 | Carmichael Residence Hall - Window walls at stairs are vulnerable to wind-driven roof gravel and tree parts, and to falling trees. Broken glass walls will hamper egress down stairs and cause interior water damage. 1. Next Reroof: Non-gravel system $0. 2. Remove (16) trees closest to building, plus aggressive trimming at (10) others. $63,000. 3. Architectural Study: Replace building glass with impact- resistant glass. Study cost $25,000. Construction cost not estimated at this time. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC54 | Carmichael Residence Hall - Large expanse of glass is within fall shadows of tall oaks. During high winds, the window wall is likely to be broken by wind-driven tree parts or falling trees. Will hamper building egress and cause interior water damage. 1. Next Reroof: Non-gravel system $0. 2. Remove (16) trees closest to building, plus aggressive trimming at (10) others. $63,000. 3. Architectural Study: Replace building glass with impact- resistant glass. Study cost $25,000. Construction cost not estimated at this time. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC55 | Carmichael Residence Hall - Exhaust pipe makes a horizontal run from building, supported by a single stanchion. Pipe is exposed to damage from falling tress and wind-driven debris. Re-route exhaust pipe or construct protective guard. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC56 | Carmichael Residence Hall - Rear building exits lead to difficult escape route. Rear site is narrow, with steep grade and many trees. Fences limit escape options. Entire area likely to be impassable after a severe wind storm, making the four rear exits at building ineffective. Landscape Architectural Study/ Design/ Costing: Design exit routing for north side of site, and rework stairs and ramp at south | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC57 | Carmichael Residence Hall - Front exit/access routes are an exterior stair and a narrow ramp. No vehicle access for emergency and repair equipment. Both will likely be blocked by fallen trees after a severe windstorm, hampering pedestrian escape routes. side for better emergency routing for pedestrians and vehicles. Study/ Design cost $65,000. Construction cost not estimated at this time. | Delete | Building does not/no longer meets Critical Facility criteria |
| UNC58 | Carmichael Residence Hall - Isolated fascia/edge metal sections are loose. High winds can tear off loose flashing, precipitate a failure of the adjacent roof system, and expose roof and wall assemblies to water entry and damage. Check all fascia and edge metal for coping for proper attachment. Install new fasteners where missing or broken. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |

| Item # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNC59 | Carmichael Residence Hall - Face width of single-piece metal fascia exceeds 8" making it vulnerable to wind damage. Fascia sections that tear off in high winds can precipitate a failure in the adjacent roof system, and expose roof and wall assemblies to water entry and damage. Cut metal fascia to 8" width or less. | Delete | Building does not/no longer meets Critical Facility criteria; Action is maintenance |

## G.7.2 Mitigation Action Plan

**Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include an] action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.**

Table G.85 comprises the mitigation action plan for UNC-CH. Each mitigation action recommended for implementation is listed in these tables along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead department responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table G.85 – Mitigation Action Plan, UNC-CH**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNC1 | Campus-Wide – For critical facilities with a roof that is at or near the end of its service life, replace roof with one that has a continuous load path and provides increased resistance to wind and driving rain. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Structural Projects | Facilities Services | $480,000 per site | State/Federal Grants | 2026-2030 | Carry Forward | Project Work Started But Not Completed Due to Inadequate Funding |
| UNC2 | CoGen - Tall square ducts can be rocked by hand, and have under-deck mounts that are not rigid. They are vulnerable to being toppled by high winds. Rework and upgrade base attachments, or add guy wires to support upper part of vent stack. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Property Protection | Energy Services | $12,000 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC3 | CoGen - The curtain walls are well-built and in good condition, but were designed under a more lenient Code. Due to the vast extent of glass on these large buildings, it is prudent to check their resistance to blow-out in high winds. Study Only: Engineering or architectural study to wind load capacity of existing glass and aluminum panels, compare to current Code requirements, estimate cost of upgraded panels, and determine cost/ benefit of upgrading panels. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Structural Projects | Energy Services | $45,000 | Operating Budget, State/ Federal Grants | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC4 | Kenan Labs Building - At courtyard north of Towers B & C, landscaping gravel could be driven by high winds to break glass at ground floor windows and doors. Install concrete pavers at graveled area. | Hurricane, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Facilities Services | $24,000 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC5 | Thurston-Bowles Bldg - Fuel lines near tank are exposed to damage from flying debris during high winds. Mitigate by re-routing or protecting the lines. Install shields for fuel lines near tank. | Hurricane, Tornadoes & Thunderstorms | 1.1 | M | Structural Projects | Facilities Services | $4,000 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC6 | Thurston-Bowles Bldg - Old-style roll-up metal door are notorious for failing during high winds. Inspect the door and determine its wind rating (if any). Inspect door for wind rating. Inspect anchorage of door frame. Possibly replace with door of modern wind rating. | Hurricane, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Facilities Services | $1,000 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC7 | MBR Bldg - The MBR roof system includes large ballast stone and a very low parapet. During very high winds, stone could be blown off the roof and impact and break windows. Mitigation depends on overall University roofing strategy. Same as for UNC58. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Property Protection | Facilities Services | n/a | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC8 | MBR Bldg - Ballast in-place may not be adequate to resist required code wind loads with the current materials, building height, and parapet conditions (SPRI/ ANSI standard). High winds could cause scour of ballast, displacement of insulation, or blow-off of ballast and protective components from the roof system. ENGINEERING STUDY prior to replacement of ballast stone: Make a detailed analysis of wind uplift forces near edges, corners, and field. Determine if existing stone ballast is adequate, and to what windspeed. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Property Protection | Facilities Services | $25,000 | Operating Budget, State/ Federal Grants | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNC9 | MBR Bldg - Operable decorative metal grille panels provide emergency firefighter access at stair landings. Panels are poorly mounted and have inadequate pin latches. High winds could open grille or dislodge its frame, creating hazard for people using the stairs. Install additional and more robust mounting bolts between panel frame and masonry wall. Install additional quick-release pin latches at exterior for firefighter use. | Hurricane, Tornadoes & Thunderstorms | 1.1 | H | Property Protection | Facilities Services | $34,000 | Operating Budget, State/ Federal Grants | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC10 | MBR Bldg - Lightning protection cable has detached from metal panels at multiple locations and may affect proper performance of the system, or cause damage during high wind events. Repair broken cable mounts. | Hurricane, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Facilities Services | $2,500 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC11 | MBR Bldg - Fuel lines, conduits, and utility equipment at fuel tank are exposed to damage from wind-blown debris. Re-routing or protective guards would mitigate these hazards. Install protective guards around fuel lines, conduits, and electrical boxes at and near fuel tank | Hurricane, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Facilities Services | $8,000 | Operating Budget | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC12 | Assess auxiliary power and water intrusion prevention capacity and conditions for critical campus infrastructure and building, and where necessary, retrofit critical facilities with emergency generators, generator hook-ups, and/or leak detectors for improved resilience to all hazards. | All Hazards | 1.1 | H | Property Protection | Facilities Services | To be determined | Operating Budget, State/ Federal Grants | 2026-2030 | Carry Forward | Project Work Not Started Due to Inadequate Funding |
| UNC13 | Implement actions to establish and/or enhance public information and education activities and programs that promote community awareness of natural hazards and mitigation techniques available for them to employ to minimize the impact of such hazards on people, property, and the environment. | All Hazards | 2.1 | H | Public Education | Facilities Services | To be determined | Operating Budget | 2026-2030 | Carry Forward | This action remains ongoing as the university continues to expand hazard awareness and preparedness outreach through emergency management communications, training, and campus safety initiatives. Progress to date includes integrating hazard preparedness messaging into campus communications and planning efforts, with additional program development planned as part of ongoing emergency management and resilience initiatives. |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNC14 | Identify and implement systems and measures to improve drainage throughout campus to avoid nuisance flooding in older campus buildings, roads, and parking lots. This includes improved building drainage and roofing systems. | All Hazards | 1.1 | H | Structural Projects | Facilities Services | To be determined | Operating Budget, State/ Federal Grants | 2026-2030 | Carry Forward | This action remains ongoing as drainage improvements are incorporated into facilities maintenance and capital improvement projects across campus as funding and project opportunities arise. Progress includes the evaluation of nuisance flooding areas and implementation of targeted stormwater, drainage, and roofing system upgrades to reduce localized flooding risks. |
| UNC15 | Campus-Wide – Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational when normal power supply is not available. | All Hazards | 3.2 | H | Property Protection | Facilities Services | $25,000-$100,000 per site | State/Federal Grants | 2026-2030 | New | |
| UNC16 | Evaluate and implement mitigation strategies at the Laurel Hill Road culvert crossing to reduce the risk of roadway undermining and sinkhole formation during flood events, including culvert outlet stabilization, roadway structural reinforcement, and erosion control measures. | Flooding | 1.1 | H | Structural Projects | Emergency Management & Planning, Facilities Department | $360,000 - $2MIL | Operating Budget, State/ Federal Grants | 2026-2030 | New | |
| UNC17 | Seek funding to install a replacement generator at the Environmental Health & Safety building to ensure continuity of Emergency Operations Center (EOC) functions during power outages. | All Hazards | 1.2 | H | Structural Projects | Emergency Management & Planning | $450,000 | State/Federal Grants | 2026-2030 | New | |
| UNC18 | Implement actions to establish and/or enhance public information and education activities and programs that promote community awareness of natural hazards and mitigation techniques available for them to employ to minimize the impact of such hazards on people, property, and the environment. | All Hazards | 2.1 | H | Public Education | Emergency Management & Planning | To be determined | Operating Budget | 2026-2030 | New | |
| UNC19 | Continue development of Emergency Action Plans (EAP) to create/update evacuation and shelter in place procedures for buildings in Tier 1, 2, & 3. | All Hazards | 2.3 | H | Emergency Services | Emergency Management & Planning | To be determined | Operating Budget | 2026-2030 | New | |
| UNC20 | Identify and implement mitigation measures at the Mason Farm Biological Reserve low water crossing to reduce debris and sediment blockage during flood events, including improvements to culvert maintenance, sediment management, and debris removal upstream and downstream of the crossing. | Flooding | 1.3 | M | Natural Resource Protection | Emergency Management & Planning, Facilities Services | $141,000 | State/Federal Grants | 2026-2030 | New | |
| UNC21 | Evaluate and implement protective measures to prevent stormwater intrusion at entrance points of the Student Recreation Center, Rams Head Recreation Center, and Frank Porter Graham Child Development Center, including installation of deployable floodgates and other entryway protection systems to reduce the risk of interior flooring and facility damage during extreme rainfall events. | Flooding | 1.1 | M | Property Protection | Emergency Management & Planning, Facilities Services | To be determined | State/Federal Grants | 2026-2030 | New | |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNC22 | Identify and implement mitigation measures for the Frances Owen Blood Research Lab to reduce future flood risk from Morgan Creek, including evaluating relocation outside of the floodplain and implementing floodproofing and structural anchorage improvements where feasible. | Flooding | 1.2 | M | Property Protection | Emergency Management & Planning. Facilities Services | To be determined | State/Federal Grants | 2026-2030 | New | |
| UNC23 | Promote campus awareness and preparedness for extreme heat events through public education campaigns focused on heat safety, hydration, and recognition of heat-related illness. | Excessive Heat | 2.1, 2.2 | H | Public Education | Environment, Health & Safety | To be determined | Operating Budget | 2026-2030 | New | |
| UNC24 | Coordinate with campus partners to plan for and provide accessible cooling/hydration stations and designated safe spaces during large-scale campus events to reduce heat-related health risks during extreme heat conditions. | Excessive Heat | 2.2 | M | Public Education | Environment, Health & Safety | To be determined | Operating Budget | 2026-2030 | New | |
| UNC25 | Coordinate with campus planning and facilities stakeholders to ensure new construction in the Campus North development area incorporates resilience and hazard mitigation strategies that reduce long-term vulnerabilities. | All Hazards | 3.1 | M | Prevention | Facilities Planning & Design, Construction & Engineering | To be determined | Operating Budget | 2026-2030 | New | |
| UNC26 | Develop and implement procedures to support campus safety during severe winter weather events, including conducting safety checks of campus conditions and increasing public awareness of safe travel routes and accessible pathways during and after winter weather. | Severe Winter Weather | 2.2 | H | Public Education | Campus Safety | To be determined | Operating | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM




# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

## Annex H: University of North Carolina at Pembroke

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# Annex H. University of North Carolina – Pembroke

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to University of North Carolina at Pembroke (UNCP). This section contains the following subsections:

- H.1 Planning Process Details
- H.2 Campus Profile
- H.3 Asset Inventory
- H.4 Hazard Identification
- H.5 Hazard Profiles, Analysis, and Vulnerability
- H.6 Capability Assessment
- H.7 Mitigation Strategy

## H.1 Planning Process Details

The table below lists the HMPC members who represented UNCP during the planning process.

**Table H.1 – HMPC Members**

| Representative | Role; Department |
|---|---|
| Charles Chavis | Environmental, Health, and Safety Professional; Environmental Health and Safety |
| Dr. Kyle Smith | Dean of Students; Student Affairs |
| George Johnson | Chief/Director; Police and Public Safety |
| Michael Bullard | Director; Environmental Health and Safety Office |
| Dr. Christie Poteet | Assistant Vice Chancellor for Student Affairs; Student Health Services |
| Victor Deese | Assistant Vice Chancellor for Facilities; Facilities Management |
| Dr. Scott Billingsley | Asst VC for Planning and Accreditation; Academic Affairs |
| Andrea Jacobs | Executive Assistant; Athletics |
| Katina Blue | Associate Vice Chancelor for Information Resources/CIO; Division of Information Technology |
| Mark Vesely | Director of Operation and Maintenance; Facilities Management |
| Joshua Johnson | Director; Student Health Services |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table H.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| UNCP Campus Master Plan | The UNCP Campus Master Plan, developed in 2011, was referenced for the Campus Profile in Section H.2 as well as the Capability Assessment in Section H.6 |
| Robeson County and Incorporated Areas Flood Insurance Study (FIS), Revised 12/06/2019 | The FIS report was referenced in the preparation of flood hazard profile in Section H.5. |
| UNC System Eastern Campuses HMP, 2021 | The previous UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section H.5. The plan was additionally used to track implementation progress (Section 2) and develop the mitigation plan (Section 7). |
| Bladen-Columbus-Robeson Regional Hazard Mitigation Plan, 2020 | The Bladen-Columbus-Robeson Regional Hazard Mitigation Plan was referenced in compiling the Hazard Identification and Risk Assessment in Section H.5. Robeson County is participating in the 2025 update to the Regional HMP. |

# H.2 Campus Profile

This section provides a general overview of the University of North Carolina at Pembroke (UNCP) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

## H.2.1 Location and Setting

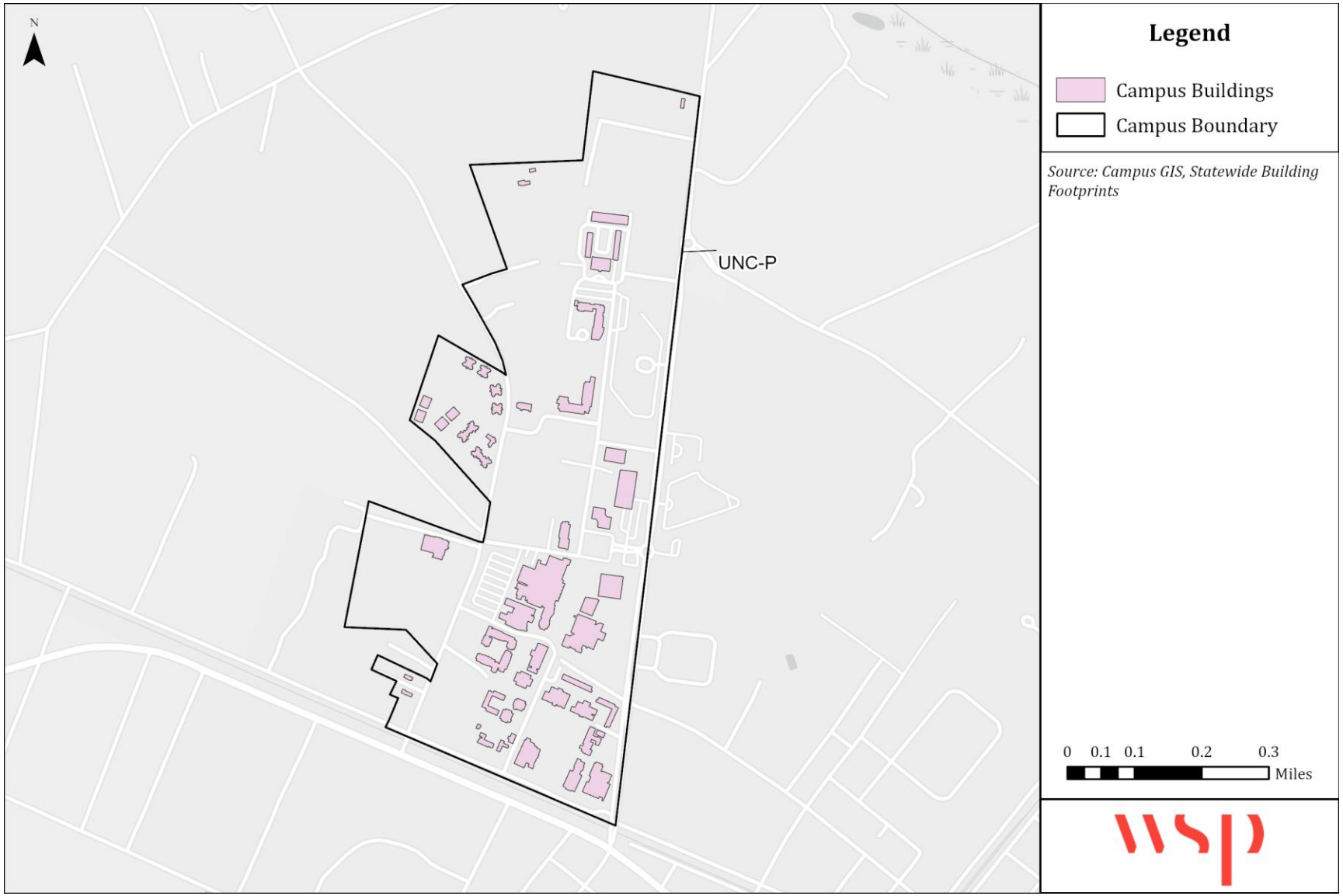
The University of North Carolina at Pembroke is in Pembroke, North Carolina. Pembroke is the historic home of UNCP and the Lumbee Tribe of North Carolina. Along with having a rich American Indian history, it is also one of the safest campuses in the University of North Carolina (UNC) System. The Town of Pembroke is convenient to most metro areas in North Carolina and nearby states, coastal beaches in the East, mountains in the West, and the famous golf courses of Pinehurst.

UNCP has a campus size of 281 acres and consists of more than 50 buildings. It has grown significantly over the last decade and offers 35 undergraduate and 19 graduate degrees. UNCP also has more than 120 student organizations, along with more than 25 intramural and club sports programs and 16 Division II varsity teams, which help cater to any area of interest a student may have, whether it be political, athletic, professional, social, ethnic, or academic. UNCP is known for small classes, close interaction with faculty, community involvement, and diversity.

The University is located approximately 10 miles from the intersection of Interstate 95 and US Highway 74 in Lumberton. UNCP has a partnership with South East Area Transit System (SEATS) to provide transportation to and from campus along with key locations in Pembroke for students, faculty, and staff. Other modes of transportation offered on campus include a shuttle service and bicycle rental program. The campus even has car charging stations for Plug-In Electric Vehicles (PEV).

Figure H.1 provides a base map of the campus. For more details on campus buildings and critical facilities, see Section H.3.

**Figure H.1 – UNC Pembroke Campus Base Map**



## H.2.2 Geography and Climate

The University of North Carolina at Pembroke is in Pembroke, in the southern part of North Carolina's Inner Coastal Plain region. Pembroke has an elevation of 171 feet above sea level and UNCP's campus is largely flat with a few rolling hills. Pembroke has a moderate climate with max temperatures dropping to 54 degrees Fahrenheit on average in January and climbing to 90 degrees Fahrenheit on average in July. The annual precipitation for the area is approximately 45 inches per year.

**Figure H.2 – Average Annual Temperature, Robeson County**

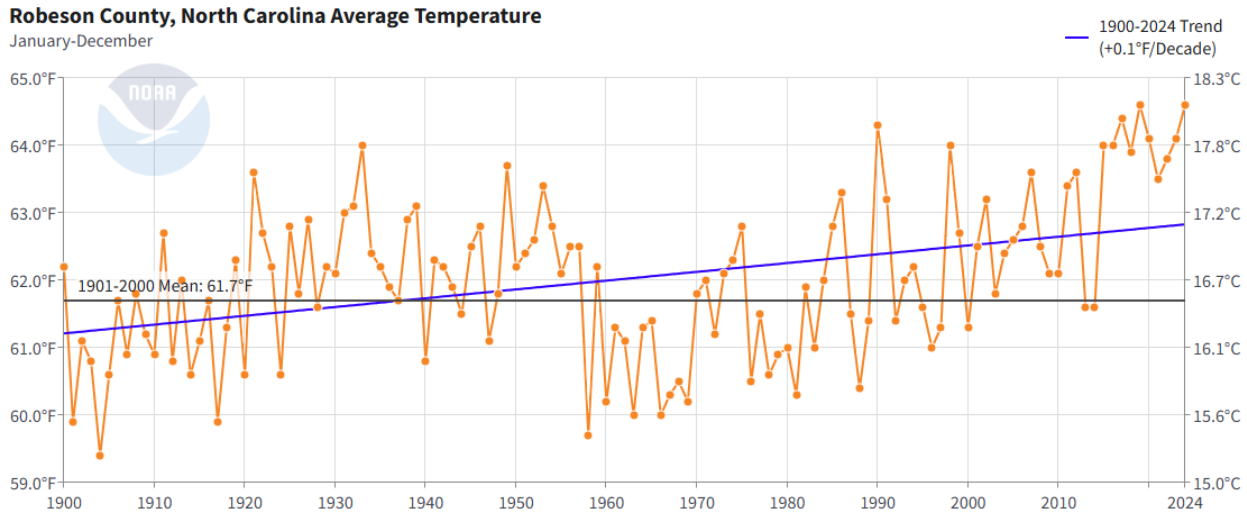
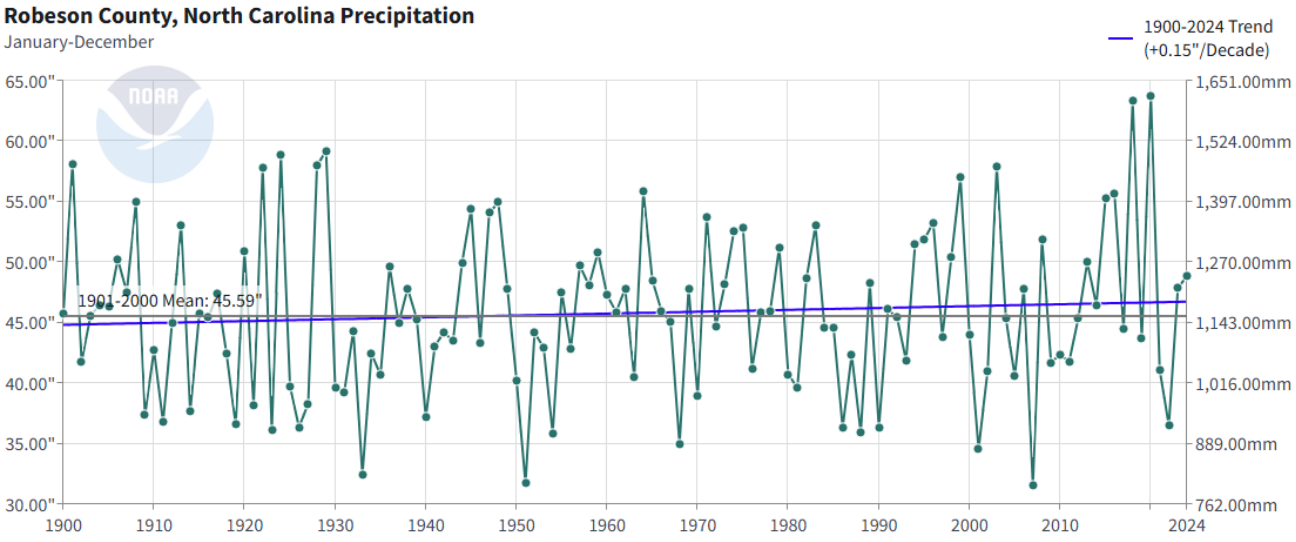



**Figure H.3 – Average Annual Precipitation, Robeson County**



## H.2.3 Population and Demographics

Table H.3 provides population counts for University of North Carolina Pembroke from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to UNC-P's website, the campus currently has a student to faculty ratio of 18 to 1. The HMPC reported 2025 student enrollment slightly higher at 8,089. There are also 989 faculty and staff permanent employees on campus.

**Table H.3 – Population Counts for UNC Pembroke, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **8,075** |
| *Undergraduate Students* | 5,648 |
| *Graduate Students* | 2,427 |
| *Full-Time Students* | 6,765 |
| *In-State Residency* | 7,272 |
| *Out-of-State Residency* | 803 |

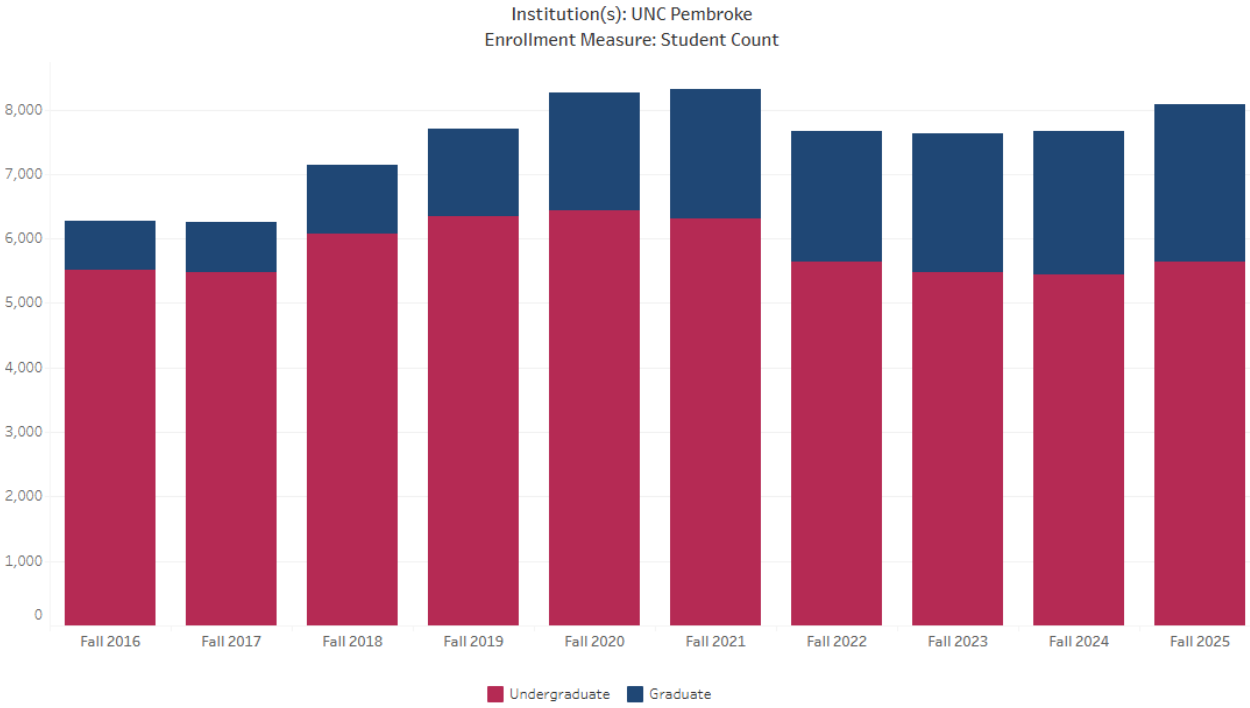
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Robeson, Cumberland, and Wake Counties as well as other counties located in the central and southern regions of North Carolina. Approximately 20% of all enrolled students come from Robeson County.

Among the UNCP student population, the most popular majors for undergraduates were Business Management, Health Professions and Related Programs, and Multi/Interdisciplinary Studies. The top graduate majors were Education, Business Management, and Health Professions and Related Programs.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure H.4. Enrollment has increased slightly over the past year after staying consistently the same for the previous three years.

### Figure H.4 – UNC Pembroke Enrollment, 2016-2025




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Undergraduate | 5,514 | 5,481 | 6,069 | 6,353 | 6,436 | 6,317 | 5,643 | 5,485 | 5,437 | 5,648 |
| Graduate | 754 | 771 | 1,068 | 1,345 | 1,826 | 2,001 | 2,023 | 2,145 | 2,237 | 2,427 |
| **Total** | **6,268** | **6,252** | **7,137** | **7,698** | **8,262** | **8,318** | **7,666** | **7,630** | **7,674** | **8,075** |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table H.4.

### Table H.4 – UNC Pembroke Student Body Demographics, Fall 2025

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 990 | 12.3% |
| Black or African American | 2,418 | 29.9% |
| Hispanic or Latino | 827 | 10.2% |
| Two or More Races | 518 | 6.4% |
| Asian | 118 | 1.5% |
| Native Hawaiian or Other Pacific Islander | 13 | 0.2% |
| White | 2,750 | 34.1% |
| Race/Ethnicity Unknown | 144 | 1.8% |
| U.S. Nonresident | 297 | 3.7% |

Source: UNC System Interactive Data Dashboards

### H.2.4 Growth and Development Trends

The University of North Carolina at Pembroke has a Planning, Design, and Construction (PDC) program within the Facilities Management Department that provides professional administration for design and construction of capital improvement projects on campus. PDC is dedicated to improving and expanding all physical facilities in support of the teaching, research, and service missions of UNCP.

There are many projects on campus currently undergoing preparations for construction, including the new Campus Security and Regional Emergency Operations Center which will provide extra space for first responders and the UNCP police force. According to news articles on the UNCP website, the university recently finished building a new Outdoor sports Complex in September 2025. Additionally, the University was awarded a grant from the Historic Preservation Fund to restore the iconic façade of Old Main which is a treasured landmark to the Lumbee community. To enhance connectivity between UNC Pembroke and the Lumbee Tribe's headquarters a Downtown Revitalization Project is underway to replace deteriorated transportation infrastructures and add in new bike and pedestrian pathways.

## H.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the UNCP campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

### H.3.1 Building Exposure

Table H.5 provides total building exposure for the campus, which was estimated by summarizing building footprints and property values provided by the North Carolina Emergency Management (NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table H.5 – UNCP Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 10 | $32,049,645.11 |
| Educational/Extracurricular | 25 | $223,828,453.30 |
| Housing | 18 | $40,732,474.04 |
| **Total** | **53** | **$296,610,572.45** |

Source: NCEM iRisk database

## H.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt campus continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by UNCP's HMPC representatives. After reviewing the following criteria designed to identify all critical buildings in the UNC System Hazard Mitigation Plan, the UNCP HMPC updated the list of critical facilities to account for changes to the building inventory, including demolitions and new buildings. Factors considered for critical building evaluation included:

- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

Figure H.5 below shows the scoring sheet used during the previous planning process to score critical buildings on campus.

## Figure H.5 – Critical Building Scoring Worksheet

**Critical Building Scoring Worksheet**

**Campus:**
**Facility Name:**

| | | Score |
|---|---|---|
| 1 | Does the facility serve as the campus Emergency Operations Center (EOC)?<br>Yes, Primary EOC = 6 pts<br>Yes, Secondary EOC = 3 pts<br>No = 0 pts | 0 |
| 2 | Does the facility house functions essential to campus operations?<br>Main Telecommunication Center = 3 pts<br>Computer Network Hub = 3 pts<br>Adminstrative Operations = 1 pts<br>Maintenance = 1 pt<br>Public Safety = 1 pt | 0 |
| 3 | Is the facility equiped with a generator or hook-ups?<br>Generator = 3 pts<br>Hook-ups = 1 pt<br>Neither = 0 pts | 0 |
| 4 | Does the facility serve as a pre or post disaster shelter?<br>Both pre and post disaster shelter = 6 pts<br>Either pre or post disaster shelter = 3 pts<br>Neither = 0 pts | 0 |
| 5 | Does the facility provide services essential to sheltering?<br>Resident Housing = 1 pt<br>Assesmbly Space = 1 pt<br>Food Preperation Facility = 1 pt<br>Shower Facilities = 1 pt | 0 |
| 6 | Does the facility provide chilled water distribution or contain HVAC systems necessary to sensitive or essential systems?<br>Yes = 3 pts<br>No = 0 pts | 0 |
| 7 | Are there hazardous materials on-site? (greater than 25 gallons)<br>Yes = 3 pts<br>No = 0 pts | 0 |
| 8 | Does the facility house research functions that have a low level of tolerance for disruption?<br>Yes = 2 pts<br>No = 0 pts | 0 |
| 9 | Does the facility serve as storage for rare or unique collections (art, artifacts, letters, etc) or is it a historically or culturally significant building?<br>Yes = 2 pts<br>No = 0 pts | 0 |
| 10 | Does the facility have hazard specific vulnerabilities (basement susceptible to flood, etc.)<br>Yes = 3 pts<br>No = 0 pts | 0 |
| Notes/ Comments | | |

| | |
|---|---|
| Total Score: | 0 |
| Total Possible Score: | **42** |

The identified critical facilities for UNCP, as shown in Figure H.6, are listed below along with their respective scores, where provided (note that newly added buildings were not scored):

- Pinchbeck Maintenance Complex (15)
- Lumbee Hall (13)
- Jones Athletic Center (12)
- Weinstein Health Sciences Building (12)
- Oxendine Science Building (11)
- Livermore Library (10)
- Campus Police and Business Services (9)
- Oak Hall (7)
- Pine Residence Hall (7)
- Chavis University Center (6)
- Brave Health Center (5)
- Cypress Hall (5)
- Old Main (5)
- New School of Business (5)
- Courtyard Apartments (1)
- Thomas Hall
- North Hall
- Belk Hall
- Oxendine Administration Building
- Student Center Annex
- Business Administration Building

Lumbee Hall serves as the primary Emergency Operations Center for campus. Pinchbeck Maintenance Complex serves as a secondary Emergency Operations Center and provides functions essential to campus operations and sheltering.

The Chavis University Center, Mary Livermore Library, Campus Police and Business Services Building, Oxendine Science Building, Lumbee Hall, Cypress Hall, Courtyard Apartments, Weinstein Health Services, Braves Health, and New School of Business provide services essential for campus operations and/or sheltering. Additionally, Oak Hall and Pine Hall are critical for continuous utility service on campus and support sheltering needs.

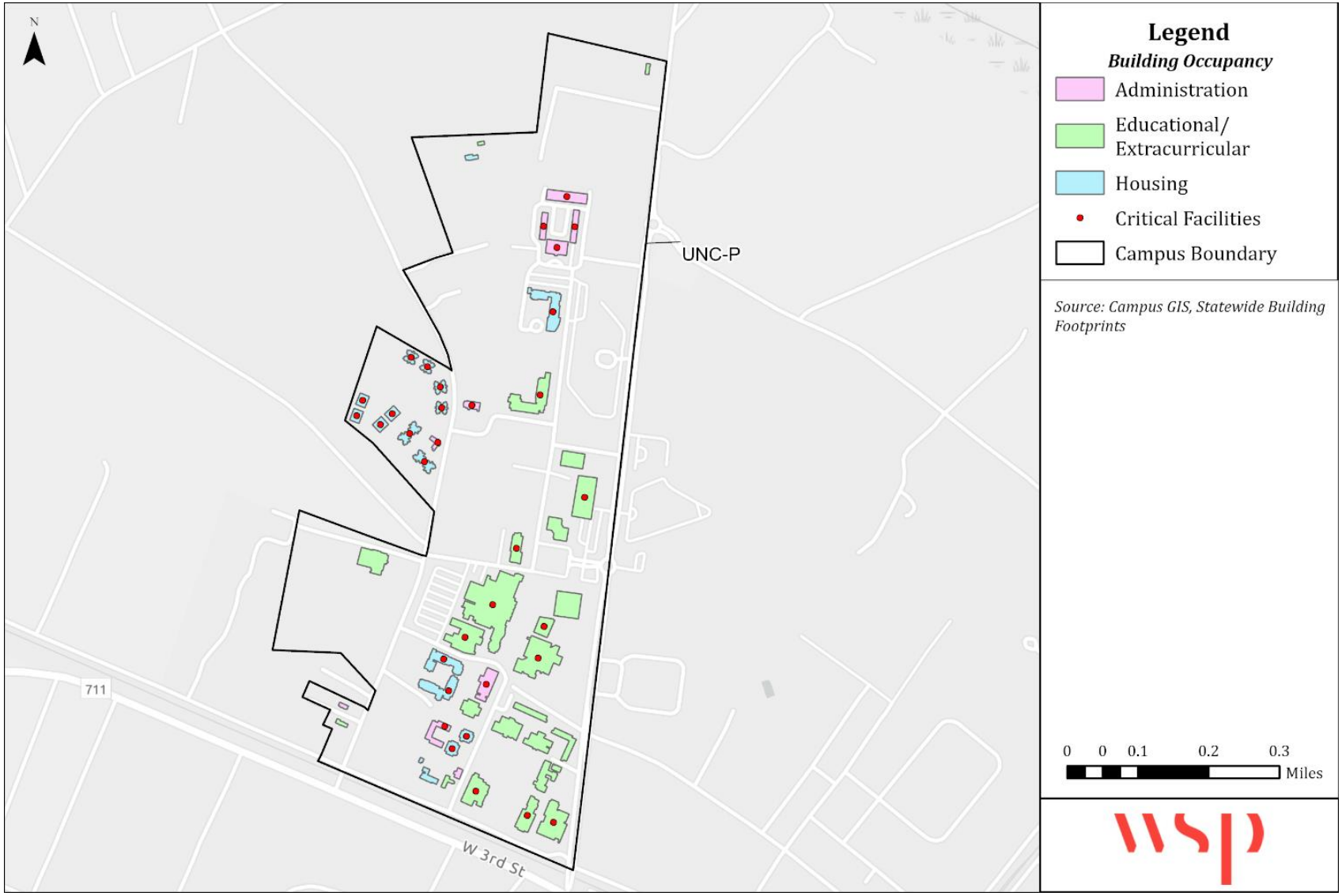
Jones Athletic Center serves as a pre- and post-disaster shelter.

Livermore Library and Old Main are historically significant and/or store important documents and artifacts.

Research functions with low levels of tolerance for disruption are housed in Oxendine Science Building and Weinstein Health Services Building.

Although it is not attached to UNCP's main campus, the HMPC also identified the off-campus Biotechnology Center as a critical campus building. It houses sensitive research functions and provides services essential to sheltering.

## Figure H.6 – UNCP Map of Critical Facilities



# H.4 Hazard Identification & Risk Assessment

## H.4.1 Hazard Identification

To identify a full range of hazards relevant to UNCP, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the UNCP Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table H.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table H.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP UNCP Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Excessive Heat | Yes | No |
| Earthquake | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failure | Yes | No |
| Drought | Yes | No |
| Tornadoes/Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkhole**s**) | Yes | Yes, Landslide |
| Hazardous Substances | Yes | No |
| Infectious Disease | Yes | No |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | No |
| Cyber Security | Yes | No |

UNCP's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State HMP and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for Robeson County was used to approximate past events that may have affected the UNCP campus. The NCEI database contains 528 records of storm events that occurred in Robeson County in the 25-year period from 2000 through 2024. Table H.7 summarizes these events.

**Table H.7 – NCEI Severe Weather Data for Robeson County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Drought | 11 | $0 | $0 | 0 | 0 |
| Flash Flood | 26 | $4,936,000 | $0 | 2 | 0 |
| Flood | 10 | $7,000 | $0 | 1 | 0 |
| Frost/Freeze | 3 | $0 | $0 | 0 | 0 |
| Funnel Cloud | 5 | $0 | $0 | 0 | 0 |
| Hail | 124 | $117,150 | $50,000 | 0 | 0 |
| Heat | 4 | $0 | $0 | 0 | 0 |
| Heavy Rain | 7 | $0 | $0 | 0 | 0 |
| Heavy Snow | 5 | $0 | $0 | 0 | 1 |
| High Wind | 3 | $0 | $0 | 0 | 0 |
| Ice Storm | 5 | $4,500,000 | $0 | 0 | 0 |
| Lightning | 7 | $506,500 | $0 | 0 | 2 |
| Strong Wind | 10 | $26,000 | $0 | 0 | 0 |
| Thunderstorm Wind | 263 | $3,612,750 | $104,000 | 0 | 4 |
| Tornado | 21 | $5,033,000 | $0 | 0 | 1 |
| Tropical Storm | 7 | $71,000 | $0 | 0 | 0 |
| Wildfire | 2 | $0 | $0 | 0 | 0 |
| Winter Storm | 10 | $20,000 | $0 | 0 | 0 |
| Winter Weather | 5 | $30,000 | $0 | 0 | 0 |
| **Total** | **528** | **$18,859,400** | **$154,000** | **3** | **8** |

Source: National Center for Environmental Information Events Database, retrieved October 2025
Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for Robeson County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, Robeson County has been designated in 20 major disaster declarations, as detailed in Table H.8, and 10 emergency declarations, as detailed in Table H.9.

**Table H.8 – FEMA Major Disaster Declarations, Robeson County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-699-NC | 30-Mar-84 | Tornado | Severe Storms & Tornadoes | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1200-NC | 15-Jan-98 | Severe Storm(s) | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-1240-NC | 27-Aug-98 | Hurricane | Hurricane Bonnie | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7,790 | $21,289,504 | $18,285,917 |
| DR-1546-NC | 10-Sep-04 | Hurricane | Tropical Storm Frances | 25,950 | $45,380,867 | $70,854,432 |
| DR-1969-NC | 20-Apr-11 | Severe Storm(s) | Severe Storms, Tornadoes, & Flooding | 1,778 | $5,391,278 | N/A |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28,971 | $98,842,213 | $291,092,954 |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34,713 | $133,948,455 | $632,937,402 |
| DR-4465-NC | 04-Oct-19 | Hurricane | Hurricane Dorian | N/A | N/A | $28,138,271 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |
| DR-4588-NC | 3-Mar-21 | Severe Storm | Tropical Storm Eta | N/A | N/A | $1,066,093 |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance; IAH = Individuals and Households; PA = Public Assistance

Note: Number of applications approved, and all dollar values represent totals for all counties included in disaster declaration.

### Table H.9 – FEMA Emergency Declarations, Robeson County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 5-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3254-NC | 15-Sep-05 | Hurricane | Hurricane Ophelia |
| EM-3314-NC | 2-Sep-10 | Hurricane | Hurricane Earl |
| EM-3327-NC | 25-Aug-11 | Hurricane | Hurricane Irene |
| EM-3380-NC | 7-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 4-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 2-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 1-Oct-22 | Hurricane | Hurricane Ian |
| EM-3608-NC | 6-Aug-24 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-24 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area to decide which hazards to include in this plan update. Table H.10 summaries the determination made for each hazard.

### Table H.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in 2021 UNCP Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | No | ▪ Not included in 2011 UNCP Annex<br>▪ Drought has minimal impact on campus; does not warrant evaluation |
| Earthquake | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Modeled building damages in iRisk database show some vulnerability and potential for losses due to earthquake |
| Excessive Heat | Yes | ▪ Included in 2021 UNCP Annex as a high risk hazard<br>▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Robeson County has had two disaster declarations related to flooding and 14 disaster declarations for hurricanes or other storms which may have involved flooding |

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Included in 2021 UNCP Annex but minimal to no landslide risk found<br>▪ No known sinkhole risk in the region |
| Hurricane & Coastal Hazards | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Robeson County has had 13 disaster declarations related to hurricanes and tropical storms |
| Tornadoes & Thunderstorms | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Robeson County has received two disaster declarations for events that included tornadoes and five additional disaster declarations for events related to severe storms |
| Severe Winter Weather | Yes | ▪ Included in 2021 UNCP Annex and rated a high-risk hazard<br>▪ Potential for power outages, freezing temperatures, and dangerous travel conditions presents risk to campus |
| Wildfire | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus and potential for up to moderate intensity fire. |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Fixed facility sites and transportation routes with hazardous materials are present in and around the campus, including a rail line adjacent to the campus |
| Infectious Disease | Yes | ▪ Included in 2021 UNCP Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in 2021 UNCP Annex<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |

# H.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and

- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

## Location

This section includes information on the hazard's physical extent, describing where on UNCP's campus the hazard can occur, with mapped boundaries where applicable.

## Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

## Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by Robeson County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

## Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses

specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory fand values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2025 Bladen Columbus Robeson County Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the number and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included Robeson County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and

campus-level information. The table below presents the source data and the associated geographic coverages.

**Table H.11 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| Earthquake | USGS, NCEI | County | Hazus 4.2 | Census Tract |
| Excessive Heat | NCEI | County | Qualitative Analysis | Campus |
| Flooding | NCEI, FEMA | County | GIS Spatial Analysis | Campus |
| Hurricanes & Coastal Hazards | NHC | County | Hazus 4.2 | Census Tract |
| Severe Winter Weather | NWS, NCEI | County | Statistical Analysis | County |
| Tornadoes & Thunderstorms | NWS, NCEI | County | Statistical Analysis | County |
| Wildfire | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| Cyber Security | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| Hazardous Substances | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| Infections Disease | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the UNCP planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table H.12.

PRI ratings are provided by category throughout each hazard profile for the planning area as a whole. The results of the risk assessment and overall PRI scoring are provided in Section 0 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table H.12 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF | **1** | **30%** |
| | **LIMITED** | MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 | **3** | |
| | **CATASTROPHIC** | HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

## H.5.1 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

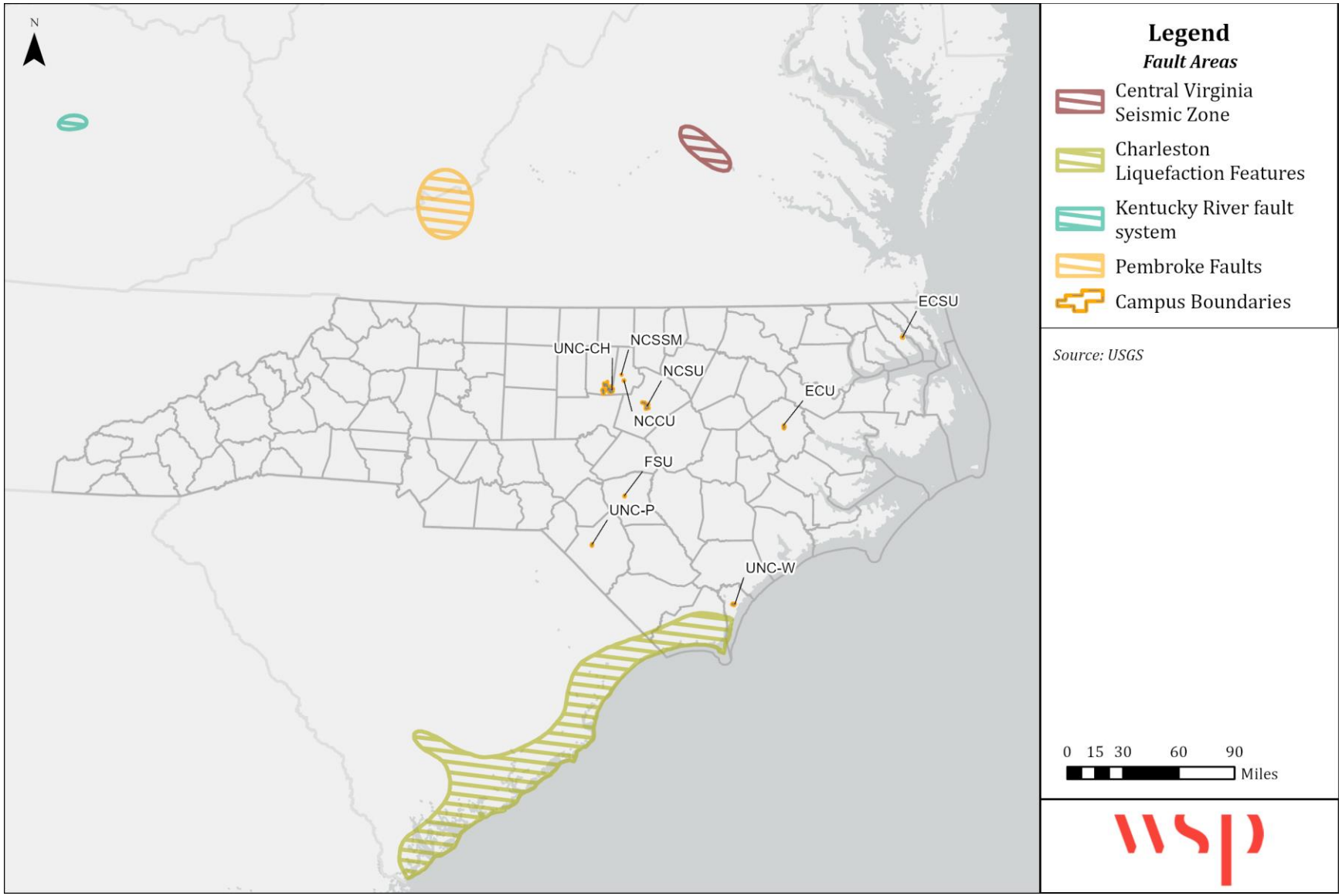
Figure H.7 reflects the quaternary faults that present an earthquake hazard for the UNCP planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. There are no active faults in Robeson County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts Robeson County is likely to be felt across most if not all of the UNCP campus.

*Spatial Extent: 4 – Large*

**Figure H.7 – U.S. Quaternary Faults**



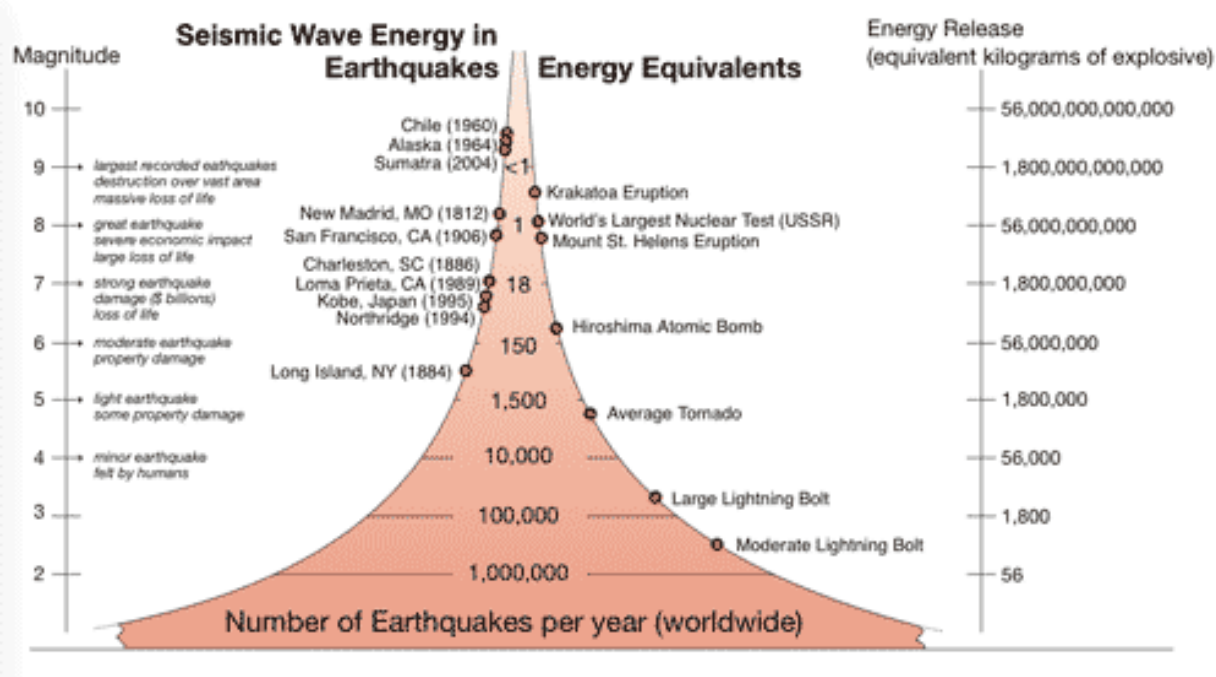
## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure H.8.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table H.13 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

*Impact: 1 – Minor*

**Figure H.8 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table H.13 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |

| MMI | Shaking | Description/Damage |
|---|---|---|
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

## Historical Occurrences

The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater from 1900 to 2024. Earthquake events that occurred within 100 miles of the UNCP campus are presented in Table H.14 and Figure H.9 shows the epicenter of these events.

### Table H.14 – Historical Earthquakes within 100 Miles of UNCP, 1900-2024

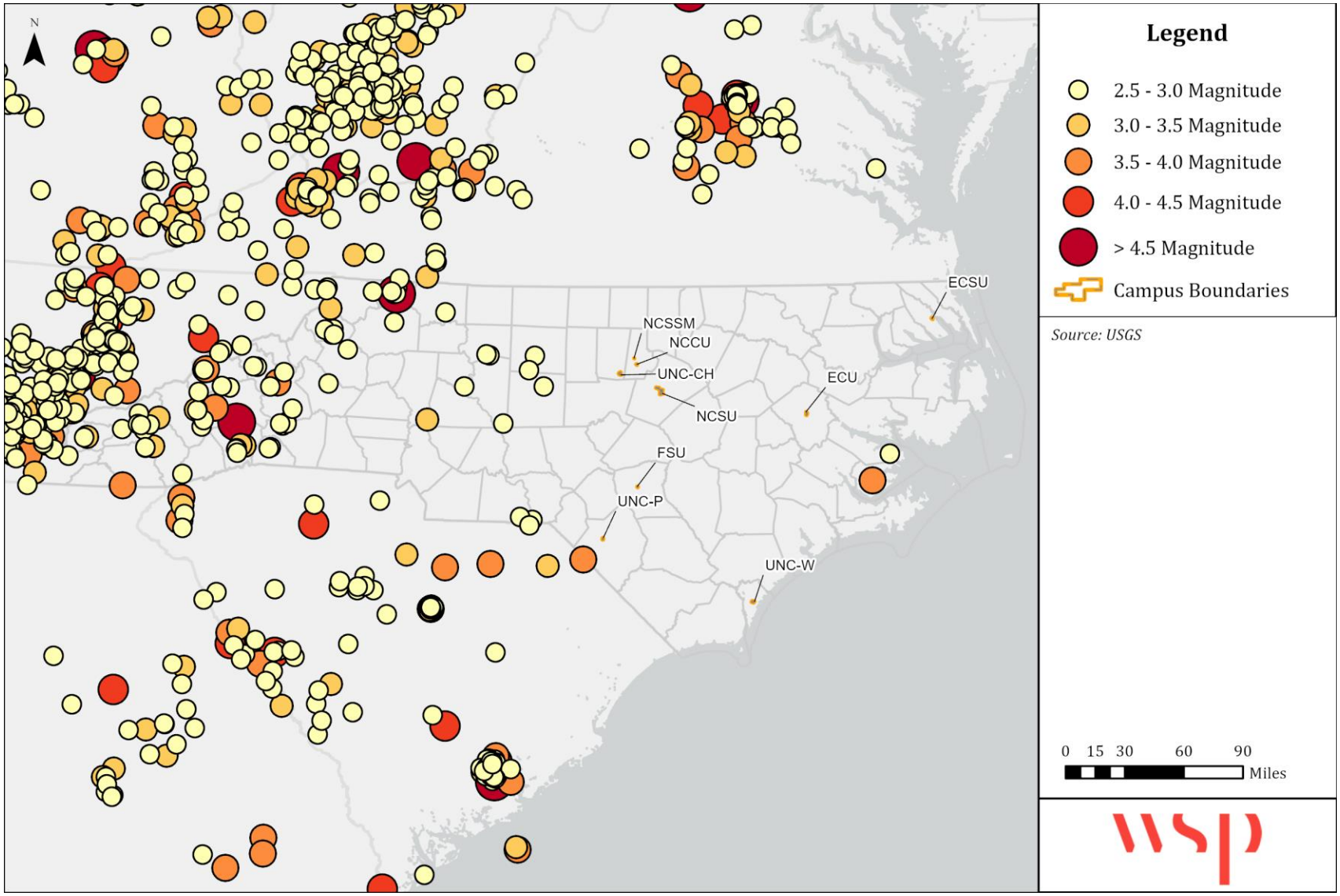
| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 10/27/1959 | 3.9 | 6 km NE of McBee, South Carolina |
| 4/9/1980 | 2.8 | 5 km NE of McFarlan, North Carolina |
| 3/4/1981 | 2.8 | 6 km E of Randleman, North Carolina |
| 10/3/1986 | 2.5 | 7 km W of Tyro, North Carolina |
| 3/16/1987 | 3.1 | 4 km WSW of Great Falls, South Carolina |
| 7/12/1993 | 2.7 | 5 km SW of Greensboro, North Carolina |
| 1/29/1994 | 2.9 | 12 km NNE of Alcolu, South Carolina |
| 4/13/1998 | 3.9 | 9 km S of Kershaw, South Carolina |
| 6/5/1998 | 3.2 | 4 km SSE of Mooresville, North Carolina |
| 9/22/2006 | 3.4 | 4 km WSW of Blenheim, South Carolina |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 10/17/2006 | 2.6 | 7 km S of Winston-Salem, North Carolina |
| 11/03/2006 | 2.5 | 6 km S of Winston-Salem, North Carolina |
| 3/21/2011 | 2.9 | 9 km S of Cordova, North Carolina |
| 7/29/2012 | 2.5 | 7 km NNW of Wallace, South Carolina |

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 11/15/2015 | 2.58 | 10 km S of Denton, North Carolina |
| 3/26/2019 | 2.5 | 8 km E of Archdale, North Carolina |
| 12/27/2021 | 2.57 | 6 km SSW of Lugoff, South Carolina |
| 12/27/2021 | 3.3 | 5 km SSW of Lugoff, South Carolina |
| 12/30/2021 | 2.51 | 6 km E of Elgin, South Carolina |
| 1/03/2022 | 2.53 | 5 km S of Lugoff, South Carolina |
| 1/5/2022 | 2.57 | 5 km SW of Lugoff, South Carolina |
| 5/9/2022 | 3.25 | 5 km ESE of Elgin, South Carolina |
| 5/10/2022 | 2.57 | 6 km E of Elgin, South Carolina |
| 5/10/2022 | 2.76 | 5 km E of Elgin, South Carolina |
| 6/26/2022 | 3.4 | 6 km E of Elgin, South Carolina |
| 6/29/2022 | 3.6 | 6 km E of Elgin, South Carolina |
| 6/29/2022 | 3.5 | 6 km E of Elgin, South Carolina |
| 10/31/2022 | 2.54 | 6 km E of Elgin, South Carolina |
| 3/09/2024 | 2.65 | 5 km E of Elgin, South Carolina |
| 9/15/2024 | 2.5 | 6 km E of Elgin, South Carolina |

Source: USGS Earthquakes Hazard Program

The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there were no earthquakes felt in or around Pembroke.

**Figure H.9 – Historical Earthquakes by Magnitude, 1900-2024**



## Probability of Future Occurrence

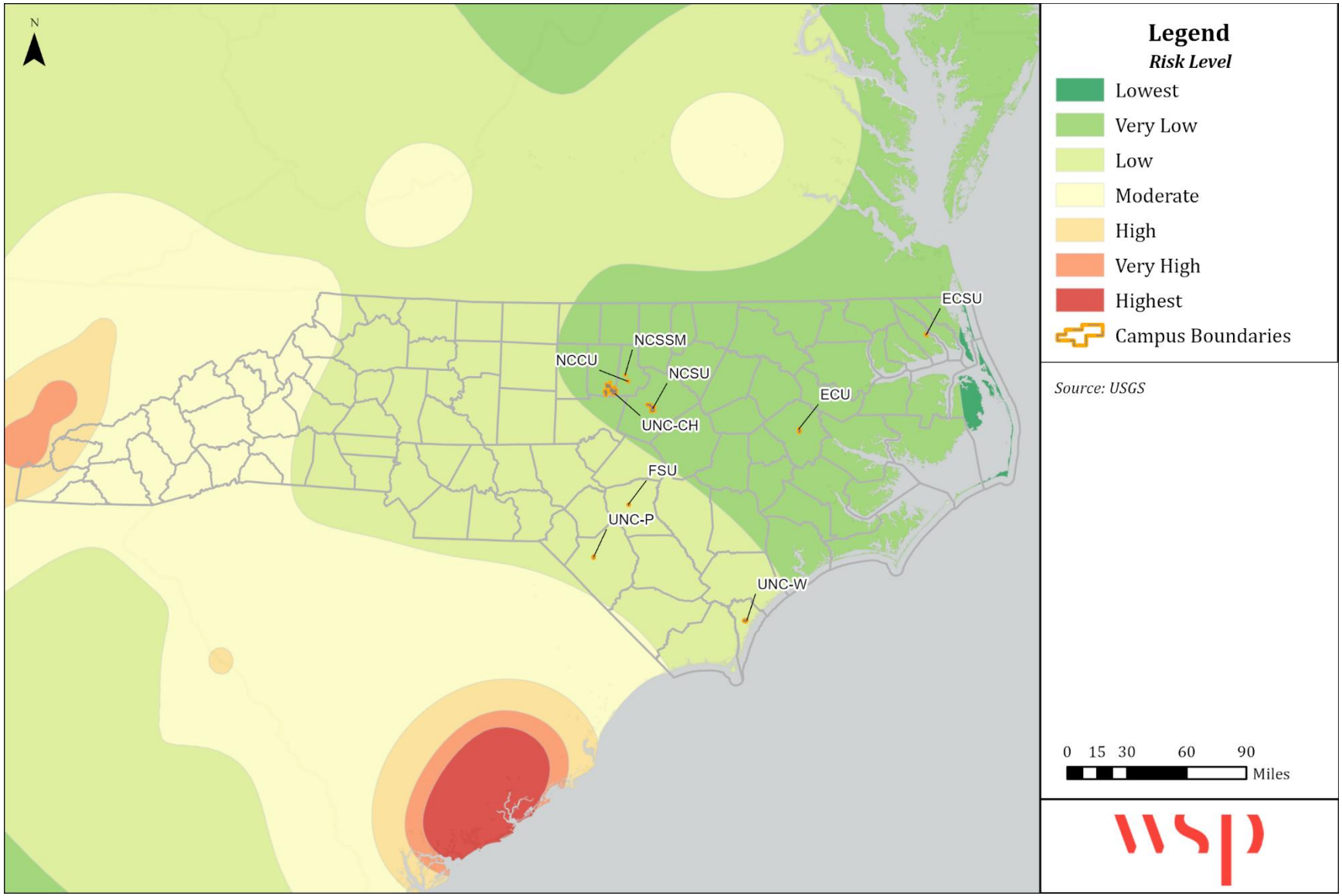
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure H.10 on the following page reflects the seismic hazard for Robeson County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of Robeson County is located within the lighter green zone which represents "low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting UNCP is unlikely.

*Probability: 1 – Unlikely*

**Figure H.10 – Seismic Hazard Information for Robeson County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damage from NCEM's iRisk database were compiled for buildings on UNC-P's campus.

### People

Earthquakes are not expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damage to infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause $694,255 of estimated total building damages.

Robeson County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structures. Table H.15 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table H.15 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $2,226.12 | $4,611.94 | $6,838.06 |
| Educational | $13,944.86 | $27,520.21 | $41,465.07 |
| Housing | $5,977.15 | $14,724.49 | $20,701.64 |
| **Total** | **$22,148.13** | **$46,856.64** | **$69,004.77** |
| **500-Year Earthquake Event** | | | |
| Administration | $21,250.49 | $44,660.81 | $65,911.30 |
| Educational | $150,980.88 | $303,878.61 | $454,859.49 |
| Housing | $56,168.60 | $117,315.63 | $173,484.23 |
| **Total** | **$228,399.97** | **$465,855.05** | **$694,255.02** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **1,000-Year Earthquake Event** | | | |
| Administration | $127,607.49 | $142,374.05 | $269,981.54 |
| Educational | $765,550.24 | $978,094.66 | $1,743,644.90 |
| Housing | $280,148.46 | $334,993.79 | $615,142.25 |
| **Total** | **$1,173,306.19** | **$1,455,462.50** | **$2,628,768.69** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in Robeson County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type of damage is unlikely based on historical occurrences and USGS seismic probability.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the UNCP campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at UNCP have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statement

- While earthquakes are an unlikely hazard event for the UNCP campus, an estimated $694,255 of total building damages to main campus could occur in the case of a 500-year earthquake event.

## H.5.2 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of excessive heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of extreme heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. Table H.16 provides counts of heat index values by threshold recorded from 2000-2024 at the Lumberton Municipal Airport (KLBT) in Robeson County. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. According to this data, Robeson County averages approximately 83 hours per year with heat index values at or above 100°F.

*Impact: 2 – Limited*

**Table H.16 – Historical Heat Index, Lumberton Municipal Airport (KLBT), Robeson County, NC, 2000-2024**

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2000 | 45 | 8 | 0 | 0 | 53 |
| 2001 | 31 | 7 | 0 | 0 | 38 |
| 2002 | 53 | 16 | 0 | 0 | 69 |
| 2003 | 29 | 0 | 0 | 0 | 29 |
| 2004 | 54 | 10 | 0 | 0 | 64 |
| 2005 | 83 | 24 | 3 | 0 | 110 |
| 2006 | 67 | 22 | 0 | 0 | 89 |

| Year | Heat Index Value | | | | Total |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2007 | 56 | 23 | 5 | 0 | 84 |
| 2008 | 85 | 3 | 0 | 0 | 88 |
| 2009 | 27 | 3 | 0 | 0 | 30 |
| 2010 | 134 | 48 | 1 | 0 | 183 |
| 2011 | 96 | 30 | 0 | 0 | 126 |
| 2012 | 78 | 33 | 5 | 4 | 120 |
| 2013 | 36 | 2 | 0 | 0 | 38 |
| 2014 | 25 | 0 | 0 | 0 | 25 |
| 2015 | 130 | 29 | 0 | 0 | 159 |
| 2016 | 172 | 20 | 0 | 0 | 192 |
| 2017 | 76 | 13 | 1 | 0 | 90 |
| 2018 | 67 | 0 | 0 | 0 | 67 |
| 2019 | N/A | N/A | N/A | N/A | N/A |
| 2020 | N/A | N/A | N/A | N/A | N/A |
| 2021 | N/A | N/A | N/A | N/A | N/A |
| 2022 | 56 | 27 | 0 | 0 | 83 |
| 2023 | 126 | 23 | 5 | 1 | 155 |
| 2024 | 114 | 53 | 19 | 0 | 186 |
| **Sum** | **1,640** | **394** | **39** | **5** | **2,078** |
| **Average*** | **74** | **19** | **2** | **0** | **83** |

Source: North Carolina State Climate Office, Heat Index Climatology

*Average excludes missing data

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

NCEI records four incidents of heat for Robeson County between 1998-2024. The highest recorded heat index was near 120 degrees on June 29, 2012. There were no recorded fatalities or injuries nor was any property or crop damage reported. The following are a selection of narrative descriptions recorded in NCEI:

- **July 21, 2011** – Excessive heat advisories and warnings were issued for the region 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** – Northwest flow aloft and southwest flow at the surface produced excessive heat at the end of June. The heat index went over 110 degrees beginning the afternoon of June 29th, continuing through the next day. The highest heat index noted was near 120 degrees. There were no reports of heat-related illnesses or fatalities.
- **July 26, 2012** – Directional flow at the surface and aloft were both from the west southwest. This contributed to heat indices above 110 degrees for several hours on both the 26th and 27th of July. There were no reports of heat-related injuries.

- **June 19, 2015** – A prolonged period of unseasonably high heat indices blanketed most of the southeastern US. Afternoon temperatures mainly between 95 and 100 combined with dewpoints in the mid-70s produced heat index values in the 105 to 110 range. The heat wave finally broke on Jun 26th with cloud cover and precipitation.

## Probability of Future Occurrence

Data was gathered on historical heat index values using Lumberton Municipal Airport (KLBT) in Robeson County. Based on 22 years of available data, the Lumberton station averages 23.5 days per year with a heat index at or above 100 degrees.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted, or plants may be killed if temperatures rise above their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized "heat islands." Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statement

- UNC-P is located within Robeson County which currently averages 83 hours per year with heat index temperatures at or above 100°F and there is a 100% annual chance of heat index values of 100°F or higher in any given year.

## H.5.3 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Minor | Negligible | 6 to 12 hrs | Less than 1 week | 2.3 |

### Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the UNCP Campus using the FIRM dated December 6, 2019. Figure H.11 reflects the 2019 mapped flood insurance zones. Table H.17 summarizes some of the flood insurance zones identified by a Digital FIRM (DFIRM). Note that not all flood zones outlined in Table H.17 intersect the UNCP Campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the Town of Pembroke and the UNCP campus. Flood risk is not limited to the 1%-annual-chance floodplain.

This assessment focuses on riverine flooding, however, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. The HMPC reported that low-lying areas of campus experience ongoing flooding, but some of these problems have been addressed through improvements made to Prospect Road and downstream canals to improve drainage and reduce flood risk.

*Spatial Extent: 1 – Negligible*

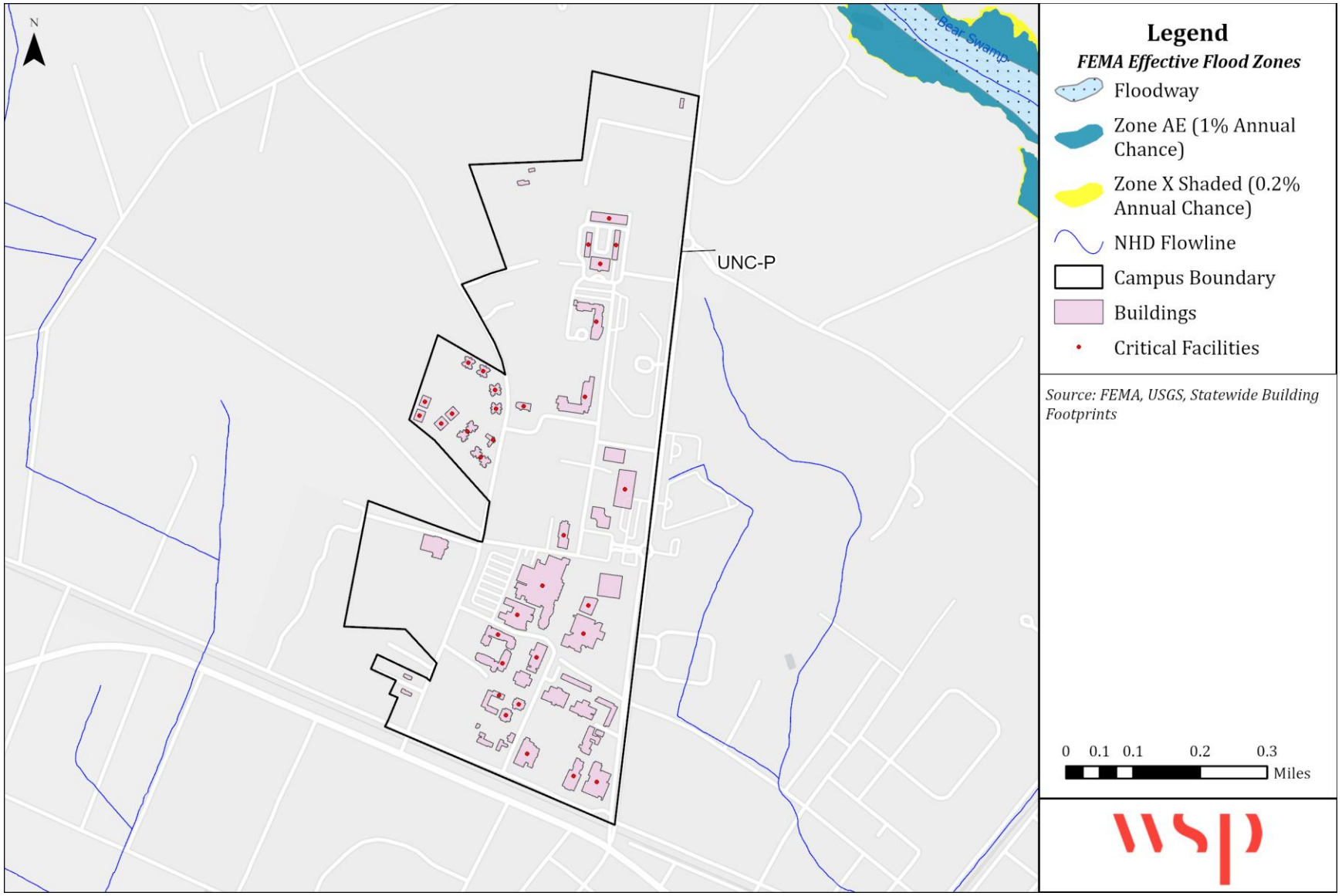
**Table H.17 – Mapped Flood Insurance Zones**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |

| Zone | Description |
|---|---|
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

Source: FEMA

**Figure H.11 – FEMA Flood Hazard Areas in UNCP's Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

As shown in Figure H.11 the SFHA does not intersect with the UNCP campus. Table H.18 provides a summary of the UNCP Campus' total area by flood zone on the 2019 effective DFIRM. While the campus is not exposed to the SFHA, flooding may occur on campus when intense rainfall cannot be carried away by natural or urban drainage systems as fast as it is falling.

Figure H.12 shows the depth of flooding predicted from a 1% annual chance flood, however, as the campus does not intersect the SFHA, flood depths are shown just outside of the campus boundary. Flood damage is closely related to depth, with greater flood depths generally resulting in more damage.

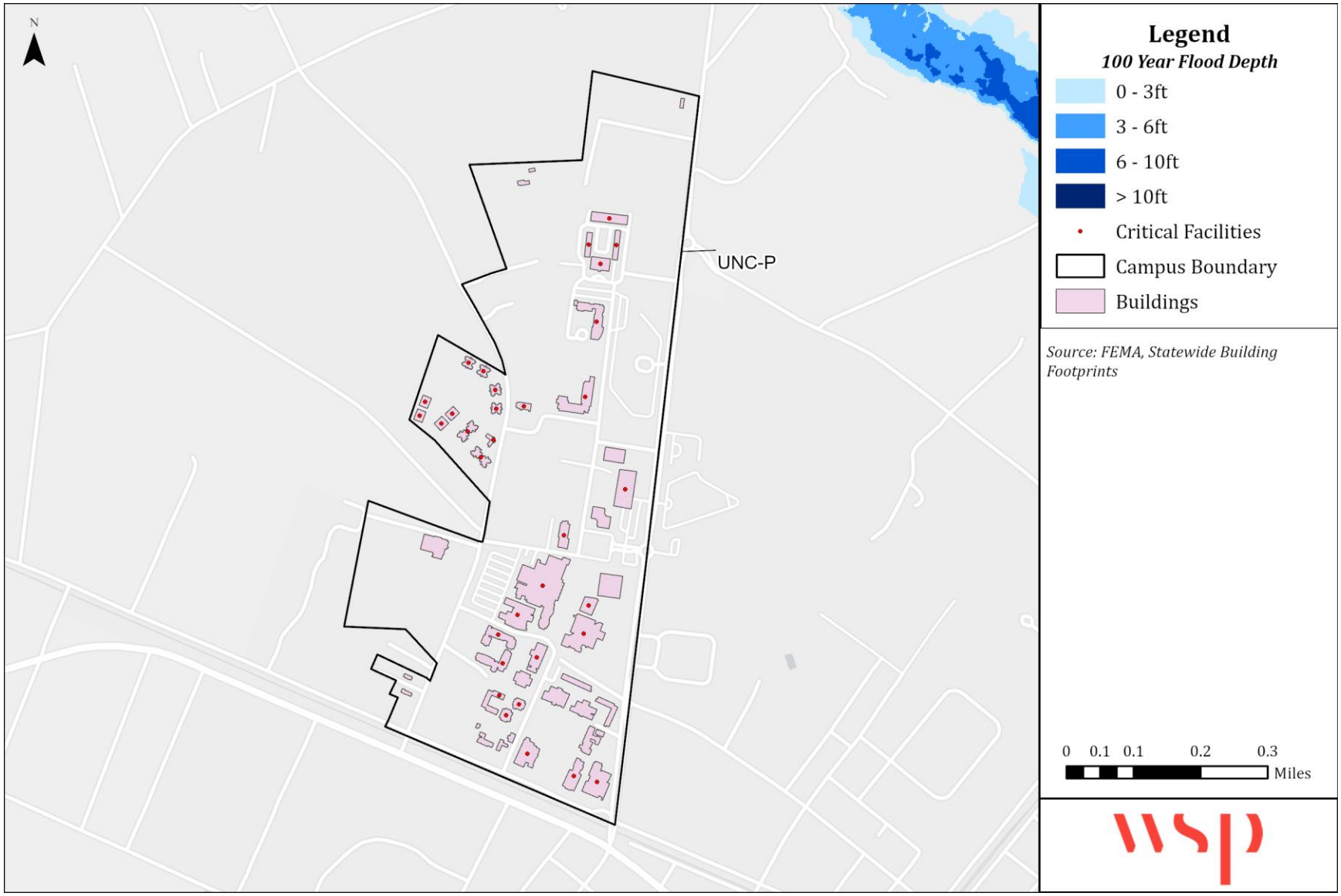
*Impact: 1 – Minor*

**Table H.18 – Flood Zone Acreage on UNCP Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| AE | 0 | 0.0% |
| Floodway | 0 | 0.0% |
| 0.2% Annual Chance Flood Hazard | 0 | 0.0% |
| Unshaded X | 210.2 | 100% |
| **Total** | **210.2** | **100%** |
| **SFHA Total** | **0** | **0.0%** |

Source: FEMA 2019 DFIRM

**Figure H.12 – Flood Depth, 1-Percent-Annual-Chance Flood, UNCP Campus**



## Historical Occurrences

Table H.19 details the historical occurrences of flooding for Robeson County identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 36 recorded flood-related events occurred on 23 separate days in Robeson County from 2000 to 2024 causing an estimated $4,927,000 in property damage, with two fatalities and no injuries or crop damage.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table H.19 – NCEI Records of Flooding for Robeson County, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| St Pauls | 6/15/2001 | 0/0 | $0 | $0 |
| Lumberton | 6/16/2001 | 0/0 | $0 | $0 |
| Elrod; | 10/8/2016 | 0/0 | $2,000,000 | $0 |
| Smiths | 10/8/2016 | 0/0 | $500,000 | $0 |
| Powers | 10/8/2016 | 0/0 | $2,000,000 | $0 |
| North Lumberton | 10/8/2016 | 0/0 | $250,000 | $0 |
| Lumberton | 9/15/2018* | 2/0 | $50,000 | $0 |
| Raynham | 9/15/2018 | 0/0 | $10,000 | $0 |
| Red Springs | 9/15/2018 | 0/0 | $10,000 | $0 |
| Roziers | 9/15/2018 | 0/0 | $10,000 | $0 |
| Smiths | 9/15/2018* | 0/0 | $20,000 | $0 |
| Oakland | 9/15/2018 | 0/0 | $10,000 | $0 |
| Lumberton Muni Arpt | 9/16/2018 | 0/0 | $20,000 | $0 |
| Buie | 9/16/2018 | 0/0 | $30,000 | $0 |
| Fairmont | 9/1/2020 | 0/0 | $0 | $0 |
| Powers | 11/12/2020 | 0/0 | $0 | $0 |
| Rowland | 6/20/2023 | 0/0 | $10,000 | $0 |
| Bloomingdale | 8/31/2023 | 0/0 | $0 | $0 |
| **Flood** | | | | |
| Lumberton | 9/9/2008 | 0/0 | $0 | $0 |
| Roziers | 5/16/2010 | 0/0 | $5,000 | $0 |
| Moss Neck | 8/19/2011 | 0/0 | $2,000 | $0 |
| Lumberton Muni Arpt | 7/11/2012 | 0/0 | $0 | $0 |
| St Pauls | 6/27/2013 | 0/0 | $0 | $0 |
| Rennert | 7/1/2013 | 0/0 | $0 | $0 |
| Red Springs | 7/1/2013 | 0/0 | $0 | $0 |
| North Lumberton | 6/26/2015 | 0/0 | $0 | $0 |
| Powers | 6/26/2015 | 0/0 | $0 | $0 |
| **Heavy Rain** | | | | |
| Lumberton | 7/13/2003 | 0/0 | $0 | $0 |

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| Fairmont | 10/6/2005 | 0/0 | $0 | $0 |
| Fairmont | 6/5/2009 | 0/0 | $0 | $0 |
| St Pauls | 8/14/2009 | 0/0 | $0 | $0 |
| Lumberton | 7/27/2010 | 0/0 | $0 | $0 |
| Lumberton | 6/3/2013 | 0/0 | $0 | $0 |
| **Total** | | **2/0** | **$4,927,000** | **$0** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **September 15, 2008** - Route 1588 was closed and impassable. Flooding as also reported on Pine Log Road and Hwy 711. Flooding was also reported on Briarcliff Lane. A male drove into a sinkhole and died. Davis Road near Hwy 301 was impassable due to flooding. The Swiftwater Rescue Team was called to Tartan Road with waist deep water. A female drove into a road that was washed out and drowned. Shaw Mill road was impassable near Dean Road due to flooding.
- **September 16, 2008** - Interstate 95 North was closed at the overpass for US-74. Snipes road was completely washed out near McQueen Road.
- **May 16, 2010** – A stationary frontal boundary, combined with the sea breeze and a short wave produced training thunderstorms and heavy rain in St Pauls. Law enforcement reported extensive flooding on all major streets in St Pauls.
- **October 8, 2016** - Flooding was reported throughout Pembroke. Flood waters were reportedly entering structures to include homes. Several roads were under water and impassable. Smith Mill Road was washed out due to flooding. Adjacent roadways and structures were impacted by the flood waters. Kahn Drive was flooded with water entering the first floor of the Econo Lodge Inn and Suites. Major Hurricane Matthew moved up the southeast coast and slowly weakened to a category 1 storm as it moved up along the South Carolina coast and then eastward near the North Carolina coast. The hurricane brought 6 to 12 inches of rain and up to 18 inches to some areas of southeast North Carolina, with the bulk of the rainfall occurring within a 12 hour period. The result was historic flooding; widespread flash flooding, and an extended period of major to record river flooding. Matthew's flooding rains, surge and wind brought loss of life, displaced tens of thousands of people, and caused hundreds of millions of dollars in structural damage as homes and businesses were devastated or totally destroyed. Major infrastructure will have to be repaired or rebuilt.
- **September 15, 2018** – Hurricane Florence began its long Atlantic trek from the Cape Verde Islands in early September. In addition to the strong storm surge, there was historic rainfall totals of 20 to 25 inches, with isolated totals of 35 inches in parts of Bladen and Robeson counties. Flash Flooding was severe and widespread, with many communities experiencing flooding for the first time. River flooding was epic, with dozens of main highways impassible. Significant flooding occurred for weeks after the storm had departed. Damage estimates from wind and water are in the tens of billions of dollars, making it one of the costliest hurricanes ever.

- **June 20, 2023** – Heavy rainfall associated with a stalled upper low to the west led to isolated evening flooding. Flooding reported on North Bond Street in downtown Rowland. Police confirmed two cars got stuck in the water and they had to rescue the drivers.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which have also included damages associated with flooding. Robeson County has received two Major Disaster Declaration for severe storms including elements of flooding in 1998 and 2011, along with nine Major Disaster Declarations for hurricanes and tropical storms in 1996, 1998, 1999, 2003, 2004, 2016, 2018, 2019, and 2021 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

None of the UNCP campus is in FEMA-mapped flood hazard areas. However, while SFHA is a useful way to identify the most at-risk areas, this does not mean there is no flood risk on campus. The UNCP campus is at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Robeson County and Pembroke and impacts from past flood events have been noted by NCEI. NCEI reports 36 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability greater than 100% for Robeson County. Therefore, the probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. However, for the UNCP campus, there are no structures located within the SFHA.

### People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.
- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.
- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.

- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. NCEI records reported two deaths caused by flood events in Robeson County.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

The 1%-annual-chance flood zone does not intersect the UNCP campus so no loss estimates were generated for the structures on campus.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the UNCP Facilities Management works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statement

- The 1%-annual-chance floodplain does not extend onto the UNCP campus, however flooding is not limited to the SFHA. Flooding may also occur on the campus when an intense rainfall occurs and water cannot be carried away by natural or urban drainage systems as fast as it is falling. Localized flooding can still impact facilities, roadways, and other locations on campus.

## H.5.4 Hurricanes

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricanes | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. UNCP is not exposed to storm surge, but hurricanes and tropical storms can occur anywhere within Robeson County and hurricane winds can impact the entire campus.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale, shown in Table H.20, which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

**Table H.20 – Saffir-Simpson Scale**

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table H.21 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table H.21 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| **1** | Minimal | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| **2** | Moderate | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| **3** | Extensive | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| **4** | Extreme | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| **5** | Catastrophic | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

Tropical cyclones weaken relatively quickly after making landfall; therefore, Robeson County will not typically experience major hurricane force winds, though these occurrences are possible. Hurricane Gaston passed within 5 miles of the campus as a tropical depression with wind speeds around 35 mph in 2004. Hurricane Fran also passed within 5 miles of UNC-P's campus as a tropical storm with wind speeds around 46 mph in 2013.

*Impact: 3 – Critical*

## Historical Occurrences

According to NCEI, five recorded hurricane-related events affected Robeson County from 2000 to 2024 causing an estimated $71,000 in property damage. There were no injuries, fatalities, or crop damage recorded for any of these events.

**Table H.22 – Recorded Hurricane and Tropical Storm Events for Robeson County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 8/29/2004 | Tropical Storm | Hurricane Gaston | 0/0 | $0 | $0 |
| 9/2/2016 | Tropical Storm | Hurricane Hermine | 0/0 | $11,000 | $0 |
| 10/8/2016 | Tropical Storm | Hurricane Matthew | 0/0 | $0 | $0 |
| 9/15/2018 | Tropical Storm | Hurricane Florence | 0/0 | $60,000 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $0 | $0 |
| **Total** | | | **0/0** | **$71,000** | **$0** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

- **Hurricane Hermine (2016)** – There was a report of tree down on powerlines at the intersection of Arnette St and Parkview Dr.
- **Hurricane Matthew (2016)** – Hurricane Matthew moved up the eastern seaboard, bringing very heavy rain and strong winds. Rainfall amounts over 12 inches occurred in multiple areas of the county. Wind gusts were surprisingly high, with a gust of 67 mph at the Lumberton Airport. Tropical storm force winds and flooded ground caused widespread tree and power line damage. The river gauge at the Lumber River at Lumberton failed, however the high watermark data from the U.S. Geological Survey indicated the water level may have reached over 25 feet. This exceeded the previous record by over 4 feet. This level bypassed the levee that protects parts of Lumberton from the river due to water passing under I-95 via VFR road. One elderly male died in his home on West Fifth Street on 10/9. The man had a heart condition and when power was lost, he was without oxygen. The family believes he may have died of a heart attack and then fell into flood waters which had overtaken his home from the Lumber River. The Lumber River also exceeded record levels at Boardman by about 2.5 feet. This resulted in the closure of U. S. Route 74, the main route between Wilmington and Lumberton. Numerous water rescues were required along and

near the Lumber River. Many homes were flooded in Pembroke. This was one of the hardest hit counties due to the historic river flooding. The offices of the Robesonian Newspaper were flooded.

- **Hurricane Florence (2018)** – Shannon Road near Hwy 71 is impassable due to power lines on trees. Hwy 211 was also impassable due to power lines on trees. Trees and power lines down on Lewis McNeill Road.
- **Hurricane Ian (2022)** - Tropical storm force wind gusts of 45 to 55 mph associated with Hurricane Ian resulted in numerous downed trees and powerlines across the county. There were a few thousand without power in several communities in the area. Rainfall amounts averaged 2 to 4 inches

According to the NOAA Historical Hurricane dataset, 22 hurricanes or tropical storms passed within 25 miles of UNC-P since 1900. These events are listed in Table H.23, and storm tracks are mapped in Figure H.13.

**Table H.23 – Hurricane Tracks within 25 miles of UNCP, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 7/14/1901 | Unnamed | Tropical Storm |
| 9/15/1904 | Unnamed | Category 1 |
| 6/15/1912 | Unnamed | Tropical Storm |
| 10/11/1913 | Unnamed | Tropical Depression |
| 9/24/1920 | Unnamed | Tropical Storm |
| 10/20/1944 | Unnamed | Tropical Storm |
| 10/10/1946 | Unnamed | Tropical Depression |
| 9/14/1949 | Unnamed | Tropical Depression |
| 7/11/1959 | Cindy | Tropical Depression |
| 7/24/1964 | Unnamed | Tropical Depression |
| 6/17/1965 | Unnamed | Tropical Storm |
| 6/22/1972 | Agnes | Tropical Depression |
| 9/16/1976 | Unnamed | Tropical Depression |
| 9/5/1998 | Earl | Tropical Storm |
| 9/20/2000 | Gordon | Tropical Depression |
| 9/24/2000 | Helene | Tropical Depression |
| 8/31/2004 | Gaston | Tropical Storm |
| 6/15/2006 | Alberto | Tropical Storm |
| 6/8/2013 | Andrea | Tropical Storm |
| 10/21/2019 | Nestor | Tropical Storm |
| 6/22/2021 | Claudette | Tropical Storm |
| 10/1/2022 | Ian | Tropical Storm |

Source: NOAA/National Hurricane Center, October 2025

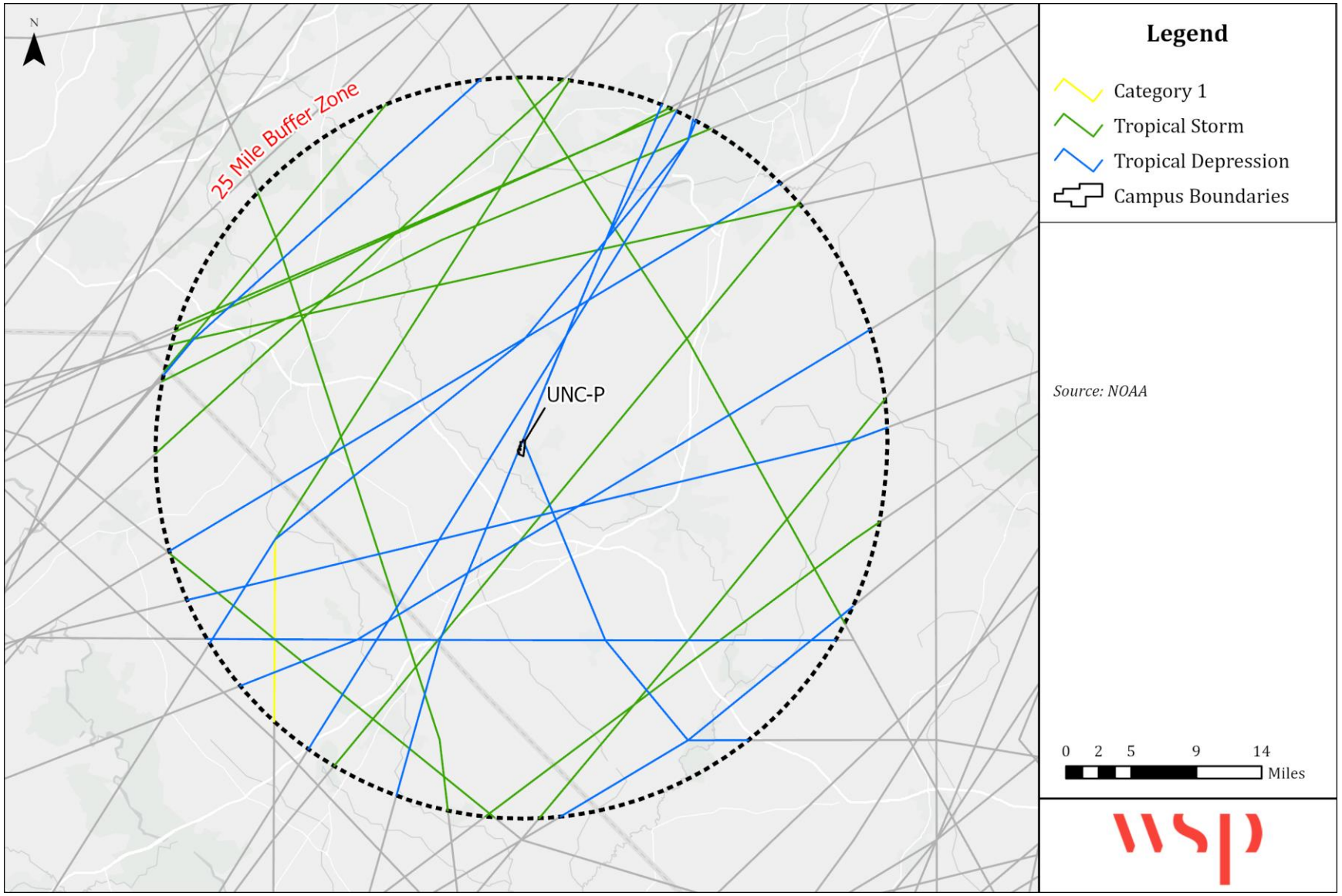
Robeson County has received six major disaster declarations and seven emergency declarations for hurricane and tropical storm events summarized in Table H.24.

## Table H.24 – Hurricane-Related Disaster Declarations & Emergency Declarations

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 8/27/1998 | DR-1240-NC | Hurricane Bonnie |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd Emergency Declarations |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/10/2004 | DR-1546-NC | Tropical Storm Frances |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 10/7/2016 | EM-3380-NC | Hurricane Matthew |
| 9/14/2018 | DR-4393-NC & EM-3401-NC | Hurricane Florence |
| 9/3/2019 | EM-3423-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |

Source: OpenFEMA, 2025

**Figure H.13 – Historical Hurricane and Tropical Storm Tracks within 25 miles of UNCP, 1990-2024**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, five hurricanes and tropical storms have impacted Robeson County, which equates to a 20 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting the County is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons. On-campus students may have limited transportation and need assistance evacuating if required. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could cause just under $1 million of estimated total building damages to UNC-P's campus.

Table H.25 details the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table H.25 – Estimated Building Damage by Hurricane Winds, UNC-P Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $63,734.29 | $10,862.85 | $74,597.14 |
| Educational | $570,298.28 | $132,365.98 | $702,664.26 |
| Housing | $152,729.51 | $62,041.71 | $214,771.22 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **Total** | **$786,762.08** | **$205,270.54** | **$992,032.62** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $486,231.33 | $232,593.78 | $718,825.11 |
| Educational | $4,383,973.62 | $2,937,028.37 | $7,321,001.99 |
| Housing | $1,492,995.54 | $1,272,763.87 | $2,765,759.41 |
| **Total** | **$6,363,200.49** | **$4,442,386.02** | **$10,805,586.51** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $1,108,164.79 | $727,060.14 | $1,835,224.93 |
| Educational | $10,347,050.46 | $8,857,365.28 | $19,204,415.74 |
| Housing | $3,612,781.77 | $3,739,946.82 | $7,352,728.59 |
| **Total** | **$15,067,997.02** | **$13,324,372.24** | **$28,392,369.26** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statement

- Historical tracks of multiple hurricane events pass within 25 miles of the UNCP Campus.
- For the 25-year period from 2000 through 2024, there have been 5 hurricane wind events which caused at least $71,000 in damage in Robeson County.

## H.5.5 Severe Winter Weather

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

Severe winter weather is usually a countywide or regional hazard, impacting the entire county at the same time. The entirety of North Carolina 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. Robeson County is accustomed to smaller scale severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, severe winter weather can occur anywhere in the county.

*Spatial Extent: 4 – Large*

### Extent

The National Oceanic and Atmospheric Administration (NOAA) uses the Regional Snowfall Index (RSI) shown in Table H.26 for the Robeson County area, to assess the societal impact of winter storms in the six easternmost regions in the United States. The index makes use of population and regional differences to assess the impact of snowfall. For example, areas which receive very little snowfall on average may be more adversely affected than other regions, resulting in a higher severity. UNCP may experience any level on the RSI scale. Robeson County receives an average of 1 to 2 inches of snowfall per year. According to NCEI records, between 2000 and 2024 the greatest snowfall amounts to impact Robeson County have been around 7 inches. During the snowstorm of December 24 to December 26, 2010, the county was classified as a Category 1 on the RSI scale and received between 5 to 7 inches of snow. It is possible that more severe events and impacts could be felt in the future.

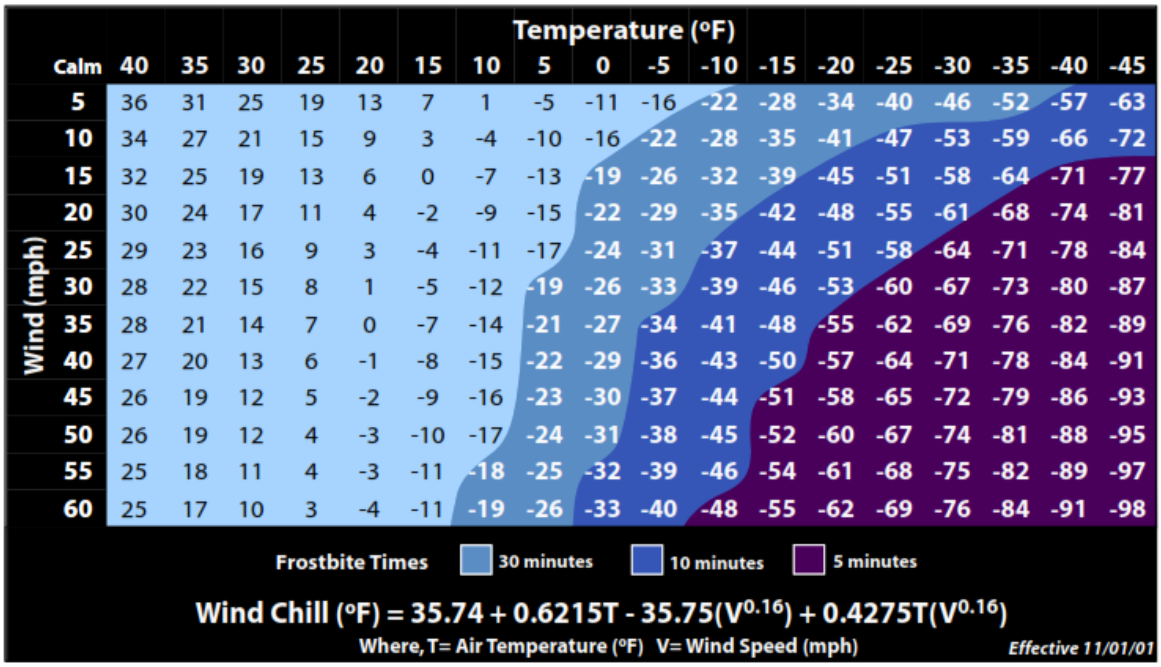
**Table H.26 – Regional Snowfall Index (RSI) Values**

| Category | RSI Value | Description |
|---|---|---|
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18+ | Extreme |

Source: NOAA

Severe winter weather often involves a mix of hazardous weather conditions. The magnitude of an event can be defined based on the severity of each of the involved factors, including precipitation type, precipitation accumulation amounts, temperature, and wind. The NWS Wind Chill Temperature Index, shown in Figure H.14, provides a formula for calculating the dangers of winter winds and freezing temperatures. This presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

**Figure H.14 – NWS Wind Chill Temperature Index**




Source: https://www.weather.gov/safety/cold-wind-chill-chart

The largest one-day snowfall to occur in Robeson County took place February 11th, 1912, with a recorded depth of 12 inches of snow occurring in the City of Lumberton.

*Impact: 2 – Limited*

## Historical Occurrences

To get a full picture of the range of impacts of severe winter weather, data for the following weather types as defined by the National Weather Service (NWS) and tracked by NCEI were collected:

- **Blizzard** – A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile.
- **Cold/Wind Chill** – Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory conditions of 0°F to -14°F with wind speeds 10 mph (9 kt) or greater.
- **Extreme Cold/Wind Chill** – A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria, defined as wind chill -15°F or lower with wind speeds 10 mph (9 kt) or greater.
- **Frost/Freeze** – A surface air temperature of 32°F or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season.
- **Heavy Snow** – Snow accumulation meeting or exceeding 12 and/or 24 hour warning criteria of 3 and 4 inches, respectively.
- **Ice Storm** – Ice accretion meeting or exceeding locally/regionally defined warning criteria of ¼ inch or greater resulting in significant, widespread power outages, tree damage and dangerous travel. Issued only in those rare instances where just heavy freezing rain is expected and there will be no "mixed bag" precipitation meaning no snow, sleet or rain.
- **Sleet** – Sleet accumulations meeting or exceeding locally/regionally defined warning criteria of ½ inch or more.
- **Winter Storm** – A winter weather event that has more than one significant hazard and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements. Defined by NWS Pembroke Forecast Office as snow accumulations 3 inches or greater in 12 hours (4 inches or more in 24 hours); Freezing rain accumulations ¼ inch (6 mm) or greater; Sleet accumulations ½ inch (13 mm) or more. Issued when there is at least a 60% forecast confidence of any one of the three criteria being met.
- **Winter Weather** – A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria.

According to the NCEI Storm Events Database, there were three frost/freeze events, five heavy snow events, five ice storm events, and 15 combined winter storm/winter weather events in Robeson County during the 25-year period from 2000 through 2024. These events caused $4,550,000 in property damage and one injury, but they did not cause any fatalities, or crop damage. It should be noted though that these types of impacts may not have been reported and are possible in future events. Events in Robeson County by type are recorded in Table H.27.

**Table H.27 – Recorded Severe Winter Weather Events in Robeson County, 2000-2024**

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Frost/Freeze | 3 | 0 | 0 | $0 | $0 |
| Heavy Snow | 5 | 0 | 1 | $0 | $0 |

| Event Type | Event Count | Fatalities | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Ice Storm | 5 | 0 | 0 | $4,500,000 | $0 |
| Winter Storm | 10 | 0 | 0 | $20,000 | $0 |
| Winter Weather | 5 | 0 | 0 | $30,000 | $0 |
| **Total** | **28** | **0** | **1** | **$4,550,000** | **$0** |

Source: NCEI

Storm impacts from NCEI are summarized below:

- **December 3, 2000** – Low pressure moving up the coast of the Carolinas combined with cold air and an upper level disturbance moving in from the Midwest to create a winter weather scenario. Snowfall measured up to around 10 inches in parts of east central North Carolina, while less fell further south in southeast NC and northeast SC. A trained spotter in Robeson County reported 3 inches. The wintery mix was directly responsible for numerous traffic accidents, reported by 911 and law enforcement.
- **December 4, 2002** – Between a tenth and a quarter inch of ice was recorded. The ice caused branches to snap on many trees, causing power outages for 9000 residences. No major traffic accidents were noted. Strong high pressure over the mid-Atlantic fed a shallow layer of cold air across interior portions of the state. Low pressure formed over the Gulf coast, spreading moisture over the Carolinas. The result was freezing rain.
- **January 30, 2010 –** A winter mix of sleet and ice fell over much of the county. Based on reports, up to a quarter inch of ice accumulated, with a half inch of ice and sleet combined accumulation over the northern portion of the county. Numerous power outages were reported.
- **December 26, 2010** – Between five and seven inch of snow fell across the county. There were sporadic power outages, and one motorist was injured when their car skidded off the road on Hwy 211. A limb 12 inches in diameter and 20 feet in length fell from the weight of the snow.
- **March 16, 2017** – Cold air pushed into the region on March 15th, courtesy of a strong cold front and a large high pressure system that settled over the region for the next two days. Temperatures on both March 16th and 17th dropped well into the mid and lower 20s for four to six hours. Significant crop damage was noted. The blueberry crop suffered the worst with nearly 50 percent of the crop damaged or lost. Fruit trees, such as the peach and pear, also suffered almost complete losses, although the crop size was rather small. Wheat also sustained mainly minor losses.
- **January 21, 2022** – Low pressure off the coast led to wintry precipitation across the area. Began as freezing rain before switching to snow inland where several inches of snow fell. Freezing rain lingered near the coast leading to accumulating ice up to 0.25 before changing to sleet overnight and ending as brief snow by early morning.

Robeson County has never received any FEMA Major Disaster Declarations for severe winter weather.

## Probability of Future Occurrence

NCEI records 28 severe winter weather related events during the 25-year period from 2000 through 2024, which equates to an annual probability greater than 100%. Therefore, the overall probability of severe winter weather in the county is considered highly likely (near or more than 100% annual probability).

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Winter storms are considered deceptive killers because most deaths are indirectly related to the storm event. The leading cause of death during winter storms is from automobile or other transportation accidents due to poor visibility and/or slippery roads. Additionally, exhaustion and heart attacks caused by overexertion may result from winter storms.

Power outages during very cold winter storm conditions can also create potentially dangerous situations. Elderly people account for the largest percentage of hypothermia victims. In addition, if the power is out for an extended period, residents are forced to find alternative means to heat their homes. The danger arises from carbon monoxide released from improperly ventilated heating sources such as space or kerosene heaters, furnaces, and blocked chimneys. House fires also occur more frequently in the winter due to lack of proper safety precautions when using an alternative heating source.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a severe winter storm is estimated at $115,872, which assumes that 10% of the undergraduate population is impacted.

**Table H.28 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Undergraduate Population (Fall 2024) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 5,437 | 544 | $115,872 |

### Property

The NCEI reported $4,550,000 of property damage in association with any winter weather events between 2000 and 2024 for Robeson County. Based on these records, the County experiences an estimated annualized loss of $182,000 in property damage. The average impact from winter weather events per incident in the County is $162,500.

### Environment

Winter storm events may include ice or snow accumulation on trees which can cause large limbs, or even whole trees, to snap and potentially fall on buildings, cars, or power lines. This potential for winter debris creates a dangerous environment to be outside in; significant injury or fatality may occur if a large limb snaps while someone is driving or walking underneath it.

## Changes in Development

Future development could potentially increase vulnerability to this hazard by increasing demand on the utilities and increasing the exposure of infrastructure networks. UNCP may wish to consider developing a flexible emergency power network to provide efficient back-up power for vulnerable populations, critical facilities, and research facilities.

## Problem Statement

- Severe winter weather events are highly likely for Robeson County and the UNCP campus.

## H.5.6 Tornadoes & Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

### Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally confined to the footprint of its associated thunderstorm. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas.

*Spatial Extent: 4 – Large*

#### TORNADO

Tornados can occur anywhere on UNCP's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado damage isn't increased in one area of the campus versus another. All of UNCP is exposed to this hazard.

#### THUNDERSTORM WINDS

The entirety of UNCP's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area.

#### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of UNCP is exposed to lightning.

#### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

### Extent

#### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28)

and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table H.29 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table H.29 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

The most intense tornadoes to pass through Robeson County in the past 75 years were three F4 tornadoes, occurring in 1957 and 1984 that together resulted in 2 deaths, 307 injuries, and $3 million in property damage.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, Thunderstorm Wind, Tornado and Hurricane. For this severe weather risk assessment, High Wind, Strong Wind and Thunderstorm Wind data was collected. Hurricane Wind and Tornadoes are addressed as individual hazards. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.

- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.
- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Robeson County occurred on May 11, 2014 with a measured gust of 125.5 mph. The event reportedly resulted in property damages around $878,000 with one injury and no fatalities.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table H.30, is a common parameter that is part of fire weather forecasts nationwide.

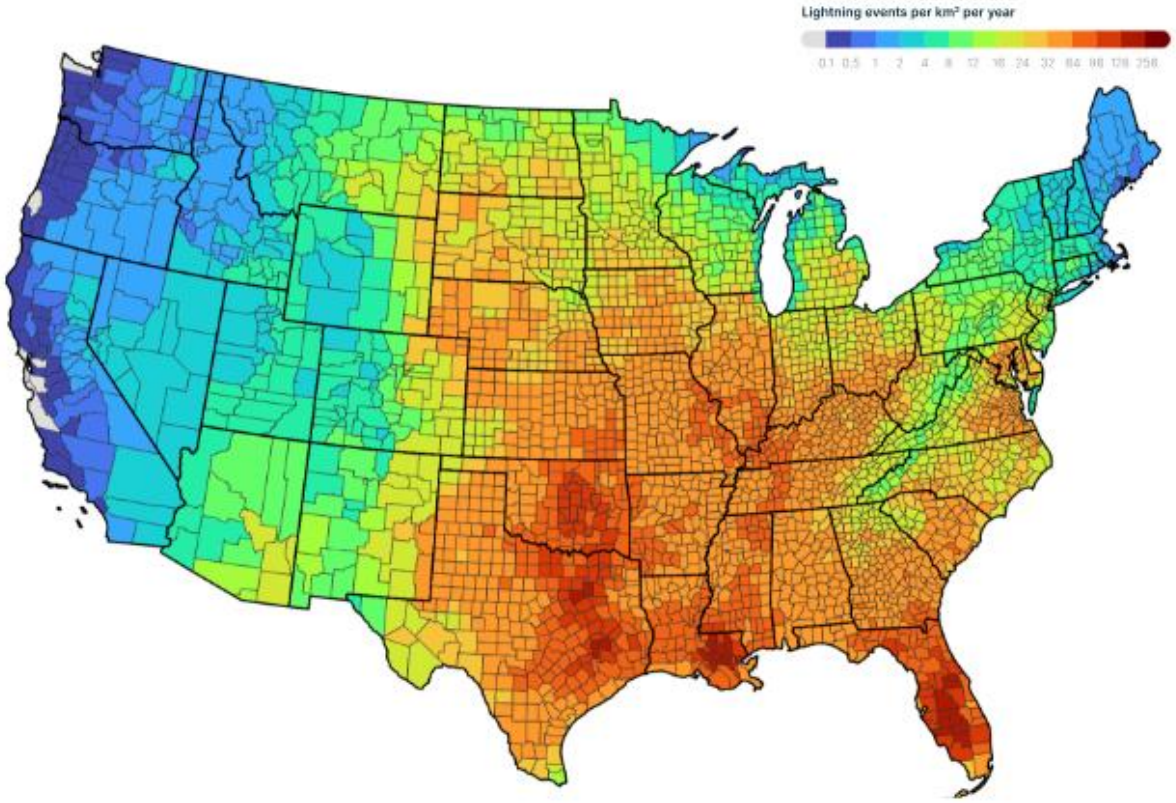
**Table H.30 – Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

Source: National Weather Service

According to the Vaisala flash density map, Robeson County experiences 32 to 64 lightning events per km per year.

**Figure H.15 – Lightning Density in the U.S. (2024)**




With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

*Impact: 1 – Minor*

## HAIL

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table H.31 indicates the hailstone measurements utilized by the National Weather Service.

**Table H.31– Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |

| Average Diameter | Corresponding Household Object |
|---|---|
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table H.32 describes typical intensity and damage impacts of the various sizes of hail.

**Table H.32– Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls pitted |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2024 in Robeson County was a little over 1" in diameter; the largest diameter hail recorded in the county was 3", which occurred on February 24, 2016.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, Robeson County has 50 recorded tornado events between 1950 and 2024, and these events occurred on 37 different days. These tornado events reported $9,565,500 in property damage, 334 injuries, 6 deaths, and no crop damage. Table H.33 shows historical tornadoes in Robeson County recorded in NCEI between 1950 and 2024, and Table H.33 shows tornado paths within 10 miles of UNCP.

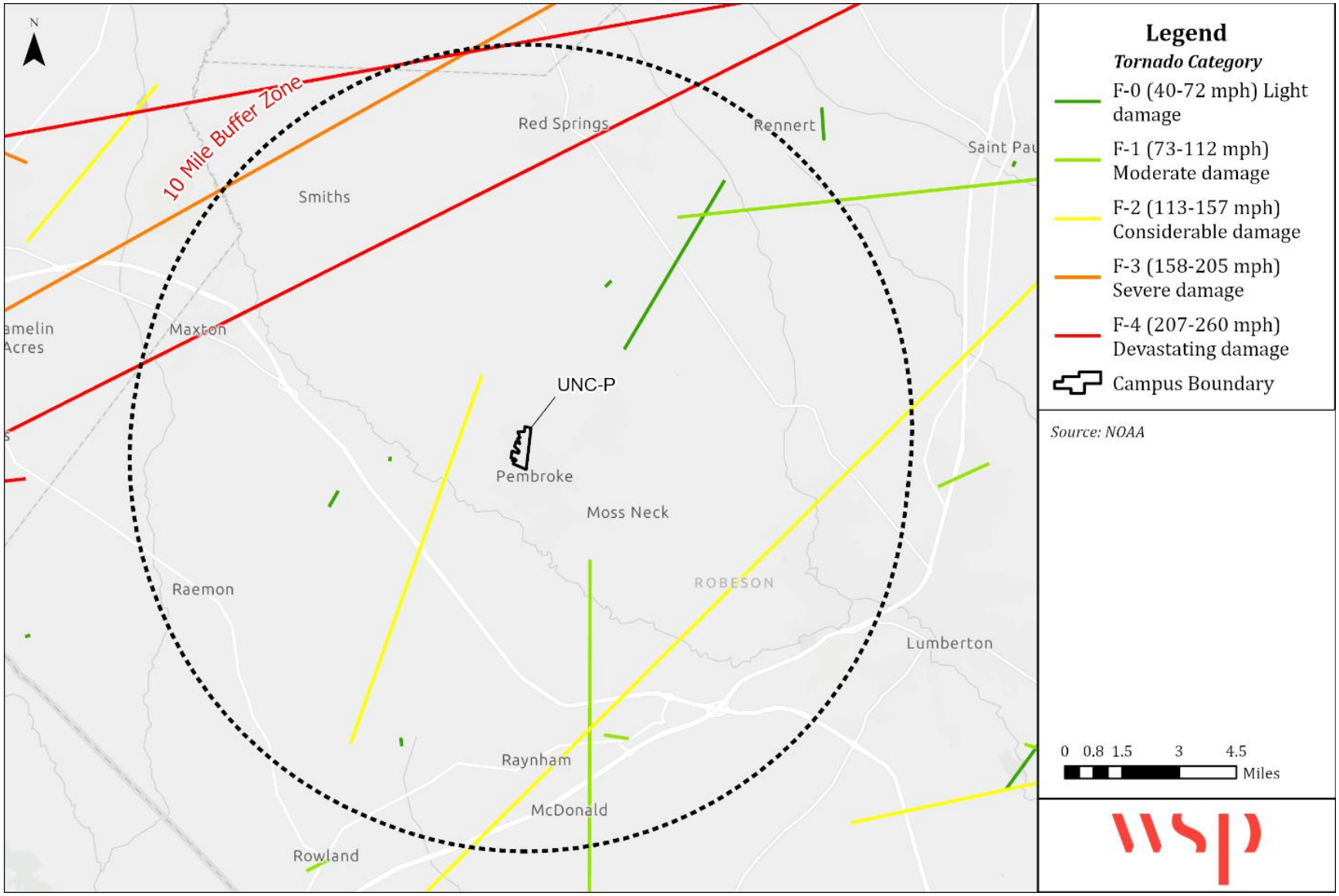
**Table H.33 – Recorded Tornadoes in Robeson County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| | 4/8/1957 | 1900 | F4 | 0 | 21 | $250,000 |
| | 4/8/1957 | 1900 | F4 | 0 | 6 | $250,000 |
| | 2/27/1958 | 1500 | F0 | 0 | 0 | $2,500 |
| | 2/19/1963 | 700 | F1 | 0 | 0 | $2,500 |
| | 7/19/1963 | 1700 | F2 | 0 | 0 | $25,000 |
| | 9/29/1963 | 200 | F2 | 0 | 0 | $250,000 |
| | 8/30/1964 | 300 | F1 | 0 | 0 | $25,000 |
| | 2/16/1975 | 1530 | F1 | 0 | 1 | $25,000 |
| | 5/15/1975 | 1710 | F1 | 0 | 0 | $2,500 |
| | 5/15/1975 | 1747 | F1 | 0 | 0 | $25,000 |
| | 5/15/1976 | 1550 | F2 | 3 | 4 | $250,000 |
| | 3/4/1977 | 1245 | F0 | 0 | 0 | $25,000 |
| | 3/4/1977 | 1315 | F1 | 0 | 4 | $250,000 |
| | 4/19/1978 | 1700 | F1 | 0 | 0 | $2,500 |
| | 6/3/1978 | 1500 | F1 | 0 | 0 | $2,500 |
| | 3/23/1979 | 2240 | F2 | 0 | 9 | $250,000 |
| | 8/21/1979 | 1700 | F0 | 0 | 0 | $0 |
| | 5/20/1980 | 1342 | F1 | 0 | 0 | $25,000 |
| | 3/28/1984 | 1840 | F4 | 2 | 280 | $2,500,000 |
| | 11/7/1995 | 1700 | F0 | 0 | 0 | $0 |
| | 9/6/1996 | 2100 | F0 | 0 | 0 | $0 |
| | 9/16/1996 | 1910 | F0 | 0 | 0 | $0 |
| | 7/5/1997 | 1750 | F1 | 0 | 0 | $20,000 |
| | 3/8/1998 | 1438 | F0 | 0 | 0 | $10,000 |
| | 3/8/1998 | 1503 | F1 | 0 | 3 | $100,000 |
| | 3/20/1998 | 2045 | F1 | 0 | 1 | $20,000 |
| | 4/15/1999 | 1915 | F2 | 1 | 4 | $200,000 |
| | 4/15/1999 | 1930 | F1 | 0 | 0 | $20,000 |
| Fairmont | 8/18/2001 | 1345 | F0 | 0 | 0 | $25,000 |
| Orrum | 9/7/2004 | 1305 | F0 | 0 | 0 | $0 |
| Lumberton | 9/7/2004 | 1347 | F0 | 0 | 0 | $0 |

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| Marietta | 9/7/2004 | 1453 | F1 | 0 | 0 | $200,000 |
| Marietta | 9/7/2004 | 1710 | F0 | 0 | 0 | $3,000 |
| St Pauls | 11/15/2008 | 0135 | EF0 | 0 | 0 | $50,000 |
| Allenton | 3/27/2009 | 1532 | EF0 | 0 | 0 | $5,000 |
| Mc Millan | 3/27/2009 | 1602 | EF2 | 0 | 1 | $35,000 |
| Rowland | 4/16/2011 | 1433 | EF1 | 0 | 0 | $1,500,000 |
| Powers | 4/16/2011 | 1447 | EF1 | 0 | 0 | $3,000,000 |
| Rennert | 9/6/2011 | 1841 | EF0 | 0 | 0 | $20,000 |
| Red Banks | 2/21/2014 | 1215 | EF0 | 0 | 0 | $9,000 |
| Roziers | 2/21/2014 | 1238 | EF0 | 0 | 0 | $11,000 |
| Raynham | 6/27/2015 | 1923 | EF1 | 0 | 0 | $40,000 |
| Allenton | 6/27/2015 | 1945 | EF1 | 0 | 0 | $20,000 |
| Lumber Bridge | 5/23/2017 | 1438 | EF0 | 0 | 0 | $100,000 |
| Purvis | 9/16/2018 | 1529 | EF0 | 0 | 0 | $0 |
| Tolarsville | 6/17/2022 | 1906 | EF0 | 0 | 0 | $0 |
| Red Banks | 5/14/2024 | 1652 | EF0 | 0 | 0 | $0 |
| Buie | 5/14/2024 | 1700 | EF0 | 0 | 0 | $10,000 |
| Phildelphus | 5/14/2024 | 1706 | EF0 | 0 | 0 | $5,000 |
| **Total:** | | | | **6** | **334** | **$9,565,500** |

Source: NCEI

**Figure H.16 – Tornado Paths within 10 miles of UNCP**



Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **May 15, 1976** – A tornado touched down near Rowland moved NNE to near Pembroke. Most damage in Pembroke area where several mobile homes were hit. Tornado resulted in 3 fatalities and 4 injuries.
- **March 28, 1984** – The tornado hit Maxton at 19:30EST and Red Springs 10 minutes later, both in Robeson County, killing 3 and injuring 280.
- **April 15, 1999** – A tornado killed a man in his mobile home and injured 4 others.
- **March 27, 2009** – A National Weather Service Storm Survey confirmed an EF-2 Tornado touched down about 3 miles east of Parkton, North Carolina. The tornado first touched down along W Parkton Tobermory Road, halfway between Highway 301 and Interstate 95, with no significant damage. The tornado tracked north-northeast and intensified to EF-2 with winds to 130 mph as it impacted structures along E Everette Road. One mobile home was completely destroyed and an adult female was thrown by the tornado. The woman suffered minor injuries. Also at this location, the tornado destroyed a two story home that was empty at the time. The tornado continued to track to the north-northeast and eventually lifted across a wooded area.
- **June 27, 2015** – A survey was conducted by the National Weather Service. The team found damage supportive of a brief EF-1 tornado with winds up to 90 mph. The tornado touched down in the Allentown community, just east of Highway 211. The tornado uprooted a healthy 100 year old three foot diameter pecan tree. The pecan tree fell across a house and punctured its roof, causing significant damage. Four smaller oak trees were also uprooted. This tornado was spawned from the same supercell that produced a tornado 14 miles to the west, 22 minutes prior.

### THUNDERSTORM WINDS

Between 2000 and 2024, the NCEI recorded wind speeds for 258 separate incidents of thunderstorm winds, occurring on 130 separate days, for Robeson County. These events caused four injuries, $3,615,250 in recorded property damage, $104,000 in crop damage and no fatalities. The recorded gusts averaged 63.1 miles per hour, with the highest gusts recorded at 125 mph on May 11, 2009. Of these events, 172 caused property damage. Wind gusts with property damage recorded averaged $21,004 in damage, with the highest reported damage being a total of $813,000 on May 11, 2009. The incidents resulting in property damage in Robeson County are recorded below in Table H.34.

**Table H.34 – Recorded Thunderstorm Winds Resulting in Property Damage, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Rowland | 5/27/2000 | 74.8 | 0 | 0 | $100,000 |
| Red Spgs | 4/1/2001 | 89.8 | 0 | 0 | $300,000 |
| Red Spgs | 5/12/2001 | 69.1 | 0 | 0 | $5,000 |
| Barnesville | 6/1/2001 | 70.2 | 0 | 0 | $25,000 |
| Lumberton | 6/16/2001 | 80.6 | 0 | 0 | $50,000 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Maxton | 3/16/2002 | 103.6 | 0 | 1 | $750,000 |
| Fairmont | 6/14/2002 | 80.6 | 0 | 0 | $100,000 |
| Pembroke | 5/2/2003 | 80.6 | 0 | 0 | $30,000 |
| Maxton | 5/25/2003 | 80.6 | 0 | 0 | $60,000 |
| Pembroke | 5/31/2003* | 80.6 | 0 | 0 | $290,000 |
| Maxton | 8/12/2004 | 69.1 | 0 | 0 | $20,000 |
| Lumberton | 3/8/2005 | 74.8 | 0 | 0 | $40,000 |
| Pembroke | 6/11/2006 | 74.8 | 0 | 0 | $15,000 |
| Lumberton | 8/29/2007 | 69.1 | 0 | 0 | $50,000 |
| Allenton | 5/11/2009* | 125.5 | 0 | 1 | $878,000 |
| Fairmont | 7/16/2009 | 57.6 | 0 | 0 | $1,000 |
| Rennert | 5/16/2010* | 59.9 | 0 | 0 | $12,000 |
| Fairmont | 5/23/2010* | 59.9 | 0 | 0 | $30,000 |
| Phildelphus | 5/28/2010* | 59.9 | 0 | 0 | $4,000 |
| East Lumberton | 6/14/2010 | 59.9 | 0 | 0 | $5,000 |
| Orrum | 6/29/2010* | 59.9 | 0 | 0 | $45,500 |
| Shannon | 7/25/2010 | 57.6 | 0 | 0 | $1,000 |
| East Lumberton | 7/27/2010 | 64.5 | 0 | 0 | $11,000 |
| Roziers | 11/17/2010 | 59.9 | 0 | 0 | $8,000 |
| Raynham | 4/5/2011* | 64.5 | 0 | 0 | $16,000 |
| Rowland | 4/16/2011* | 74.8 | 0 | 0 | $54,000 |
| Proctorville | 5/14/2011 | 57.6 | 0 | 0 | $1,000 |
| Lumber Bridge | 5/22/2011 | 59.9 | 0 | 0 | $7,000 |
| Alma | 6/12/2011* | 59.9 | 0 | 0 | $16,000 |
| Wakulla | 6/18/2011* | 57.6 | 0 | 0 | $34,500 |
| Maxton | 6/23/2011* | 74.8 | 0 | 0 | $32,000 |
| Allenton | 6/24/2011* | 57.6 | 0 | 0 | $5,000 |
| Red Spgs | 6/28/2011 | 64.5 | 0 | 0 | $9,000 |
| Rennert | 7/13/2011 | 64.5 | 0 | 0 | $3,000 |
| Proctorville | 8/19/2011 | 57.6 | 0 | 0 | $2,000 |
| Powers | 8/21/2011* | 57.6 | 0 | 0 | $5,500 |
| Parkton | 8/29/2011* | 57.6 | 0 | 0 | $3,000 |
| Proctorville | 11/16/2011* | 57.6 | 0 | 0 | $4,000 |
| Rowland | 7/5/2012* | 59.9 | 0 | 0 | $5,500 |
| Parkton | 7/10/2012* | 57.6 | 0 | 0 | $7,000 |
| Elrod | 7/21/2012* | 59.9 | 0 | 0 | $9,000 |
| Fairmont | 1/30/2013* | 57.6 | 0 | 0 | $6,000 |
| Tolarsville | 1/31/2013 | 57.6 | 0 | 0 | $3,000 |
| Oakland | 4/19/2013* | 57.6 | 0 | 0 | $5,000 |
| Raemon | 6/9/2013 | 59.9 | 0 | 0 | $5,000 |
| Mc Millan | 6/26/2013 | 62.2 | 0 | 0 | $1,000 |
| Rennert | 6/26/2013* | 62.2 | 0 | 0 | $56,000 |
| Buie | 2/21/2014* | 59.9 | 0 | 0 | $18,000 |
| Pembroke | 5/29/2014 | 57.6 | 0 | 0 | $1,000 |
| Bloomingdale | 6/5/2014 | 70.2 | 0 | 0 | $25,000 |
| Red Spgs Cnfdrte Arp | 6/17/2014 | 62.2 | 0 | 0 | $4,000 |

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Fairmont | 6/19/2014* | 59.9 | 0 | 0 | $5,000 |
| Mc Millan | 8/23/2014* | 57.6 | 0 | 0 | $8,000 |
| Parkton | 9/3/2014* | 57.6 | 0 | 0 | $1,500 |
| Fairmont | 6/18/2015 | 59.9 | 0 | 0 | $10,000 |
| Maxton | 6/19/2015* | 59.9 | 0 | 0 | $6,000 |
| Rennert | 6/26/2015* | 57.6 | 0 | 0 | $2,000 |
| Raynham | 6/27/2015* | 64.5 | 0 | 0 | $20,000 |
| Pembroke | 2/24/2016* | 59.9 | 0 | 2 | $8,000 |
| Pates | 5/2/2016* | 59.9 | 0 | 0 | $7,000 |
| Purvis | 7/4/2016 | 64.5 | 0 | 0 | $12,000 |
| Smiths | 7/5/2016 | 57.6 | 0 | 0 | $1,000 |
| Maxton | 7/11/2016* | 64.5 | 0 | 0 | $40,000 |
| Powers | 7/19/2016* | 64.5 | 0 | 0 | $12,250 |
| Alma | 3/18/2017 | 57.6 | 0 | 0 | $3,000 |
| Red Spgs | 6/24/2017 | 57.6 | 0 | 0 | $2,000 |
| Parkton | 7/10/2017* | 57.6 | 0 | 0 | $2,000 |
| Fairmont | 7/23/2017 | 57.6 | 0 | 0 | $3,000 |
| Fairmont | 8/23/2017 | 59.9 | 0 | 0 | $5,000 |
| Mc Donalds | 3/1/2018 | 57.6 | 0 | 0 | $3,000 |
| Pates | 6/11/2018 | 69.1 | 0 | 0 | $50,000 |
| Lumberton | 6/18/2018* | 63.3 | 0 | 0 | $10,500 |
| Smiths | 6/24/2018* | 63.3 | 0 | 0 | $2,000 |
| Rowland | 4/19/2019* | 64.5 | 0 | 0 | $7,000 |
| Parkton | 5/30/2019* | 70.2 | 0 | 0 | $100,000 |
| Fairmont | 6/22/2019 | 70.2 | 0 | 0 | $20,000 |
| Maxton | 7/19/2019 | 59.9 | 0 | 0 | $10,000 |
| Red Spgs | 4/13/2020 | 70.2 | 0 | 0 | $5,000 |
| Allenton | 5/22/2020 | 59.9 | 0 | 0 | $1,000 |
| Moss Neck | 8/26/2023 | 57.6 | 0 | 0 | $10,000 |
| Parkton | 1/9/2024 | 57.6 | 0 | 0 | $1,000 |
| **Total** | | | **0** | **4** | **$3,615,250** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **May 27, 2000** – Emergency manager reported trees and power lines down...8 buildings were damaged. Nickle-size hail was also reported.
- **April 1, 2001** – Damage occurred to 8 homes, with several sustaining significant damage. One roof was blown completely off. Many trees were down, all as a result of straight-line winds. The estimated peak wind for the event was 90 mph.
- **March 16, 2002** – A NWS Storm survey determined that straight line thunderstorm winds produce extensive damage to a trailer park in the northern part of Robeson County. 18 structures in all were damaged. 8 mobile homes were completely destroyed with one double wide trailer moved 10 feet off its foundation. A large metal electrical tower in the area

was also blown down. A woman was injured in her mobile home during the event, dislocating her elbow. Large hail was also produced from the strong thunderstorm, with 2.5 hail reported in the area.

- **May 31, 2003** – Thunderstorm winds overturned a mobile home on Roberts Ave. Seven or eight homes were damaged in The Oaks subdivision. Car windows were blown out at a dealership. A sign was blown down at Rt 301 and Ten Mile Rd.
- **May 11, 2009** – A super-cell thunderstorm with damaging winds accelerated as it moved across Robeson County. Numerous trees and power lines were down and there was considerable structural damage. A NWS Storm Survey concluded that a wet microburst produced a swath of damaging straight-line winds up to 125 mph. The damage began near the intersection of Wilton Drive and Gem Road. Several trees were uprooted or snapped off and minor to moderate damage was observed to roof shingles and siding. Significant damage was observed east of NC Highway 72. Numerous large trees were snapped off or uprooted along NC Highway 72 and significant structural damage occurred to approximately 8 homes on Sadie Drive; one was completely destroyed and another lost its entire roof. Several sheds and outbuildings were destroyed in this area. One adult woman suffered broken bones. The damage had a maximum path width of 350 yards and a path length of 2.25 miles. The Robeson County Emergency Manager estimated the damage at $813,000.
- **June 11, 2018** – Thunderstorm winds produced extensive damage to a house on Philadelphus Road. There was a report of treetops snapped, with damage to an out building.
- **August 26, 2023** – Pictures relayed via social media show a large tree was uprooted in the Deep Brach community between Pembroke, NC and Lumberton, NC. The tree fell on a house and may have caused some structural damage to the home.

### LIGHTNING

According to NCEI data, there were seven lightning strikes reported between 2000 and 2024. These lightning strike events recorded two injuries and an estimated $506,500 worth of property damage. No crop damage or fatalities were recorded by these strikes. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table H.35 details NCEI-recorded lightning strikes from 2000 through 2024 for Robeson County.

**Table H.35 – Recorded Lightning Strikes in Robeson County, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| St Pauls | 5/27/2001 | 900 | 0 | 0 | $40,000 |
| Red Spgs | 8/18/2001 | 1400 | 0 | 0 | $0 |
| Lumberton | 8/28/2001 | 1430 | 0 | 1 | $300,000 |
| St Pauls | 5/26/2006 | 1520 | 0 | 0 | $15,000 |
| Orrum | 6/16/2010 | 510 | 0 | 0 | $1,500 |
| Lumberton | 6/12/2011 | 2128 | 0 | 1 | $0 |
| Fairmont | 6/19/2014 | 2130 | 0 | 0 | $150,000 |
| | | **Total** | **0** | **2** | **$506,500** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Pembroke:

- **May 27, 2001** – Lightning started a fire that destroyed a storage unit at the Barker Mobile Home Park.
- **August 28, 2001** – Lightning struck a business (body shop) on 1205 Roberts Ave. The resulting fire destroyed the building, as well as caused second degree burns to the owner.
- **June 12, 2011** – A man was injured when lightning struck as he was unplugging a pool pump.
- **June 19, 2014** – Lightning struck the Lumber River Electric Company building at the corner of Main and Red Cross Streets. The resulting fire destroyed the interior of the structure.

### HAIL

NCEI records 68 days with hail incidents between 2000 and 2024 in Robeson County. These events were reported to have caused $117,150 in property damage and $50,000 in crop damage. The largest diameter hail recorded in the county was 3 inches, which occurred on February 24, 2016. The average hail size of all events in the County was just over one inch in diameter. Table H.36 summarizes hail events for Robeson County. In some cases, hail was reported for multiple locations on the same day.

**Table H.36 – Summary of Hail Occurrences in Robeson County**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| Fairmont | 4/17/2000* | 1 |
| Fairmont | 4/28/2000* | 0.75 |
| Barnesville | 6/3/2000* | 1.75 |
| Pembroke | 6/14/2000* | 1.75 |
| Pembroke | 6/22/2000* | 0.75 |
| St Pauls | 7/16/2000* | 1.75 |
| Lumber Bridge | 8/18/2000 | 0.75 |
| Orrum | 4/1/2001 | 0.75 |
| Lumberton | 6/22/2001 | 0.75 |
| Barnesville | 8/28/2001 | 0.88 |
| Lumberton | 3/31/2002* | 1.75 |
| Rennert | 7/31/2002 | 1.25 |
| Orrum | 3/6/2003 | 0.75 |
| Pembroke | 5/3/2003* | 1.75 |
| Fairmont | 5/25/2003 | 0.75 |
| Pembroke | 5/31/2003* | 0.88 |
| Lumberton | 4/11/2004* | 0.88 |
| Tolarsville | 5/8/2004 | 0.75 |
| Lumberton | 5/23/2004 | 0.75 |
| Marietta | 4/3/2006 | 0.75 |
| Lumberton | 5/5/2006 | 0.88 |
| Pembroke | 5/20/2006 | 0.75 |
| Lumberton | 5/26/2006* | 0.88 |
| Lumberton | 6/8/2006 | 0.88 |

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| Marietta | 6/12/2007* | 0.88 |
| Lumberton | 6/13/2007* | 1 |
| Orrum | 3/15/2008* | 1.75 |
| Allenton | 5/11/2008 | 1 |
| Powers | 6/9/2008* | 0.88 |
| Fairmont | 6/17/2008 | 0.75 |
| Raynham | 6/20/2008 | 1 |
| Smiths | 7/31/2008 | 0.75 |
| Pembroke | 10/1/2008 | 0.75 |
| Lumberton Muni Arpt | 5/11/2009 | 0.75 |
| Fairmont | 5/29/2009* | 1.13 |
| Lumberton | 4/27/2010* | 0.88 |
| Lowe | 5/23/2010* | 1 |
| Red Spgs | 5/28/2010 | 0.75 |
| Allenton | 6/29/2010 | 0.75 |
| East Lumberton | 7/27/2010 | 0.88 |
| Lumberton | 2/28/2011 | 0.75 |
| Pembroke | 4/16/2011* | 1.75 |
| East Lumberton | 4/28/2011 | 1.75 |
| Mc Donalds | 5/10/2011* | 1.5 |
| Powers | 5/14/2011 | 1 |
| Lumber Bridge | 5/22/2011* | 1.25 |
| Plainview | 5/27/2011* | 1.75 |
| Allenton | 6/16/2011 | 1 |
| Lumberton Muni Arpt | 3/25/2012 | 1 |
| Fairmont | 4/26/2012 | 1 |
| Allenton | 5/15/2012 | 1 |
| Mc Millan | 5/22/2012 | 1 |
| East Lumberton | 5/23/2012 | 1 |
| Parkton | 7/1/2012* | 1.75 |
| Elrod | 7/21/2012 | 1 |
| Alfords | 9/3/2013 | 0.88 |
| Red Spgs | 4/28/2014 | 1 |
| Red Banks | 5/29/2014* | 0.88 |
| Parkton | 4/9/2015 | 1.25 |
| Smiths | 6/26/2015 | 0.88 |
| Pembroke | 2/24/2016* | 3 |
| Tolarsville | 5/3/2016* | 1.25 |
| Roziers | 4/6/2017 | 0.75 |
| Proctorville | 4/22/2023* | 1 |
| Pates | 4/20/2024* | 1.75 |
| Lumberton | 5/8/2024* | 1.75 |
| Proctorville | 5/10/2024* | 1.75 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **July 16, 2000** – Robeson 911 center reported golf ball size hail and large garbage dumpsters blown over.
- **April 16, 2011** – Hail to the size of golf balls was reported near the University of North Carolina at Pembroke. The hail lasted for about 15 minutes.
- **February 24, 2016** – Hail up to around 3 inches or greater was measured.
- **May 10, 2024** – Robeson County EM reports golf ball size hail near Proctorville.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Robeson County averages 5.2 days with wind events per year. Over this same period, five lightning events were reported as having caused property damage, which equates to an average of 0.25 damaging lightning strikes per year.

The average hail storm in Robeson County occurs in the evening and has a hail stone with a diameter of just over one inch. Over the 25-year period from 2000 through 2024, Robeson County experienced 68 days with reported hail incidents; this averages to 2.72 days per year with reported incidents somewhere in the County.

Probability of future occurrence was calculated based on past occurrences and was assumed to be uniform across the county.

In a 75-year span between 1950 and 2024, Robeson County recorded 50 tornadoes, and these events occurred on 37 separate days. This correlates to a 67 percent annual probability that the County will experience a tornado somewhere in its boundaries. Of these past tornado events, 40 events were EF0/F0 or EF1, 5 of these events were EF2, and 3 were F4. Based on eight tornado events having a magnitude higher than EF1, the annual probability of a significant tornado event is 10.6 percent.

Based on these historical occurrences, there is between a 10% to 100% chance that Robeson County will experience severe weather each year. The probability of damaging impacts is likely.

*Probability: 3 –Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on UNC-P's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Since 2000,

thunderstorm winds have resulted in 4 injuries. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes. Since 2000, lightning has caused two injuries in Robeson County.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $115,872, which assumes that 10% of the undergraduate population is impacted.

**Table H.37 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Undergraduate Population (Fall 2024) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 5,437 | 544 | $115,872 |

The availability of sheltered locations such as basements, buildings constructed using hail-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Residents living in mobile homes are more vulnerable to hail events due to the lack of shelter locations and the vulnerability of the housing unit to damage.

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Since 1950, tornadoes have resulted in 6 fatalities and 334 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Robeson County, the two events with recorded property damage were due to fires ignited by lightning strikes.

NCEI records lightning impacts over 25 years (2000-2025), with $506,500 in property damage recorded during five separate events. Based on these records, the County experiences an annualized loss of $20,260 in property damage. The average impact from lightning per incident in Robeson County is $72,357.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and

building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Robeson County, NCEI reported $117,150 in property damage and $50,000 in crop damage caused by hail events. This equates to an estimated annualized loss of $6,686 due to hail-related events across the County.

It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damage in Robeson County, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $3,615,250 in property damage and $104,000 in crop damage, which equates to an annualized loss of $148,770 across the County.

Tornado damages to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in the County have been directly responsible for $9,565,500 worth of damage to property according to NCEI data. This equates to an annualized loss of $127,540. Per the iRisk analysis, an F2 tornado event could cause over $216 million of estimated total building damage on campus.

Table H.38 details the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table H.38 – Estimated Building Damage by Tornado Events, UNC-P Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $242,975.21 | $359,159.91 | $602,135.12 |
| Educational | $2,232,457.57 | $3,302,764.53 | $5,535,222.10 |
| Housing | $533,431.75 | $785,646.59 | $1,319,078.34 |
| **Total** | **$3,008,864.53** | **$4,447,571.03** | **$7,456,435.56** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F1 Tornado Event** | | | |
| Administration | $1,955,494.52 | $2,894,043.62 | $4,849,538.14 |
| Educational | $17,957,800.94 | $26,608,134.23 | $44,565,935.17 |
| Housing | $4,294,670.53 | $6,331,325.09 | $10,625,995.62 |
| **Total** | **$24,207,965.99** | **$35,833,502.94** | **$60,041,468.93** |
| **F2 Tornado Event** | | | |
| Administration | $7,010,586.93 | $10,441,500.35 | $17,452,087.28 |
| Educational | $64,376,880.40 | $95,993,462.85 | $160,370,343.25 |
| Housing | $15,426,087.48 | $22,856,853.03 | $38,282,940.51 |
| **Total** | **$86,813,554.81** | **$129,291,816.23** | **$216,105,371.04** |
| **F3 Tornado Event** | | | |
| Administration | $11,120,964.44 | $16,594,513.38 | $27,715,477.82 |
| Educational | $102,150,376.49 | $152,572,828.56 | $254,723,205.05 |
| Housing | $24,484,355.13 | $36,332,519.16 | $60,816,874.29 |
| **Total** | **$137,755,696.06** | **$205,499,861.10** | **$343,255,557.16** |
| **F4 Tornado Event** | | | |
| Administration | $11,516,480.38 | $17,187,787.27 | $28,704,267.65 |
| Educational | $105,788,312.13 | $158,029,731.96 | $263,818,044.09 |
| Housing | $25,356,512.26 | $37,632,094.45 | $62,988,606.71 |
| **Total** | **$142,661,304.77** | **$212,849,613.68** | **$355,510,918.45** |

Source: NCEM iRISK Database

### Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statement

- The most intense tornado to pass through Robeson County in the past 75 years were 3 F4s that resulted in 2 deaths, 307 injuries, and $3 million in property damage.
- The strongest recorded thunderstorm wind event for Robeson County in the past 25 years occurred on May 11, 2009 and had a gust of 125.5 MPH.
- Thunderstorms and tornadoes are frequent hazard events in Robeson County and around the UNCP campus. Reported damages for the 25-year period from 2000-2024 include $9,565,500 for tornadoes, $506,500 for lightning, $167,150 for hail, and $3,615,250 for thunderstorm winds.
- Between 1950 and 2024, tornadoes caused $9,565,500 in damage.

## H.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Likely | Limited | Large | More than 24 hrs | More than 1 week | 2.8 |

### Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 17 percent of the UNCP campus is within the primary exposure category and 75 percent is within the secondary exposure category of the Functional WUI. Table H.39 details the Functional WUI acreage in the UNCP campus, and

Figure H.17 below shows the Functional WUI areas. On a county level, the majority of Robeson County, particularly the western and eastern portion of the county, is predominately classified as Wildfire Transmission Zone with very little to no housing density. Areas around Lumberton and Pembroke have a higher concentration of area classified as secondary exposure with some primary exposure – buildings within closer proximity to burnable land cover.

The expansion of residential development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

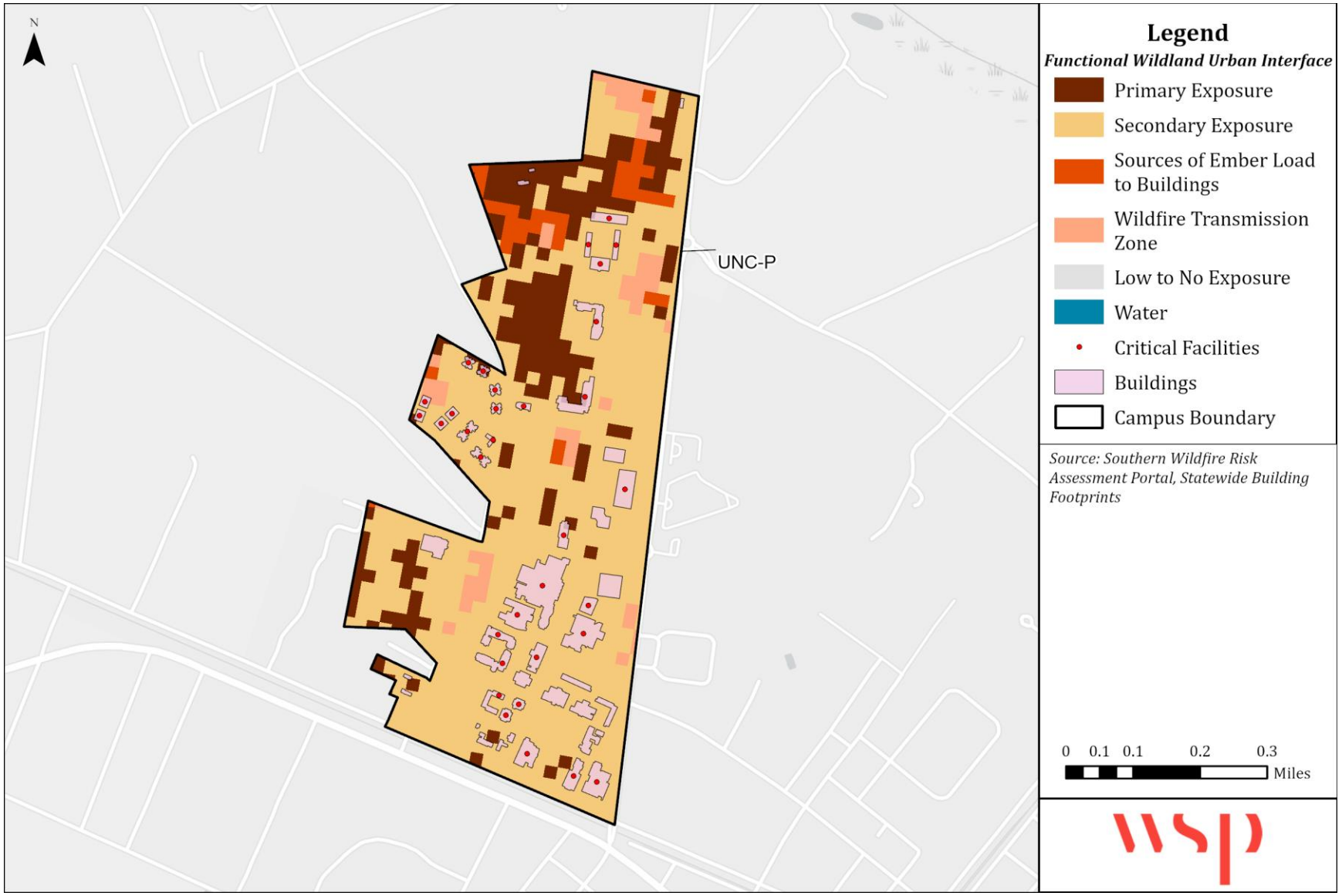
*Spatial Extent: 4 – Large*

**Table H.39 – Functional Wildland Urban Interface, UNCP Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 36 | 17% |
| | Secondary Exposure | 157 | 75% |
| | Sources of Ember Load to Buildings | 10 | 5% |
| | Wildfire Transmission Zone | 8 | 4% |
| | Low to No Exposure | 0 | 0% |
| | Water | 0 | 0% |
| | **Total** | **210** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure H.17 – Wildland Urban Interface Areas, UNCP**



## Extent

The entire state is at risk to a wildfire occurrence. 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.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table H.40, consists of five classes, as defined by SWRA. Table H.41 and Figure H.18 detail the characteristic fire intensity scale across the UNCP campus.

### Table H.40 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

### Table H.41 – Characteristic Fire Intensity, UNCP Campus

| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 167 | 79% |
| | 1 - Very Low | 4 | 2% |
| | 1.5 | 3 | 1% |
| | 2 - Low | 10 | 5% |
| | 2.5 | 8 | 4% |
| | 3 - Moderate | 10 | 5% |
| | 3.5 | 3 | 1% |
| | 4 - High | 4 | 2% |
| | 4.5 | 0 | 0% |

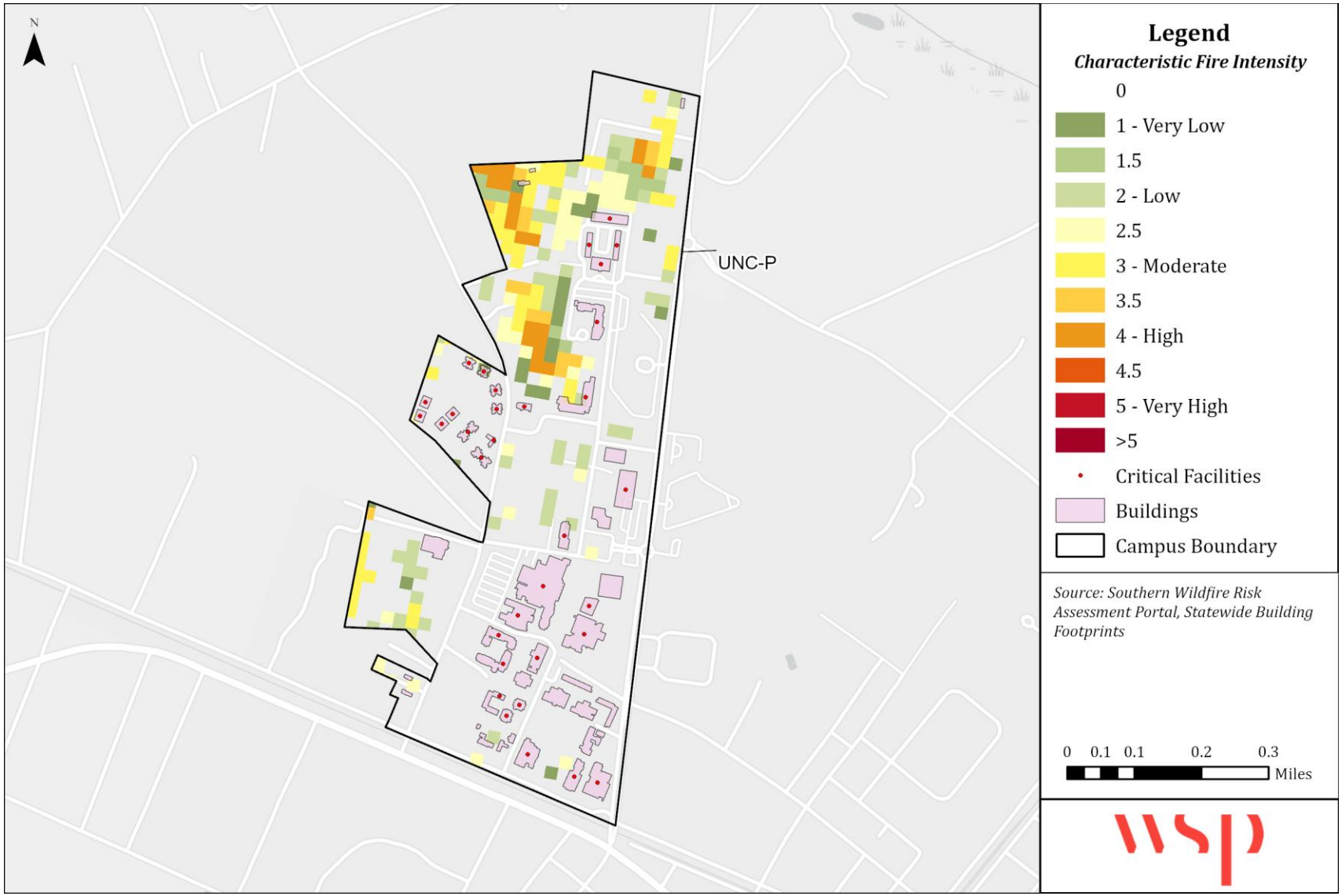
| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **210** | **100%** |

Source: Southern Wildfire Risk Assessment

Most of the campus (79%) is rated non-burnable on the characteristic fire intensity scale. Class 4 is the highest classification that the campus is exposed to, however only 2 percent of the total campus acreage has class 4 fire intensity. Class 4 fire intensity can result in significant harm or damage to life and property. The areas with greatest potential fire intensity are within the WUI. Around 6 percent of the campus may experience Class 3-3.5 fire intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the planning area (12%) would face a Class 1 to Class 2.5 fire intensity, which is easily suppressed.

*Impact: 2 – Limited*

**Figure H.18 – Characteristic Fire Intensity, UNCP**



## Historical Occurrences

Table H.42 lists past occurrences of wildfire in Robeson County from 2000-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 5,003 noted wildfires within Robeson County between 2000 and 2024. The total acreage burned during this period was 57,011 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, Robeson County experiences 200.1 fires and 2,280.4 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 11.40 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table H.42– Records of Wildfire in Robeson County, 2000-2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 2000 | 183 | 2,437.10 | 13.32 |
| 2001 | 489 | 5,707.20 | 11.67 |
| 2002 | 345 | 5,175.10 | 15.00 |
| 2003 | 61 | 569.00 | 9.33 |
| 2004 | 166 | 2,138.50 | 12.88 |
| 2005 | 166 | 2,050.40 | 12.35 |
| 2006 | 210 | 2,605.60 | 12.41 |
| 2007 | 417 | 7,232.20 | 17.34 |
| 2008 | 118 | 1,605.20 | 13.60 |
| 2009 | 117 | 1,447.00 | 12.37 |
| 2010 | 183 | 2,454.20 | 13.41 |
| 2011 | 199 | 3,568.10 | 17.93 |
| 2012 | 125 | 2,159.60 | 17.28 |
| 2013 | 115 | 1,922.70 | 16.72 |
| 2014 | 116 | 1,670.70 | 14.40 |
| 2015 | 80 | 855.16 | 10.69 |
| 2016 | 94 | 582.74 | 6.20 |
| 2017 | 186 | 2,825.59 | 15.19 |
| 2018 | 211 | 1,490.20 | 7.06 |
| 2019 | 189 | 1,128.25 | 5.97 |
| 2020 | 62 | 393.87 | 6.35 |
| 2021 | 357 | 2,035.26 | 5.70 |
| 2022 | 436 | 3,153.65 | 7.23 |
| 2023 | 208 | 1,076.71 | 5.18 |
| 2024 | 170 | 726.83 | 4.28 |
| **Total** | **5,003** | **57,010.86** | **11.40** |

Source: North Carolina Forest Service

## Probability of Future Occurrence

The SWRA provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the UNCP campus is presented in Table H.43 and illustrated in Figure H.19.

**Table H.43 – Burn Probability, UNCP Campus**

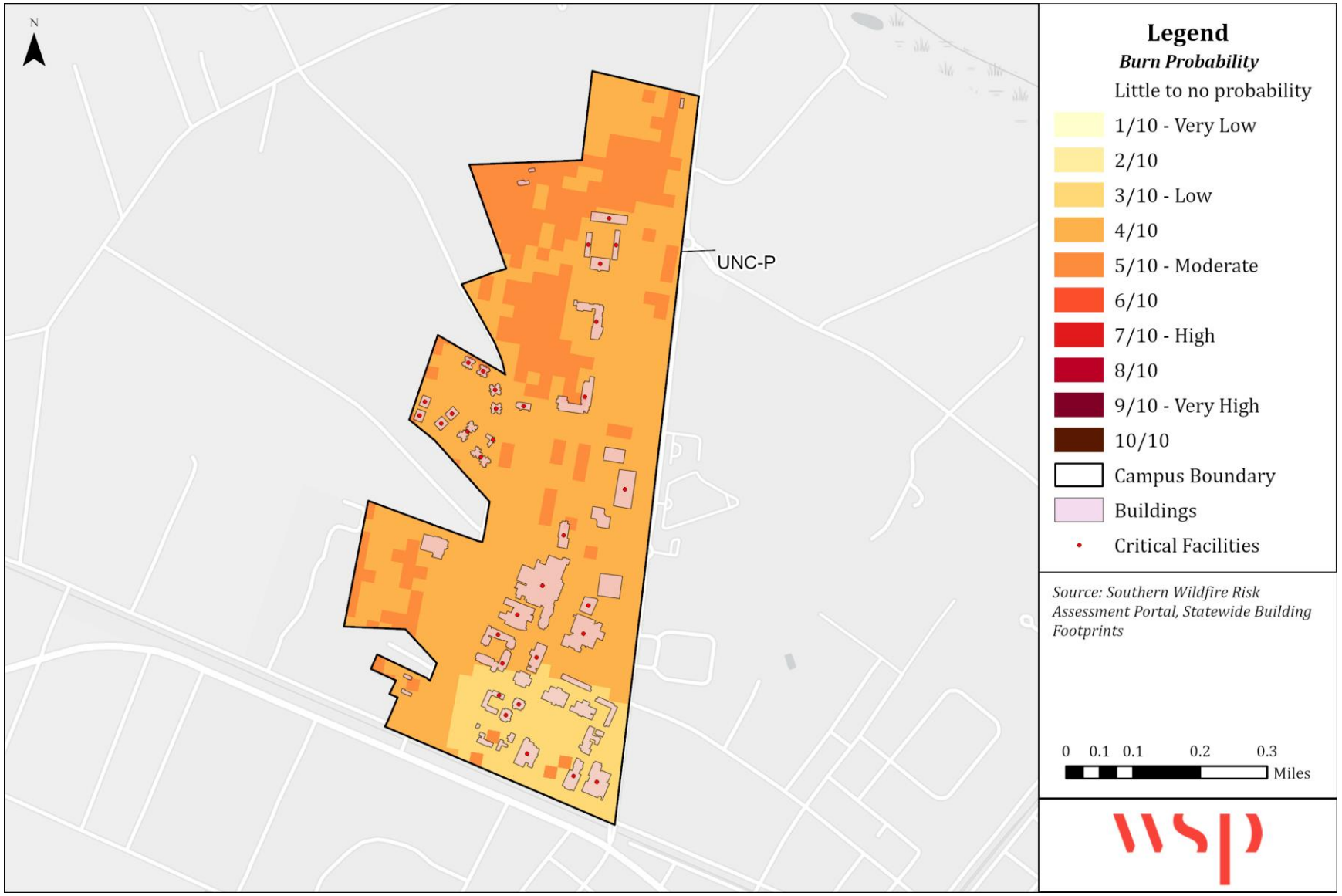
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 0 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 0 | 0% |
| | 2/10 | 0.0001000 - 0.0002154 | 0 | 0% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 27 | 13% |
| | 4/10 | 0.0004642 - 0.0010000 | 141 | 67% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 42 | 20% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **210** | **100%** |

Source: Southern Wildfire Risk Assessment

The UNCP campus has low to moderate burn probability. The majority of the campus, 80 percent has low probability falling within category 3 and 4. The remaining 20 percent of the campus has moderate probability of experiencing wildfire. Based on the SWRA data, the probability of wildfire across the campus is considered likely.

*Probability: 3 – Likely*

**Figure H.19 – Burn Probability, UNCP**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10, and so on.

All of the 53 structures assessed on the UNC-P campus have a wildfire exposure score of between 3/10 to 5/10 which represents relatively low to moderate vulnerability. Table H.44 below shows the number and value of campus buildings by occupancy type that fall within Wildfire Exposure Scores 3 through 5.

**Table H.44 – Building Counts and Values within the Wildfire Exposure Score**

| Occupancy | Wildfire Exposure Score 3 | | Wildfire Exposure Score 4 | | Wildfire Exposure Score 5 | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 0 | $0 | 6 | $22,953,275 | 4 | $9,096,370 |
| Extracurricular /Educational | 1 | $5,654,488 | 22 | $217,682,692 | 2 | $491,274 |
| Housing | 0 | $0 | 11 | $30,529,904 | 7 | $10,202,570 |
| **Total** | **1** | **$5,654,488** | **39** | **$271,165,871** | **13** | **$19,790,214** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Growth on the UNCP campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. Although a wildfire community protection plan exists for the state of North Carolina, there are no community wildfire protection plans and no wildfire-specific mitigation review requirements or regulations for development in the wildland-urban interface in Robeson County.

To reduce wildfire impacts, the University can work with the City and/or Robeson County to coordinate fuel reduction efforts, educate residents and campus population, train firefighters, and establish local wildfire management plans.

## Problem Statement

- The entire UNCP campus is located within an identified functional WUI area.
- A portion of the UNCP campus (20%) is located within Burn Probability areas defined as Class 4, having moderate probability.
- Robeson County experiences wildfires on an annual basis with 200.1 fires and 2,280.4 acres burned annually, as reported by the NCFS. The actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire department.
- Coordination with the City of Pembroke and/or Robeson County is recommended to reduce fuel efforts and establish a local wildfire management plan.
- Approximately 24 percent of all buildings on the UNC-P campus fall within a Wildfire Exposure Score of 5 which represents moderate probability of these structures being damaged during a wildfire event.

## H.5.8 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

### Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the UNCP campus, the Division of Information Technology (DoIT) provides integrated technology support for administrative computing, client services, IT infrastructure systems, and IT security. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

### Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the UNCP campus could cause significant disruption and impact a large number of records.

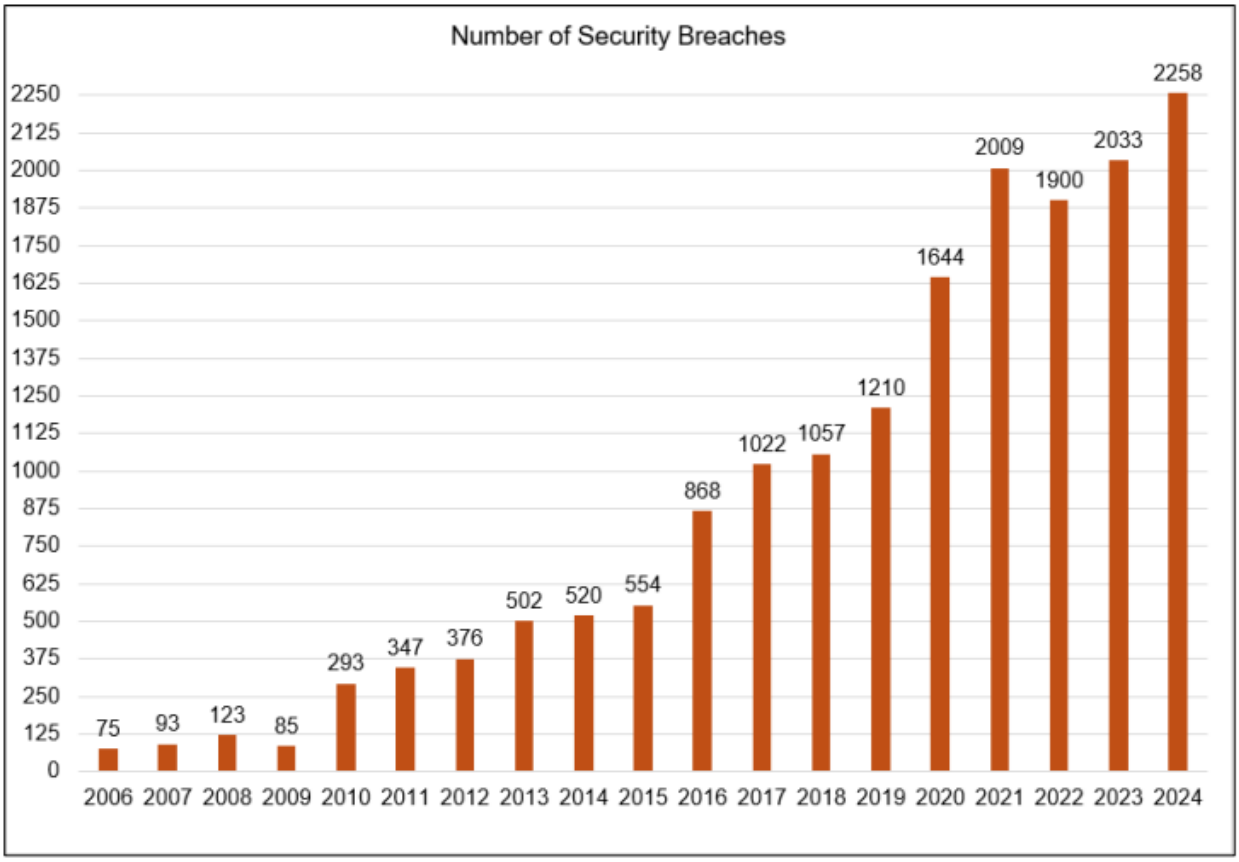
*Impact: 2 – Limited*

### Historical Occurrences

According to local news reports, UNCP does not have any recent reports of severe cyber attacks or data breaches.

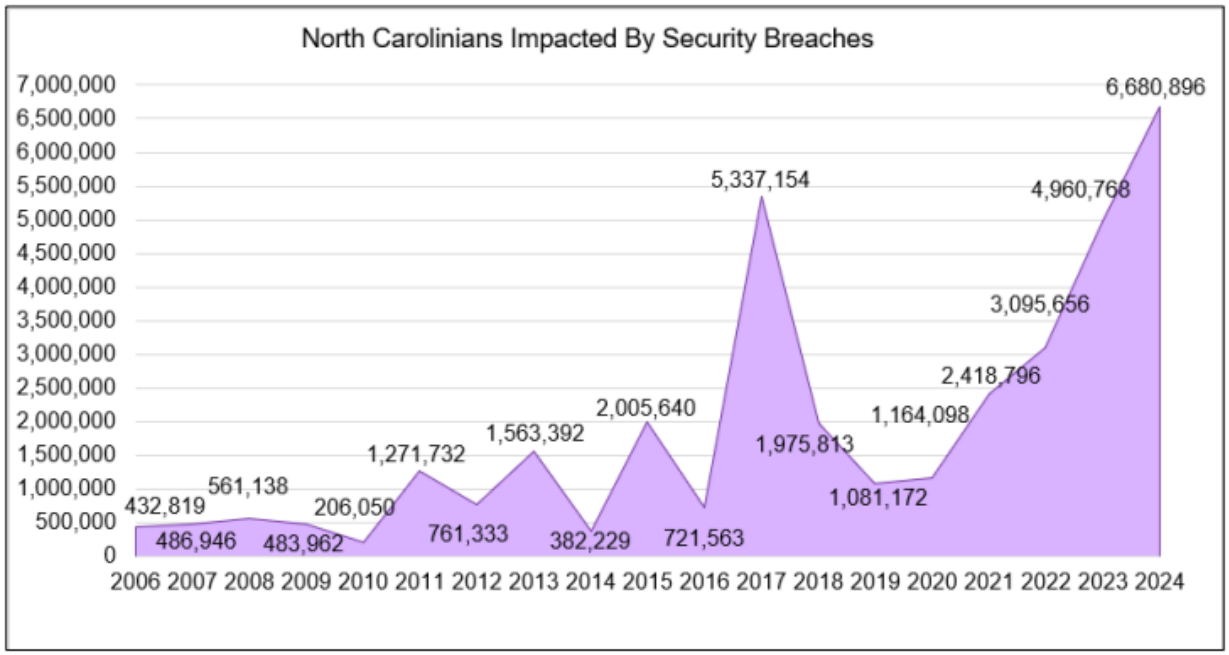
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure H.20 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure H.21 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been some notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- In January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- In November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- In August 2020, The University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNCW; the University reported that no vulnerable financial or personal information was included.[1]

[1] https://portcitydaily.com/story/2020/08/06/uncw-reports-ransomware-attack-hackers-accessed-personal-details-but-no-financial-info/

- In November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack.[2]

## Probability of Future Occurrence

Cyber security threats occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of UNCP are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the university are less likely but cannot be ruled out.

*Probability: 2 – Possible*

## Vulnerability Assessment

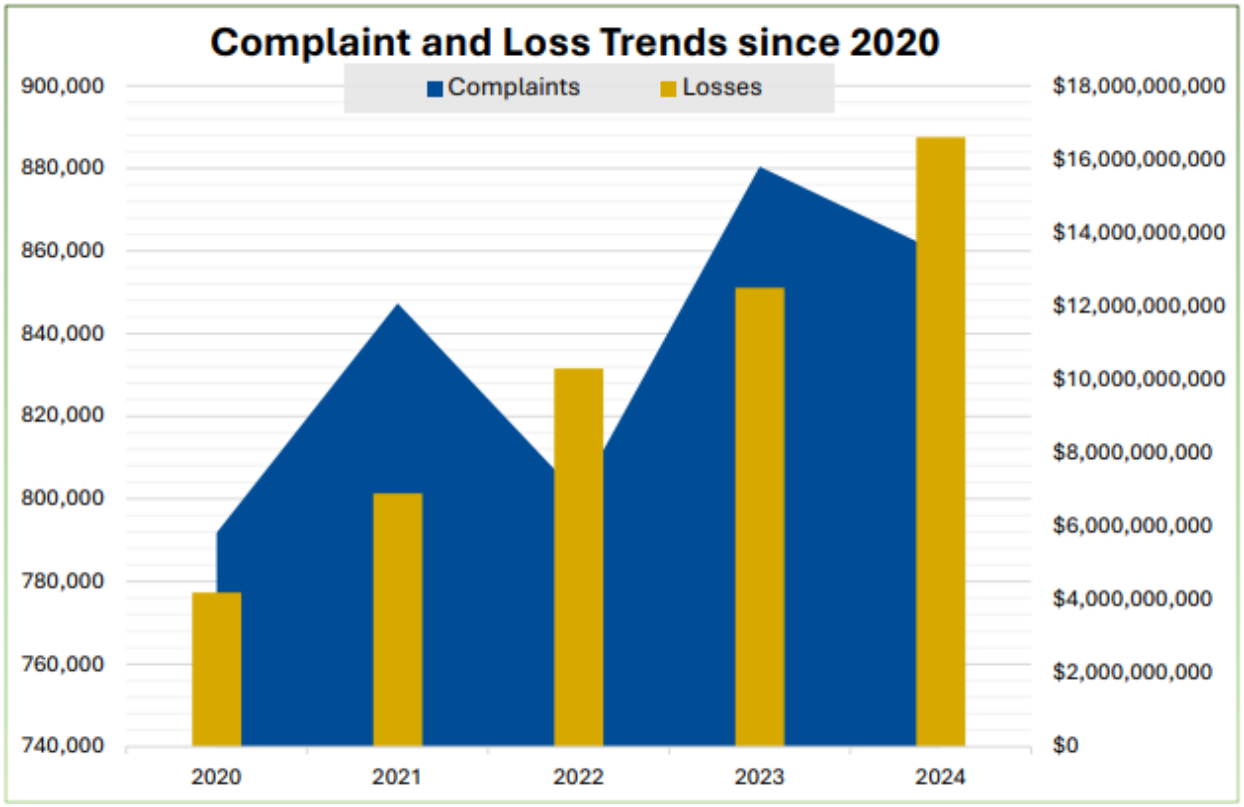
As discussed above, the impacts from a cyber-attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure H.22.

[2] https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/

**Figure H.22 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers continued usage of online services, such as banking and shopping, increase vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber attacks is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment increasing since the last plan, the number of users of campus networks and software has increased. For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statement

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Division of Information Technology (DoIT) addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.

## H.5.9 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Substances | Possible | Limited | Small | Less than 6 hrs | Less than 24 hrs | 2.2 |

### Location

Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of UNCP's campus.

The HMPC identified the following critical buildings on UNCP's campus with hazardous materials stored on site:

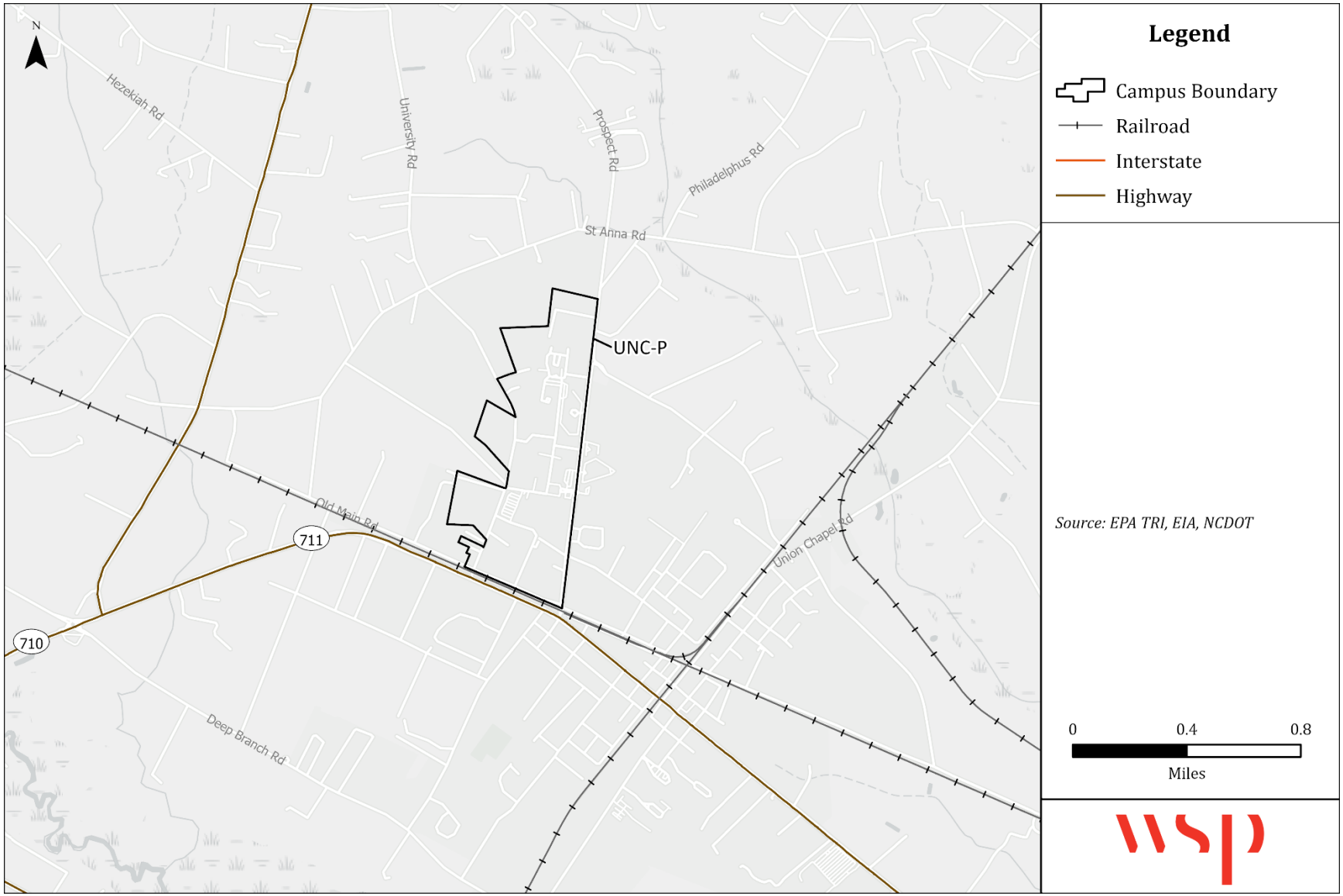
- Pinchbeck Maintenance Complex
- Oxendine Science Building
- Weinstein Health Services

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure H.23 shows the modes of transportation for hazardous materials adjacent to or through UNCP's campus.

The campus sits along a CSX Transportation freight route, which exposes the campus to risks associated with rail transport of hazardous materials.

*Spatial Extent: 2 – Small*

## Figure H.23 – Major Transportation Routes, UNCP



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a “serious incident” as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor’s visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 2 – Limited*

## Historical Occurrences

The USDOT’s PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there have not been any recorded releases in Pembroke from 2000 through 2024. Figure H.24 describes all nine hazard classes.

**Figure H.24 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have not been any serious hazardous materials releases in the planning area in the 25-year period from 2000 through 2024. However, given the proximity of the campus to a freight rail line, the HMPC considered there to be between 1% and 10% annual probability of occurrence.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among people living near certain chemical facilities. However there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities, but there is a chance they may be impacted.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Any development that takes place in these areas will place more people and structures in the risk area for hazardous materials events, however since most hazardous material spills are localized to an extremely small area this will not have an effect on the overall risk assessment for this hazard.

## Problem Statement

- Transportation routes for hazardous materials are located adjacent to the UNCP campus.
- According to PHMSA, there have not been any reported incidents within Pembroke between January 2000 and December 2024.

# H.5.10 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table H.45 according to the World Health Organization.

**Table H.45 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

Another way to measure the extent of an infectious disease is by using the case-fatality rate. The case-fatality rate does not represent the overall spread of the disease but rather the proportion of people diagnosed with the disease who die from it. It should be noted that the case-fatality rate has limitations because it does not take into account unreported cases.

The John Hopkins Coronavirus Resource Center reports that between March 2020 and March 2023, COVID-19 had a case fatality rate of 1.1%. The COVID-19 pandemic disproportionately killed older people, so case-fatality rate does vary significantly amongst age groups.

An additional way to measure extent is the number of deaths per 100,000 people. This captures confirmed cases, unreported cases, and healthy people. Between March 2020 and March 2023, the U.S. experienced 341.11 deaths per 100,000 people.

*Impact: 3 – Critical*

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958:** This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969:** global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by

March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between March 2020 and May 2023, Robeson County experienced 53,145 cases of COVID-19 and 608 deaths. Per 100,000 people, Robeson County experienced 608 deaths, significantly higher than the state's rate of 284. Robeson County has a low rate of COVID-19 vaccination, 44% in 2023, compared to the state's (65%).

### *Other Infectious Diseases*

For the year 2023, Robeson County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 42 deaths to certain infectious and parasitic diseases, excluding COVID-19. The majority of these deaths (21) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Infectious Gastroenteritis, Salmonella, Tuberculosis, Staph infection, Strep infection, Viral Hepatitis, HIV, and Candidiasis.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other

natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of 20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

With enrollment increasing since the last plan, the number of students and employees on campus has grown. In the last 2 years, UNCP experienced 23% growth. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statement

- Based on the recent COVID-19 pandemic, it is clear the UNCP campus population is susceptible to the infectious disease pandemic.
- UNCP has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# H.5.11 Conclusions on Hazard Risk

## Priority Risk Index

As discussed in Section H.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below. Table H.46 summarizes the degree of risk assigned to each identified hazard using the PRI method.

**Table H.46 – Summary of PRI Results**

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Minor | Negligible | 6 to 12 hours | Less than 1 week | 2.3 |
| Hurricane | Likely | Critical | Large | More than 24 hrs | Less than 24 hrs | 2.9 |
| Severe Winter Weather | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Tornadoes & Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hours | 3.1 |
| Wildfire | Likely | Limited | Large | More than 24 hrs | More than 1 week | 2.8 |
| Cyber Security | Possible | Critical | Large | Less than 6 hours | More than 1 week | 3.1 |
| Hazardous Substances | Possible | Limited | Small | Less than 6 hours | Less than 24 hrs | 2.2 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table H.47:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.

**Table H.47 – Summary of Hazard Risk Classification**

| | |
|---|---|
| **High Risk (≥ 3.0)** | Excessive Heat<br>Tornadoes & Thunderstorms<br>Cyber Security<br>Severe Winter Weather |
| **Moderate Risk (2.0 – 2.9)** | Hurricanes<br>Wildfire<br>Infectious Disease<br>Flooding<br>Hazardous Substances |
| **Low Risk (< 2.0)** | Earthquake |

# H.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- H.6.1 Overview of Capability Assessment
- H.6.2 Planning and Regulatory Capability
- H.6.3 Administrative and Technical Capability
- H.6.4 Fiscal Capability

## H.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## H.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, ordinances, policies and programs that guide development on campus. **Table H.48** lists these local resources currently in place at UNCP.

**Table H.48 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | UNCP, Vision 2031 |
| Campus Master Plan | Y | UNCP Master Plan, 2026 |
| Capital improvements plan | Y | UNCP Capital Improvements Plan, 6-yr, 2025 |
| Local emergency operations plan | Y | Emergency Operations Plan, revised 2025 |

More details on several relevant tools are provided below:

- **Strategic Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth. UNC-P is currently developing their 2026-2031 strategic plan, which will be presented for the Board of Trustees for approval in spring 2026.
- **Campus Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The 2011 plan addresses the campus landscape, districts, mobility, and infrastructure.
- **Capital Improvement Plan (CIP)** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC Campus creates and maintains a 6-year CIP, which helps inform the University of North Carolina System's CIP.
- **Emergency Operations Plan** outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

## H.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table H.49 provides a summary of the administrative and technical capabilities for UNCP.

**Table H.49 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Contracted out |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Facilities Management; AVC |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Contracted out |
| Personnel skilled in GIS | Yes | Facilities Planning Design and Construction; CAD Tech |

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Emergency Manager | Yes | Finance and Administration |
| Grant Writer | Yes | Sponsored Research |
| Public Information Officer | Yes | University Communications and Marketing |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | Campus Police<br>RAVE; Code Red; AppArmor; Blue Light 2 Outdoor sirens |

Additional resources include the following:

Additional resources and departments that may support administrative capabilities include the following:

- **Facilities Operations** (composed of Administration, Carpentry/Locksmith, Electrical, Grounds, Housekeeping, HVAC/Plumbing, Motor Pool, Painting and Setups/Labor) provides support services to the University community.
- **Facilities Planning and Construction (FPC)** provides professional administration for design and construction of capital improvement projects.
- **Environmental Health and Safety (EH&S) Office** provides high-quality and informative training, comprehensive workplace evaluations, emergency response, and guidance on proper hazardous materials and hazardous waste management; EH&S promulgates regulatory guidance across Campus.

## H.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. **Table H**.50 provides a summary of the fiscal resources at UNCP.

**Table H.50 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Community Development Block Grants | Y; Need a partnership, UNCP has worked with the Town of Pembroke for storm drain management in the past. |
| Capital improvements project funding | Y |
| In-Kind Services | Y; Education enrichment programs |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y; used for new EOC and renovation of campus building for police department |

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y; UNCP has worked with NCDOT on stormwater and roadway improvements. |

# H.7 Mitigation Strategy

## H.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table H.51 summarizes the status of mitigation actions from the 2021 plan. Table H.52 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section H.7.2 in the Mitigation Action Plan.

**Table H.51 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| UNCP | 8 | 2 | 14 |

## Table H.52 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNCP8 | Educate the campus community regarding the dangers of extreme heat and cold and the steps they can take to protect themselves when extreme temperatures occur through flyers and online training. | Completed | Employee and student training is accomplished via a combination of Percipio online training, supervisor training, and work scheduling for affected employees and in-person educational sessions for student athletes. |
| UNCP11 | Install flood panels around flood-prone areas such as mechanical room entrances. Belk & North Hall exterior mechanical rooms. DF Lowry boiler room, Chancellors Guest House, water tower pump house (highest criticality). | Completed | Panels installed at Locklear Hall and Auxiliary Services. |
| UNCP12 | Raise electrical components of transformers above base flood elevation in flood-prone areas. Belk & North Hall transformers & generator, Primary Electric Switch 12. | Completed | Switch 12 is now on a 12 inch pedestal. |
| UNCP13 | During retrofitting or new building development raise utilities or other mechanical devices if in a flood zone area. | Completed | Standard practice |
| UNCP14 | Identifying saferoom locations in campus buildings where the university community can gather during severe weather. | Delete | Locations have not yet been identified |
| UNCP15 | Protecting propane tanks or other external fuel sources, by installing bollards to protect the storage areas. | Completed | LP tanks are housed inside secure utility courtyards. |
| UNCP17 | Institute security access controls to limit access to the campus' critical infrastructure. | Completed | DoIT has implemented comprehensive key card access and video camera surveillance for it's critical infrastructure locations in all campus telecommunication closets and data centers. DoIT maintains and updates access policies for these locations as well. |
| UNCP18 | Install secure locks and protection on all internal/external doors, with quick-release capability. During a active threat internal doors could be secured with some type of locking device to protect those inside. | Delete | Most campus buildings have been upfitted with exterior door locks with the ability to be locked from a central location. Implementation is pending. Internal door locks are delayed due to funding requirements. |

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNCP19 | Training and exercise development to prepare for multiple hazards. | Completed | Since 2022, the university has hosted multiple tabletop exercises (with a variety of scenarios) and one full scale exercise involving outside agencies including Fire, Police, EMS, and a regional HAMAT team. |
| UNCP22 | On the south end of campus, we have a railroad the runs east to west. Several buildings are near the rail line, Oxendine Science, Old Main, Livermore Library, Hickory Hall, Hickory Hall North, and Chancellor's Residence. An internal warning system is needed to warn occupants of any significant issues from the rail line. | Completed | All campus emergencies now include an initial emergency notification from Campus Police via RAVE/Brave Alerts and then a transition to campus messaging from University Communications and Marketing. |

## H.7.2 Mitigation Action Plan

The following table comprises the mitigation action plan for UNCP. Each mitigation action recommended for implementation is listed in this table along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table H.53 – Mitigation Action Plan, UNCP**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCP1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Chavis University Center and UC Annex; Jones Athletic Center; Lumbee Hall; Mary Livermore Library; Oak Hall; Old Main; Oxendine Science Building; Pinchbeck Maintenance Complex; Pine Hall; and Student Health Services Building. | All Hazards | 1.1 | Moderate | Property Protection | Facilities Operations & Maintenance | $5,000-$25,000 per site | Operating Budget | 2026-2030 | Carry Forward | Will require designer for (IBC) and (IMC) compliance. |
| UNCP2 | Campus-Wide – Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational when normal power supply is not available. | All Hazards | 1.2 | High | Property Protection | Facilities Operations | $25,000-$100,000 per site | State/Federal Grants | 2026-2030 | Carry Forward | Majority of campus facilities have generator with primary focus on life safety. Critical facilities have backup power for data centers, Campus Police, Dining Services food storage equipment. Portable power generation ongoing as funding is made available. |
| UNCP3 | Campus Wide – Develop and/or provide campus-wide outreach and mitigation training to inform the public about severe winter weather impacts and how to stay safe during winter weather events through emails, flyers, and online training; severe weather week participation; and cyber security awareness. | All Hazards | 2.1 | Low | Public Education & Awareness | EHS, University Communications and Marketing, Police and Public Safety; and DoIT | < 1,000 | Operating Budget | 2026-2030 | Carry Forward | UNCP requires and tracks mandatory annual cybersecurity awareness training. DoIT leads cybersecurity awareness initiatives during October – Cybersecurity Awareness Month. Program still under development |
| UNCP4 | Mary Livermore Library - There is no redundant source of climate control for the special collections. In the event of a prolonged power outage or failure of the main HVAC system, materials would be exposed to environmental conditions which encourage mold growth and accelerate deterioration of documents. Provide a redundant source of climate control for the special collections which is capable of operating during power outages. | All Hazards | 1.2 | High | Property Protection | Facilities Operations & Maintenance | >$250,000 | Federal/State Grants | 2026-2030 | Carry Forward | We completed this project in 2023 and installed a dedicated HVAC system for special collects. New genset in design phase that will provide power to life safety systems and Special Collections in the event of an outage. |
| UNCP5 | Mary Livermore Library - Several large pine trees are adjacent to the building and mechanical equipment areas. The health of the large pine trees should be monitored to reduce the exposure of the building to impacts from the large trees falling on the facility and its utilities. | Hurricanes, Tornadoes/Thunderstorms, Severe Winter Weather | 1.1 | Moderate | Property Protection | Facilities Operations & Maintenance | <$5,000 | Operating Budget | 2026-2030 | Carry Forward | Assessment conducted December 2025. Findings reflect that trees are not in decline nor compromised. |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCP6 | Oak Hall - The adjacent parking lot for the football stadium has a history of flooding during intense rains which leads to vehicle damage. Facility personnel reported flooding on Faculty Row due to insufficient drainage along the road. Additional drainage should be added to Faculty Row. The bottleneck in the main drainage lines to the east of campus should be corrected to prevent system backup. | Flooding | 1.1 | High | Structural Projects | Facilities Operations & Maintenance | >$100,000 | State/Federal Grants | 2026-2030 | Carry Forward | No progress has been made on this action. There is serious drainage flow constriction on the west side of Pembroke which impacts drainage movement off the west side of campus. |
| UNCP7 | Increasing tree plantings around buildings to shade parking lots and along public rights-of-ways. | Extreme Heat | 1.3 | Low | Property Protection | Facilities Operations & Maintenance | >$12,000 | Operating Budget | 2026-2030 | Carry Forward | Part of Master Plan |
| UNCP8 | Installing, re-routing, or increasing the capacity of a storm drainage system in flood prone areas. | Flooding, Hurricanes | 1.1 | High | Structural Projects | Facilities Operations & Maintenance, Facilities Planning, Design and Construction | >$20,000 | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Mitigation projects ongoing as funding is made available. New construction incorporates storm expansions. |
| UNCP9 | Stormwater Awareness campaign: a stormwater awareness campaign can provide information to the university community on the necessity of keeping the stormwater system clean and the role they can play. | Flooding | 2.1 | Low | Public Education & Awareness | Facilities Management, EHS, University Communications and Marketing | <$1,000 | Operating Budget | 2026-2030 | Carry Forward | No progress to date on this item. |
| UNCP10 | Harden campus facilities to act as shelters during hazardous events | All-Hazards | 2.3 | Moderate | Emergency Services | EHS, Police and Public Safety | <$1,500 | Operating Budget | 2026-2030 | Carry Forward | Locations have not yet been identified |
| UNCP11 | Auxiliary Services Building - The UNCP Police and Public Safety Department was inaccessible during recent hurricanes due to rising floodwaters; this critical department needs to be relocated to a more accessible location to avoid a scenario were it would be impossible to access the Police and Public Safety Department. | All-Hazards | 1.2 | High | Structural Projects | Facilities Operations & Maintenance, Facilities Planning, Design and Construction, Space Allocation Committee | To be determined | Federal/State Grants | 2026-2030 | Carry Forward | See below UNCP12. An EOC project is in design. |
| UNCP12 | UNCP Jones Athletic building served as a hub for first responders during past disasters; need to strengthen this facility to function as a shelter for first responders and government organizations (NC EM) during/after disasters. A standalone generator capable of handling the potential large load due to acting as a hub is needed. UNCP does not currently house a standalone EOC; now, we utilize conference rooms to convene the EOC when needed. A dedicated EOC space is necessary for the group to complete its duties effectively. Jones PE Center is the space recommended to house the primary EOC. It would need power, voice, and data ports throughout the room to facilitate rapid setup and operation of the EOC | All-Hazards | 1.2 | High | Structural Projects | Facilities Operations & Maintenance, Facilities Planning, Design and Construction | $1,000,000 | Federal/State Grants | 2026-2030 | Carry Forward | Currently have an EOC in Design with Becker Morgan Group. Goal is to have EOC complete by end of 2027 |
| UNCP13 | Some chemical storage cabinets located at Oxendine, Comtec and Weinstein Health Science are not vented. Some chemicals contain hazardous fumes and must be stored respectively. A vented chemical storage cabinet is necessary for protecting the rest of the laboratory environment from these noxious fumes. | Hazardous Substances | 1.1 | Moderate | Structural Projects | Facilities Operations & Maintenance, Facilities Planning, Design and Construction | $80,000-$100,000 | Operating Budget | 2026-2030 | Carry Forward | Pending Funding. Updated design fees and a rough construction estimate totaling $128,100 was submitted to leadership on October 23, 2025. |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCP14 | A Spill Prevention, Control, and Countermeasure (SPCC) Plan is needed. The purpose of the Spill Prevention, Control, and Countermeasure (SPCC) rule is to help facilities prevent a discharge of oil into navigable waters or adjoining shorelines. The SPCC rule requires facilities to develop, maintain, and implement an oil spill prevention plan, called an SPCC Plan. These Plans help facilities prevent oil spill, as well as control a spill should one occur. | Hazardous Substances | 3.2 | High | Prevention | Facilities Operations & Maintenance, Facilities Planning, Design and Construction | $8,000-$12,000 | Operating Budget | 2026-2030 | Carry Forward | Spill Prevention, Control, and Countermeasure (SPCC) completed June 2025. Spill kits staged. Finalizing virtual map tool for location identification. |
| UNCP15 | Conduct outreach campaigns to raise awareness about heat-related risks | Excessive Heat | 2.1 | High | Public Information | EHA | To be determined | Operating Budget | 2026-2030 | New | |

THE UNIVERSITY OF NORTH CAROLINA SYSTEM




# UNC System Eastern Campuses
# Regional Hazard Mitigation Plan

## Annex I: University of North Carolina at Wilmington

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# Annex I. University of North Carolina - Wilmington

This section provides planning process, campus profile, hazard risk, vulnerability, capability, and mitigation action information specific to the University of North Carolina – Wilmington (UNC-W). This section contains the following subsections:

- I.1 Planning Process Details
- I.2 Campus Profile
- I.3 Asset Inventory
- I.4 Hazard Identification
- I.5 Hazard Profiles, Analysis, and Vulnerability
- I.5 Capability Assessment
- I.6 Mitigation Strategy

## I.1 Planning Process Details

The table below lists the HMPC members who represented UNC-W during the planning process.

**Table I.1 – HMPC Members**

| Representative | Agency/Department |
|---|---|
| Jeff Campbell | Director; Environmental Health and Safety |
| Rhonda Olson | Assistant Director and Emergency Manager; Environmental Health and Safety |
| Jade Myers | Business Services Coordinator; Environmental Health and Safety |
| Stuart Borrett | Associate Provost; Research and Innovation |
| Parker Moran | Director of Networking, IT Operations & Research; ITS |
| Mike Cherry | Associate Athletic Director of Facilities & Event Management; Athletics |
| Paul Townend | Associate Vice Chancellor & Dean; Undergraduate Studies |
| Larry Wray | Executive Director; Campus Life |
| Wes Merrill | Director of Operations; College of Health and Human Services |
| Kevin Meaney | Executive Director; Housing and Residence Life |
| Laura McBrayer | Associate Dean; Library Information Technology & Scholarly Research |
| Kristy Burnette | Institutional Risk Management Coordinator; Enterprise Risk Management |
| Mark Morgan | Associate Vice Chancellor; Facilities |
| Steven Still | Emergency Management Director; New Hanover County Emergency Management |

### Coordination with Other Community Planning Efforts and Hazard Mitigation Activities

The table below lists campus and community resources referenced throughout the planning process and used in the plan development.

**Table I.2 – Summary of Existing Studies and Plans Reviewed**

| Resource Referenced | Use in this Plan |
|---|---|
| UNC-W Campus Master Plan | The UNC-W Campus Master Plan, developed in 2017 and updated in 2024, was referenced for the Campus Profile in Section I.2 as well as the Capability Assessment in Section I.6 |
| New Hanover County and Incorporated Areas Flood Insurance Study (FIS), Revised 1/17/2025 | The FIS report was referenced in the preparation of flood hazard profile in Section I.5. |
| UNC System Eastern Campuses HMP, 2021 | The UNC System Eastern Campuses HMP was used in preparation of the hazard profiles in Section I.5. The HMP was additionally used to track implementation progress (Section 2) and develop the mitigation plan (Section 7). |
| Southeastern NC Regional Hazard Mitigation Plan, January 2021 | The Southeastern NC Regional Hazard Mitigation Plan, which includes New Hanover County & Wilmington, was referenced in compiling the Hazard Identification and Risk Assessment in Section I.5. |

# I.2 Campus Profile

This section provides a general overview of the University of North Carolina at Wilmington (UNC-W) campus and area of concern to be addressed in this plan. It consists of the following subsections:

- Location and Setting
- Geography and Climate
- Population and Demographics
- Growth and Development Trends

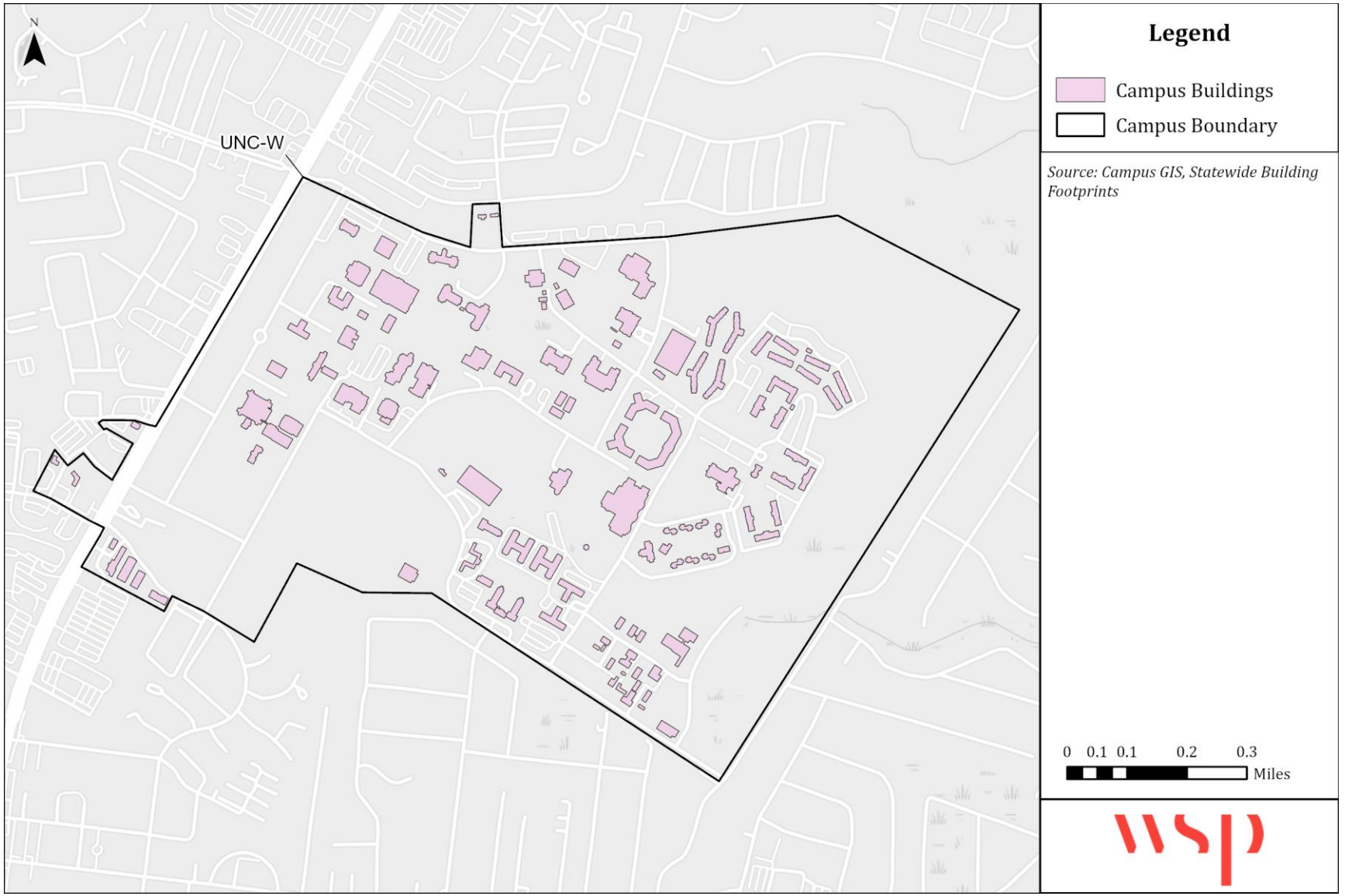
## I.2.1 Location and Setting

The University of North Carolina at Wilmington is in the historic port city of Wilmington, North Carolina, which is located on the Cape Fear River. The UNC-W campus is located about 5 miles from the historic downtown riverfront to the west and the Atlantic Ocean and Wrightsville Beach about 5 miles to the east. The University is situated on 650 acres, which includes 55 academic and student service buildings. UNC-W has grown significantly over the last decade and now offers close to 60 undergraduate degrees and almost 40 graduate degrees. UNC-W also has more than 250 student organizations which help cater to any area of interest a student may have and promote a sense of belonging. UNC-W is known for small classes with custom designed courses tailored to student need and is dedicated to the integration of teaching, mentoring, research, and service.

United States Highways 17 and 117 make UNC-W easily accessible by automobile. The University provides shuttle services on and around campus, a bicycle rental program, and they maintain bicycle, skateboard, and pedestrian amenities.

Figure I.1 provides a base map of the campus. For more information on campus buildings and critical facilities, see Section I.3.

**Figure I.1 – UNC-W Campus Base Map**



## I.2.2 Geography and Climate

The University of North Carolina at Wilmington is in Wilmington, which is in the Tidewater portion of North Carolina's Inner Coastal Plain region. Wilmington has an elevation of 36 feet above sea level and UNC-W's campus is largely flat with a few rolling hills. Wilmington has a moderate climate with max temperatures dropping to 56 degrees Fahrenheit on average in January and climbing to 88 degrees Fahrenheit on average in July. The annual precipitation for the County is approximately 53 inches per year.

**Figure I.2 – Average Annual Temperature, New Hanover County**

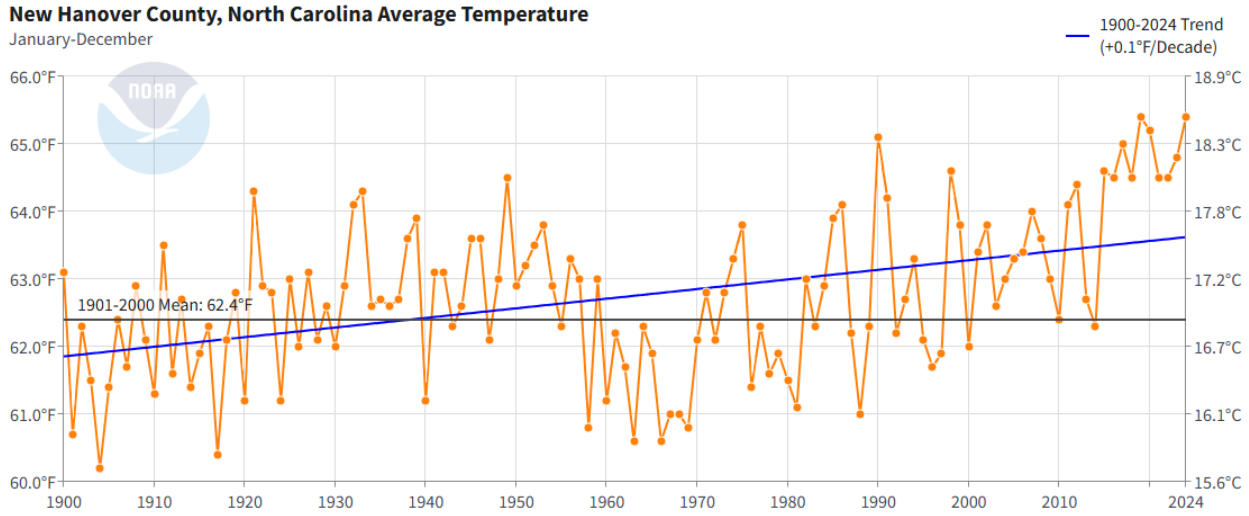
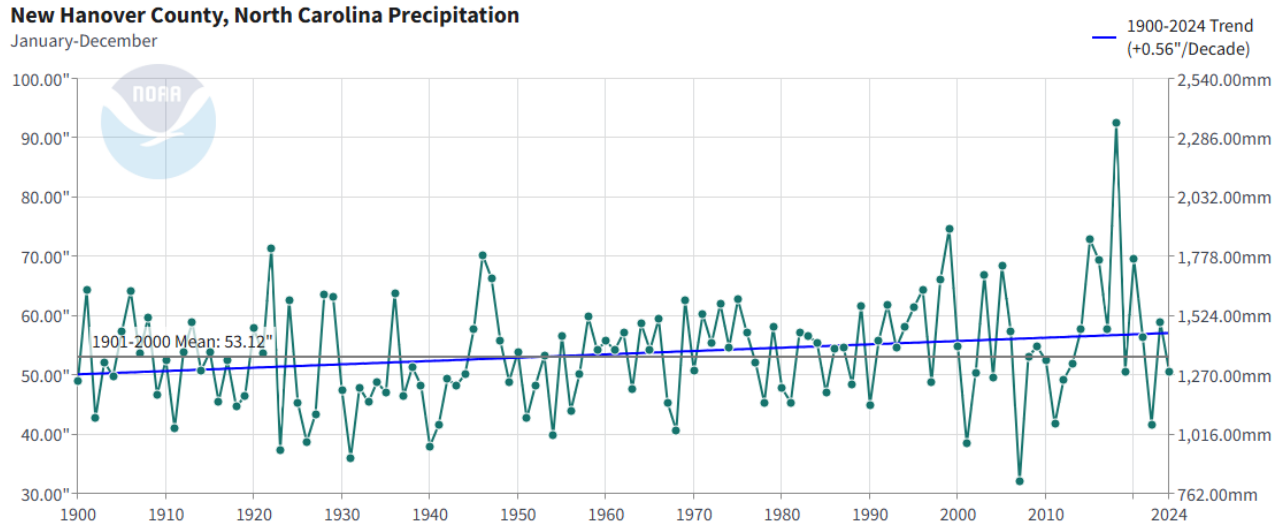



**Figure I.3 – Average Annual Precipitation, New Hanover County**



## I.2.3 Population and Demographics

Table I.3 provides population counts for UNC Wilmington from Fall 2025, including the number of students and their residency status. Student counts are broken down by undergraduate and graduate students, full-time students, and in-state students. According to UNC-W's website, the campus employs more than 960 instructional and research faculty.

**Table I.3 – Population Counts for UNC Wilmington, Fall 2025**

| Group | 2025 Population |
|---|---|
| **Students** | **19,895** |
| *Undergraduate Students* | 16,131 |
| *Graduate Students* | 3,764 |
| *Full-Time Students* | 18,034 |
| *In-State Residency* | 17,290 |
| *Out-of-State Residency* | 2,605 |

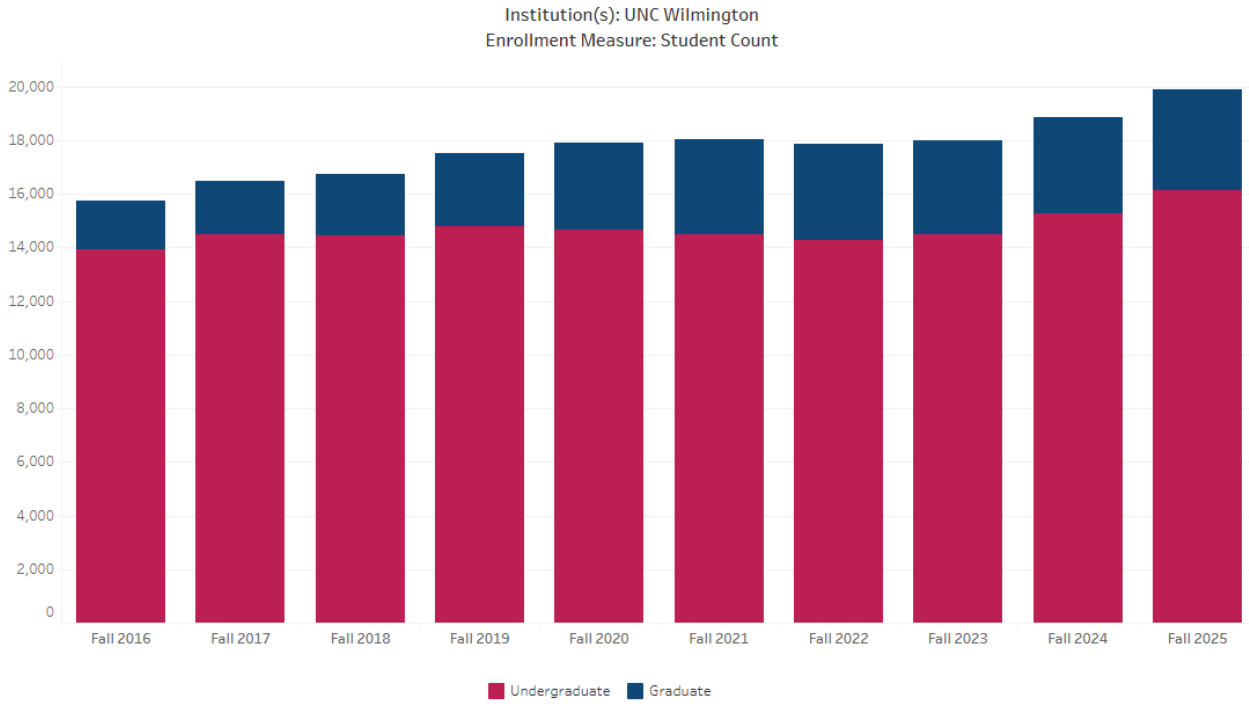
Source: UNC System Interactive Data Dashboards

According to the UNC System Interactive Data Dashboard, most students who attend the university come from Wake, New Hanover, and Mecklenburg Counties as well as other counties located throughout the state of North Carolina. Approximately 13.4% of all enrolled students come from New Hanover County.

Among the UNC-W student population, the most popular majors for undergraduates were Health Professions and Related Programs, Business Management, and Social Sciences. The top graduate programs are Health Professions and Related Programs, Business Management, and Education.

Enrollment from Fall 2016 through Fall 2025 is shown in Figure I.4. Enrollment has increased slightly over the last four years.

**Figure I.4 – UNC Wilmington Enrollment, 2016-2025**




| | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 | Fall 2020 | Fall 2021 | Fall 2022 | Fall 2023 | Fall 2024 | Fall 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Undergraduate** | 13,914 | 14,502 | 14,452 | 14,785 | 14,650 | 14,488 | 14,294 | 14,494 | 15,254 | 16,131 |
| **Graduate** | 1,826 | 1,985 | 2,295 | 2,714 | 3,265 | 3,542 | 3,549 | 3,493 | 3,594 | 3,764 |
| **Total** | **15,740** | **16,487** | **16,747** | **17,499** | **17,915** | **18,030** | **17,843** | **17,987** | **18,848** | **19,895** |

Source: UNC System Interactive Data Dashboards

The racial demographics of the college are presented below in Table I.4.

**Table I.4 – UNC Wilmington Student Body Demographics, Fall 2025**

| Race/Ethnicity | Student Count | Percent of Total Student Count |
|---|---|---|
| American Indian or Alaska Native | 103 | 0.5% |
| Black or African American | 1,095 | 5.5% |
| Hispanic or Latino | 1,927 | 9.7% |
| Two or More Races | 750 | 3.8% |
| Asian | 460 | 2.3% |
| Native Hawaiian or Other Pacific Islander | 30 | 0.2% |
| White | 14,811 | 74.4% |
| Race/Ethnicity Unknown | 356 | 1.8% |
| U.S. Nonresident | 363 | 1.8% |

Source: UNC System Interactive Data Dashboards

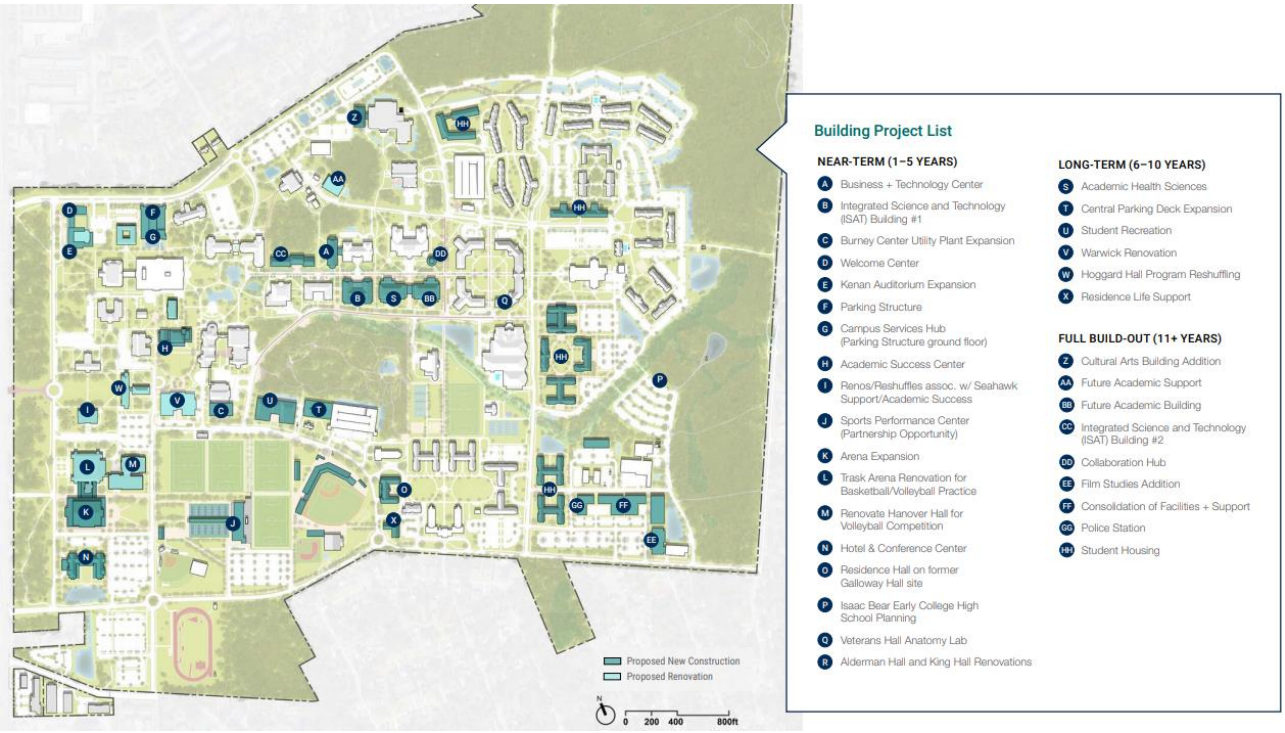
## I.2.4 Growth and Development Trends

UNC-W has been gradually adding buildings over the years when funding sources and support has been contributed to the campus. Between 2018 and 2023, planning, construction and

renovation projects totaled more than $600 million, including Dobo Hall, four new residence halls, coastal engineering building, film studies building, The Shore dining hall, additional recreation fields and facilities, a second parking deck and the renovation and expansion of UNC-W Library.

With the 2024 Campus Master Plan as their guide, UNC-W is currently taking steps to expand Cameron Hall, renovate Kenan Auditorium and construct a new welcome center, hotel and conference center and student housing, among other projects. Figure I.5 shows the building expansions and renovations that are scheduled for both the near-term and long-term on UNC-W's campus.

**Figure I.5 – UNC Wilmington Future Building Plans**




Source: 2024 UNC-W Campus Master Plan

# I.3 Asset Inventory

An inventory of assets was compiled to identify the total count and value of property exposure on the UNC-W campus. This asset inventory serves as the basis for evaluating exposure and vulnerability by hazard. Assets identified for analysis include buildings, critical facilities, and critical infrastructure.

## I.3.1 Building Exposure

Table I.5 provides total building exposure for the campus, which was estimated by summarizing building footprints and property values provided by the North Carolina Emergency Management

(NCEM) iRisk database. All occupancy types were summarized into the following three categories: administration, educational/extracurricular, and housing.

**Table I.5 – UNC-W Building Exposure by Occupancy**

| Occupancy | Estimated Building Count | Structure Value |
|---|---|---|
| Administration | 32 | $91545006.87 |
| Educational/Extracurricular | 55 | $397864038.9 |
| Housing | 39 | $199984366.1 |
| **Total** | **126** | **$689393411.9** |

Source: NCEM iRisk database

## I.3.2 Critical Buildings and Infrastructure Exposure

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are those essential services and lifelines that, if damaged during an emergency event, would disrupt campus continuity of operations or result in severe consequences to public health, safety, and welfare.

Critical buildings are a subset of the total building exposure and were identified by UNC-W's HMPC representatives. After reviewing the following criteria designed to evaluate all critical buildings in the UNC System Hazard Mitigation Plan, the UNC-W HMPC updated the list of critical facilities to reflect current campus needs and building uses. Factors considered for this ranking included:

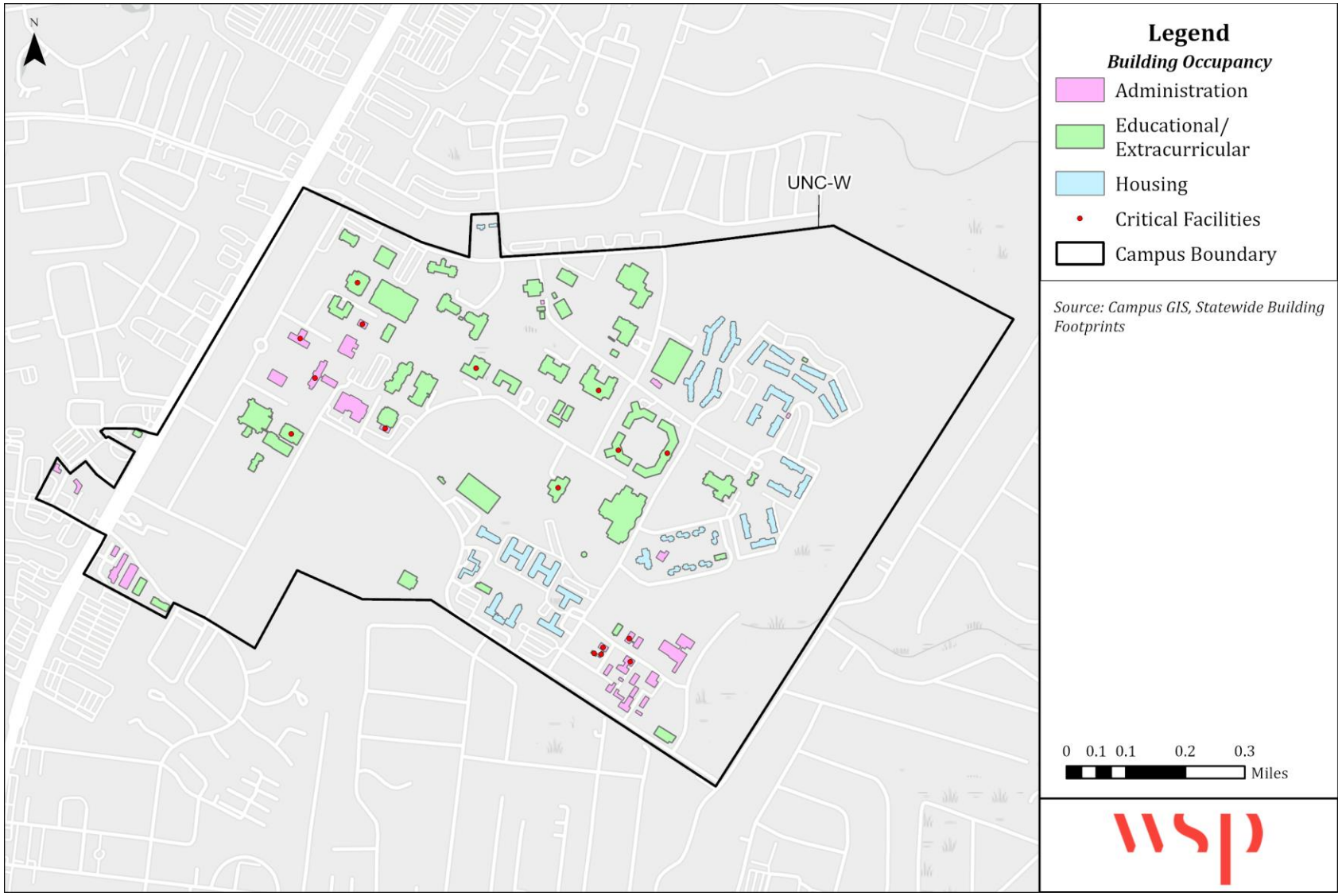
- the building's use for emergency response,
- the building's use for essential campus operations
- the building's use as an emergency shelter or for essential sheltering services,
- the presence of a generator or generator hook-ups,
- the building's use for provision of energy, chilled water or HVAC for sensitive or essential systems,
- the storage of hazardous materials,
- the building's use for sensitive research functions,
- the building's cultural or historical significance, and
- building-specific hazard vulnerabilities

The identified critical facilities for UNC-W, as shown in Figure I.6, include the following:

- Alderman Hall
- Burney Center Energy Plant
- Center for Marine Science and Technology (CMAST)
- Congdon Hall
- Discovery Hall
- Dobo Hall
- Facilities
- Hanover Hall

- Hoggard Hall
- Lift Station 1
- Lift Station 2
- Lift Station 3
- Teaching Laboratory
- Telecommunications
- University Police Department
- Veterans Hall
- Wagoner Central Energy Plant
- Westside Central Energy Plant

**Figure I.6 – UNC-W Map of Critical Facilities**



# I.4 Hazard Identification & Risk Assessment

## I.4.1 Hazard Identification

To identify a full range of hazards relevant to UNC-W, HMPC representatives began with a review of the list of hazards identified in the 2023 North Carolina State Hazard Mitigation Plan (HMP) and the UNC-W Annex of the 2021 UNC Eastern Campuses Regional Hazard Mitigation Plan (RHMP), as summarized in Table I.6. This ensured consistency with the state and regional hazard mitigation plans and across each campus' planning efforts.

**Table I.6 – Hazards Included in Previous Planning Efforts**

| Hazard | Included in 2023 State HMP? | Included in 2021 UNC Eastern Campuses RHMP UNC-W Annex? |
|---|---|---|
| Flooding | Yes | Yes |
| Hurricanes and Coastal Hazards | Yes | Yes |
| Severe Winter Weather | Yes | Yes |
| Extreme Heat | Yes | No |
| Earthquakes | Yes | Yes |
| Wildfire | Yes | Yes |
| Dam Failures | Yes | No |
| Drought | Yes | No |
| Tornadoes/Thunderstorms | Yes | Yes |
| Geological (Landslides, Sinkholes) | Yes | Yes, Sinkhole |
| Hazardous Substances | Yes | Yes |
| Infectious Disease | Yes | Yes |
| Radiological Emergency | Yes | No |
| Terrorism | Yes | Yes |
| Cyber Security | Yes | Yes |

UNC-W's HMPC representatives evaluated the above list of hazards by considering existing hazard data, past disaster declarations, local knowledge, and information from the 2023 State Plan and the 2021 UNC Eastern Campuses RHMP to determine the significance of each hazard to the campus. Significance was measured in general terms and focused on key criteria such as frequency, severity, and resulting damage, including deaths and injuries, as well as property and economic damage.

One key resource in this effort was the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) Storm Events Database, which contains an archive by county of storms or weather events having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. The database also provides a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another

event. The database contains records of tornado events since 1950, thunderstorm wind and hail events since 1955, and all other tracked event types since 1996. NCEI receives storm data from the National Weather Service (NWS), which compiles their information from a variety of sources, including but not limited to county, state and federal emergency management officials; local law enforcement officials; SkyWarn spotters; NWS damage surveys; newspaper clipping services; the insurance industry and the general public, among others. While NCEI is not a comprehensive list of past hazard events, it can provide an indication of relevant hazards to the planning area and offers some statistics on injuries, deaths, damages, as well as narrative descriptions of past impacts.

Data for New Hanover County was used to approximate past events that may have affected the UNC-W campus. The NCEI database contains 549 records of storm events that occurred in New Hanover County in the 25-year period from 2000 through 2024. Table I.7 summarizes these events.

**Table I.7 – NCEI Severe Weather Data for New Hanover County, 2000-2024**

| Type | # of Events | Property Damage | Crop Damage | Deaths | Injuries |
|---|---|---|---|---|---|
| Coastal Flood | 11 | $0 | $0 | 0 | 0 |
| Drought | 4 | $0 | $0 | 0 | 0 |
| Flash Flood | 89 | $7,501,000 | $0 | 0 | 0 |
| Flood | 60 | $27,000 | $0 | 0 | 2 |
| Frost/Freeze | 2 | $0 | $0 | 0 | 0 |
| Funnel Cloud | 11 | $0 | $0 | 0 | 0 |
| Hail | 62 | $15,450 | $0 | 0 | 0 |
| Heat | 7 | $0 | $0 | 0 | 0 |
| Heavy Rain | 47 | $1,663,000 | $0 | 0 | 2 |
| High Wind | 12 | $10,000 | $0 | 0 | 0 |
| Hurricane (Typhoon) | 4 | $1,000,000,000 | $0 | 0 | 1 |
| Ice Storm | 2 | $0 | $0 | 0 | 0 |
| Lightning | 35 | $1,108,000 | $0 | 5 | 15 |
| Rip Current | 54 | $0 | $0 | 14 | 3 |
| Storm Surge/Tide | 2 | $0 | $0 | 0 | 0 |
| Strong Wind | 2 | $17,000 | $0 | 0 | 0 |
| Thunderstorm Wind | 93 | $1,692,000 | $2,000 | 0 | 1 |
| Tornado | 18 | $1,683,000 | $0 | 0 | 3 |
| Tropical Depression | 1 | $20,000 | $0 | 0 | 0 |
| Tropical Storm | 22 | $3,028,000 | $0 | 0 | 0 |
| Waterspout | 2 | $0 | $0 | 0 | 0 |
| Wildfire | 1 | $2,500 | $0 | 0 | 0 |
| Winter Storm | 8 | $0 | $0 | 0 | 0 |
| **Total** | **549** | **$1,016,766,950** | **$2,000** | **19** | **27** |

Source: National Center for Environmental Information Events Database, retrieved November 2025
Note: Losses reflect totals for all impacted areas for each event.

The HMPC also researched past events that resulted in a federal and/or state emergency or disaster declaration for New Hanover County in order to identify significant hazards. Two types of disaster declarations are provided in the Stafford Disaster Relief and Emergency Assistance

Act of 1988: emergency declarations and major disaster declarations. If a disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration allows for the provision of federal assistance.

- Emergency declarations: When federal assistance is needed, the President of the United States can declare an emergency for any occasion or disaster. Emergency declarations aide State and local efforts in providing emergency services that help protect human lives.
- Major disaster declarations: When a local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county, and state resources are insufficient and the situation is beyond their recovery capabilities.

Records of designated counties for FEMA major disaster declarations start in 1954. Since then, New Hanover County has been designated in 23 major disaster declarations, as detailed in Table I.8; and 15 emergency declarations, as detailed in Table I.9.

**Table I.8 – FEMA Major Disaster Declarations, New Hanover County**

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-28-NC | 17-Oct-54 | Hurricane | Hurricane | N/A | N/A | N/A |
| DR-37-NC | 13-Aug-55 | Hurricane | Hurricanes | N/A | N/A | N/A |
| DR-56-NC | 24-Apr-56 | Severe Storm(s) | Severe Storm | N/A | N/A | N/A |
| DR-87-NC | 01-Oct-58 | Hurricane | Hurricane & Severe Storm | N/A | N/A | N/A |
| DR-107-NC | 16-Sep-60 | Hurricane | Hurricane Donna | N/A | N/A | N/A |
| DR-130-NC | 16-Mar-62 | Flood | Severe Storm, High Tides & Flooding | N/A | N/A | N/A |
| DR-179-NC | 13-Oct-64 | Flood | Severe Storms & Flooding | N/A | N/A | N/A |
| DR-724-NC | 21-Sep-84 | Hurricane | Hurricane Diana | N/A | N/A | N/A |
| DR-1127-NC | 18-Jul-96 | Hurricane | Hurricane Bertha | N/A | N/A | N/A |
| DR-1134-NC | 06-Sep-96 | Hurricane | Hurricane Fran | N/A | N/A | N/A |
| DR-1240-NC | 27-Aug-98 | Hurricane | Hurricane Bonnie | N/A | N/A | N/A |
| DR-1292-NC | 16-Sep-99 | Hurricane | Hurricane Floyd Major Disaster Declarations | N/A | N/A | $298,105,794 |
| DR-1490-NC | 18-Sep-03 | Hurricane | Hurricane Isabel | 7,790 | $21,289,504 | $18,285,917 |
| DR-1608-NC | 07-Oct-05 | Hurricane | Hurricane Ophelia | N/A | N/A | $16,887,659 |
| DR-1801-NC | 08-Oct-08 | Severe Storm(s) | Tropical Storm Hanna | N/A | N/A | $4,657,982 |

| Disaster # | Dec. Date | Incident Type | Event Title | IA Applications Approved | Total IAH Program Dollars Approved | Total PA Grant Dollars Obligated |
|---|---|---|---|---|---|---|
| DR-1942-NC | 14-Oct-10 | Severe Storm(s) | Severe Storms, Flooding, And Straight-Line Winds | 2,037 | $8,587,054 | $19,065,881 |
| DR-4019-NC | 31-Aug-11 | Hurricane | Hurricane Irene | 10,270 | $37,238,655 | $88,847,065 |
| DR-4285-NC | 10-Oct-16 | Hurricane | Hurricane Matthew | 28,971 | $98,842,213 | $291,092,954 |
| DR-4393-NC | 15-Sep-18 | Hurricane | Hurricane Florence | 34,713 | $133,948,455 | $632,937,402 |
| DR-4465-NC | 04-Oct-19 | Hurricane | Hurricane Dorian | N/A | N/A | $28,138,271 |
| DR-4487-NC | 25-Mar-20 | Biological | Covid-19 Pandemic | N/A | N/A | $174,898,697 |
| DR-4568-NC | 14-Oct-2020 | Hurricane | Hurricane Isaias | N/A | N/A | N/A |
| DR-4837-NC | 19-Oct-2024 | Tropical Storm | Potential Tropical Cyclone Eight | N/A | N/A | N/A |

Source: FEMA Disaster Declarations Summary, October 2025

IA = Individual Assistance, IAH = Individuals and Households, PA = Public Assistance

Note: Number of applications approved and all dollar values represent totals for all counties included in disaster declaration.

### Table I.9 – FEMA Emergency Declarations, New Hanover County

| Disaster # | Dec. Date | Incident Type | Event Title/Description |
|---|---|---|---|
| EM-3110-NC | 17-Mar-93 | Snow | Severe Snowfall & Winter Storm |
| EM-3141-NC | 01-Sep-99 | Hurricane | Hurricane Dennis |
| EM-3146-NC | 15-Sep-99 | Hurricane | Hurricane Floyd Emergency Declarations |
| EM-3222-NC | 05-Sep-05 | Hurricane | Hurricane Katrina Evacuation |
| EM-3254-NC | 15-Sep-05 | Hurricane | Hurricane Ophelia |
| EM-3314-NC | 02-Sep-10 | Hurricane | Hurricane Earl |
| EM-3327-NC | 25-Aug-11 | Hurricane | Hurricane Irene |
| EM-3380-NC | 07-Oct-16 | Hurricane | Hurricane Matthew |
| EM-3401-NC | 11-Sep-18 | Hurricane | Hurricane Florence |
| EM-3423-NC | 04-Sep-19 | Hurricane | Hurricane Dorian |
| EM-3471-NC | 13-Mar-20 | Biological | Covid-19 |
| EM-3534-NC | 02-Aug-20 | Hurricane | Hurricane Isaias |
| EM-3586-NC | 1-Oct-2022 | Hurricane | Hurricane Ian |
| EM-3608-NC | 6-Aug-2024 | Tropical Storm | Tropical Storm Debby |
| EM-3617-NC | 26-Sep-2024 | Tropical Storm | Hurricane Helene |

Source: FEMA Disaster Declarations Summary, October 2025

Using the above information and additional discussion, the HMPC evaluated each hazard's significance to the planning area in order to decide which hazards to include in this plan update. Table I.10 summaries the determination made for each hazard.

## Table I.10 – Hazard Evaluation Results

| Hazard | Included in this plan update? | Explanation for Decision |
|---|---|---|
| **Natural Hazards** | | |
| Dam Failure | No | ▪ Not included in the 2021 UNC-W Annex<br>▪ No known risk to inundation from failure of a high hazard dam |
| Drought | Yes | ▪ Over the 25-year period from January 2000 through September 2025, New Hanover County had 488 weeks of drought conditions ranging from abnormally dry to exceptional drought. |
| Earthquake | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ Modeled building damages in iRisk database show some vulnerability and potential for losses due to earthquake |
| Excessive Heat | Yes | ▪ Increasing frequency and severity of hot days and warm nights; trend expected to continue<br>▪ Potential high vulnerability groups on campus, including student athletes and individuals working outdoors |
| Flooding | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ New Hanover County has had 2 disaster declarations for flooding and 16 declarations for hurricanes that may have involved flooding. |
| Geological Hazards (Sinkhole & Landslide) | No | ▪ Included in the 2021 UNC-W Annex<br>▪ The HMPC opted to remove this hazard as there is limited geological basis for sinkholes. Drainage-related sinkholes will be addressed within the flooding profile. |
| Hurricane & Coastal Hazards | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ New Hanover County has had 16 disaster declarations for hurricanes. |
| Severe Winter Weather | No | ▪ Not included in the 2021 UNC-W Annex<br>▪ Severe winter weather was determined to present small risk to campus and was not seen as necessary to include by the HMPC |
| Tornadoes & Thunderstorms | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ Up to an F2 tornado has passed within 10 miles of campus |
| Wildfire | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ Southern Wildfire Risk Assessment data shows exposure to wildland urban interface on campus |
| **Technological and Human-Caused Hazards & Threats** | | |
| Hazardous Substances | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ There are fixed facility sites and transportation routes with hazardous materials in/near the campus |
| Infectious Disease | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ High concentration and interaction of people on campus makes infectious disease a significant hazard |
| Cyber Security | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ Perceived increase in frequency of cyber security incidents and vulnerability to threats |
| Terrorism | Yes | ▪ Included in the 2021 UNC-W Annex<br>▪ High concentration and interaction of people on campus makes terrorism and mass shootings a significant hazard |

# I.5 Hazard Profiles, Analysis, and Vulnerability

The Disaster Mitigation Act of 2000 requires that the HMPC evaluate the risks associated with each of the hazards identified in the planning process. Each hazard was evaluated to determine where it may occur, the severity of potential events, records of past events, the probability of future occurrences, and potential impacts from the hazard. A vulnerability assessment was conducted for each hazard using quantitative and/or qualitative methods depending on the available data, to determine its potential to cause significant human and/or monetary losses. A consequence analysis was also completed for each hazard.

To account for regional differences in hazard risk across each of the campuses, this risk assessment is divided into two parts:

- a set of summary hazard profiles describing each hazard and summarizing the risk findings for each campus, presented in Section 3.5; and
- a campus-specific risk assessment profiling the location, extent, historical occurrences, probability of future occurrence, and vulnerability of each campus, presented in each campus annex.

In the campus-level hazard profiles presented here, each hazard is profiled in the following format:

### Location

This section includes information on the hazard's physical extent, describing where on UNC-W's campus the hazard can occur, with mapped boundaries where applicable.

### Extent

This section includes information on the hazard extent in terms of magnitude and describes how the severity of the hazard can be measured. Where available, the most severe event on record used as a frame of reference.

### Historical Occurrences

This section contains information on historical events, including the location and consequences of all past events on record within or near the planning area, approximated by New Hanover County in some cases. Where possible, this plan uses a consistent 25-year period of record except for hazards with significantly longer average recurrence intervals or where data limitations otherwise restrict the period of record.

### Probability of Future Occurrence

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event

happening in any given year according to historical occurrence (e.g. 10 winter storm events over a 30-year period equates to a 33 percent chance of experiencing a severe winter storm in any given year).

## Vulnerability Assessment

This section quantifies, to the extent feasible using best available data, assets at risk to natural hazards and potential loss estimates. Details on hazard specific methodologies and assumptions are provided where applicable. People, properties and critical facilities, and environmental assets that are vulnerable to the hazard are identified.

The vulnerability assessments followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (August 2001). This risk assessment first describes the total vulnerability and values at risk and then discusses specific exposure and vulnerability by hazard. Data used to support this assessment included the following:

- Geographic Information System (GIS) datasets, including County parcel data from NC OneMap, campus building inventory and values from the NCEM iRisk Database, topography, transportation layers, and critical facility and infrastructure locations;
- Hazard layer GIS datasets from state and federal agencies;
- Written descriptions of inventory and risks provided by the 2023 State of North Carolina Hazard Mitigation Plan;
- Written descriptions of inventory and risks provided by the 2021 Southeastern Regional Hazard Mitigation Plan; and
- Exposure and vulnerability estimates derived using local parcel data.

Two distinct risk assessment methodologies were used in the formation of the vulnerability assessment. The first consists of a quantitative analysis that relies upon best available data and technology, while the second approach consists of a qualitative analysis that relies on local knowledge and rational decision making.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical facilities and infrastructure, historic resources, and valued natural resources (e.g., an identified wetland or endangered species habitat). Together, this information conveys the vulnerability of that area to that hazard.

For applicable hazards, the quantitative analysis involved the use of NCEM's iRisk database, which provides building level modeled loss estimates for multiple hazards. The iRisk database contains a statewide building inventory using building footprint and parcel data updated between 2020-2025. Footprints with an area less than 500 square feet were excluded from the analysis. To determine if a building is in a hazard area, building footprints were intersected with each of

the mapped hazard areas. If a building intersects two or more hazard areas (such as the 1-percent-annual-chance flood zone and the 0.2-percent-annual-chance flood zone), it is counted as being in the hazard area of highest risk. The parcel data provides building value and year built. Building value was used to estimate exposure and potential losses. Year built was used to determine if a building was constructed prior to or after the community joined the National Flood Insurance Program (NFIP) and had an effective FIRM and building codes enforced.

Additional GIS-based analysis was completed using data collected from local, regional and national sources that included New Hanover County, NCEM, and FEMA.

The data collected for the hazard profiles and vulnerability assessment was obtained from multiple sources covering a variety of spatial areas including county-, jurisdictional-, and campus-level information. The table below presents the source data and the associated geographic coverages.

**Table I.7 – Summary of Hazard Data Sources and Geographic Coverage**

| Hazard | Hazard Data Sources | Profile Geographic Area | Vulnerability Methodology | Vulnerability Geographic Area |
|---|---|---|---|---|
| **Drought** | U.S. Drought Monitor | County | Qualitative Analysis | County |
| **Earthquake** | USGS, NCEI | County | iRisk | Campus |
| **Excessive Heat** | NCEI | County | Qualitative Analysis | Campus |
| **Flooding** | NCEI, FEMA | Jurisdiction | iRisk | Campus |
| **Hurricanes & Coastal Hazards** | NHC | County | iRisk | Campus |
| **Tornadoes & Thunderstorms** | NWS, NCEI | County, Jurisdiction | Statistical Analysis | Jurisdiction |
| **Wildfire** | NCFS, SouthWRAP | County, Campus | GIS Spatial Analysis | Campus |
| **Cyber Security** | Internet Research | County, Higher Education | Qualitative Analysis | Higher Education |
| **Hazardous Substances** | EPA; USDOT | Jurisdiction | GIS Spatial Analysis | Campus |
| **Infectious Disease** | CDC; WHO | National, Higher Education | Qualitative Analysis | Higher Education |
| **Terrorism** | Southern Poverty Law Center | National, Higher Education | Qualitative Analysis | Higher Education |

CDC = Centers for Disease Control and Prevention; EPA = United States Environmental Protection Agency; FEMA = Federal Emergency Management Agency; NCEI = National Centers for Environmental Information; NCFS = North Carolina Forest Service; NHC = National Hurricane Center; NWS = National Weather Service; SouthWRAP = Southern Group of State Foresters, Wildfire Risk Assessment Portal; USDOT = United States Department of Transportation; USGS = United States Geological Survey; WHO = World Health Organization

### Changes in Development

This section describes how changes in development have impacted vulnerability since the last plan was adopted. Future development is also discussed in this section, including how exposure to the hazard may change in the future or how development may affect hazard risk.

### Problem Statements

This section summarizes key mitigation planning concerns related to this hazard.

## Priority Risk Index

The conclusions drawn from the hazard profiling and vulnerability assessment process are used to prioritize all potential hazards to the UNC-W planning area. The Priority Risk Index (PRI) was applied for this purpose because it provides a standardized numerical value so that hazards can be compared 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 was assigned a value (1 to 4) and a weighting factor as summarized in Table I.5 on the following page.

PRI ratings are shown at the top of each hazard profile and provided by category throughout the profile. The results of the risk assessment and overall PRI scoring are provided in Section I.5.12 Conclusions on Hazard Risk.

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

**PRI = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]**

The purpose of the PRI is to categorize and prioritize all potential hazards for the campus planning area as high, moderate, or low risk. The summary hazard classifications generated through the use of the PRI allows for the prioritization of those high and moderate hazard risks for mitigation planning purposes.

## Table I.8 – Priority Risk Index

| RISK ASSESSMENT CATEGORY | LEVEL | DEGREE OF RISK CRITERIA | INDEX | WEIGHT |
|---|---|---|---|---|
| **PROBABILITY** What is the likelihood of a hazard event occurring in a given year? | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | **1** | **30%** |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | **2** | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | **3** | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | **4** | |
| **IMPACT** In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs? | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & 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 > 1 DAY | **2** | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 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 > 30 DAYS. | **4** | |
| **SPATIAL EXTENT** How large of an area could be impacted by a hazard event? Are impacts localized or regional? | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | **1** | **20%** |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | **2** | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | **3** | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | **4** | |
| **WARNING TIME** Is there usually some lead time associated with the hazard event? Have warning measures been implemented? | **MORE THAN 24 HRS** | SELF DEFINED | **1** | **10%** |
| | **12 TO 24 HRS** | SELF DEFINED | **2** | |
| | **6 TO 12 HRS** | SELF DEFINED | **3** | |
| | **LESS THAN 6 HRS** | SELF DEFINED | **4** | |
| **DURATION** How long does the hazard event usually last? | **LESS THAN 6 HRS** | SELF DEFINED | **1** | **10%** |
| | **LESS THAN 24 HRS** | SELF DEFINED | **2** | |
| | **LESS THAN 1 WEEK** | SELF DEFINED | **3** | |
| | **MORE THAN 1 WEEK** | SELF DEFINED | **4** | |

# I.5.1 Drought

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Drought | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |

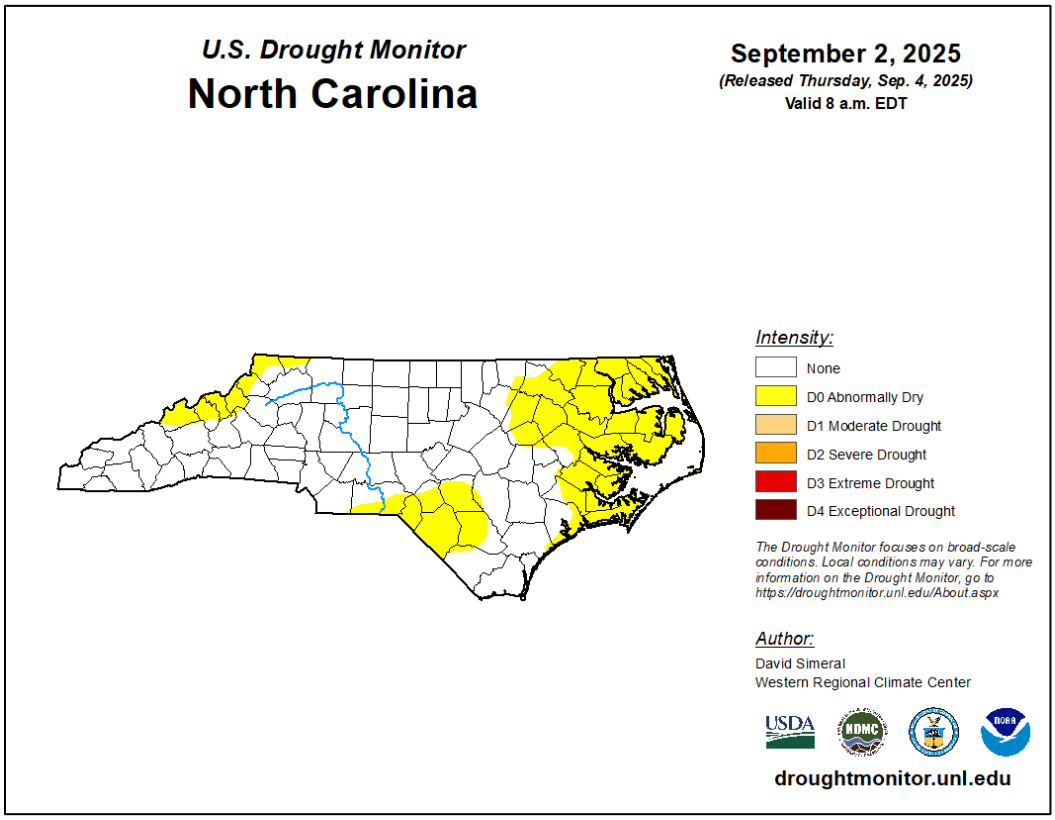
## Location

Drought is a regional hazard that can cover the entire planning area, and in some cases the entire state. The National Weather Service views drought and extreme heat as a phenomenon affecting broad forecast "zones", making it uncommon to pinpoint locations within planning areas that are more vulnerable to these hazards than others. Historically, the Eastern United Staes has experienced fewer significant long-term droughts compared to the Central and Western regions of the county.

The figure below illustrates the U.S. Drought Monitor's drought ratings for North Carolina as of September 2, 2025; as of that date, New Hanover County was experiencing no impacts of drought.

*Spatial Extent: 4 – Large*

**Figure I.7 – US Drought Monitor for Week of September 2, 2025**




Source: U.S. Drought Monitor

## Extent

The most significant impacts of drought are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Drought conditions can cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Drought extent can be defined in terms of intensity, using the U.S. Drought Monitor scale. The Drought Monitor Scale measures drought episodes with input from the Palmer Drought Severity Index, the Standardized Precipitation Index, the Keetch-Byram Drought Index, soil moisture indicators, and other inputs as well as information on how drought is affecting people. Figure I**.8** details the classifications used by the U.S. Drought Monitor. A category of D2 (severe) or higher on the U.S. Drought Monitor Scale can typically result in crop or pasture losses, water shortages, and the need to institute water restrictions.

**Figure I.8 – US Drought Monitor Classifications**

| | | | 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:<br>▪ short-term dryness slowing planting, growth of crops or pastures<br>Coming out of drought:<br>▪ some lingering water deficits<br>▪ 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<br>▪ Streams, reservoirs, or wells low, some water shortages developing or imminent<br>▪ 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<br>▪ Water shortages common<br>▪ 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<br>▪ 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<br>▪ 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: US Drought Monitor

From late 2007 through mid-2008, North Carolina experienced the worst drought in state history. During this time, portions of New Hanover County experienced extreme drought conditions.

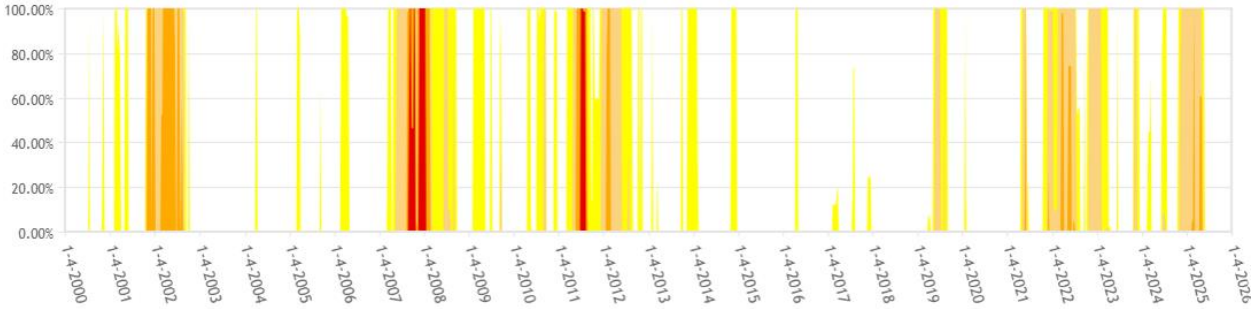
*Impact: 1 – Minor*

## Historical Occurrences

Between 2000 and 2025, New Hanover County was in some level of drought 36% of the time. The County recorded 22 weeks in “extreme” drought or worse during this timeframe. Figure I**.9**

shows the historical periods where New Hanover County was considered in some level of drought conditions. The color key shown in Figure I.8 indicates the intensity of the drought.

**Figure I.9 – US Drought Monitor Historical Trends – New Hanover County 2000-2025**




Source: US Drought Monitor

The National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln, provides a clearinghouse for information on the effects of drought, based on reports from media, observers, impact records, and other sources.

According to the National Drought Mitigation Center's Drought Impact Reporter, during the 10-year period from January 2015 through September 2025, 1,447 drought impacts were noted for the State of North Carolina, of which 16 were reported to affect New Hanover County. Table I.11 summarizes the number of impacts reported by category and the years impacts were reported for each category. Note that the Drought Impact Reporter assigns multiple categories to each impact.

**Table I.11 – Drought Impacts Reported for New Hanover County, January 2015 through September 2025**

| Category | Impacts | Years Reported |
|---|---|---|
| Agriculture | 3 | 2019, 2021, 2024 |
| Fire | 9 | 2019 2021, 2024 |
| Plants & Wildlife | 1 | 2016 |
| Relief, Response & Restrictions | 13 | 2019, 2020, 2021, 2024, 2025 |
| Society & Public Health | 2 | 2016, 2024 |
| Water Supply & Quality | 6 | 2019, 2020, 2021, 2024, 2025 |

Source: Drought Impact Reporter, http://droughtreporter.unl.edu

### I.5.1.1.1 Probability of Future Occurrence

Over the 25-year (1340 week) period from January 2000 through September 2025, New Hanover County had 488 weeks of drought conditions ranging from abnormally dry to exceptional drought. This equates to a 36 percent chance of drought in any given week. Of this time, 95 weeks were categorized as a severe (D2) drought or greater, which equates to a 7 percent chance of severe drought in any given week.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Vulnerability to drought is based on historical occurrences of drought in the planning area and generalized concerns regarding potential drought consequences.

### People

Drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Drought can also contribute to health issues by compromising water quality due to decreased water levels. Additionally, when coupled with extreme heart, droughts can lead to an increase in heat-related illnesses such heat-stroke, potentially resulting in loss of life.

The historical and potential impacts of drought on populations include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased costs to local and state government for large-scale water acquisitions and delivery, water rationing, and water wells running dry for individuals and families.

### Property

Direct structural damage from drought is rare, though it can happen. Droughts can disrupt soil cycles, leading to soil shrinking and swelling, potentially causing cracks in foundations and damaging infrastructure. It can also profoundly impact landscapes, posing financial burdens on property owners. Drought is unlikely to cause damage to the built environment. However, in areas with shrinking and expansive soil, drought may lead to structural damage.

### Environment

Environmental losses from drought are associated with damage to plants, animals, wildfire, and air and water quality, forest and range fires, landscape degradation, biodiversity loss, and soil erosion. While some impacts are transient, resolving once the drought subsides, others endure or may become irreversible. For instance, wildlife habitats may suffer from the loss of wetlands, lakes, and vegetation, yet many species can eventually rebound. Landscape degradation and heightened soil erosion may lead to lasting declines in biological productivity. Despite the challenges in quantifying environmental losses, heightened public awareness and concern for environmental well-being have prompted public officials to allocate greater attention and resources to mitigate these effects. Moreover, if climate change forecasts of prolonged drought followed by intense rainfall events hold true, the risk of flash flooding also escalates under such conditions.

### Changes in Development

As new development on campus occurs and population rises, water demand will likely increase, which could lower the threshold for socioeconomic drought in terms of the inability of water

supply to meet water demand on campus and in the larger Wilmington and New Hanover County communities.

## Problem Statement

- New Hanover County experienced drought periods of 70 weeks or longer two times between 2000-2025: 74 weeks from May 2007 through September 2008 including 27 weeks at D2 or higher, and 77 weeks from March 2011 through August 2012 including 18 weeks at D2 or higher.
- UNC-W receives treated water from the Cape Fear River Public Utility Authority (CFPUA). CFPUA, in coordination with the North Carolina Drought Monitor and Lower Cape Fear Water & Sewer Authority (LCFWSA), monitor drought conditions, to determine any changes to CFPUA's operating conditions. Various thresholds are used to determine source or supply triggers. These conditions are outlined by CFPUA's water shortage and emergency management advisories stages that correspond to certain water restrictions.

## I.5.2 Earthquake

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |

### Location

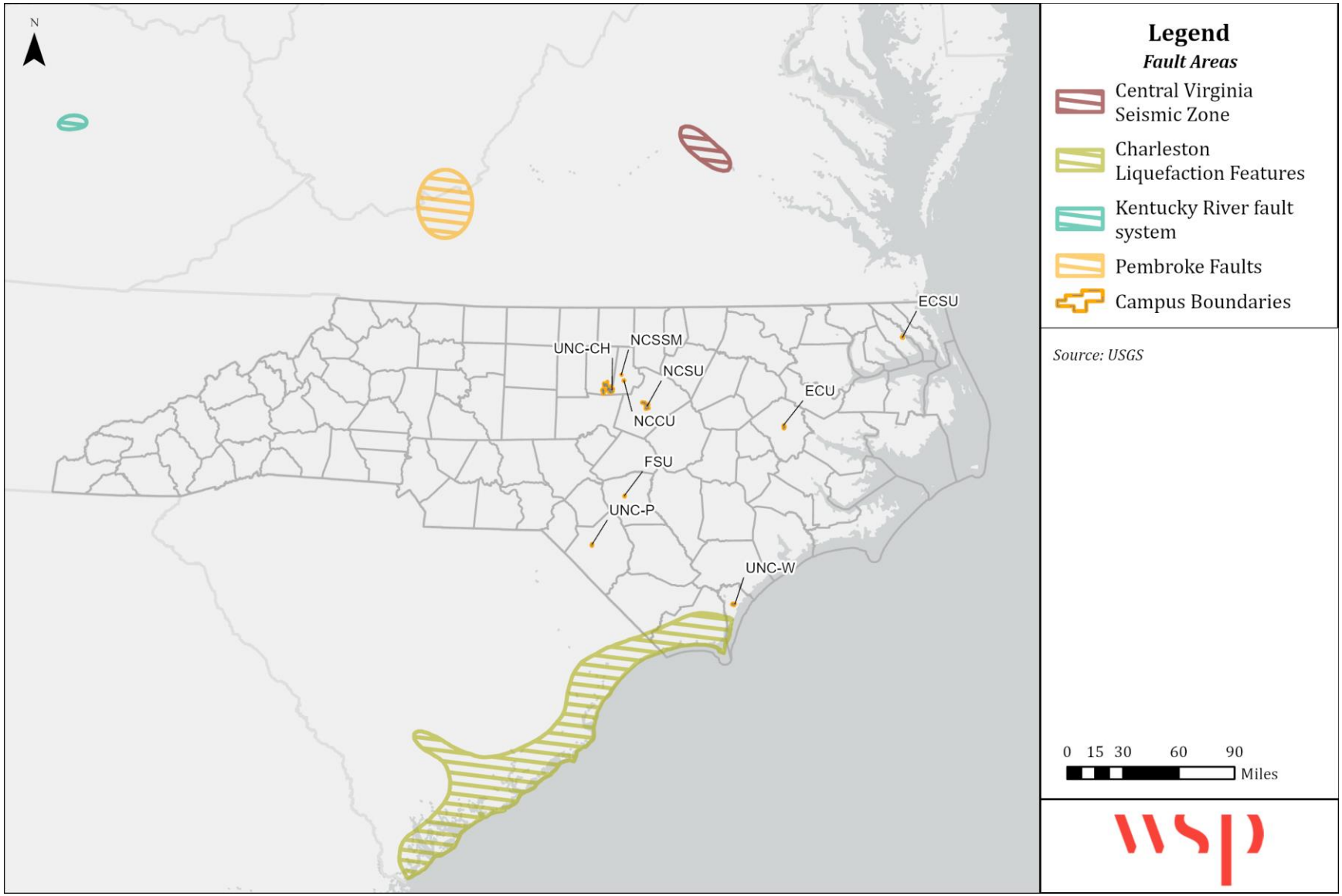
Figure I.10 reflects the quaternary faults that present an earthquake hazard for the UNC-W planning area based on data from the USGS Earthquake Hazards Program. Quaternary faults have shown evidence of movement within the last 1.6 million years.

All of North Carolina is subject to earthquakes, with the western and southern region most vulnerable to a damaging earthquake. The Charleston Fault in South Carolina and New Madrid Fault in Tennessee affect the state. Both faults have generated earthquakes measuring greater than 8.0 on the Richter Scale during the last 200 years. In addition, there are several smaller fault lines in eastern Tennessee and throughout North Carolina that could produce less severe shaking. No active faults were noted in New Hanover County.

Earthquakes are generally felt over a wide area, with impacts occurring hundreds of miles from the epicenter. Therefore, any earthquake that impacts New Hanover County is likely to be felt across most if not all of the planning area.

*Spatial Extent: 4 – Large*

**Figure I.10 – U.S. Quaternary Faults**

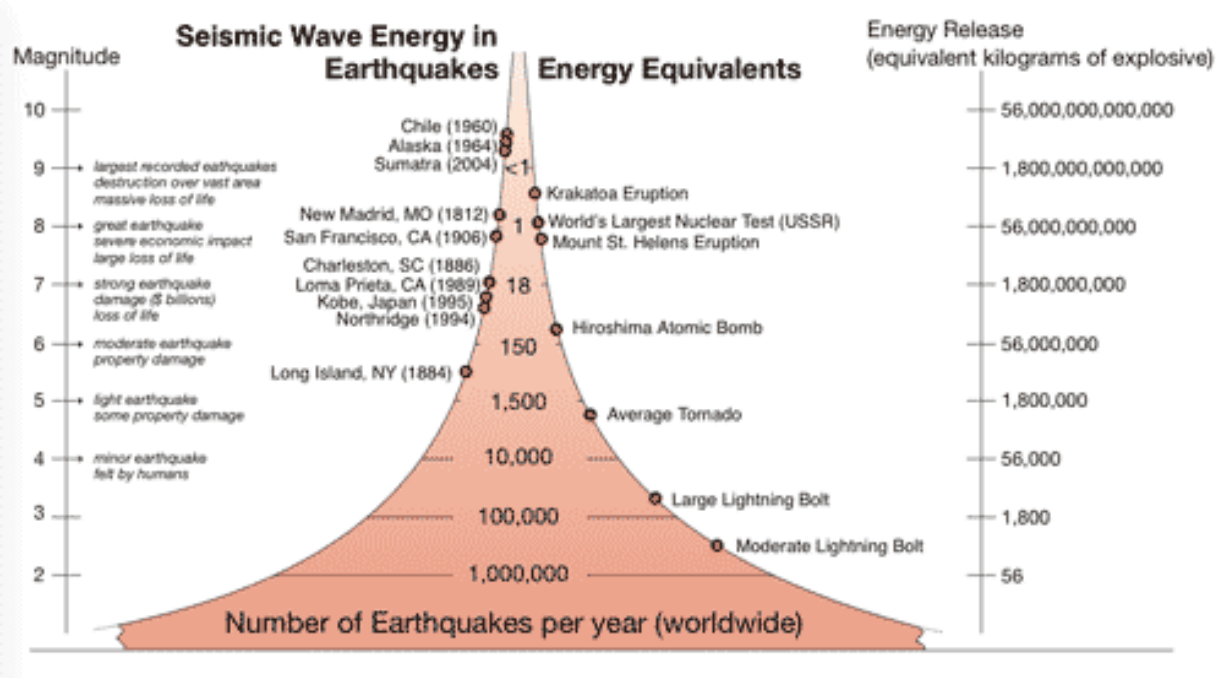


## Extent

Earthquakes are measured in terms of their magnitude and intensity. The Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude is usually used by the news media when reporting the intensity of earthquakes and is the scale most familiar to the public. However, the USGS now uses moment magnitude, which is an extension of the Richter Scale and is based on physical properties of the earthquake derived from an analysis of all the waveforms recorded from the shaking. Earthquake magnitude is described in Figure I.11.

A more meaningful measurement is an earthquake's intensity. The intensity scale used by the scientific community in the United States is called the Modified Mercalli Intensity (MMI) scale. The MMI scale is an arbitrary ranking based on observed effects. Table I.12 shows descriptions for levels of earthquake intensity on the MMI scale compared to the Richter scale. Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

**Figure I.11 – Earthquake Magnitude and Energy Release**




Source: USGS Earthquake Hazards Program

**Table I.12 – Modified Mercalli Intensity (MMI) Scale**

| MMI | Shaking | Description/Damage |
|---|---|---|
| I | Not felt | Not felt except by a very few under especially favorable conditions. |
| II | Weak | Felt by a few persons at rest, especially on upper floors of buildings. |
| III | Weak | Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| IV | Light | Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. |
| V | Moderate | Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| VI | Strong | Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| VII | Very strong | Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| VIII | Severe | Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. |
| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some will-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

Source: USGS Earthquake Hazards Program

*Impact: 1 – Minor*

## Historical Occurrences

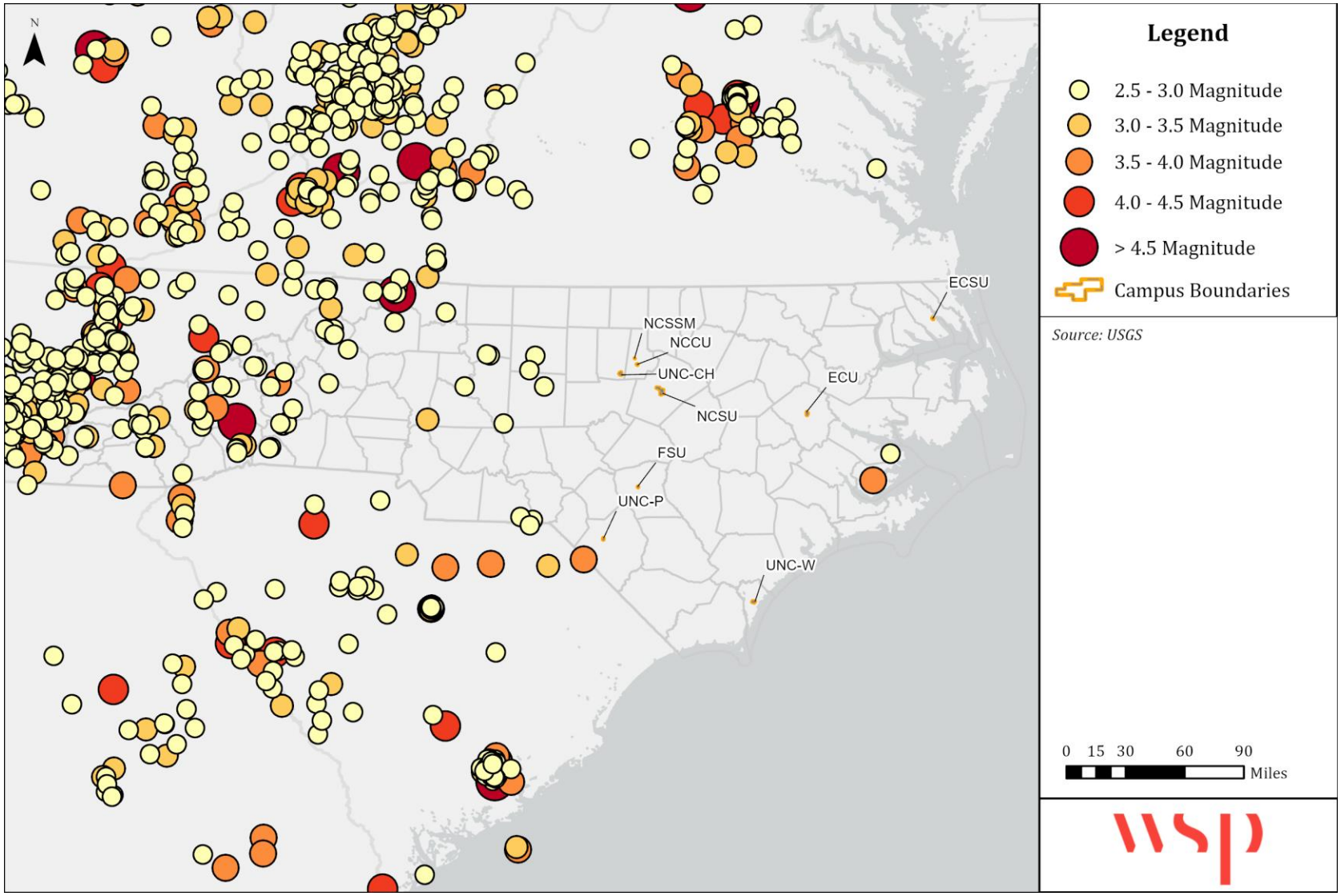
The USGS Earthquake Hazards Program maintains a database of historical earthquakes of a magnitude 2.5 and greater from 1900 to 2024. Earthquake events that occurred within 100 miles of the UNC-W campus are presented in Table I.13 and Figure I.12.

**Table I.13 – Historical Earthquakes within 100 Miles of UNC-W, 1900-2024**

| Date of Occurrence | Magnitude | Location |
|---|---|---|
| 8/6/1994 | 3.6 | 4 km SSW of Bayboro, North Carolina |
| 9/22/2006 | 3.4 | 4 km WSW of Blenheim, South Carolina |
| 9/25/2006 | 3.7 | 7 km W of Rowland, North Carolina |
| 2/11/2014 | 2.9 | 7 km NW of Hobucken, North Carolina |

Source: USGS

**Figure I.12 – Historical Earthquakes by Magnitude, 1900-2024**



The National Center for Environmental Information (NCEI) maintains a database of the felt intensity of earthquakes from 1638 to 1985 including the maximum intensity for each locality that felt the earthquake. According to this database, in the 100-year period from 1885-1985, there have been 17 earthquakes felt in and around Wilmington with MMI ranging from II in November 1928 to VIII in September 1886.

## Probability of Future Occurrence

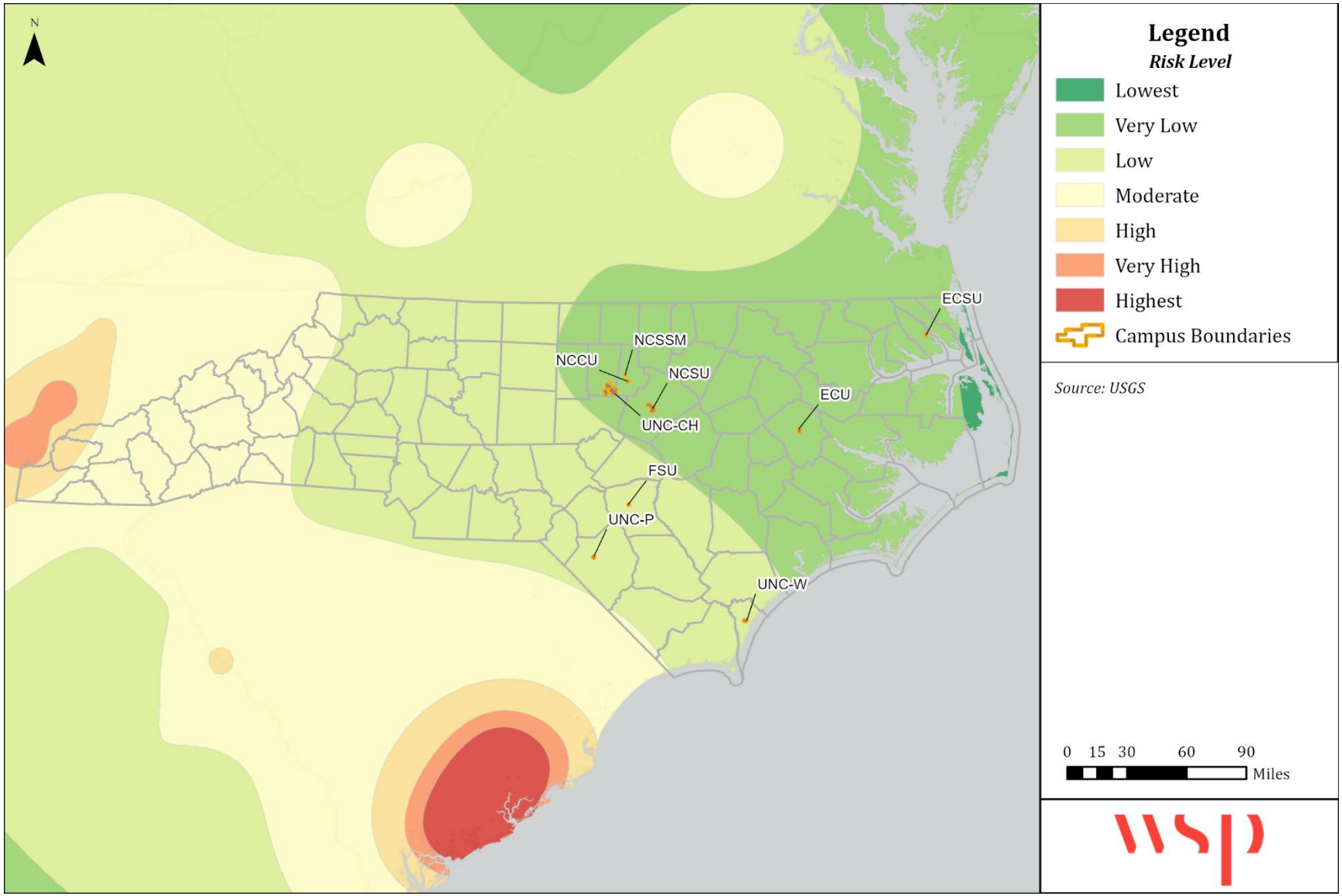
Ground motion is the movement of the earth's surface due to earthquakes or explosions. It is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source and travels through the earth and along its surface. Ground motion is amplified when surface waves of unconsolidated materials bounce off of or are refracted by adjacent solid bedrock. The probability of ground motion is depicted in USGS earthquake hazard maps by showing, by contour values, the earthquake ground motions that have a common given probability of being exceeded in 50 years.

Figure I.13 on the following page reflects the seismic hazard for New Hanover County based on the national USGS map of peak acceleration with two percent probability of exceedance in 50 years. To produce these estimates, the ground motions being considered at a given location are those from all future possible earthquake magnitudes at all possible distances from that location. The ground motion coming from a particular magnitude and distance is assigned an annual probability equal to the annual probability of occurrence of the causative magnitude and distance. The method assumes a reasonable future catalog of earthquakes, based upon historical earthquake locations and geological information on the occurrence rate of fault ruptures. When all the possible earthquakes and magnitudes have been considered, a ground motion value is determined such that the annual rate of its being exceeded has a certain value. Therefore, for the given probability of exceedance, two percent, the locations shaken more frequently will have larger ground motions.

As shown in the map below, all of New Hanover County is located within the lighter green zone which represents "low" seismic hazard risk. Based on this data, it can be reasonably assumed that an earthquake event affecting New Hanover County is unlikely.

*Probability: 1 – Unlikely*

**Figure I.13 – Seismic Hazard Information for New Hanover County**



## Vulnerability Assessment

### Methodology & Assumptions

Loss estimates reflecting modeled earthquake damages from NCEM's iRisk database were compiled for buildings on UNC-W's campus.

### People

Earthquakes would not be expected to cause a level of impact that would threaten life safety.

### Property

In a severe earthquake event, buildings can be damaged by the shaking itself or by the ground beneath them settling to a different level than it was before the earthquake (subsidence). Buildings can even sink into the ground if soil liquefaction occurs. If a structure (a building, road, etc.) is built across a fault, the ground displacement during an earthquake could seriously damage that structure.

Earthquakes can also cause damage to infrastructure, resulting in secondary hazards. Damage to dams or levees could cause failures and subsequent flooding. Fires can be started by broken gas lines and power lines. Fires can be a serious problem, especially if the water lines that feed the fire hydrants have been damaged as well. Impacts of earthquakes also include debris clean-up and service disruption. Per the iRisk analysis, a 500-year earthquake event could cause $476,414 of estimated total building damages.

New Hanover County has not been impacted by an earthquake with more than a low intensity, so major damage to the built environment is unlikely. However, there is potential for impacts to certain masonry buildings, as well as environmental damage with secondary impacts on structures. Table I.14 details the estimated buildings impacted by a 250-, 500-, and 1,000-year earthquake event.

**Table I.14 – Estimated Buildings Impacted by Earthquake Events**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **250-Year Earthquake Event** | | | |
| Administration | $1,067.58 | $756.36 | $1,823.94 |
| Educational | $6,227.24 | $3,224.26 | $9,451.50 |
| Housing | $1,855.20 | $1,817.63 | $3,672.83 |
| **Total** | **$9,150.02** | **$5,798.25** | **$14,948.27** |
| **500-Year Earthquake Event** | | | |
| Administration | $54,717.98 | $48,713.73 | $103,431.71 |
| Educational | $156,285.82 | $104,761.27 | $261,047.09 |
| Housing | $53,196.29 | $58,739.23 | $111,935.52 |
| **Total** | **$264,200.09** | **$212,214.23** | **$476,414.32** |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **1,000-Year Earthquake Event** | | | |
| Administration | $298,782.67 | $228,508.99 | $527,291.66 |
| Educational | $886,568.71 | $394,173.64 | $1,280,742.35 |
| Housing | $256,802.33 | $211,138.13 | $467,940.46 |
| **Total** | **$1,442,153.71** | **$833,820.76** | **$2,275,974.47** |

Source: NCEM iRISK Database

### Environment

An earthquake is unlikely to cause substantial impacts to the natural environment in New Hanover County. Impacts to the built environment (e.g. ruptured gas line) could damage the surrounding environment. However, this type damage is unlikely based on historical occurrences.

## Changes in Development

Building codes substantially reduce the costs of damage to future structures from earthquakes. Future construction on the UNC-W campus must follow the applicable requirements of the NC building codes, the State of North Carolina statutes for state owned buildings and zoning for the local jurisdiction.

Development changes at UNC-W have not affected the risk characteristics of earthquakes. The probability, impact, spatial extent, warning time, and duration of earthquakes have not changed.

## Problem Statement

- While earthquakes are an unlikely hazard event for the UNC-W campus, an estimated $476,414 of total building damages to main campus could occur in the case of a 500-year earthquake event.

## I.5.3 Excessive Heat

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |

### Location

The entire planning area is susceptible to high temperatures and incidents of excessive heat.

*Spatial Extent: 4 – Large*

### Extent

The extent of excessive heat can be defined by the maximum apparent temperature reached. Apparent temperature is a function of ambient air temperature and relative humidity and is reported as the heat index. The National Weather Service Forecast Office in Raleigh sets the following criteria for heat advisory and excessive heat warning:

- **Heat Advisory** – Heat Index of 105°F to 109°F for 3 hours or more. Can also be issued for lower values 100ºF to 104ºF for heat lasting several consecutive days
- **Excessive Heat Watch** – Potential for heat index values of 110°F or hotter within 24 to 48 hours. Also issued during prolonged heat waves when the heat index is near 110°F
- **Excessive Heat Warning** – Heat Index of 110°F or greater for any duration

Heat index records maintained by the North Carolina Climate Office indicate that the county regularly experiences heat index temperatures above 100°F. Counts are provided as the number of hours in a given year where the heat index reached or exceeded 100°F. According to this data, New Hanover County averages approximately 78 hours per year with heat index values at or above 100°F.

*Impact: 2 – Limited*

**Table I.15 – Historical Heat Index, Wilmington International Airport (KILM), New Hanover County, 2000-2024**

| Year | Heat Index Value (Hours) | | | | Total Hours |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2000 | 15 | 6 | 0 | 0 | 21 |
| 2001 | 53 | 5 | 0 | 0 | 58 |
| 2002 | 56 | 21 | 4 | 0 | 81 |
| 2003 | 43 | 4 | 0 | 0 | 47 |
| 2004 | 27 | 2 | 0 | 0 | 29 |
| 2005 | 56 | 19 | 4 | 1 | 80 |
| 2006 | 44 | 11 | 0 | 0 | 55 |
| 2007 | 24 | 9 | 7 | 1 | 41 |

| Year | Heat Index Value (Hours) | | | | Total Hours |
|---|---|---|---|---|---|
| | 100-104°F | 105-109°F | 110-114°F | ≥115°F | |
| 2008 | 54 | 5 | 0 | 0 | 59 |
| 2009 | 20 | 0 | 0 | 0 | 20 |
| 2010 | 77 | 23 | 1 | 0 | 101 |
| 2011 | 79 | 29 | 6 | 1 | 115 |
| 2012 | 66 | 35 | 7 | 2 | 110 |
| 2013 | 19 | 1 | 0 | 0 | 20 |
| 2014 | 44 | 0 | 0 | 0 | 44 |
| 2015 | 91 | 34 | 5 | 0 | 130 |
| 2016 | 129 | 19 | 1 | 0 | 149 |
| 2017 | 81 | 15 | 0 | 0 | 96 |
| 2018 | 35 | 10 | 0 | 0 | 45 |
| 2019 | 101 | 11 | 0 | 0 | 112 |
| 2020 | 58 | 11 | 0 | 0 | 69 |
| 2021 | 81 | 19 | 2 | 0 | 102 |
| 2022 | 111 | 21 | 3 | 0 | 135 |
| 2023 | 111 | 16 | 8 | 0 | 135 |
| 2024 | 75 | 12 | 1 | 0 | 88 |
| **Sum** | **1,550** | **338** | **49** | **5** | **1,942** |
| **Average** | **62** | **14** | **2** | **0** | **78** |

Source: North Carolina State Climate Office, Heat Index Climatology

## Historical Occurrences

According to NOAA, 2019 was North Carolina's hottest year on record; that record stretches back 123 years to 1895.

New Hanover County experienced 4 heat-related incidents according to NCEI between 2000 and 2024, which are summarized below.

- **July 21, 2011** - Excessive heat advisories and warnings were issued for the region 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** - The heat index went over 110 degrees beginning the afternoon of June 29th, continuing through the next day. The highest heat index noted was near 120 degrees. There were no reports of heat-related illnesses or fatalities.
- **July 26, 2012** - Directional flow at the surface and aloft were both from the west southwest. This contributed to heat indices above 110 degrees for several hours on both the 26th and 27th of July. There were no reports of heat-related injuries.
- **June 14, 2015** - A prolonged period of unseasonably high heat indices blanketed most of the southeastern US. Afternoon temperatures mainly between 95 and 100 combined with dewpoints in the mid-70s produced heat index values in the 105 to 110 range. The heat wave finally broke on Jun 26th with cloud cover and precipitation.

## Probability of Future Occurrence

Data was gathered from the North Carolina State Climate Office's Climate Thresholds Tool using the Wilmington International Airport (KILM). Based on 83 years of available data, Wilmington station averages 23.7 days per year with a heat index at or above 100 degrees.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Extreme heat can cause heat stroke and even loss of human life. The elderly and the very young are most at risk to the effects of heat. People who are isolated, people who work outdoors and/or do strenuous labor, people with chronic health problems such as heart disease or asthma, people who are obese, and people who are on certain medications, such as tranquilizers, antidepressants, sleeping pills, or drugs for Parkinson's disease are also more vulnerable to extreme heat.

### Property

Excessive heat is unlikely to cause significant damage to the built environment. However, road surfaces can be damaged as asphalt softens, and concrete sections may buckle under expansion caused by heat. Train rails may also distort or buckle under the stress of heat induced expansion. Power transmission lines may sag from expansion and if contact is made with vegetation the line may short out causing power outages. Additional power demand for cooling also increases power line temperature adding to heat impacts.

### Environment

Wild animals are vulnerable to heat disorders similar to humans, including mortality. Vegetation growth will be stunted, or plants may be killed if temperatures exceed their tolerance extremes.

## Changes in Development

Increases in impervious surface area can exacerbate heat conditions through the urban heat island effect, whereby the concentration of structures, infrastructure, and human activity, traps and stores heat resulting in localized "heat islands." Information is not available concerning the extent to which impervious surface coverage on campus has changed since the adoption of the previous hazard mitigation plan.

## Problem Statement

- UNC-W is located within New Hanover County which currently averages 62 hours per year with heat index temperatures of 100°F or higher, and there is a 100% annual chance of heat index values of 100°F or higher in any given year.

# I.5.4 Flooding

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Flooding | Highly Likely | Minor | Negligible | 6 to 12 hrs | Less than 1 week | 2.3 |

## Location

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). A FIRM is the official map for a community on which FEMA has delineated both the Special Flood Hazard Areas (SFHAs) and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage.

For this risk assessment, flood prone areas were identified within the UNC-W Campus using the FIRM dated August 28, 2018. Figure I.14 reflects the 2018 mapped flood insurance zones. Table I.16 summarizes some of the flood insurance zones identified by the Digital FIRM (DFIRM). Note that not all flood zones outlined in Table I.16 intersect the UNC-W campus.

While the SFHA indicates areas with a high risk of flooding, flooding can occur anywhere in the City of Wilmington and the UNC-W campus. Flood risk is not limited to the 1%-annual-chance floodplain.

Although this assessment focuses on riverine flooding, it is also important to note that localized stormwater flooding can also occur on campus and may affect areas outside the mapped floodplain. Data was not available to evaluate the location or extent of stormwater flooding on campus.

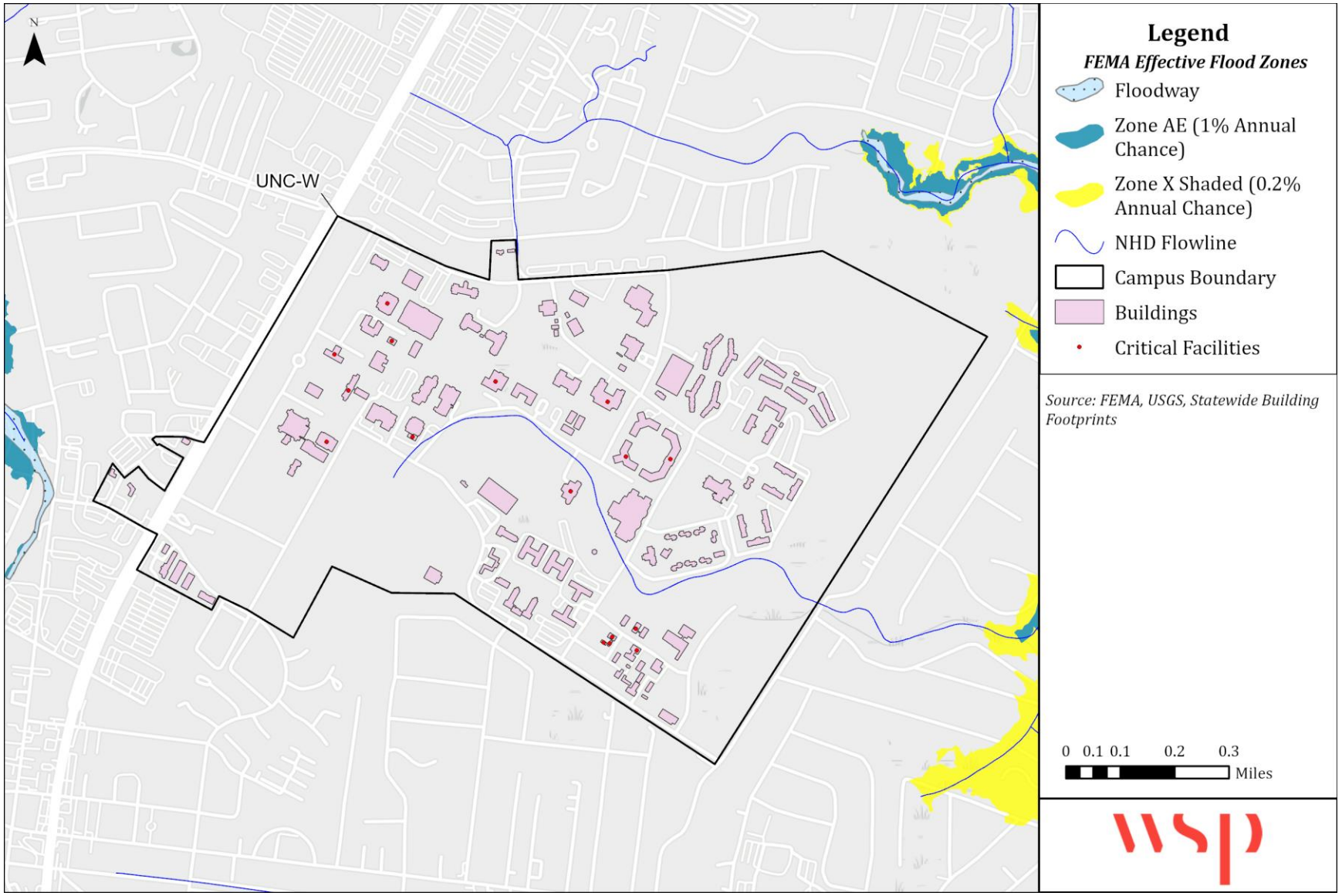
*Spatial Extent: 1 – Negligible*

**Table I.16 – Mapped Flood Insurance Zones in New Hanover County**

| Zone | Description |
|---|---|
| **A** | Zone A is the flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined in the FIS Report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. |
| **AE** | AE Zones, also within the 1% annual chance flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet. The AE Zone generally extends from the landward VE zone limit to the limits of the 1% annual chance flood from coastal sources, or until it reaches the confluence with riverine flood sources. The AE Zones also depict the SFHA due to riverine flood sources, but instead of being subdivided into separate zones of differing BFEs with possible wave effects added, they represent the flood profile determined by hydrologic and hydraulic investigations and have no wave effects. |
| **AH** | Zone AH is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 |

| Zone | Description |
|---|---|
| | and 3 feet. Whole-foot Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. |
| **AO** | Zone AO is the flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone. |
| **0.2% Annual Chance (Shaded Zone X)** | Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.) |
| **Zone X (Unshaded)** | Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. Zone X (unshaded) is used on new and revised maps in place of Zone C. |

**Figure I.14 – FEMA Flood Hazard Areas in UNC-W's Campus Boundary**



## Extent

Flood extent can be defined by the amount of land in the floodplain and the potential magnitude of flooding as measured by flood depth and velocity. FEMA Flood Insurance Studies (FIS) define the probability of flooding by flood events of a magnitude which are expected to be equaled or exceeded once on average during a specific time period, or recurrence interval.

As shown in Figure I.14 the SFHA does not intersect with the UNC-W campus. Table I.17 provides a summary of the UNC-P Campus' total area by flood zone on the 2018 effective DFIRM. While the campus is not exposed to the SFHA, flooding may occur on campus when intense rainfall cannot be carried away by natural or urban drainage systems as fast as it is falling.

Flood damage is closely related to depth, with greater flood depths generally resulting in more damage. Figure I.15 shows the depth of flooding predicted from a 1% annual chance flood, however, as the campus does not intersect the SFHA, flood depths are shown just outside of the campus boundary.

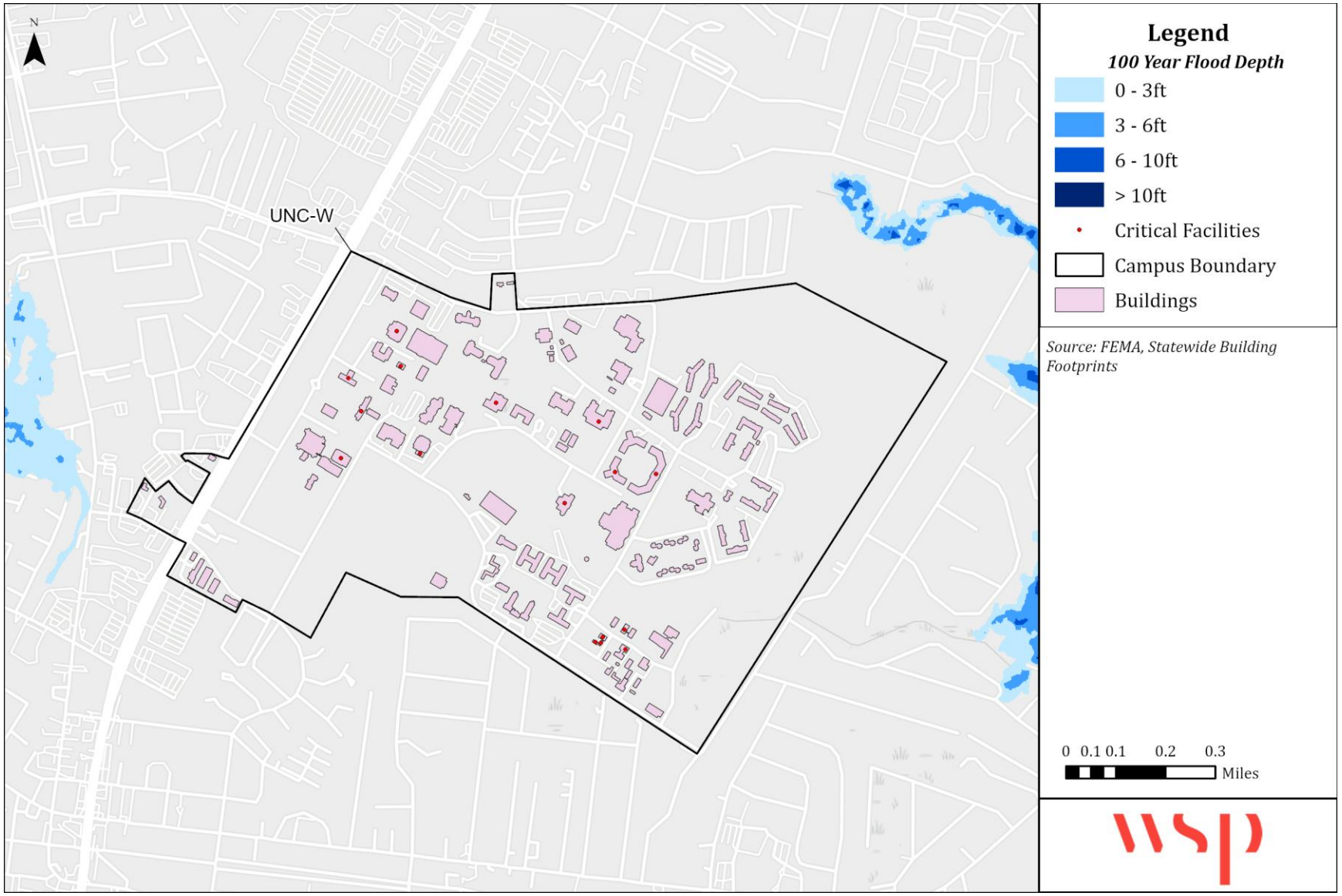
*Impact: 1 – Minor*

**Table I.17 – Flood Zone Acreage on UNC-W Campus**

| Flood Zone | Acreage | Percent of Total (%) |
|---|---|---|
| Unshaded X | 579.7 | 100% |
| **Total** | **579.7** | **100%** |
| **SFHA Total** | **0.0** | **0.0%** |

Source: FEMA 2018 DFIRM

**Figure I.15 – Flood Depth, 1-Percent-Annual-Chance Flood, UNC-W Campus**



## Historical Occurrences

Table I.18 details the historical occurrences of flooding for Wilmington and New Hanover County identified from 2000 through 2024 by NCEI Storm Events database. According to NCEI, 74 recorded flood-related events occurred on 55 separate days in Wilmington and New Hanover County from 2000 to 2024 causing an estimated $3,014,000 in property damage, with three injuries and no fatalities or crop damage. Additional property and crop damages likely occurred but wasn't recorded.

It should be noted that only those historical occurrences listed in the NCEI database are shown here and that other unrecorded or unreported events may have occurred within the planning area during this timeframe. It is also important to note that many of the events attributed to the county are countywide or cover large portions of the county.

**Table I.18 – NCEI Records of Flooding, 2000-2024**

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| **Flash Flood** | | | | |
| Wilmington | 3/20/2001 | 0/0 | $50,000 | $0 |
| Wilmington | 8/14/2001 | 0/0 | $0 | $0 |
| Wilmington | 8/31/2006 | 0/0 | $0 | $0 |
| Wilmington | 7/6/2009* | 0/0 | $0 | $0 |
| East Wilmington | 9/27/2010 | 0/0 | $250,000 | $0 |
| East Wilmington/Wilmington | 9/29/2010* | 0/0 | $700,000 | $0 |
| East Wilmington | 10/5/2015 | 0/0 | $50,000 | $0 |
| Wilmington | 9/2/2016* | 0/0 | $0 | $0 |
| Wilmington | 10/8/2016 | 0/0 | $50,000 | $0 |
| Wilmington | 9/14/2018 | 0/0 | $250,000 | $0 |
| Wilmington | 7/3/2019* | 0/0 | $0 | $0 |
| East Wilmington | 9/6/2019 | 0/0 | $0 | $0 |
| Wilmington | 9/22/2021 | 0/0 | $0 | $0 |
| **Flood** | | | | |
| Wilmington | 7/2/2001 | 0/1 | $0 | $0 |
| Wilmington | 9/1/2002 | 0/0 | $0 | $0 |
| Wilmington | 9/15/2002 | 0/0 | $0 | $0 |
| Wilmington | 8/19/2010 | 0/0 | $1,000 | $0 |
| Wilmington | 9/30/2010 | 0/0 | $0 | $0 |
| East Wilmington | 6/29/2011 | 0/0 | $0 | $0 |
| Wilmington/South Wilmington | 9/26/2011* | 0/0 | $0 | $0 |
| Wilmington | 6/27/2013 | 0/0 | $0 | $0 |
| South Wilmington | 7/12/2013 | 0/0 | $0 | $0 |
| Wilmington | 9/12/2014 | 0/0 | $0 | $0 |
| Wilmington | 12/24/2014 | 0/0 | $0 | $0 |
| Wilmington | 6/9/2015 | 0/0 | $0 | $0 |
| Wilmington | 7/23/2015* | 0/0 | $0 | $0 |

| Location | Date | Deaths/Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|
| East Wilmington | 7/31/2015* | 0/0 | $0 | $0 |
| East Wilmington | 8/25/2015 | 0/0 | $0 | $0 |
| (Ilm)Wilmington Arpt | 10/2/2015 | 0/0 | $0 | $0 |
| East Wilmington | 5/19/2018 | 0/0 | $0 | $0 |
| **Heavy Rain** | | | | |
| Wilmington | 9/18/2000 | 0/2 | $5,000 | $0 |
| Wilmington | 7/15/2002 | 0/0 | $0 | $0 |
| Wilmington | 8/29/2002 | 0/0 | $0 | $0 |
| Wilmington | 8/30/2002 | 0/0 | $0 | $0 |
| Wilmington | 8/31/2002 | 0/0 | $0 | $0 |
| Wilmington | 7/29/2004 | 0/0 | $0 | $0 |
| Wilmington | 8/15/2004 | 0/0 | $0 | $0 |
| Wilmington | 9/1/2004* | 0/0 | $0 | $0 |
| Wilmington | 9/10/2004 | 0/0 | $0 | $0 |
| Wilmington | 9/14/2004 | 0/0 | $0 | $0 |
| Wilmington | 7/13/2005 | 0/0 | $0 | $0 |
| Wilmington | 8/23/2005* | 0/0 | $0 | $0 |
| Wilmington | 10/7/2005 | 0/0 | $1,500,000 | $0 |
| Wilmington | 11/21/2005 | 0/0 | $1,000 | $0 |
| Wilmington | 8/27/2007 | 0/0 | $0 | $0 |
| Wilmington | 5/11/2008 | 0/0 | $0 | $0 |
| Wilmington | 6/22/2008* | 0/0 | $0 | $0 |
| Wilmington | 9/25/2008 | 0/0 | $0 | $0 |
| Wilmington | 9/22/2009 | 0/0 | $5,000 | $0 |
| Wilmington | 12/2/2009* | 0/0 | $0 | $0 |
| Wilmington | 9/27/2010 | 0/0 | $150,000 | $0 |
| Wilmington | 8/1/2012 | 0/0 | $0 | $0 |
| Wilmington | 4/12/2013 | 0/0 | $0 | $0 |
| Wilmington | 8/22/2013 | 0/0 | $2,000 | $0 |
| South Wilmington | 4/26/2023 | 0/0 | $0 | $0 |
| **Total** | | **0/3** | **$3,014,000** | **$0** |

Source: NCEI Storm Events Database

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of flood events on the county:

- **September 18, 2000** – Two accidents occurred due to the heavy rain on the Cape Fear Memorial Bridge. Minor injuries were reported.
- **August 29, 2002** – Heavy rain on already saturated soil caused street flooding over much of Wilmington. Old Mill road was under 4 feet of water, with scattered flooding reported in North Chase and other subdivisions north of Market Street. Burnt Mill Creek breached its banks and flooded a large part of Mary Bridge Park off Princess Place Drive.
- **November 21, 2005** – Rainfall amounts of three to four inches produced street flooding in Wilmington and Carolina Beach. Market Street had flooding between College Road and

Gorden Road. Many businesses had standing water in their parking lots, with one business sustaining minor water damage. In Carolina Beach, moderate street flooding was observed, with a section of Lake Park Boulevard closed.

- **September 27, 2010** - A nearly stationary upper low over northern Alabama, combined with a plume of tropical moisture, produced record rainfall over portions of Brunswick and New Hanover Counties. The Wilmington NC airport (ILM) received 10.33 inches of rainfall on the 27th, the second highest daily precipitation total since recordings began back in 1871. Brunswick County declared a state of emergency, with many roads impassable.
- **September 29, 2010** - A nearly continuous feed of tropical moisture, combined with a series of upper level low pressure systems, produced record rainfall over the region. Many areas received over 20 inches of rainfall over a four-day period. Rainfall accumulations led to significant flooding that included the closure of dozens of roadways. Many low-lying bridges were overtopped and swift waters led to numerous road scours and closings. The impacts of the rain were greatest in the Cape Fear region. In New Hanover County, there were 137 homes impacted, and 34 buildings at the University of North Carolina at Wilmington sustained water damage.
- **October 10, 2015** – A deep amplitude east coast upper trough closed off across the southeast states for several days while a surface front meandered across the area. Deep moisture from the Gulf of Mexico and Atlantic Ocean continued to feed into the area. Tropical moisture from the periphery of Hurricane Joaquin, well off the coast, helped to boost precipitable water values to near record levels. Rainfall amounts averaged 5 to 15 inches across the area during the event. Isolated spots received near 20 inches. This produced rare flash flooding. Coastal flooding was significant during the time of high tide. Widespread river flooding followed. There were more than a hundred evacuations due to flooding, but no reports of death or injury. There was significant damage to structures to include homes and businesses and infrastructure such as roads as well as personal property. There were reports of overtopped levees and earthen dams. Monetary losses were estimated to be several hundred thousand dollars.
- **September 14, 2018** - Flash flooding occurred in the area of Oleander Dr and S College Rd. Flooding on New Center Drive. NWS employee reported significant flooding on Kerr Ave. Flooding was reported on Gordon Rd at the I-40 overpass. There was a road failure on Shire Lane. High water was reported on Castle Hayne Road.
- **July 3, 2019** – Strong instability, combined with low pressure and a thermal trough, produced a variety of severe weather over southeast North Carolina. Water was flowing two feet deep on Water St and Queen St. Water was up to the hoods of cars at the intersection of Castle and 14th Street.
- **April 26, 2023** – An upper level disturbance brought locally heavy rain to the Cape Fear Region. Water up to 6 inches deep was observed near 17th and College Road. Estimates and several COCORAHS observations of 3 inches of rain were received.

The state of North Carolina has had five FEMA Major Disaster Declarations for severe storms that include elements of flooding in 1998, 2010, 2011, 2020, in addition to 25 Major Disaster Declarations for Hurricanes, Tropical Storms, and Flood declared between 1954 - 2024 which

have also included damages associated with flooding. New Hanover County has received two FEMA Major Disaster Declaration for a severe storm that included elements of flooding in 2008 and 2010 along with 13 Major Disaster Declarations for Hurricanes and Tropical in 1984, 1996, 1998, 1999, 2003, 2005, 2011, 2016, 2018, 2019, 2020, and 2024 which also may have included damages associated with flooding.

## Probability of Future Occurrence

By definition, SFHAs are those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 500-year flood area is defined as those areas that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year; it is not the flood that will occur once every 500 years.

The UNC-W campus does not have any land area in FEMA-mapped flood hazard areas. The SFHA is a useful way to identify the most at-risk areas, but the City of Wilmington and the UNC-W campus are at risk of other types and magnitudes of flooding such as stormwater and localized floods that occur outside of the SFHA and with varying probabilities.

Floods of varying severity occur regularly in Wilmington, and impacts from past flood events have been noted by NCEI. NCEI reports 74 flood-related events in the 24-year period from 2000-2024, which equates to an annual probability greater than 100% for Wilmington alone. Therefore, the overall probability of flooding is considered highly likely.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### Methodology & Assumptions

To quantify vulnerability, WSP performed a GIS spatial analysis of the flood hazard by overlaying the depth raster for the SFHA on the building inventory. For the UNC-W campus, there are no structures located within the SFHA.

### People

Flood events pose many threats to public health and safety. While such problems are often not reported, three general types of health hazards accompany floods: physical hazards from the water itself, environmental hazards in the aftermath of the flood, and long-term psychological hazards. These common health and safety hazards are detailed below:

- **Contaminated water:** Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or where their wastes are stored can contribute polluted waters to the receiving streams. Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines, or wastewater treatment plants may be

flooded or over loaded. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as E.coli and other disease causing agents. Private sewer and septic systems may also introduce pollutants into floodwaters. Private wells may become contaminated through infiltration of polluted water. Given the many potential sources of contamination, direct or indirect contact with floodwaters poses a significant health risk for contraction of infectious disease.

- **Debris:** During a flood, debris carried by floodwaters can cause physical injury from impact. During the recovery process, people may often need to clear debris out of their properties but may encounter dangers such as sharp materials or rusty nails that pose a risk of tetanus.
- **Unsafe food:** If floodwaters come into contact with food items, that food may no longer be safe for consumption due to the potential contaminants in the floodwaters. Foods stored in cardboard, plastic bags, jars, bottles, and paper packaging may all be subject to contamination. Even if foods don't come into direct contact with floodwaters, the introduction of mold and mildew from flooding may cause foods to spoil faster. Additionally, power outages may cause refrigerated and frozen foods to spoil.
- **Mosquitos and animals:** After most of the water has receded, stagnant pools can become breeding grounds for mosquitoes, which may carry infectious diseases such as West Nile virus or St. Louis encephalitis. Wild animals such as snakes or rodents may carried by floodwaters or lose their habitat and seek shelter in buildings. Snakes may also be swimming in floodwaters seeking higher ground. People may be at risk for bites or disease if they come in contact with these animals or animal carcasses.
- **Mold and mildew:** Areas of a building that were exposed to excessive moisture can breed mold and mildew. Molds can start to grow in only 24 to 48 hours and will continue to grow without steps to dry out and disinfect the affected surface. Some molds are allergens, while others can produce harmful mycotoxins. Exposure to mold can cause respiratory problems; nasal and sinus congestion; eye, nose, and throat irritation; aches and pains; and effects on the nervous system. Infants, children, immunocompromised individuals, elderly adults, pregnant women, and individuals with respiratory conditions are all at higher risk.
- **Reentering a flooded building:** Health hazards may occur when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the public water systems lose pressure, public water supplies may be contaminated, and a boil order may be issued to protect people and animals from contaminated water.
- **Mental stress:** Long-term psychological impacts can result after having been through a flood and seeing one's home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home can also put a severe strain on people, especially individuals who were unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on

floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Floods can also result in fatalities. Individuals face high risk when driving through flooded streets. However, NCEI does not contain any records of deaths in the City of Wilmington caused by flood events.

### Property

Administration buildings, education and/or extracurricular facilities, housing, as well as critical facilities and infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters.

No campus structures or critical facilities identified for UNC-W are located within the 1%-annual-chance floodplain, therefore there are no estimated damages.

Damage to infrastructure may cause drainage-related sinkholes on or around UNC-W campus. However, such events are typically minor.

### Environment

During a flood event, chemicals and other hazardous materials may end up contaminating local water bodies. Flooding kills animals and in general disrupts the ecosystem. Snakes and insects may also make their way to the flooded areas.

Floods can also cause significant erosion, which can alter streambanks and deposit sediment, changing the flow of streams and rivers and potentially reducing the drainage capacity of those waterbodies.

## Changes in Development

The likelihood of future flood damage can be reduced through appropriate land use planning, building siting and building design. In addition, the UNC-W Facilities Management works to maintain compliance with all applicable state and federal regulations regarding water resources, provides a regulatory framework to ensure development has minimal impact on the environment, and manages the stormwater infrastructure.

## Problem Statement

- None of the UNC-W Campus falls within the SFHA. However, flooding may also occur on the campus when an intense rainfall occurs within the urban area and cannot be carried away by natural or urban drainage systems as fast as it is falling.
- Tropical Storm Nicole caused flood damage at 34 UNC-W buildings. These buildings may be vulnerable to repeat flooding without mitigation.

## I.5.5 Hurricanes & Coastal Hazards

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hurricanes & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |

### Location

While coastal areas are most vulnerable to hurricanes, the wind and rain impacts of these storms can be felt hundreds of miles inland. Hurricanes and tropical storms can occur anywhere within New Hanover County.

Storm surges are limited to the coastal areas. Due to its proximity to the coast, UNC-W could potentially be impacted by the storm surge of a Category 5 hurricane. Figure I.16 through Figure I.20 below show the different storm surge extents for hurricane categories 1-5 at UNC-W. Over 10% of the campus could be inundated during a Category 5 storm surge event. Additionally, hurricane winds can impact the entire campus, so the spatial extent was determined to be large.

*Spatial Extent: 4 – Large*

### Extent

Hurricane intensity is classified by the Saffir-Simpson Scale (Figure I.21), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

### Table I.19 – Saffir-Simpson Scale

| Category | Maximum Sustained Wind Speed (MPH) | Types of Damage |
|---|---|---|
| 1 | 74–95 | Very dangerous winds will produce some damage; Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96–110 | Extremely dangerous winds will cause extensive damage; Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. |
| 3 | 111–129 | Devastating damage will occur; Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 | 130–156 | Catastrophic damage will occur; Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 | 157 + | Catastrophic damage will occur; A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

Source: National Hurricane Center

**Figure I.16 – Category 1 Storm Surge Inundation Areas, UNC-W**

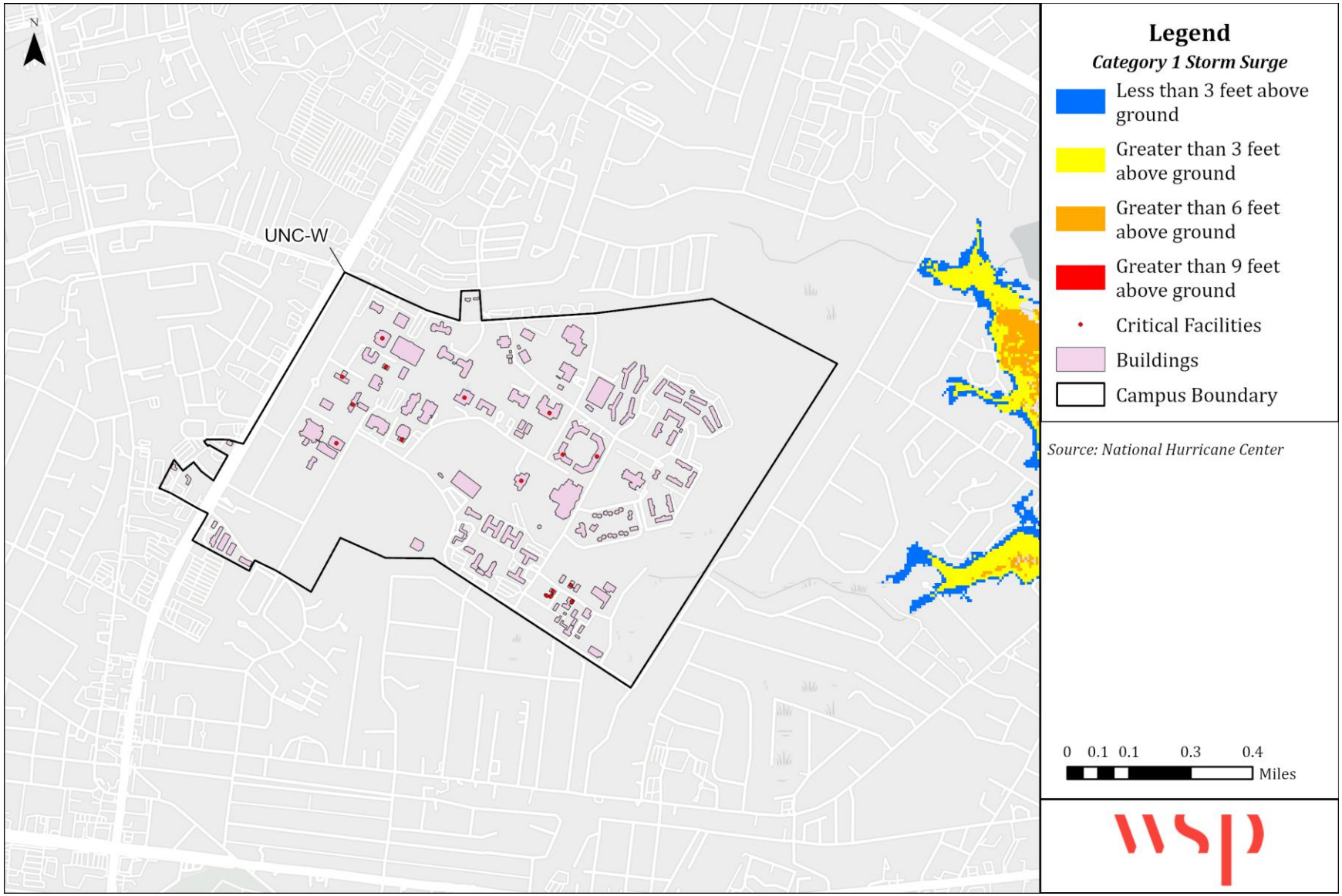


**Figure I.17 – Category 2 Storm Surge Inundation Areas, UNC-W**

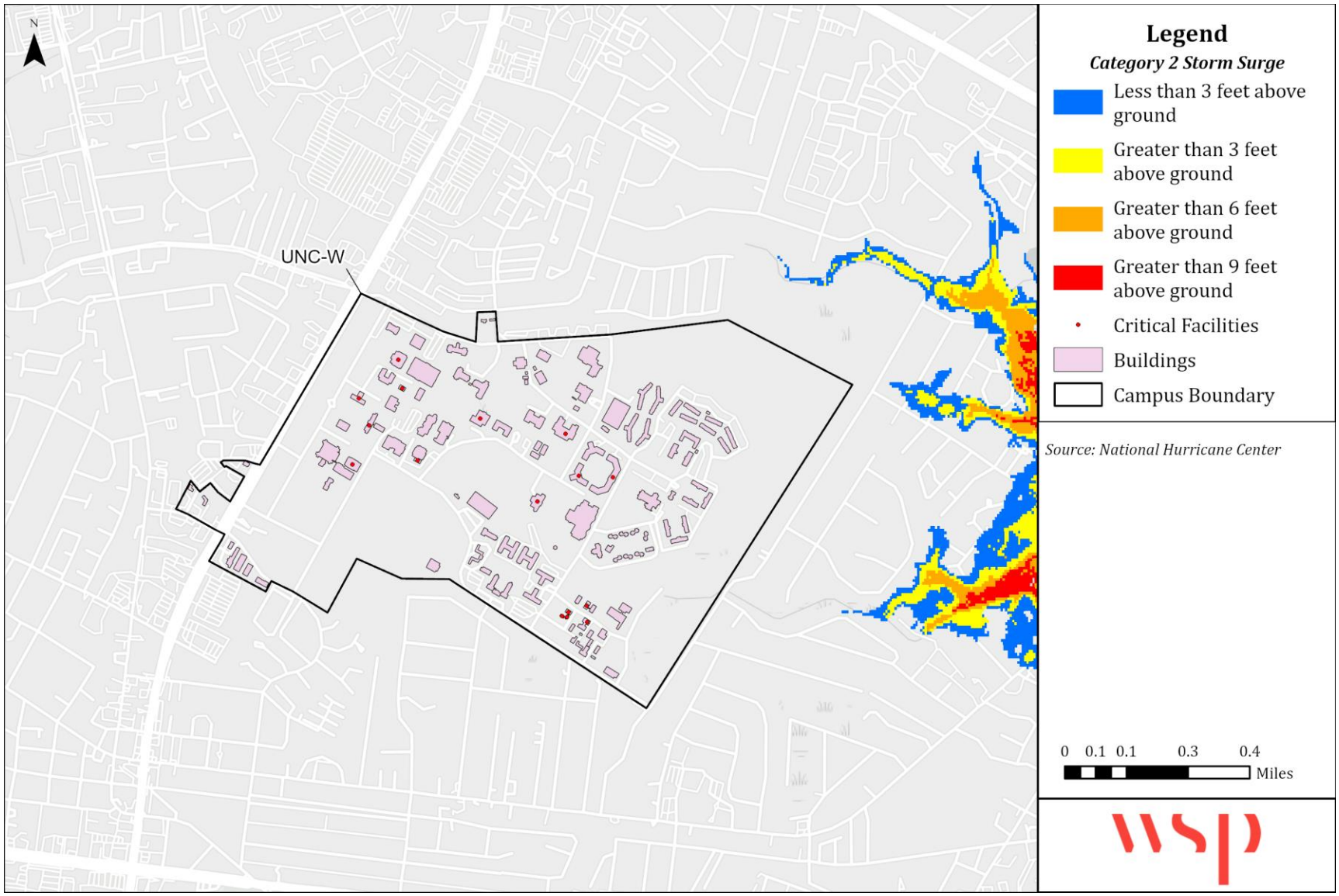


**Figure I.18 – Category 3 Storm Surge Inundation Areas, UNC-W**

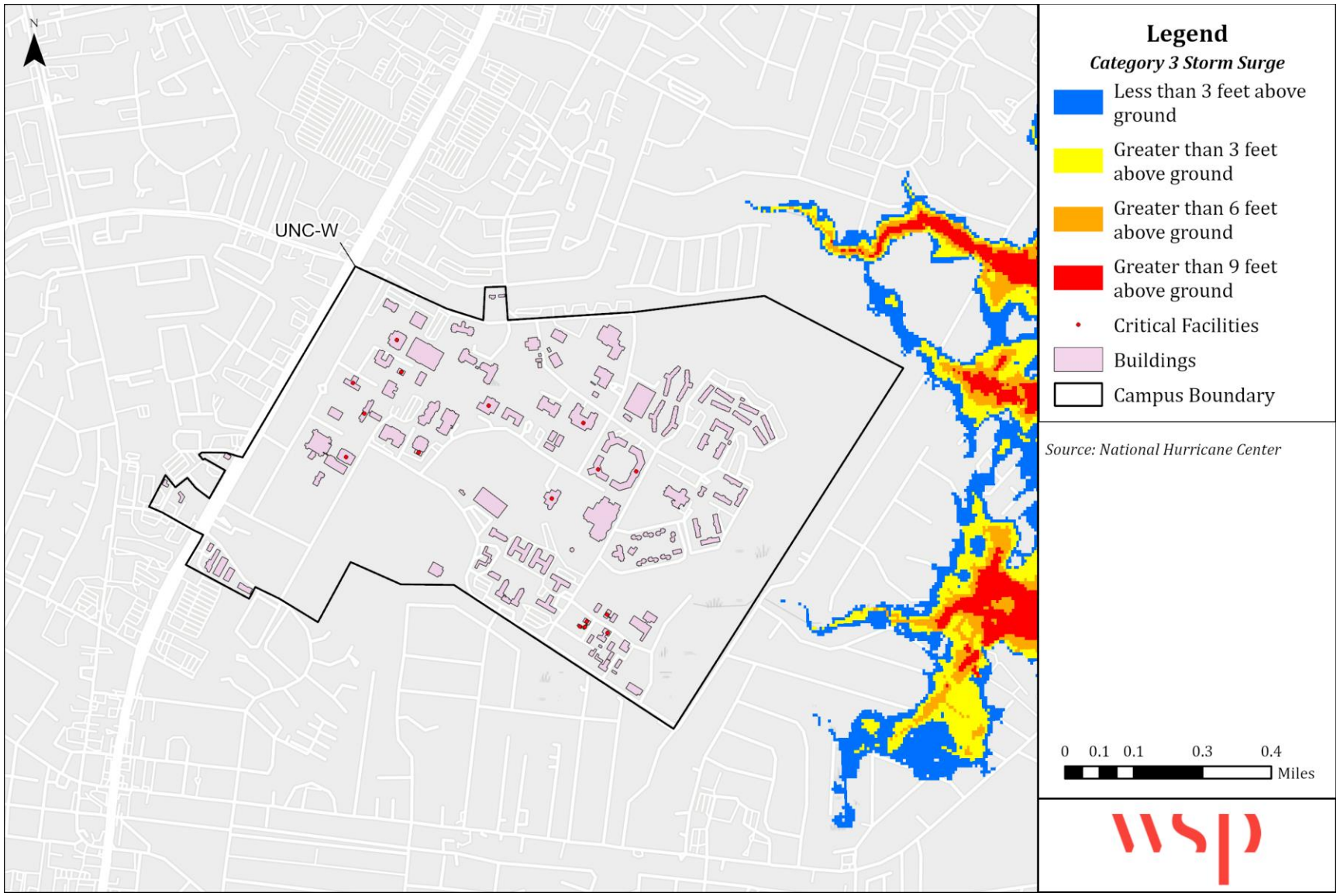


**Figure I.19 – Category 4 Storm Surge Inundation Areas, UNC-W**

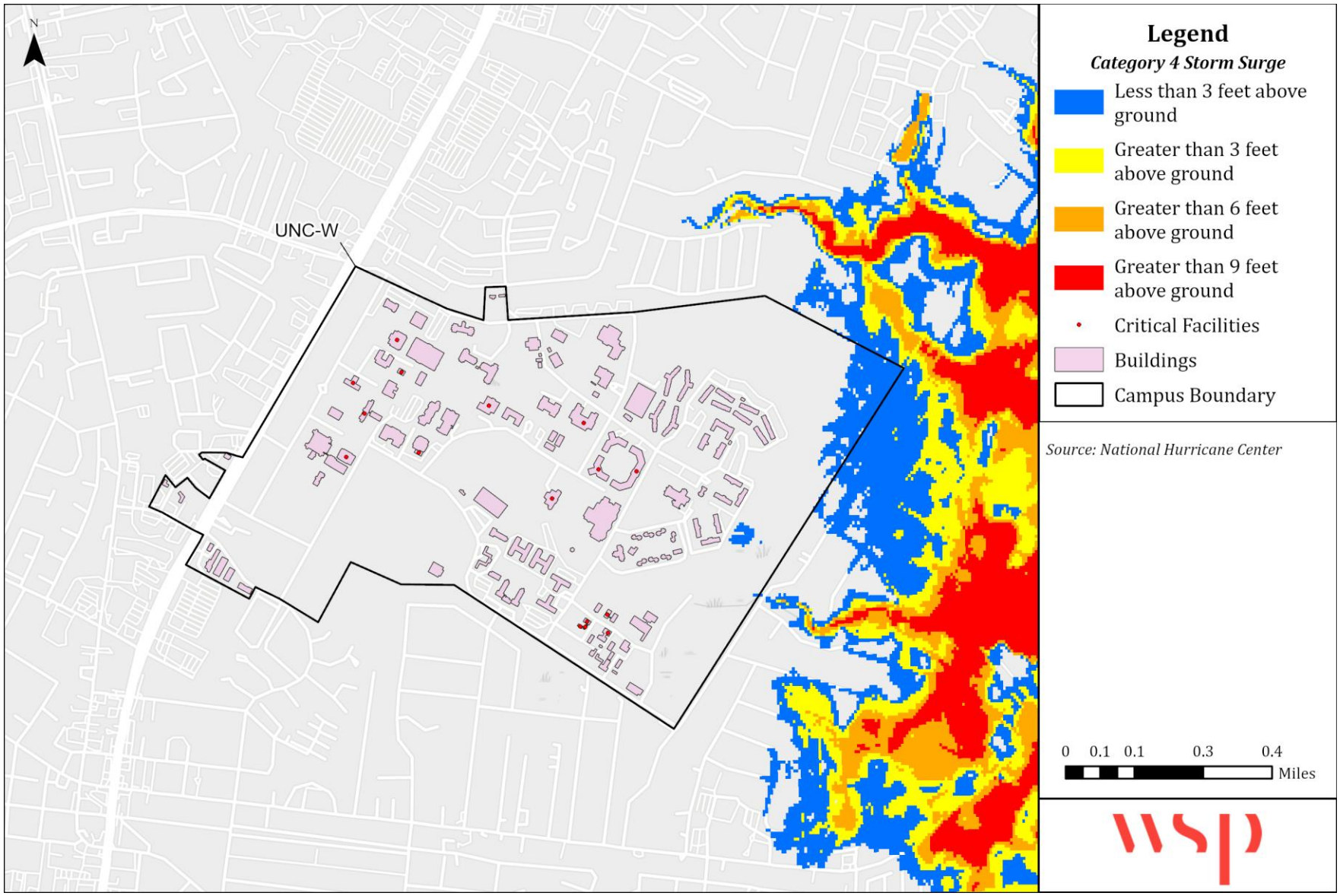
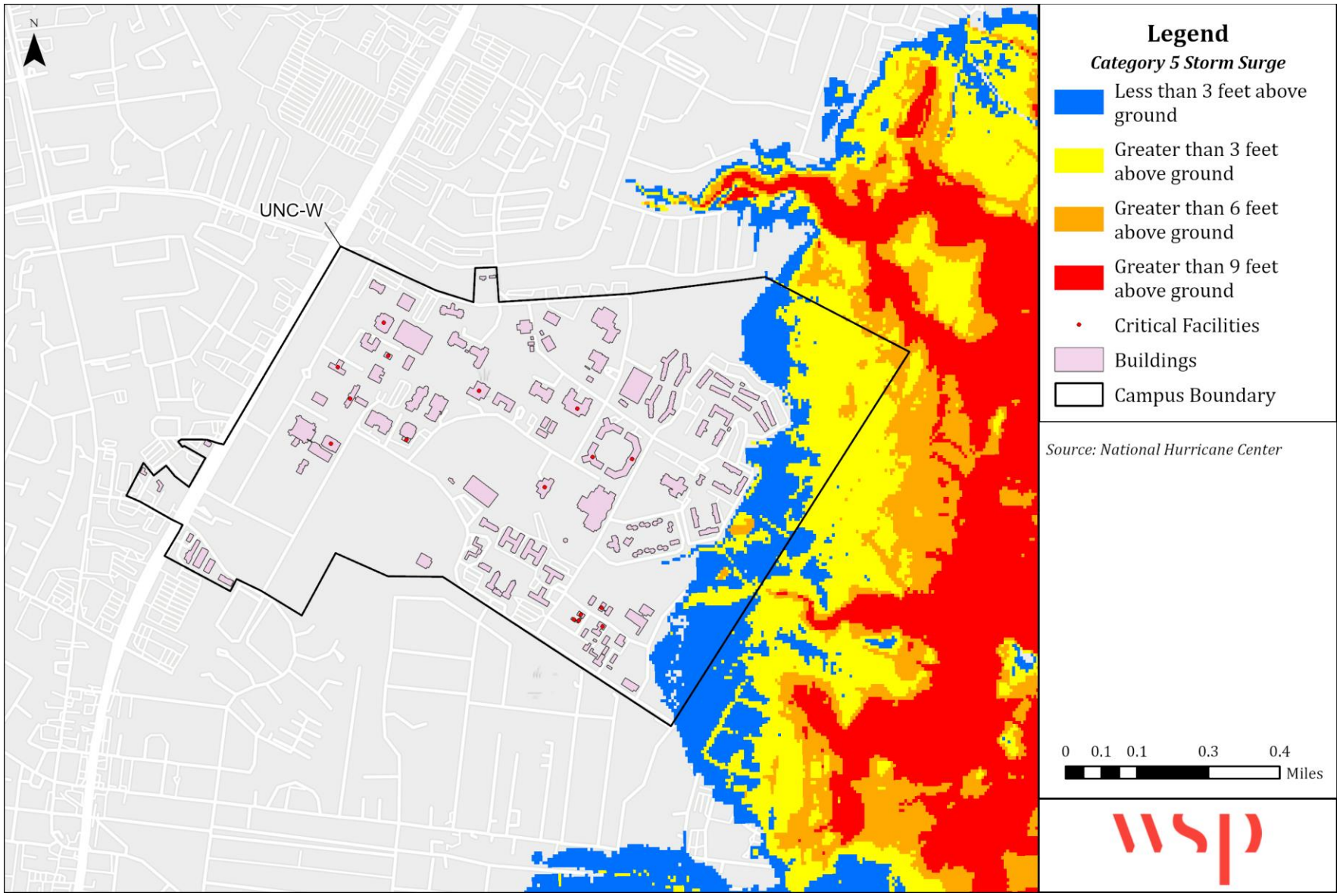


**Figure I.20 – Category 5 Storm Surge Inundation Areas, UNC-W**



The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds and barometric pressure, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as “major” hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. Table I.20 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

**Table I.20 – Hurricane Damage Classifications**

| Storm Category | Damage Level | Description of Damages | Photo Example |
|---|---|---|---|
| **1** | MINIMAL | No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. |  |
| **2** | MODERATE | Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. |  |
| **3** | EXTENSIVE | Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. |  |
| **4** | EXTREME | More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. |  |
| **5** | CATASTROPHIC | Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. |  |

Source: National Hurricane Center; Federal Emergency Management Agency

New Hanover County may experience any category of hurricane force winds. Hurricane Bertha passed within 5 miles of UNC-W’s campus as a Category 2 storm with wind speeds around 104 mph in 1996. Hurricane Florence also passed within 5 miles of UNC-W’s campus as a Category 1 storm with wind speeds around 92 mph in 2018.

*Impact: 4 – Catastrophic*

## Historical Occurrences

According to NCEI, there were 27 recorded hurricane-related events caused by 12 different individual hurricanes, tropical storms, or tropical depressions that affected New Hanover County from 2000 to 2024 causing an estimated $1 billion in property damage. There were no fatalities

and only one injury recorded for any of these events. Additionally, according to the university's records, UNC-W sustained $23,187.82 in damage from Hurricane Matthew in 2016. Note that NCEI records may be incomplete due to limitations in reporting. Table I.21 details these storm events.

**Table I.21 – Hurricane and Tropical Storm Events for New Hanover County, 2000-2024**

| Date | Type | Storm | Deaths/ Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| 8/26/2011 | Tropical Storm | Hurricane Irene | 0/0 | $3,000,000 | $0 |
| 10/27/2012 | Tropical Storm | Hurricane Sandy | 0/0 | $0 | $0 |
| 6/7/2013 | Tropical Storm | Tropical Storm Andrea | 0/0 | $0 | $0 |
| 7/3/2014 | Tropical Storm | Hurricane Arthur | 0/0 | $0 | $0 |
| 5/9/2015 | Tropical Storm | Tropical Storm Ana | 0/0 | $0 | $0 |
| 9/2/2016 | Tropical Storm | Hurricane Hermine | 0/0 | $25,000 | $0 |
| 10/8/2016 | Hurricane | Hurricane Matthew | 0/0 | $0 | $0 |
| 9/14/2018 | Hurricane | Hurricane Florence | 0/1 | $1,000,000,000 | $0 |
| 7/8/2021 | Tropical Storm | Tropical Storm Elsa | 0/0 | $0 | $0 |
| 7/2/2022 | Tropical Storm | Tropical Storm Colin | 0/0 | $0 | $0 |
| 9/30/2022 | Tropical Storm | Hurricane Ian | 0/0 | $0 | $0 |
| 9/22/2023 | Tropical Depression | Tropical Storm Ophelia | 0/0 | $20,000 | $0 |
| **Total** | | | **0/1** | **$1,003,048,000** | **$0** |

Source: NCEI

The following event narratives are provided in the NCEI Storm Events Database and illustrate the impacts of hurricane and tropical storm events on the county:

**Tropical Storm Ana (2015)** – Slow moving Tropical Storm Ana produced tropical storm force winds with torrential rain for two days along the coast. The peak wind in the county was 46 mph at Johnny Mercer Pier with numerous reports over 34 mph. Rainfall amounts were around four inches county wide. Minor beach erosion was observed.

**Hurricane Matthew (2016)** – Hurricane Matthew moved up the eastern seaboard, bringing very heavy rain and strong winds. Rainfall ranged from three to six inches. A peak wind of 70 mph was reported at the Wilmington airport, with a suspect report of 82 mph recorded at Federal Point. Many roads became flooded due to the heavy rain. The downtown Wilmington gauge along the lower Cape Fear River peaked at 8.21 feet, eclipsing the old record of 8.15 feet set in 1954 by Hurricane Hazel. These levels led to flooding in portions of Carolina Beach. Moderate ocean over wash was observed along the immediate coast due to the storm surge.

**Hurricane Florence (2018)** – A large tree fell through the roof of a home at Nantucket Pointe. There was significant damage to the house. Multiple large trees in the road in Murrayville, with power lines down as well. A Scotchman gas station on 23rd had a pump station knocked down

with awning damage. Multiple trees down on Independence Rd and River Rd. Large trees were reported down throughout the town of Wilmington and Hampstead. A 105 mph was recorded at Wilmington International Airport. A structural fire due to storm damage on Bay Blossom Rd. An injury occurred when a tree fell on a house on Mercer Ave.

**Hurricane Ian (2022)** – Frequent wind gusts of 40 to 60 mph resulted in scattered to numerous trees and power lines down across New Hanover County. Rainfall amounts averaged three to four inches. Ian resulted in a variety of impacts across southeast North Carolina from strong winds to storm surges and an isolated tornado.

According to the NOAA Historical Hurricane Tracks dataset, 39 hurricanes, tropical storms, and tropical depressions passed within 25 miles of UNC-W since 1900. These events are listed in Table I.22, and storm tracks are mapped in Figure I.21.

**Table I.22 – Hurricane Tracks within 25 Miles of UNC-W, 1900-2024**

| Date | Storm Name | Storm Category |
|---|---|---|
| 7/12/1901 | Unnamed | Tropical Storm |
| 9/18/1901 | Unnamed | Tropical Storm |
| 6/29/1907 | Unnamed | Tropical Storm |
| 7/31/1908 | Unnamed | Category 1 |
| 10/20/1910 | Unnamed | Tropical Storm |
| 9/6/1916 | Unnamed | Tropical Storm |
| 9/17/1924 | Unnamed | Tropical Storm |
| 8/1/1944 | Unnamed | Category 1 |
| 7/6/1946 | Unnamed | Tropical Storm |
| 9/13/1949 | Unnamed | Tropical Storm |
| 8/17/1955 | Diane | Tropical Storm |
| 10/17/1956 | Unnamed | Tropical Storm |
| 7/29/1960 | Brenda | Tropical Storm |
| 9/12/1960 | Donna | Category 2 |
| 9/14/1961 | Unnamed | Tropical Storm |
| 9/13/1964 | Dora | Tropical Storm |
| 6/18/1967 | Unnamed | Tropical Storm |
| 6/12/1968 | Abby | Tropical Depression |
| 7/12/1972 | Unnamed | Tropical Depression |
| 8/20/1981 | Dennis | Tropical Storm |
| 6/19/1982 | Unnamed | Tropical Storm |
| 9/11/1984 | Diana | Category 4 |
| 11/22/1985 | Kate | Tropical Storm |
| 8/8/1987 | Arlene | Tropical Depression |
| 6/6/1995 | Allison | Tropical Storm |
| 7/12/1996 | Bertha | Category 2 |
| 9/6/1996 | Fran | Category 3 |
| 8/26/1998 | Bonnie | Category 3 |
| 9/16/1999 | Floyd | Category 2 |
| 6/14/2001 | Allison | Tropical Depression |
| 10/11/2002 | Kyle | Tropical Storm |
| 8/14/2004 | Charley | Category 1 |

| Date | Storm Name | Storm Category |
|---|---|---|
| 8/13/2004 | Bonnie | Tropical Depression |
| 9/1/2006 | Ernesto | Tropical Storm |
| 6/3/2007 | Barry | Tropical Storm |
| 5/30/2012 | Beryl | Tropical Storm |
| 9/3/2016 | Hermine | Tropical Storm |
| 8/29/2017 | Unnamed | Tropical Storm |
| 9/14/2018 | Florence | Category 2 |

Source: NOAA/National Hurricane Center, October 2025

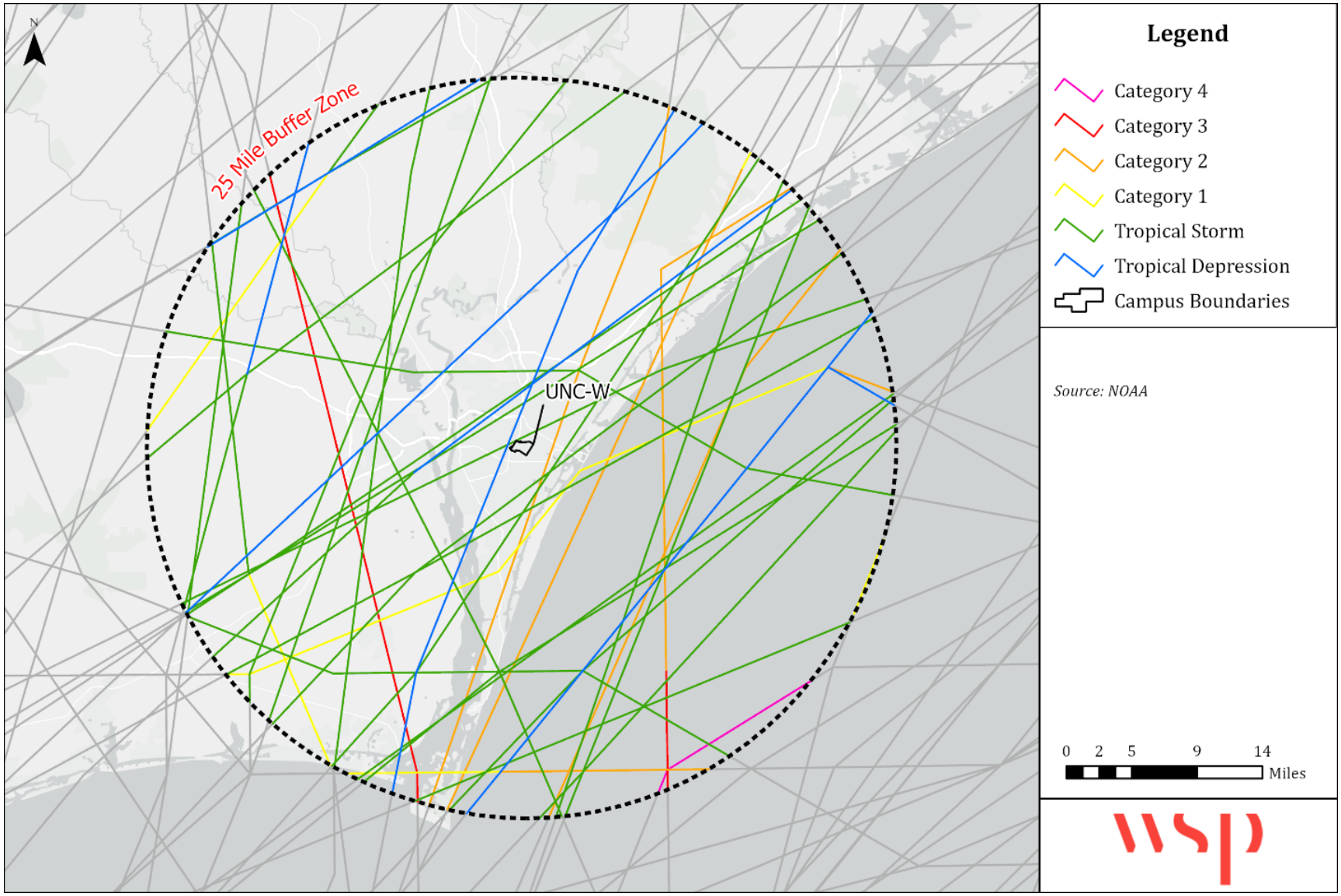
New Hanover County has received 13 major disasters and 13 emergency declarations for Hurricane and Tropical Storm events summarized in Table I.23.

**Table I.23 – Hurricane Related Disaster Declarations & Emergency Declarations for New Hanover County**

| Date | Disaster ID | Event Name |
|---|---|---|
| 9/21/1984 | DR-724-NC | Hurricane Diana |
| 7/18/1996 | DR-1127-NC | Hurricane Bertha |
| 9/6/1996 | DR-1134-NC | Hurricane Fran |
| 8/27/1998 | DR-1240-NC | Hurricane Bonnie |
| 9/1/1999 | EM-3141-NC | Hurricane Dennis |
| 9/15/1999 | EM-3146-NC & DR-1292-NC | Hurricane Floyd |
| 9/18/2003 | DR-1490-NC | Hurricane Isabel |
| 9/5/2005 | EM-3222-NC | Hurricane Katrina Evacuation |
| 9/14/2005 | EM-3254-NC & DR-1608-NC | Hurricane Ophelia |
| 9/1/2010 | EM-3314-NC | Hurricane Earl |
| 8/25/2011 | EM-3327-NC & DR-4019-NC | Hurricane Irene |
| 10/7/2016 | EM-3380-NC & DR-4285-NC | Hurricane Matthew |
| 9/10/2018 | EM-3401-NC & DR-4393-NC | Hurricane Florence |
| 9/3/2029 | EM-3423-NC & DR-4465-NC | Hurricane Dorian |
| 8/2/2020 | EM-3534-NC & DR-4568-NC | Hurricane Isaias |
| 10/1/2022 | EM-3586-NC | Hurricane Ian |
| 8/6/2024 | EM-3608-NC | Tropical Storm Debby |
| 9/26/2024 | EM-3617-NC | Hurricane Helene |
| 10/19/2024 | DR-4837-NC | Potential Tropical Cyclone Eight |

Source: OpenFEMA, 2025

**Figure I.21 – Hurricane and Tropical Storm Tracks within 25 Miles of UNC-W**



## Probability of Future Occurrence

In the 25-year period from 2000 through 2024, NCEI reports 12 hurricanes and tropical storms impacting the New Hanover County, which equates to a 48 percent annual probability of hurricane winds impacting the county. This probability does not account for impacts from hurricane rains, which may also be severe. Overall, the probability of a hurricane or tropical storm impacting the County is likely.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of a 100-year, 300-year, and 700-year hurricane event on campus. These damage estimates are for wind-related damage caused during hurricanes.

### People

The very young, the elderly and disabled individuals are more vulnerable to harm from hurricanes, as are those who are unable to evacuate for medical reasons, including special-needs patients and those in hospitals and nursing homes. Many of these patients are either oxygen-dependent, insulin-dependent, or in need of intensive or ongoing treatment. For all affected populations, the stress from disasters such as a hurricane can result in immediate and long-term physical and emotional health problems among victims.

### Property

Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland. Hurricanes can produce winds exceeding 157 mph as well as tornadoes and microbursts. Additionally, hurricanes often bring intense rainfall that can result in flash flooding. Floods and flying debris from the excessive winds are often the deadly and most destructive results of hurricanes. Per the iRisk analysis, a 100-year hurricane wind event could just under $20 million of estimated total building damages to UNC-W's campus.

Table I.24 details the estimated buildings impacted by a 100-, 300-, and 700-year hurricane wind event.

**Table I.24 – Estimated Building Damage by Hurricane Winds, UNC-W Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **100-Year Hurricane Wind Event** | | | |
| Administration | $2,543,702.07 | $1,013,434.14 | $3,557,136.21 |
| Educational | $10,376,664.62 | $2,922,590.07 | $13,299,254.69 |

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| Housing | $2,239,181.05 | $773,815.86 | $3,012,996.91 |
| **Total** | **$15,159,547.74** | **$4,709,840.07** | **$19,869,387.81** |
| **300-Year Hurricane Wind Event** | | | |
| Administration | $11,122,862.47 | $5,774,204.28 | $16,897,066.75 |
| Educational | $46,037,747.63 | $15,910,475.44 | $61,948,223.07 |
| Housing | $8,357,731.73 | $4,892,003.54 | $13,249,735.27 |
| **Total** | **$65,518,341.83** | **$26,576,683.26** | **$92,095,025.09** |
| **700-Year Hurricane Wind Event** | | | |
| Administration | $19,553,670.53 | $11,764,197.54 | $31,317,868.07 |
| Educational | $69,952,931.06 | $27,301,530.75 | $97,254,461.81 |
| Housing | $15,267,838.22 | $10,995,322.92 | $26,263,161.14 |
| **Total** | **$104,774,439.81** | **$50,061,051.21** | **$154,835,491.02** |

Source: NCEM iRISK Database

### Environment

Hurricane winds can cause massive damage to the natural environment, uprooting trees and other debris within the storm's path. Animals can either be killed directly by the storm or impacted indirectly through changes in habitat and food availability caused by high winds and intense rainfall. Endangered species can be dramatically impacted. Forests can be completely defoliated by strong winds.

## Changes in Development

Future development that occurs in the planning area should consider high wind hazards at the planning, engineering and architectural design stages. The University should consider evacuation planning in the event of a hurricane event.

## Problem Statement

- Historical tracks of multiple hurricane events pass within 25 miles of the UNC-W Campus.
- For the 25-year period from 2000 through 2024, there have been 27 hurricane related events causing over $1 billion in damage to New Hanover County.

# I.5.6 Tornadoes/Thunderstorms

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Tornado/Thunderstorm | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |

## Location

Thunderstorm wind, lightning, and hail events do not have a defined vulnerability zone. The scope of lightning and hail is generally confined to the footprint of its associated thunderstorm. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas because damages are more likely to occur where exposure is greater in more densely developed urban areas.

*Spatial Extent: 4 – Large*

### TORNADO

Tornados can occur anywhere on UNC-W's campus. Tornadoes typically impact a small area, but damage may be extensive. Tornado locations are completely random, meaning risk to tornado isn't increased in one area of the campus versus another. All of UNC-W is exposed to this hazard.

### THUNDERSTORM WINDS

The entirety of UNC-W's campus can be affected by severe weather hazards. Thunderstorm wind events can span many miles and travel long distances, covering a significant area in one event. Due to the small size of the planning area, any given event will impact the entire planning area, approximately 50% to 100% of the planning area could be impacted by one event.

### LIGHTNING

While the total area vulnerable to a lightning strike corresponds to the footprint of a given thunderstorm, a specific lightning strike is usually a localized event and occurs randomly. It should be noted that while lightning is most often affiliated with severe thunderstorms, it may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall. All of UNC-W is exposed to lightning.

### HAIL

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. However, large-scale hail tends to occur in a more localized area within the storm.

## Extent

### TORNADO

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates

(not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table I.25 shows the wind speeds associated with the enhanced Fujita scale ratings and the damage that could result at different levels of intensity.

**Table I.25 – Enhanced Fujita Scale**

| EF Number | 3 Second Gust (mph) | Damage |
|---|---|---|
| 0 | 65-85 | **Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| 1 | 96-110 | **Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| 2 | 111-135 | **Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| 3 | 136-165 | **Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance. |
| 4 | 166-200 | **Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |
| 5 | Over 200 | **Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur. |

Tornadoes have not reached beyond a magnitude of EF1 in New Hanover County.

*Impact: 3 – Critical*

### THUNDERSTORM WINDS

The magnitude of a thunderstorm event can be defined by the storm's maximum wind speed and its impacts. NCEI divides wind events into several types including High Wind, Strong Wind, Thunderstorm Wind, Tornado and Hurricane. For this severe weather risk assessment, High Wind, Strong Wind and Thunderstorm Wind data was collected. Hurricane Wind and Tornadoes are addressed as individual hazards. The following definitions come from the NCEI Storm Data Preparation document.

- **High Wind** – Sustained non-convective winds of 40mph or greater lasting for one hour or longer or winds (sustained or gusts) of 58 mph for any duration on a widespread or localized basis.
- **Strong Wind** – Non-convective winds gusting less than 58 mph, or sustained winds less than 40 mph, resulting in a fatality, injury, or damage.

- **Thunderstorm Wind** – Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 58 mph, or winds of any speed (non-severe thunderstorm winds below 58 mph) producing a fatality, injury or damage.

The strongest recorded thunderstorm wind event for Wilmington occurred on May 31, 2003 with a measured gust of 87 mph. The event reportedly caused $750,000 in property damages and resulted in no fatalities, injuries, or crop damage.

*Impact: 2 – Limited*

### LIGHTNING

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL, shown in Table I.26, is a common parameter that is part of fire weather forecasts nationwide.

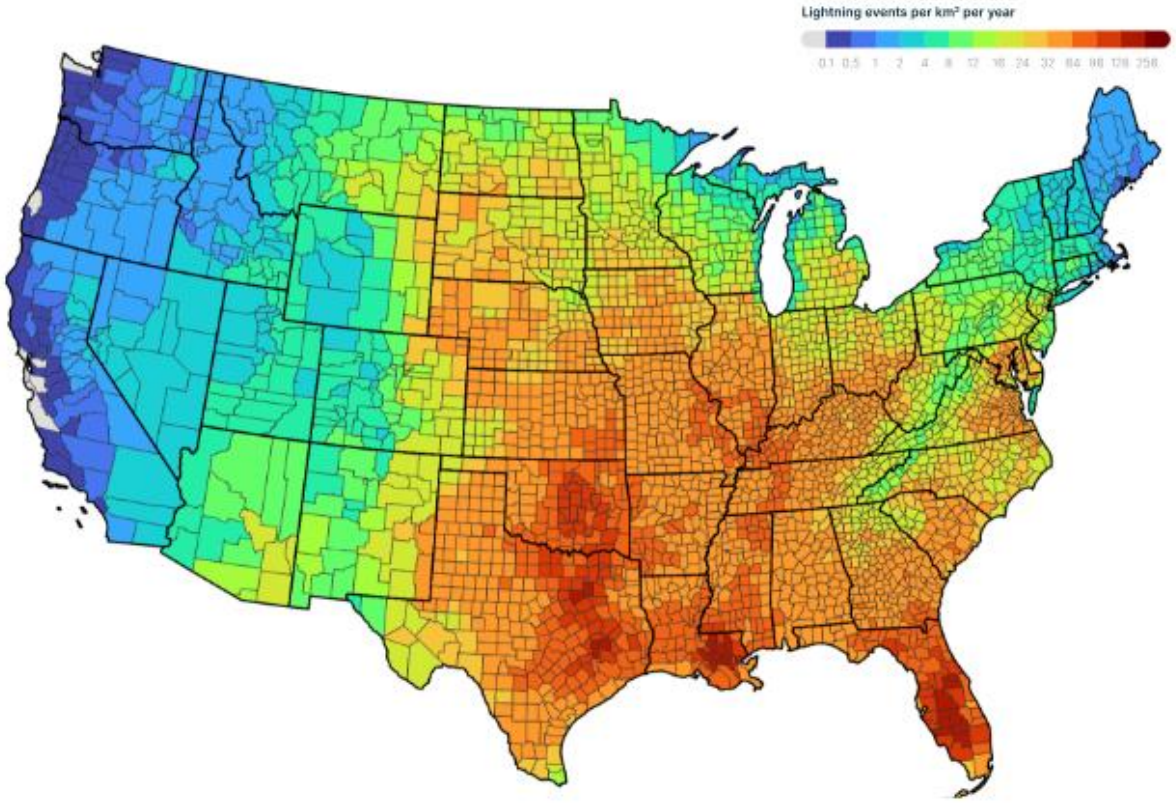
**Table I.26 – Lightning Activity Level Scale**

| Lightning Activity Level Scale | |
|---|---|
| LAL 1 | No thunderstorms |
| LAL 2 | Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground lightning strikes in a five minute period |
| LAL 3 | Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five minute period |
| LAL 4 | Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five-minute period |
| LAL 5 | Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five-minute period |
| LAL 6 | Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning |

Source: National Weather Service

According to Vaisala flash density map, New Hanover County experiences 32 to 64 lightning events per km per year.

**Figure I.22 – Lighting Density in the U.S. (2024)**




With the right conditions in place, the entire county is susceptible to each lightning activity level as defined by the LAL. Most lightning strikes cause limited damage to specific structures in a limited area, and cause very few injuries or fatalities, and minimal disruption on quality of life.

*Impact: 1 – Minor*

### HAIL

The National Weather Service classifies hail by diameter size and corresponding everyday objects to help relay scope and severity to the population, as listed in Table I.27.

**Table I.27– Hailstone Measurement Comparison Chart**

| Average Diameter | Corresponding Household Object |
|---|---|
| .25 inch | Pea |
| .5 inch | Marble/Mothball |
| .75 inch | Dime/Penny |
| .875 inch | Nickel |
| 1.0 inch | Quarter |
| 1.5 inch | Ping-pong ball |
| 1.75 inch | Golf ball |
| 2.0 inch | Hen egg |

| Average Diameter | Corresponding Household Object |
|---|---|
| 2.5 inch | Tennis ball |
| 2.75 inch | Baseball |
| 3.00 inch | Teacup |
| 4.00 inch | Grapefruit |
| 4.5 inch | Softball |

Source: National Weather Service

The Tornado and Storm Research Organization (TORRO) has further described hail sizes by their typical damage impacts. Table I.28 describes typical intensity and damage impacts of the various sizes of hail.

**Table I.28 – Tornado and Storm Research Organization Hailstorm Intensity Scale**

| Intensity Category | Diameter (mm) | Diameter (inches) | Size Description | Typical Damage Impacts |
|---|---|---|---|---|
| Hard Hail | 5-9 | 0.2-0.4 | Pea | No damage |
| Potentially Damaging | 10-15 | 0.4-0.6 | Mothball | Slight general damage to plants, crops |
| Significant | 16-20 | 0.6-0.8 | Marble, grape | Significant damage to fruit, crops, vegetation |
| Severe | 21-30 | 0.8-1.2 | Walnut | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| Severe | 31-40 | 1.2-1.6 | Pigeon's egg > squash ball | Widespread glass damage, vehicle bodywork damage |
| Destructive | 41-50 | 1.6-2.0 | Golf ball > Pullet's egg | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| Destructive | 51-60 | 2.0-2.4 | Hen's egg | Bodywork of grounded aircraft dented, brick walls pitted |
| Destructive | 61-75 | 2.4-3.0 | Tennis ball > cricket ball | Severe roof damage, risk of serious injuries |
| Destructive | 76-90 | 3.0-3.5 | Large orange > softball | Severe damage to aircraft bodywork |
| Super Hailstorms | 91-100 | 3.6-3.9 | Grapefruit | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| Super Hailstorms | >100 | 4.0+ | Melon | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

The average hailstone size recorded between 2000 and 2019 in Wilmington was a little under 1" in diameter; the largest hailstone recorded was 1.75", recorded on June 8, 2006.

*Impact: 1 – Minor*

## Historical Occurrences

### TORNADO

NCEI storm reports were reviewed from 1950 through 2024 to assess whether recent trends varied from the longer historical record. According to NCEI, New Hanover County experienced 32 tornado incidents on 22 separate days. These events caused $2,400,750 in property damage, 8 injuries, and no fatalities, or crop damage. Table I.29 shows historical tornadoes in New Hanover County during this time, and Figure I.23 shows tornadoes within 10 miles of UNC-W.

**Table I.29 – Recorded Tornadoes in New Hanover County, 1950-2024**

| Beginning Location | Date | Time | Magnitude | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| - | 6/23/1954 | 1615 | F1 | 0 | 0 | $250,000 |
| - | 6/12/1958 | 1500 | F1 | 0 | 0 | $25,000 |
| - | 10/15/1959 | 110 | F1 | 0 | 1 | $25,000 |
| - | 8/1/1972 | 530 | F0 | 0 | 0 | $0 |
| - | 5/13/1978 | 1745 | F1 | 0 | 0 | $2,500 |
| - | 5/13/1978 | 1805 | F0 | 0 | 0 | $250 |
| - | 7/16/1991 | 1027 | F0 | 0 | 0 | $0 |
| South Wilmington | 10/8/1996 | 640 | F0 | 0 | 0 | $0 |
| Wilmington | 1/8/1998 | 901 | F1 | 0 | 3 | $175,000 |
| Wilmington | 5/7/1998 | 2248 | F1 | 0 | 0 | $40,000 |
| Wilmington | 5/23/1998 | 1415 | F1 | 0 | 1 | $50,000 |
| Wilmington | 6/19/1998 | 1820 | F1 | 0 | 0 | $150,000 |
| Wilmington | 9/15/1999 | 920 | F0 | 0 | 0 | $0 |
| Murraysville | 9/15/1999 | 1420 | F0 | 0 | 0 | $0 |
| Kirkland | 5/11/2008 | 1703 | EF0 | 0 | 0 | $0 |
| Carolina Beach | 8/18/2011 | 915 | EF0 | 0 | 0 | $3,000 |
| Wrightsboro | 12/24/2014 | 1030 | EF1 | 0 | 1 | $60,000 |
| Baymeade | 5/5/2016 | 1328 | EF1 | 0 | 1 | $500,000 |
| Murraysville | 9/15/2018 | 1816 | EF1 | 0 | 0 | $300,000 |
| Kirkland | 9/15/2018 | 2029 | EF0 | 0 | 0 | $0 |
| Baymeade | 9/15/2018 | 2302 | EF0 | 0 | 0 | $150,000 |
| Wrightsboro | 9/15/2018 | 2309 | EF0 | 0 | 0 | $0 |
| East Wilmington | 9/15/2018 | 2342 | EF1 | 0 | 0 | $50,000 |
| Myrtle Grove | 9/15/2018 | 2348 | EF1 | 0 | 0 | $0 |
| South Wilmington | 9/16/2018 | 51 | EF0 | 0 | 0 | $5,000 |
| Masonboro | 12/20/2018 | 1710 | EF0 | 0 | 0 | $30,000 |
| East Wilmington | 9/5/2019 | 517 | EF0 | 0 | 0 | $5,000 |
| (Ilm)Wilmington Arpt | 9/5/2019 | 539 | EF0 | 0 | 0 | $50,000 |
| Myrtle Grove | 9/5/2019 | 558 | EF0 | 0 | 0 | $25,000 |
| Kirkland | 9/5/2019 | 1048 | EF1 | 0 | 1 | $500,000 |
| East Wilmington | 9/17/2020 | 2028 | EF0 | 0 | 0 | $5,000 |
| Sea Breeze | 8/30/2023 | 1831 | EF1 | 0 | 0 | $0 |
| | | | **Total:** | **0** | **8** | **$2,400,750** |

Source: NCEI

**Figure I.23 – Tornado Paths within 10-Miles of UNC-W**



Narratives from NCEI illustrate that damage occurred in many of these incidents even if a monetary value was not recorded. Specific incidents include:

- **May 23, 1998** – Tornado touchdown occurred on U.S. 421 and proceeded about 1.5 miles SE to Monkey Junction at N.C. 132. Damage was spotty. A 30 foot camper trailer was tossed 150 feet into a vacant mobile home, destroying both. Roofing from another building broke through a windshield, injuring a woman. The Myrtle Grove fire house lost it's antenna tower.
- **May 9, 2008** – A tornado touched down near the intersection of Floral Parkway and Park Avenue, causing minor tree damage as it moved quickly northwest. Damage became more severe as it passed east and north of Empie Park where a few pine trees up to 18 inches in diameter were snapped, and numerous large limbs broken. A nearly continuous path of tree damage was observed as the tornado continued northwest across the Forest Hills community and 23rd Street between Market Street and Princess Place Drive. This area also received significant tree damage during the landfall of Hurricane Florence, however the path of the tornado was discernible by observing damage limited primarily to broken and twisted limbs amongst treetops. The heavy damage to large oak trees in Forest Hills and on 23rd Street was apparently a result of the hurricane and not the tornado. The tornado moved northwest, crossing Princess Place Drive and snapping several trees up to 10 inches in diameter, along with numerous limbs along 21st Street and the intersection with Klein Road. The tornado broke large limbs from a few trees along Wynnwood Street in the Love Grove community before lifting.
- **April 25, 2014** – A weak tornado with winds generally 55 to 65 mph caused mainly minor tree damage from near Wrightsville Ave around Eisenhower Rd into the Burnt Mill Creek area. The tornado quickly moved toward the northwest and completely lifted near the west end of Klein Rd. Another short-lived tornado impacted the Brookfield Community near Gordon Rd in the Wilmington area. The tornado formed just south of Stones Edge Loop causing some damage to trees. The tornado moved across Northbrook Rd and knocked large limbs down. It also caused the walls to buckle at a home along Northbrook Rd., destroyed a nearby shed, and knocked several large limbs out of a large tree. The tornado moved northwest causing damage to an old shed on the south side of Briercrest Dr. The tornado then crossed Briercrest Dr. causing minor damage to a home and knocking large limbs out of trees. The tornado lifted in the vicinity of Gordon Rd. east of North Kerr Ave.
- **September 5, 2019** - A waterspout moved ashore over the northern end of Figure Eight Island, causing EF0 damage to a couple beachfront homes and trees. The tornado track was evident across the marsh towards the Intracoastal Waterway, where it affected Bald Eagle Ln. At the Bald Eagle Ln area there was one injury, numerous trees snapped and uprooted, along with mostly minor home damage. The tornado moved northwest towards Fazio Dr where it created its widest damage, including some roof damage and large trees snapped near the Porter's Neck golf course. The tornado continued to move northwest to Futch Creek Rd and Plantation Landing Dr where it lifted after producing EF0 damage, mainly to trees.

### THUNDERSTORM WINDS

From 2000 through 2024, NCEI recorded wind speeds for 34 separate incidents of thunderstorm winds, occurring on 28 separate days, for Wilmington. These events caused $1,238,000 in recorded property damage, one injury, and no fatalities. The recorded gusts averaged 66 miles per hour, with the highest gusts recorded at 100.1 mph on May 31, 2003. Of these events, 15 caused property damage. Wind gusts with property damage recorded averaged $72,823 in damage, with the highest reported damage being a total of $750,000 on May 31, 2003. These incidents are aggregated by the date the events occurred and are recorded in Table I.30. These records specifically note thunderstorm wind impacts for Wilmington. In some cases, strong winds were reported for multiple locations on the same day.

**Table I.30 – Recorded Thunderstorm Winds, Wilmington, 2000-2024**

| Location | Date | Wind Speed (mph) | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Wilmington | 2/14/2000 | 62.2 | 0 | 0 | $- |
| Wilmington | 8/24/2000 | 57.6 | 0 | 0 | $30,000 |
| Wilmington Arpt | 6/7/2001* | 71.4 | 0 | 0 | $- |
| Wilmington | 5/10/2002 | 61.0 | 0 | 0 | $- |
| Wilmington | 6/14/2002* | 89.8 | 0 | 0 | $265,000 |
| Wilmington | 7/20/2002 | 63.3 | 0 | 0 | $5,000 |
| Wilmington | 3/20/2003 | 58.7 | 0 | 0 | $- |
| Wilmington Arpt | 5/8/2003 | 71.4 | 0 | 0 | $- |
| Wilmington | 5/31/2003 | 100.1 | 0 | 0 | $750,000 |
| Wilmington | 3/5/2005 | 58.7 | 0 | 0 | $- |
| Wilmington | 3/8/2005 | 88.6 | 0 | 1 | $150,000 |
| Wilmington | 4/3/2006 | 69.1 | 0 | 0 | $- |
| Wilmington | 7/15/2006* | 69.1 | 0 | 0 | $- |
| Wilmington | 8/8/2006 | 69.1 | 0 | 0 | $- |
| South Wilmington | 7/10/2008 | 57.6 | 0 | 0 | $- |
| Wilmington | 4/11/2009 | 59.9 | 0 | 0 | $8,000 |
| (Ilm)Wilmington Arpt | 6/23/2011 | 74.8 | 0 | 0 | $1,000 |
| South Wilmington | 6/29/2011* | 71.4 | 0 | 0 | $4,000 |
| Wilmington | 7/1/2012 | 70.2 | 0 | 0 | $- |
| Wilmington | 1/31/2013 | 57.6 | 0 | 0 | $3,000 |
| (Ilm)Wilmington Arpt | 6/18/2015 | 62.2 | 0 | 0 | $- |
| South Wilmington | 6/17/2016 | 57.6 | 0 | 0 | $5,000 |
| (Ilm)Wilmington Arpt | 7/8/2016 | 57.6 | 0 | 0 | $- |
| Wilmington | 7/23/2018 | 59.9 | 0 | 0 | $1,000 |
| Wilmington | 12/20/2018 | 59.9 | 0 | 0 | $4,000 |
| East Wilmington | 7/3/2019 | 59.9 | 0 | 0 | $1,000 |
| Wilmington | 9/9/2019 | 64.5 | 0 | 0 | $10,000 |
| East Wilmington | 12/11/2023 | 57.6 | 0 | 0 | $0 |
| Wilmington | 1/9/2024 | 57.6 | 0 | 0 | $1,000 |
| | | **Total** | **0** | **1** | **$1,238,000** |

Source: NCEI

*Note: Multiple events occurred on these dates. Injuries, fatalities, and property damage are totaled, wind speed is highest reported.

The following narratives provide detail on select thunderstorm winds from the above list of NCEI recorded events:

- **May 10, 2002** – Television station reported trees down. A wind gust of 62 mph was recorded at State Port. The strong winds and lightning caused power outages for approximately 4600 residents in the county.
- **June 14, 2002** – National Weather Service storm survey concluded a microburst with estimated 80-90 mph winds caused widespread damage along a path approximately 1/2 mile long with a maximum width of 50 to 100 yards. Wrightsboro Elementary School sustained three broken windows. Portions of school's metal roof were peeled back or were torn off and blown 50 yards from the building. One trailer was blown off its concrete blocks. Seventeen houses sustained damage along Long Leaf Drive. Damage included shingles blown off roofs, siding torn off houses or significant damage to porches. An 18 inch diameter tree was snapped off about 20 feet above ground level, with numerous other trees uprooted. Fallen trees and limbs damaged power lines and at least 4 cars. No injuries were reported.
- **May 31, 2003** – A NWS storm survey concluded a microburst produced estimated 100 mph wind gusts, causing extensive damage to many homes in the Brittany Woods subdivision. Nearly 100 homes sustained at least some damage. The more serious damage occurred to half a dozen homes when their garage doors were blown in, allowing the wind to blow portions of walls and/or roofs away. One home sustained extensive damage when a fence was demolished, with the projectiles blown through the house's walls. A large travel trailer and an RV motor home were overturned, and an SUV and an attached trailer were turned around. The storm continued east southeast, with numerous trees and power lines reported down. The thunderstorm dropped penny to nickel size hail 3 miles northeast of Wilmington and 7 miles north of Wilmington, as well as 3 miles east of Murraysville. More penny size hail was reported in Wrightsville Beach, as the storm finally moved offshore.
- **March 8, 2005** –The Wilmington ASOS measured an 89 mph wind gust. A private hangar at the airport was damaged, and a man in Wilmington was injured. In downtown Wilmington, a section of the roof of city hall was damaged, and an historic home, built in 1738, was moderately damaged when a chimney collapsed. The Oceanic pier also measured a 69 mph wind gust.
- **July 23, 2015** - A survey conducted by the National Weather Service concluded a microburst with winds up to 90 mph produced considerable damage in Wilmington, North Carolina. The damage path began on the premises of Colonial Parke Apartments on Hunt Club Road. A two foot diameter tree was uprooted and crashed through the roof and window of a second story apartment causing severe damage. Three other apartments in the complex sustained damage. The damage path continued across Market Street to just northeast of the Market Street and North College Road intersection. Numerous branches from 6 to 10 inches in diameter were broken from trees. A couple stores within a shopping center sustained damage to include ceiling tiles, windows and store merchandise. As the microburst crossed Market Street, it lifted a large rooftop HVAC unit from Bonefish Grill and deposited it 30 yards away. The HVAC unit landed inside a neighboring storage unit facility

after breaking down a garage door. Damage continued east along Market Street to just beyond North College Road where a small portion of the roof of Builders First Source was lifted off. Several buildings along the path of this microburst sustained damage ranging from minor shingle loss to partial roof loss. Most of the damage was consistent with 75 to 80 mph wind speeds, however the HVAC damage was consistent with a maximum wind speed of 90 mph. The path length was about eight-tenths of a mile and the maximum path width was 200 yards. There were no reports of injury or death although some people did have to seek safe shelter as the severe winds hit. More than 3000 people were briefly without electricity.

### Lightning

According to NCEI data, there were 12 lightning strikes reported between 2000 and 2024. These events caused two fatalities, one injury, and $379,000 in damages. It should be noted that lightning events recorded by the NCEI are only those that are reported; it is certain that additional lightning incidents have occurred. Table I.31 details NCEI-recorded lightning strikes from 2000 through 2024 for Wilmington.

**Table I.31– Recorded Lightning Strikes in Wilmington, 2000-2024**

| Location | Date | Time | Fatalities | Injuries | Property Damage |
|---|---|---|---|---|---|
| Wilmington | 8/11/2000 | 1500 | 0 | 0 | $106,000 |
| Wilmington | 6/16/2001 | 1530 | 0 | 0 | $15,000 |
| Wilmington | 7/20/2002 | 1345 | 0 | 1 | $0 |
| Wilmington | 3/5/2005 | 1600 | 0 | 0 | $20,000 |
| Wilmington | 7/28/2007 | 1414 | 0 | 0 | $50,000 |
| Wilmington | 7/28/2007 | 1430 | 0 | 0 | $30,000 |
| Wilmington | 6/26/2009 | 1530 | 0 | 0 | $20,000 |
| Wilmington | 6/27/2009 | 1745 | 0 | 0 | $15,000 |
| East Wilmington | 8/19/2010 | 1445 | 0 | 0 | $100,000 |
| Wilmington | 7/10/2012 | 1950 | 0 | 0 | $1,000 |
| Wilmington | 7/12/2018 | 1500 | 0 | 0 | $20,000 |
| Wilmington | 8/5/2020 | 1150 | 2 | 0 | $2,000 |
| | | **Total** | **2** | **1** | **$379,000** |

Source: NCEI

The following are a selection of narrative descriptions recorded in NCEI for lightning events that occurred in Wilmington:

- **August 11, 2000** – Lightning stuck a home on Avenshire Circle, setting it ablaze. A fire captain estimated the damage at $100,000. Lightning also struck a shed behind a private home on Meares Street, causing approximately $6000 in fire damage.
- **June 16, 2001** – Lightning struck an apartment unit, starting a fire.
- **July 20, 2002** – A women was injured when struck by lightning and was sent to the hospital.
- **August 19, 2010** – Lightning struck a house at 5119 Somersett Lane, causing significant damage.

- **August 5, 2020** - Two men were clearing debris after Hurricane Isaias when lightning struck and killed the two men. The lightning also sparked an attic fire at a neighboring house.

### Hail

NCEI records 17 separate days with hail incidents between 2000 and 2024 in Wilmington. None of these events were reported to have caused death, injury, property damage or crop damage. The largest diameter hail recorded in the city was 1.75 inches, which occurred on June 8, 2006. The average hail size of all events in the city was just under one inch in diameter. Table I.32 summarizes hail events for Wilmington. In some cases, hail was reported for multiple locations on the same day.

**Table I.32– Summary of Hail Occurrences in Wilmington**

| Beginning Location | Date | Hail Diameter |
|---|---|---|
| Wilmington | 4/18/2000 | 0.75 |
| Wilmington | 5/22/2000 | 0.75 |
| Wilmington | 4/1/2001 | 0.88 |
| Wilmington | 5/28/2001 | 1 |
| Wilmington | 4/3/2002 | 0.75 |
| Wilmington | 7/31/2002 | 0.75 |
| Wilmington | 3/11/2003* | 1.25 |
| Wilmington | 5/31/2003 | 1 |
| Wilmington | 8/23/2003 | 1 |
| Wilmington | 7/13/2005 | 0.75 |
| Wilmington | 1/2/2006 | 0.75 |
| Wilmington | 4/3/2006 | 0.75 |
| Wilmington | 6/6/2006* | 0.88 |
| Wilmington | 6/8/2006* | 1.75 |
| Wilmington | 6/25/2007 | 0.75 |
| Wilmington | 3/15/2008 | 1 |
| Wilmington | 6/22/2008* | 0.88 |

Source: NCEI

*Note: Multiple events occurred on these dates. Hail diameter is highest reported for that specific date.

The following narratives provide detail on select hailstorms from the above list of NCEI recorded events:

- **March 11, 2003 –** Spotter reported half dollar size hail. The police also reported dime size hail at Wrightsville Beach.
- **May 31, 2003 –** Widespread hail was reported in and around the city of Wilmington, ranging from penny to quarter size.
- **August 23, 2003 –** New Hanover 911 reported quarter size hail in Wrightsboro.

## Probability of Future Occurrence

Based on historical occurrences recorded by NCEI for the 25-year period from 2000 through 2024, Wilmington averages 1.1 days with wind events per year. Over this same period, 12 lightning events were reported as having caused death, injury, or property damage, which equates to an average of 0.48 damaging lightning strikes per year.

The average hailstorm in Wilmington occurs in the afternoon and has a hail stone with a diameter of just under one inch. Over the 25-year period from 2000 through 2024, Wilmington experienced 17 days with reported hail incidents; this averages to 0.68 days per year with reported incidents somewhere in the planning area.

In a 75-year span between 1950 and 2024, New Hanover County recorded 28 tornado incidents on 18 separate days. This correlates to a 37 percent annual probability that the County will experience a tornado somewhere in its boundaries. Of these past tornadoes, all events were EF0 or EF1, and therefore, the annual probability of a significant tornado event is less than 1%.

*Probability: 3 – Likely*

## Vulnerability Assessment

### Methodologies and Assumptions

Loss estimates from NCEM's iRisk database were used to quantify the potential impact of an EF0, EF1, EF2, EF3, or EF4 tornado event on UNC-W's campus.

### People

People and populations exposed to the elements are most vulnerable to severe weather. A common hazard associated with wind events is falling trees and branches. Risk of being struck by lightning is greater in open areas, at higher elevations, and on the water. Since 2000, thunderstorm winds have caused 1 injury in Wilmington.

Lightning can also cause cascading hazards, including power loss. Loss of power could critically impact those relying on energy to service, including those that need powered medical devices. Additionally, the ignition of fires is always a concern with lightning strikes. Since 2000, NCEI records report 2 deaths and 1 injury attributed to lightning strikes in Wilmington.

Because severe storms can result in power loss, an estimate of the potential cost of electric loss was developed using FEMA's benefit cost analysis (BCA) tool. The BCA values electric loss of use at $213 per day. Therefore, the loss of use estimates for a tornado/thunderstorm is estimated at $423,657, which assumes that 10% of the student population is impacted.

**Table I.33 – Loss of Use Estimates for Power Failure Associated with Severe Weather**

| Student Population (Fall 2025) | Estimated Affected Population (10%) | Electric Loss of Use Estimate ($213 per person per day) |
|---|---|---|
| 19,895 | 1,989 | $423,657 |

People and populations exposed to the elements are most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. Since 1950, tornadoes have resulted in 7 injuries.

### Property

Property damage caused by lightning usually occurs in one of two ways – either by direct damages through fires ignited by lightning, or by secondary impacts due to power loss. According to data collected on lightning strikes in Wilmington, the 11 events with recorded property damage were due to lightning strikes resulting in fires.

NCEI records lightning impacts over 25 years (2000-2024), with $379,000 in property damage recorded during 11 separate events. Based on these records, the planning area experiences an annualized loss of $15,160 in property damage. The average impact from lightning per incident in Wilmington is $37,900.

Hail damage to property is direct, including destroyed windows, dented cars, and building, roof and siding damage in areas exposed to hail. Hail can also cause enough damage to cars to cause them to be totaled. The level of damage is commensurate with both a material's ability to withstand hail impacts, and the size of the hailstones that are falling. Construction practices and building codes can help maximize the resistance of the structures to damage. Large amounts of hail may need to be physically cleared from roadways and sidewalks, depending on accumulation. Hail can cause other cascading impacts, including power loss.

During a 25-year span between 2000 and 2024 in Wilmington, NCEI did not report any property damage as a direct result of hail.

It should be noted that property damage due to hail is usually insured loss, with damages covered under most major comprehensive insurance plans. Because of this, hail losses are notoriously underreported by the NCEI. It is difficult to find an accurate repository of hail damages in Wilmington, thus the NCEI is still used to form a baseline.

Wind events reported in NCEI for the 25-year period from 2000 through 2024 totaled $1,238,000 in property damage, which equates to an annualized loss of $49,520 across the city.

Tornado damage to property is both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost

anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services.

Since 1950, damaging tornadoes in the City have been directly responsible for $2,100,750 worth of damage to property according to NCEI data. This equates to an annualized loss of $28,010. Per the iRisk analysis, an F2 tornado event could cause over $479 million of estimated total building and contents damage on campus.

Table I.34 details the estimated buildings impacted by an EF0, EF1, EF2, EF3, or EF4 tornado event.

**Table I.34 – Estimated Building Damage by Tornado Events, UNC-W Campus**

| Occupancy Type | Estimated Building Damage | Estimated Content Loss | Estimated Total Damage |
|---|---|---|---|
| **F0 Tornado Event** | | | |
| Administration | $2,889,857.94 | $2,087,640.96 | $4,977,498.90 |
| Educational | $9,701,619.80 | $4,728,491.30 | $14,430,111.10 |
| Housing | $2,823,840.49 | $2,250,014.39 | $5,073,854.88 |
| **Total** | **$15,415,318.23** | **$9,066,146.65** | **$24,481,464.88** |
| **F1 Tornado Event** | | | |
| Administration | $12,791,446.72 | $9,302,881.20 | $22,094,327.92 |
| Educational | $41,083,897.77 | $20,251,391.76 | $61,335,289.53 |
| Housing | $11,848,390.50 | $9,429,038.06 | $21,277,428.56 |
| **Total** | **$65,723,734.99** | **$38,983,311.02** | **$104,707,046.01** |
| **F2 Tornado Event** | | | |
| Administration | $56,631,709.76 | $40,887,076.26 | $97,518,786.02 |
| Educational | $189,522,722.49 | $92,561,439.17 | $282,084,161.66 |
| Housing | $55,440,169.92 | $44,186,198.18 | $99,626,368.10 |
| **Total** | **$301,594,602.17** | **$177,634,713.61** | **$479,229,315.78** |
| **F3 Tornado Event** | | | |
| Administration | $57,044,437.02 | $41,085,568.80 | $98,130,005.82 |
| Educational | $190,108,745.20 | $92,854,450.52 | $282,963,195.72 |
| Housing | $55,440,169.92 | $44,186,198.18 | $99,626,368.10 |
| **Total** | **$302,593,352.14** | **$178,126,217.50** | **$480,719,569.64** |
| **F4 Tornado Event** | | | |
| Administration | $57,044,437.02 | $41,085,568.80 | $98,130,005.82 |
| Educational | $190,108,745.20 | $92,854,450.52 | $282,963,195.72 |
| Housing | $55,440,169.92 | $44,186,198.18 | $99,626,368.10 |
| **Total** | **$302,593,352.14** | **$178,126,217.50** | **$480,719,569.64** |

Source: NCEM iRISK Database

### Environment

The main environmental impact from wind is damage to trees or crops. Wind events can also bring down power lines, which could cause a fire and result in even greater environmental impacts. Lightning may also result in the ignition of wildfires. This is part of a natural process, however, and the environment will return to its original state in time.

Hail can cause extensive damage to the natural environment, pelting animals, trees and vegetation with hailstones. Melting hail can also increase both river and flash flood risk.

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris within the tornado's path. This is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

Future development projects should consider severe thunderstorms hazards and tornado and high wind hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. University buildings with high occupancies should consider inclusion of a tornado shelters to accommodate occupants in the event of a tornado.

## Problem Statement

- Thunderstorms and tornadoes are frequent hazard events in Wilmington and the UNC-W campus. Reported damage for the 25-year period from 2000-2024 includes $1,237,000 for thunderstorm winds and $379,000 for lightning strikes.
- Between 1950 and 2024, tornadoes caused $2,100,750 in damage.

# I.5.7 Wildfire

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Wildfire | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |

## Location

The location of wildfire risk can be defined by the acreage of Functional Wildland Urban Interface (WUI). The Functional WUI is described as the classification of the land near buildings into zones that generally describe wildfire exposure to structures and risk mitigation activities appropriate for each zone. Buildings used in producing the Functional WUI are defined as greater than 40 square meters. There are six Functional WUI categories recognized.

- Primary Exposure: Structures are immediately nearby (within 75m of) burnable land cover. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. Buildings in this zone also require hardening of the structure to resist ignition.
- Secondary Exposure: Land where structures are within 1500 m of burnable land cover, meaning homes in this zone could be impacted by lofted embers or by home-to-home spread even though they are not immediately located with vegetation types classified as burnable. Structures in this zone would benefit from the hardening of the structure to resist ignition from embers and nearby structures, but defensible space is usually not required due to the heavily developed nature of the zone.
- Sources of Ember Load to Buildings: The areas of burnable land cover that produce embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.
- Wildfire Transmission Zone: The unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Wildfire Transmission Zone have an immediate threat of reaching the nearby structures; fuel treatments that slow fire spread in this zone can reduce risk to these structures.
- Low-to-no Exposure: Structures are beyond 1500m from large (500 ha) contiguous blocks of burnable land cover. Flames—even from home-to-home spread—and embers have a relatively low likelihood of reaching structures in this zone, but smoke and evacuations could still impact this area.
- Water: Areas of non-burnable water.

The Southern Wildfire Risk Assessment (SWRA) estimates that 12 percent of the UNC-W campus is within the primary exposure category and 55 percent is within the secondary exposure category of the Functional WUI. Table I.35 details the Functional WUI acreage in the UNC-W campus, and Figure I.24 below shows the Functional WUI areas. On a county level, the majority of New Hanover County is predominately classified as secondary exposure. The northern portion of New Hanover County has a higher concentration of contiguous areas of

wildfire transmission zone with some sources of ember load to buildings surrounding developed areas.

The expansion of residential development from urban centers out into rural landscapes increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. Population growth within the WUI substantially increases the risk of wildfire.

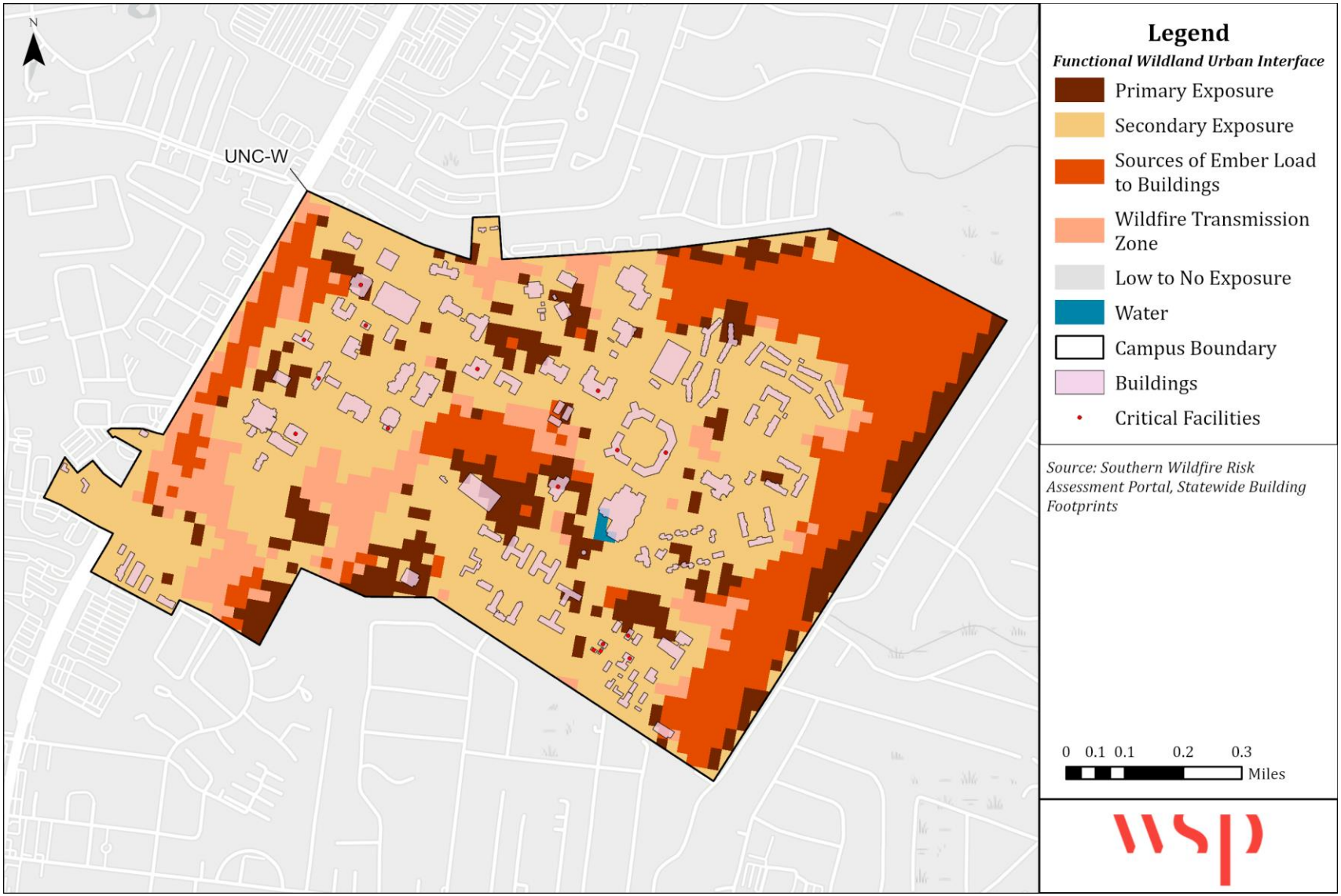
*Spatial Extent: 4 – Large*

**Table I.35 – Functional Wildland Urban Interface, UNC-W Campus**

| | Functional Wildland Urban Interface (WUI) Category | Acres | Percent |
|---|---|---|---|
| | Primary Exposure | 72 | 12% |
| | Secondary Exposure | 317 | 55% |
| | Sources of Ember Load to Buildings | 61 | 11% |
| | Wildfire Transmission Zone | 129 | 22% |
| | Low to No Exposure | 0 | 0% |
| | Water | 1 | 0% |
| | **Total** | **580** | **100%** |

Source: Southern Wildfire Risk Assessment

**Figure I.24 – Functional Wildland Urban Interface, UNC-W Campus**



## Extent

The entire state is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor may make wildfire more likely in certain areas.

Wildfire extent can be defined by the fire's intensity and measured by the Characteristic Fire Intensity Scale, which identifies areas where significant fuel hazards which could produce dangerous fires exist. Fire Intensity ratings identify where significant fuel hazards and dangerous fire behavior potential exist based on fuels, topography, and a weighted average of four percentile weather categories. The Fire Intensity Scale, shown in Table I.36, consists of five classes, as defined by Southern Wildfire Risk Assessment. Table I.37 and Figure I.25 detail the characteristic fire intensity scale across the UNC-W campus.

### Table I.36 – Fire Intensity Scale

| Class | Description |
|---|---|
| 1, Very Low | Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment. |
| 2, Low | Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools. |
| 3, Moderate | Flames up to 9 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property. |
| 4, High | Large Flames, up to 40 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property. |
| 5, Very High | Flames exceeding 200 feet in length; expect extreme fire behavior. |

Source: Southern Wildfire Risk Assessment

### Table I.37 – Characteristic Fire Intensity, UNC-W Campus

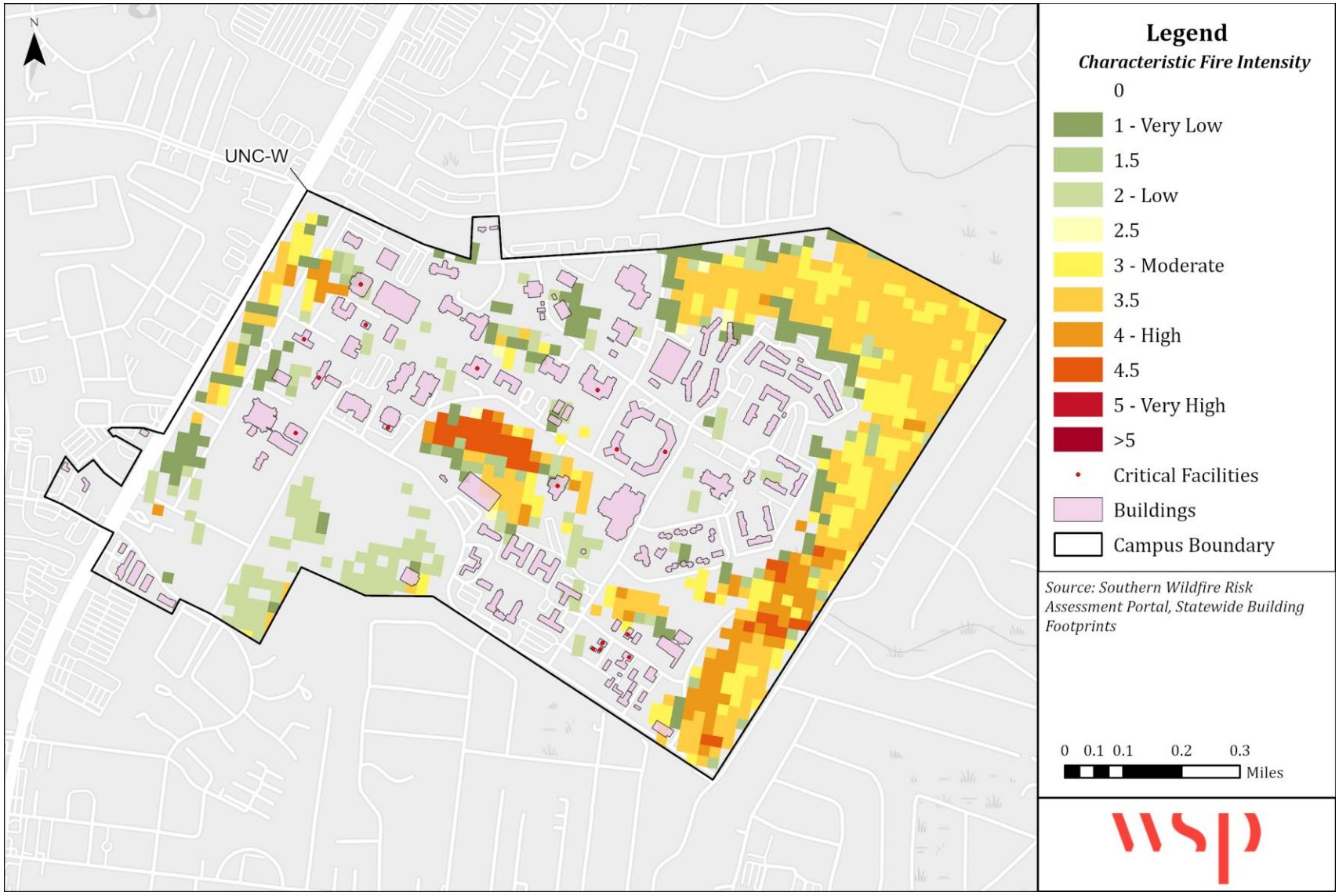
| | Characteristic Fire Intensity Scale Category | Acres | Percent |
|---|---|---|---|
| | 0 | 376 | 65% |
| | 1 - Very Low | 31 | 5% |
| | 1.5 | 7 | 1% |
| | 2 - Low | 34 | 6% |
| | 2.5 | 2 | 0% |
| | 3 - Moderate | 35 | 6% |
| | 3.5 | 69 | 12% |
| | 4 - High | 17 | 3% |
| | 4.5 | 9 | 2% |
| | 5 - Very High | 0 | 0% |
| | > 5 | 0 | 0% |
| | **Total** | **580** | **100%** |

Source: Southern Wildfire Risk Assessment

The majority of the campus (65%) is rated non-burnable on the characteristic fire intensity scale. Class 4.5 is the highest classification that the campus is exposed to, however only 5 percent of the total campus acreage has class 4 or higher fire intensity. Class 4 is considered high fire intensity and can result in significant harm or damage to life and property. The areas with greatest potential fire intensity are within the WUI. Around 18 percent of the campus may experience Class 3-3.5 fire intensity, which has potential for harm to life and property but is easier to suppress with dozer and plows. The remainder of the planning area (12%) would face a Class 1 to Class 2.5 fire intensity, which is easily suppressed.

*Impact: 2 – Limited*

**Figure I.25 – WUI Characteristic Fire Intensity, UNC-W**



## Historical Occurrences

Table I.38 lists past occurrences of wildfire in New Hanover County from 2000-2024. The data was provided by the North Carolina Forest Service (NCFS). According to NCFS there were 544 noted wildfires within New Hanover County between 2000 and 2024. The total acreage burned during this period was 2,332 acres. This data only accounts for occurrences within unincorporated areas, which fall under the NCFS jurisdiction, as well as larger events in incorporated areas where local fire departments requested NCFS support for fire suppression. Actual number of fires and acreage burned are higher than what can be reported here.

On average, New Hanover County experiences 21.8 fires and 93.3 acres burned annually from fires reported by the NCFS. Based on these records, the average wildfire event can be calculated as 4.29 acres. Actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire departments.

**Table I.38 – Records of Wildfire in New Hanover County, 2000-2024**

| Year | Wildfire Count | Acres Burned | Average Acreage Burned |
|---|---|---|---|
| 2000 | 91 | 74.80 | 0.82 |
| 2001 | 65 | 37.50 | 0.57 |
| 2002 | 42 | 241.50 | 5.75 |
| 2003 | 17 | 14.20 | 0.83 |
| 2004 | 43 | 34.80 | 0.80 |
| 2005 | 24 | 38.90 | 1.62 |
| 2006 | 34 | 29.70 | 0.87 |
| 2007 | 41 | 55.20 | 1.34 |
| 2008 | 15 | 1259.50 | 83.97 |
| 2009 | 20 | 51.20 | 2.56 |
| 2010 | 19 | 37.70 | 1.98 |
| 2011 | 18 | 31.10 | 1.72 |
| 2012 | 9 | 100.40 | 11.15 |
| 2013 | 6 | 16.00 | 2.67 |
| 2014 | 6 | 2.70 | 0.45 |
| 2015 | 6 | 8.82 | 1.47 |
| 2016 | 15 | 21.43 | 1.42 |
| 2017 | 13 | 25.39 | 1.95 |
| 2018 | 4 | 45.46 | 11.36 |
| 2019 | 3 | 4.12 | 1.37 |
| 2020 | 5 | 38.70 | 7.74 |
| 2021 | 12 | 18.00 | 1.50 |
| 2022 | 15 | 45.55 | 3.03 |
| 2023 | 10 | 27.27 | 2.72 |
| 2024 | 11 | 72.05 | 6.55 |
| **Total** | **544** | **2,331.99** | **4.29** |

Source: North Carolina Forest Service

## Probability of Future Occurrence

The Southern Wildfire Risk Assessment provides a Burn Probability analysis which signifies the likelihood of a wildfire burning a specific location within a set time frame – commonly represented as the chance of burning during one calendar year or wildfire season. According to the SWRA, Burn Probability can be expressed as a fraction (ex. 0.005) or odds (1-in-200) and is based on fire behavior modeling across thousands of simulations of possible fire seasons. In each simulation, factors contributing to the probability of a fire occurring, including weather and ignition likelihood are varied based on patterns derived from observations in recent decades. It is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Burn Probability does not say anything about the intensity of fire if it occurs. The Burn Probability for the UNC-W campus is presented in Table I.39 and illustrated in Figure I.26.

**Table I.39 – Burn Probability, UNC-W**

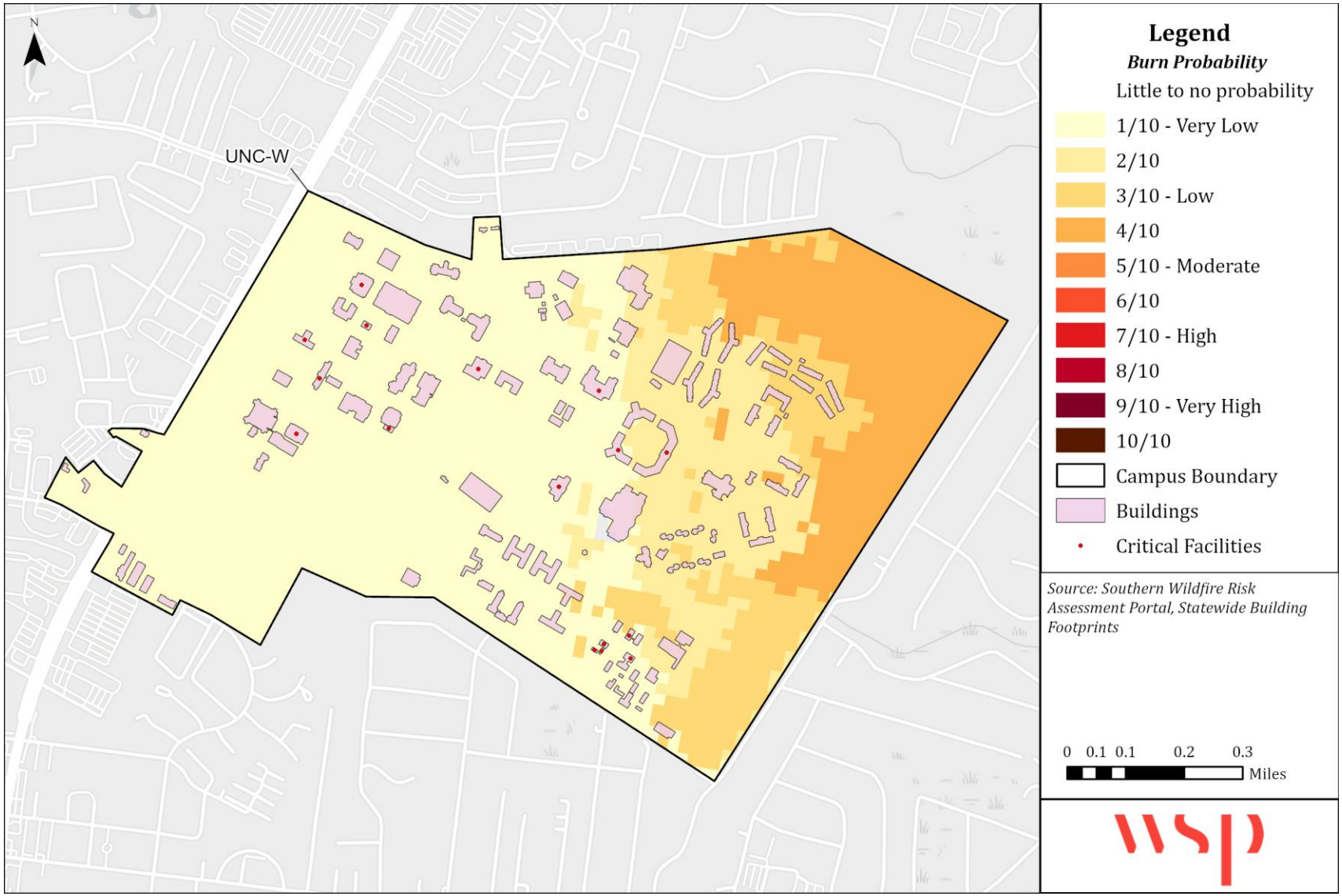
| | Burn Probability Category | Burn Probability Percent | Acres | Percent |
|---|---|---|---|---|
| | Little to no probability | 0 | 1 | 0% |
| | 1/10 - Very Low | >0 - 0.0001000 | 338 | 58% |
| | 2/10 | 0.0001000 - 0.0002154 | 94 | 16% |
| | 3/10 - Low | 0.0002154 - 0.0004642 | 62 | 11% |
| | 4/10 | 0.0004642 - 0.0010000 | 85 | 15% |
| | 5/10 - Moderate | 0.0010000 - 0.0021544 | 0 | 0% |
| | 6/10 | 0.0021544 - 0.0046416 | 0 | 0% |
| | 7/10 - High | 0.0046416 - 0.0100000 | 0 | 0% |
| | 8/10 | 0.0100000 - 0.0215443 | 0 | 0% |
| | 9/10 - Very High | 0.0215443 - 0.0464159 | 0 | 0% |
| | 10/10 | 0.0464159 - 0.1000000 | 0 | 0% |
| | | **Total** | **580** | **100%** |

Source: Southern Wildfire Risk Assessment

The UNC-W campus has very low to low burn probability. The majority of the campus, 74 percent has very low probability, falling within category 1 and 2 burn probability. Areas of very low burn probability are concentrated in the western half of the campus. Around 26 percent of the campus has low burn probability, slightly higher probably than the western part of campus – around 11 percent within category 3 and 15 percent in category 4. These areas are concentrated on the eastern portion of the campus with the highest burn probability occurring along the eastern border of the campus with high concentration of trees and vegetation. Based on the SWRA results, the probability of wildfire across the campus is considered possible.

*Probability: 2 – Possible*

**Figure I.26 – Burn Probability, UNC-W Campus**



## Vulnerability Assessment

### People

Wildfire can cause fatalities and human health hazards. Ensuring procedures are in place for rapid warning and evacuation are essential to reducing vulnerability.

### Property

Wildfire can cause direct property losses, including damage to buildings, vehicles, landscaped areas, agricultural lands, and livestock. Construction practices and building codes can increase fire resistance and fire safety of structures. Techniques for reducing vulnerability to wildfire include using street design to ensure accessibility to fire trucks, incorporating fire resistant materials in building construction, and using landscaping practices to reduce flammability and the ability for fire to spread.

Using the Wildfire Exposure Score from the Southern Wildfire Risk Assessment, a GIS analysis was used to estimate the exposure of buildings most at risk. Wildfire exposure score combines SWRA Burn Probability (likelihood of wildfire) and Damage Potential (estimated damage to homes). The scores range from 1 to 10, where lower values represent lower exposure, or less vulnerability due to low probability and low potential damage. Each wildfire exposure score category accounts for a 1.5 times (or 50 percent) difference in exposure. For example, a structure located within Class 3/10 is 1.5 times more exposed than one in Class 2/10.

All of the 126 structures assessed on the UNC-W campus have a wildfire exposure score of between 2/10 to 5/10 which represents relatively low to moderate vulnerability. Table I.40 below shows the number and value of campus buildings by occupancy type that fall within Wildfire Exposure Scores 2 through 5.

### Table I.40 – Building Counts and Values within the Wildfire Exposure Score

| Occupancy | Wildfire Exposure Score 2 | | Wildfire Exposure Score 3 | | Wildfire Exposure Score 4 | | Wildfire Exposure Score 5 | |
|---|---|---|---|---|---|---|---|---|
| | Number of Buildings | Building Value | Number of Buildings | Building Value | Number of Buildings | Building Value | Number of Buildings | Building Value |
| Administration | 12 | $45,013,923 | 3 | $1,470,537 | 17 | $45,060,547 | - | - |
| Extracurricular/ Educational | 26 | $209,448,988 | 14 | $72,552,382 | 14 | $112,322,296 | 1 | $3,540,373 |
| Housing | 3 | $72,582,555 | 8 | $45,073,143 | 24 | $71,769,885 | 4 | $10,558,783 |
| **Total** | **41** | **$327,045,465** | **25** | **$119,096,063** | **55** | **$229,152,728** | **5** | **$14,099,156** |

Source: GIS Analysis, Southern Wildfire Risk Assessment

### Environment

Wildfires have the potential to destroy forest and forage resources and damage natural habitats. Wildfire can also damage agricultural crops on private land. Wildfire is part of a natural process, however, and the environment will return to its original state in time.

## Changes in Development

While not likely, growth on the UNC-W campus within the wildland-urban interface area will increase the vulnerability of people, property, and infrastructure to wildfires. The New Hanover County Fire Rescue Department has a Community Risk Assessment Standards of Cover which evaluates population and development growth and how this impacts the departments ability to serve the County. Although a wildfire community protection plan exists for the state of North Carolina, there are no community wildfire protection plans and no wildfire-specific mitigation review requirements or regulations for development in the wildland-urban interface in New Hanover County.

## Problem Statement

- The entire UNC-W campus is located within an identified functional WUI area.
- Approximately 23% of the campus area is identified as class 3 fire intensity or higher which is moderate to high fire intensity and would have the potential for harm to life and property.
- New Hanover County experiences wildfires on an annual basis with 21.8 fires and 93.3 acres burned annually, as reported by the NCFS. The actual number of fires and acreage burned is likely higher because smaller fires within jurisdictional boundaries are managed by local fire department.
- Coordination with the City of Wilmington and/or New Hanover County is recommended to reduce fuel efforts and establish a local wildfire management plan.
- Approximately 47 percent of all buildings on the UNC-W campus falls within the Wildfire Exposure Score of 4 and 5 which represents low to moderate probability of these structures being damaged during a wildfire event.

## I.5.8 Cyber Security

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Cyber Threat | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |

### Location

Cyber disruption events can occur and/or impact virtually any location in the state where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the region can still impact people, businesses, and institutions within the region.

On the UNC-W campus, the Information Security division of Information Technology Services (ITS) is responsible for safeguarding the confidentiality, integrity, and availability of all information processed, stored or transmitted using university electronic resources while also taking proactive measures to counter threats, vulnerabilities and cyber-attacks. The University's critical applications require passwords for access. Modifications of the application software are protected from abuse by an electronic software control procedure. Information security is managed and controlled in accordance with the university's Information Security Policy.

*Spatial Extent: 4 – Large*

### Extent

The extent or magnitude/severity of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions/processes. Disruptions of large, integrated systems could impact many functions/processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. With the amount of data retained by universities – including student, staff, and faculty personal information as well as research data – a data breach on the UNC-W campus could cause significant disruption and impact a large number of records.

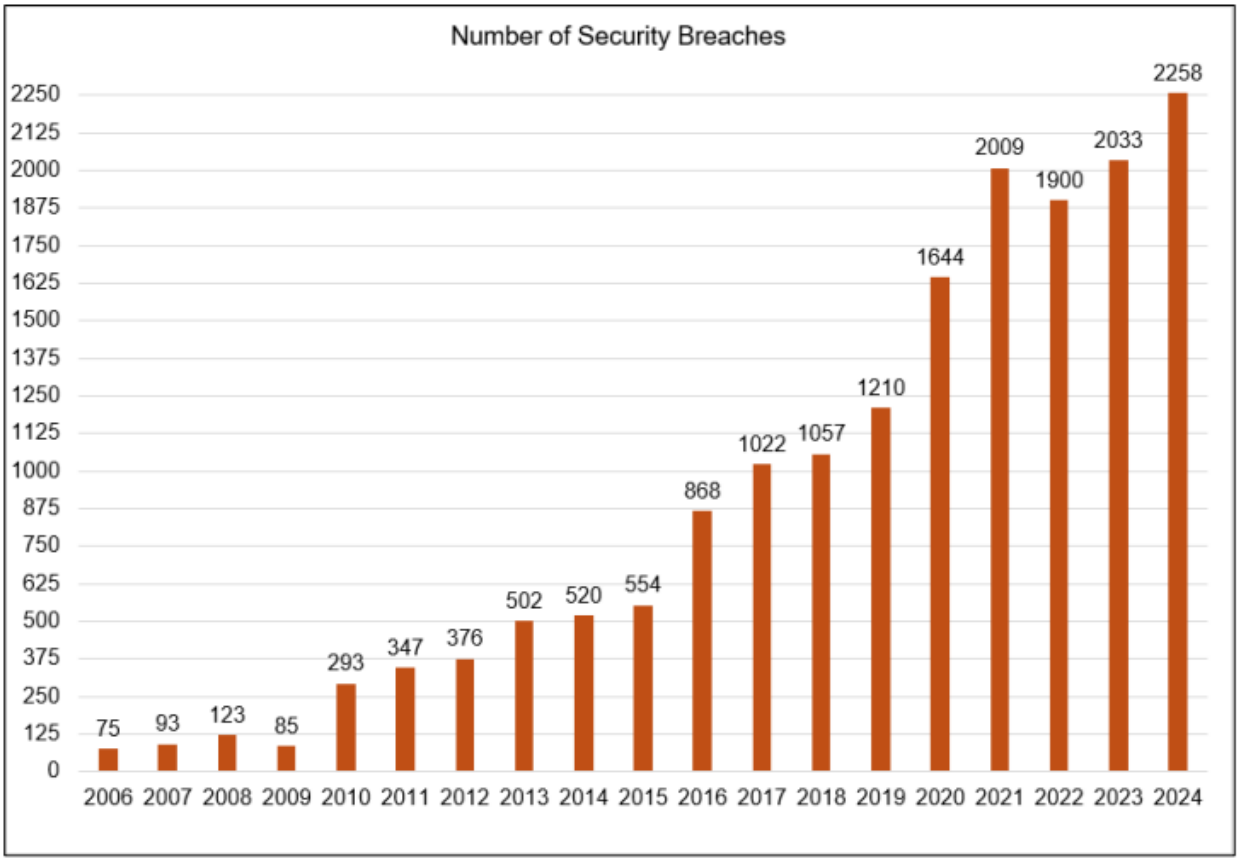
*Impact: 3 – Critical*

## Historical Occurrences

According to local news reports, the University of North Carolina Wilmington's Division of University Advancement (DUA) was hacked by a ransomware attack in August of 2020. The data included names, addresses, phone numbers, email addresses, and history of gifts made to UNC-W; the University reported that no vulnerable financial or personal information was included.

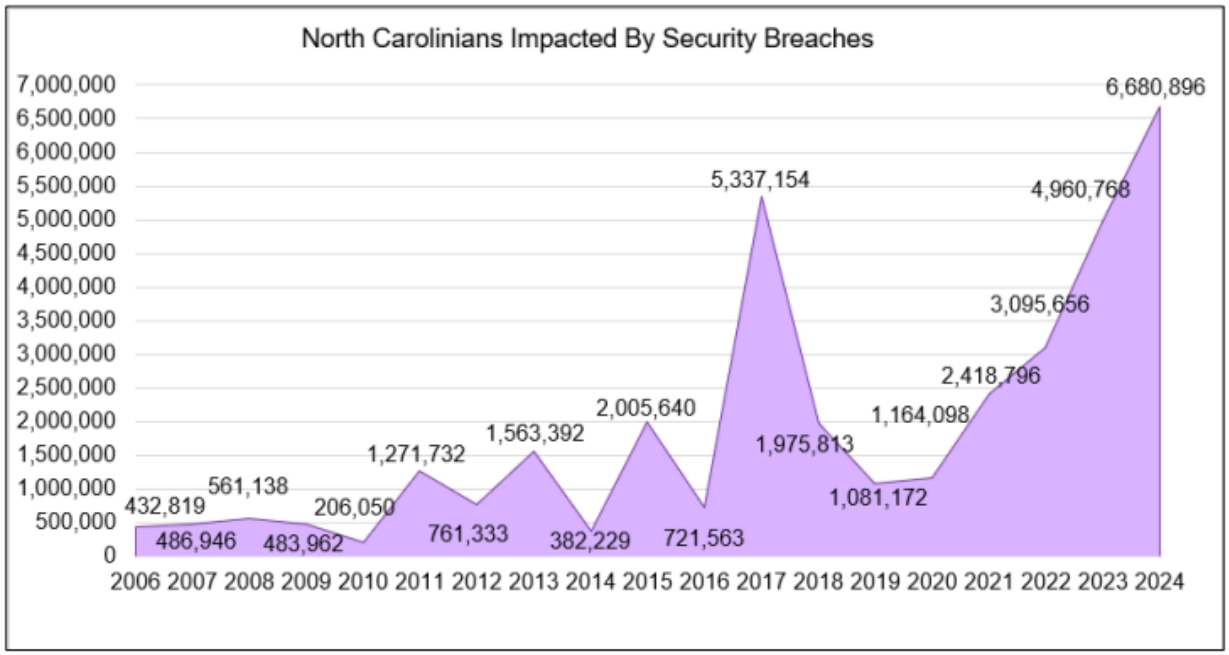
In North Carolina, businesses and organizations that experience data breaches are required to report the breach and the information that was compromised to the NC Department of Justice (DOJ). In 2024, the DOJ received 2,258 data breach notices from organizations according to their annual Data Breach Report. These breaches impacted more than 6.6 million North Carolinians – the highest number of people impacted in a single year. Additionally, in 2024, hacking-related breaches were at a record high with 1,755 breaches reported for the year. The report noted that ransomware attacks have increased nearly 50 percent and contributed to more than half of all data breaches reported in 2024.

**Figure I.27 – Number of Security Breaches in North Carolina**




Source: North Carolina Department of Justice

**Figure I.28 – North Carolinians Impacted by Security Breaches**




Source: North Carolina Department of Justice

There have been some notable disruption events within the Education target distribution that attained statewide attention in the last few years:

- January 2025, PowerSchool, one of the largest providers of cloud-based education software for K-12 schools in the U.S. was hit with a major breach of information. A hacker attacked the PowerSchool system and downloaded personal information such as student enrollment, grades, health, and attendance. The North Carolina Department of Public Instruction noted that there were no actions by the schools that could have prevented this incident from occurring. (https://www.wunc.org/education/2025-01-08/nc-schools-powerschool-data-breach-lose-chromebooks)
- November 2023, North Carolina Central University was attacked by a ransomware program called BlackCat. This cyber attack devastated NCCU's digital infrastructure and made it difficult for students and staff to use software systems run through the university such as Canvas. This led to delays in students submitting final projects and exams for the semester. N.C. Agricultural and Technical State University was cyberattacked as well by BlackCat ransomware in March of 2022 over spring break. (https://campusecho.com/nccu-stunned-by-sunday-morning-cyberintrusion/)
- November 2019, The University of North Carolina Chapel Hill School of Medicine reported over 3,500 individuals having private information stolen in phishing cyber-attack, (https://www.databreaches.net/the-university-of-north-carolina-chapel-hill-school-of-medicine-notifying-patients-after-2018-phishing-incident/).

## Probability of Future Occurrence

Cyber attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become a commonplace occurrence but are usually stopped with minimal impact. Similarly, data breaches impacting the information of students and faculty of UNC-W are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems at the University are less likely but cannot be ruled out.

*Probability: 2 – Possible*

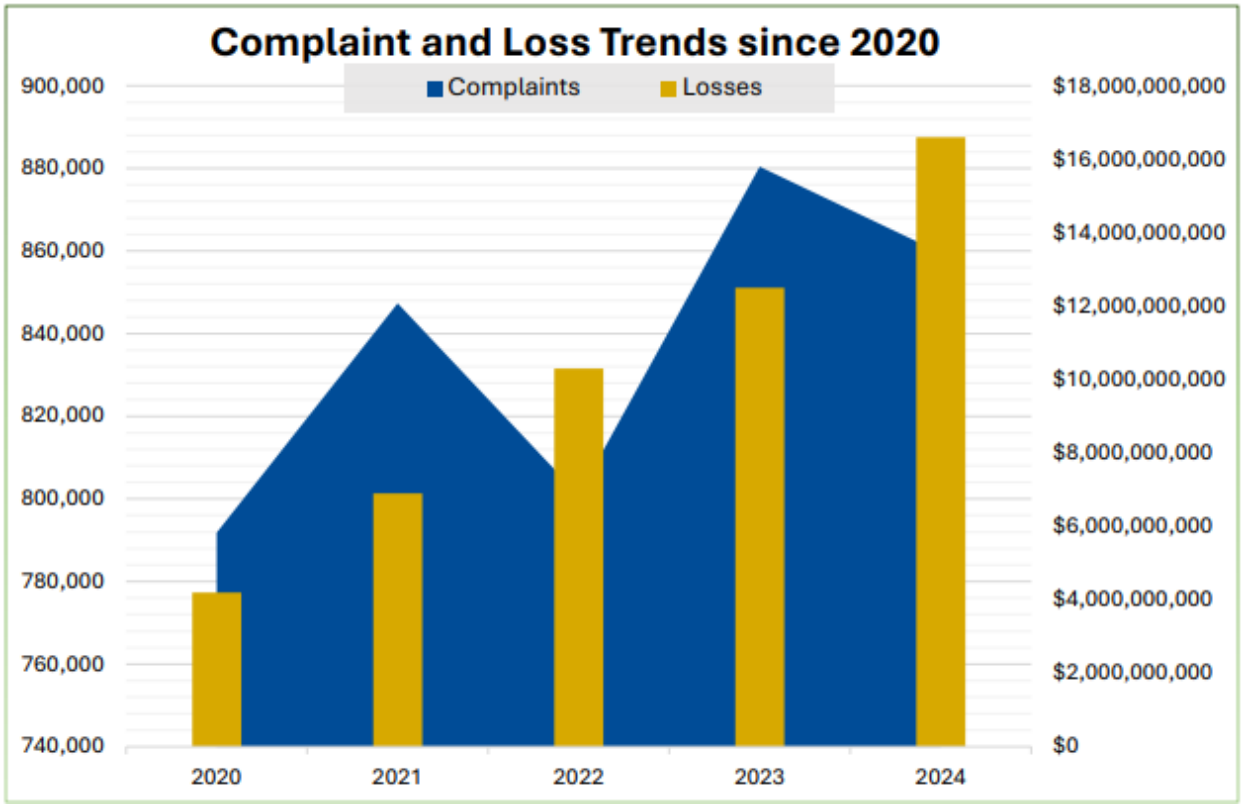
## Vulnerability Assessment

As discussed above, the impacts from a cyber attack vary greatly depending on the nature, severity, and success of the attack.

### People

Cyber-attacks can have a significant cumulative economic impact. According to the Internet Crime Complaint Center run by the Federal Bureau of Investigation, the U.S. experienced a loss of $50.5 billion between the years 2020 to 2024. Economic losses associated with cybercrime increased every year during this five-year period as shown in Figure I.29.

**Figure I.29 – 2020-2024 Complaints and Losses due to Cybercrime in the U.S.**




Source: Internet Crime Complaint Center 2024 Annual Report

Businesses continue to use evolving technologies to improve operations, and increasingly, personal and financial information is stored and transferred online. Phishing scams have reached an all-time high in 2022, up 60 percent from 2020 with over 1 million attacks in the first quarter of 2022 alone.

Consumers continued usage of online services, such as banking and shopping, increase vulnerability to personal and financial information theft or manipulation. Between 2016 and 2021, Americans lost more than $9 billion to lost or stolen financial information.

In recent years, cyber criminals have begun to target hospitals, which create a significant health and safety concern. For example, in 2024, a ransomware attack targeted Ascension, the third largest health system in the U.S. that provides care to over 6 million people each year. This ransomware attack took down Ascension's computer system, and nurses were left scrambling to find paper backups of medical history and prescribed medications. This attack undoubtedly slowed down the hospital system and forced Ascension facilities to redirect patients to other providers. The Ascension computer system was down for 37 days, and the hospital spent $130 million in response to the attack.

It should be noted that direct injuries or fatalities from cyber-attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure.

### Property

Short of a major cyber terrorist attack against critical infrastructure, property damage from cyber-attacks is typically limited to computer systems. However, infrastructure attacks using social engineering temporarily disabled the Colonial Pipeline, risking access to oil products across the East Coast.

### Environment

Short of a major cyber terrorist attacks against critical infrastructure, property damage from cyber attacks is typically limited to computer systems. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

## Changes in Development

With enrollment increasing since the last plan, the number of users of campus networks and software have significantly increased.

For future development, as the number of users and/or access points to the network and campus software increases, the opportunity for cyber-attacks is also likely to increase.

## Problem Statement

- Cyber-attacks occur daily, but most have negligible impacts at the local or regional level. The possibility of a larger disruption affecting systems within the region is a constant threat, but difficult to quantify.
- The University's Information Security division addresses IT security through policies addressing users, physical security, system security, password administration, communications, wireless devices, computer viruses, disaster recovery, and compliance with law and policy.

## I.5.9 Hazardous Substances

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |

### Location

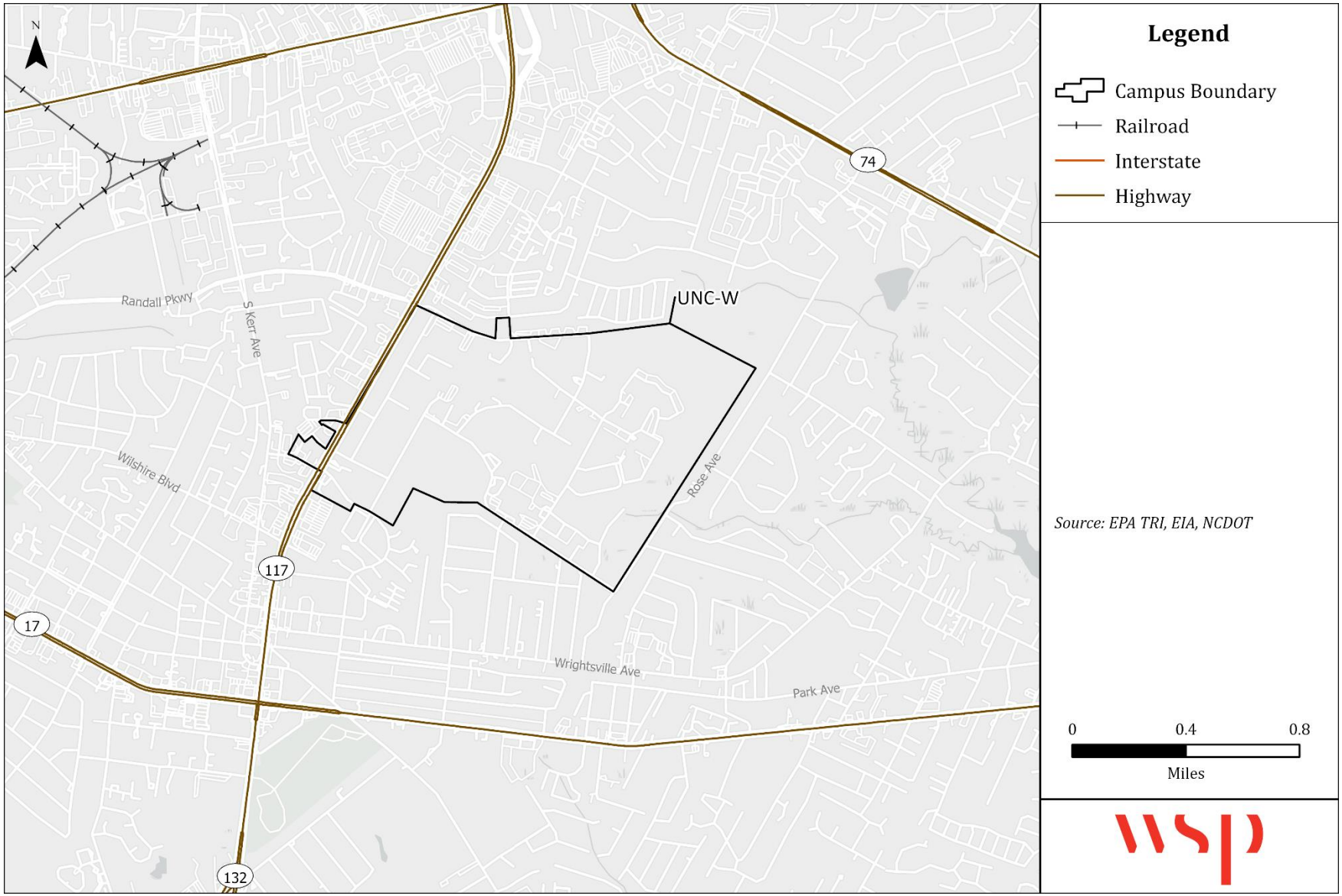
Hazardous materials releases at fixed sites can cause a range of contamination from very minimal to catastrophic. The releases can go into the air, onto the surface, or into the ground and possibly into groundwater, or a combination of all. Although releases into the air or onto the ground surface can pose a great and immediate risk to human health, they are generally easier to remediate than those releases which enter into the ground or groundwater. Soil and groundwater contamination may take years to remediate causing possible long-term health problems for individuals and rendering land unusable for many years.

The Toxics Release Inventory (TRI) Program run by the EPA maintains a database of industrial facilities across the country and the type and quantity of toxic chemicals they release. The program also tracks pollution prevention activities and which facilities are reducing toxic releases. As of November 2025, the Toxic Release Inventory does not report any sites with hazardous materials within 1 mile of UNC-W's campus.

Transportation hazardous materials incidents can occur when hazardous materials are being transported from one location to another in the normal course of business for manufacturing, refining, or other industrial purposes. Additionally, hazardous materials incidents can occur as hazardous waste is transported for final storage and/or disposal. Figure I.30 shows the routes of transportation for hazardous materials adjacent to or through UNC-W's campus.

*Spatial Extent: 1 – Negligible*

**Figure I.30 – Hazardous Materials Transportation Routes near the UNC-W Campus**



## Extent

The magnitude of a hazardous materials incident can be defined by the material type, the amount released, and the location of the release. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), which records hazardous material incidents across the country, defines a "serious incident" as a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident. Potential losses can vary greatly for hazardous material incidents. For even a small incident, there are cleanup and disposal costs. In a larger scale incident, cleanup can be extensive and protracted. There can be deaths or injuries requiring doctor's visits and hospitalization, disabling chronic injuries, soil and water contamination can occur, necessitating costly remediation. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damage, with clean-ups that can last for years.

*Impact: 1 – Minor*

## Historical Occurrences

The USDOT's PHMSA maintains a database of reported hazardous materials incidents by location and hazardous material class. According to PHMSA records, there were 178 recorded releases in the City of Wilmington from 2000 through 2024. Of these events, only seven were flagged as serious incidents. Of the total incidents to occur in the planning area, these events caused an estimated $454,862 in damage with 93 percent of all incidents occurring on highways and roads. The most common materials spilled in the city were Class 3 (Flammable and Combustible Liquids) and Class 8 (Corrosives). Figure I.31 describes all nine hazard classes.

**Figure I.31 – Hazardous Materials Classes**




Source: U.S. Department of Transportation

## Probability of Future Occurrence

Based on historical occurrences recorded by PHMSA, there have been 178 incidents of hazardous materials release in the 25-year period from 2000 through 2024. Using historical occurrences as an indication of future probability, there is over a 100 percent annual probability of a hazardous materials incident occurring throughout the City of Wilmington.

However, the number of serious incidents is significantly lower: only 7 in 25 years or an average of 0.3 serious incidents per year. This means that based on historical data, there is a 28 percent annual chance of the planning area experiencing a damaging hazardous materials incident.

*Probability: 4 – Highly Likely*

## Vulnerability Assessment

### People

Hazardous materials incidents can cause injuries, hospitalizations, and even fatalities to people nearby. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities. For example, a toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. Individuals working with or transporting hazardous materials are also at heightened risk.

In addition to the immediate health impacts of releases, a handful of studies have found long term health impacts such as increased incidence of certain cancers and birth defects among

people living near certain chemical facilities. However there has not been sufficient research done on the subject to allow detailed analysis.

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. Large and publicized hazardous material-related events can deter tourists and could potentially discourage residents and businesses. Economic effects from major transportation corridor closures can be significant.

### Property

The impact of a fixed hazardous facility, such as a chemical processing facility is typically localized to the property where the incident occurs. The impact of a small spill (i.e. liquid spill) may also be limited to the extent of the spill and remediated if needed. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to property.

Hazardous materials spills reported by PHMSA for the 25-year period from 2000 through 2024 totaled $454,862 in damage, which equates to an annualized loss of $18,194 across the City of Wilmington.

Impacts of hazardous material incidents on critical facilities are most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities.

### Environment

Hazardous material incidents may affect a small area at a regulated facility or cover a large area outside such a facility. Widespread effects occur when hazards contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

## Changes in Development

Structures located near fixed facilities, highways and other high traffic roadways are most at risk to a hazardous materials event. Development in these areas may expose more people to hazardous materials risk. However, since most hazardous material spills are localized to an extremely small area this will not affect the overall risk of this hazard.

## Problem Statement

- Transportation routes for hazardous materials are located adjacent to the UNC-W campus.
- The number of reported incidents within Wilmington can be approximated to over a 100 percent annual probability.

# I.5.10 Infectious Disease

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |

## Location

Infectious disease outbreaks can occur anywhere in the planning area, especially where there are groups of people in close quarters.

*Spatial Extent: 4 – Large*

## Extent

Extent of a disease can be measured by the overall spread of the disease and the case-fatality rate. The overall spread of an infectious disease, such as a pandemic flu, is broken down into six phases, shown in Table I.41 according to the World Health Organization.

**Table I.41 – World Health Organization's Pandemic Flu Phases**

| Phase | Description |
|---|---|
| 1 | No animal influenza virus circulating among animals have been reported to cause infection in humans. |
| 2 | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| 3 | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level breakouts. |
| 4 | Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level breakouts has been verified. |
| 5 | The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region. |
| 6 | In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region. |
| Post-Peak Period | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| Post-Pandemic Period | Levels of influenza activity have returned to levels seen for seasonal influenza in most countries with adequate surveillance. |

Source: World Health Organization

*Impact: 3 – Critical*

## Historical Occurrences

In the 20th century, three lethal pandemics swept the globe and are detailed below:

- **Spanish Flu (H1N1 Virus) of 1918-1919**: Beginning in March 1918, when World War I was in its fourth year, the Spanish Flu swept the world in three waves during a two-year period, rivalling the war itself as the greatest killer in human history. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza between 1918 and 1919 and 20 million people died.
- **Asian Flu (H2N2 Virus) of 1957-1958**: This influenza pandemic was first identified in February 1957 in East Asia. Unlike the Spanish Flu, the 1957 virus was quickly identified, and vaccine production began in May 1957. It resulted in an estimated 1.1 million to 2 million deaths globally, and 116,000 deaths in the U.S.
- **Hong Kong Flu (H2N2) of 1968-1969**: global outbreak of influenza that originated in China in July 1968 and killed between one to four million people worldwide and approximately 100,000 in the U.S.

In recent years, two pandemics have occurred – the Swine Flu and COVID-19.

### *Swine Flu (H1N1 Virus), 2009-2010*

This influenza pandemic emerged from Mexico in 2009. The first U.S. case of H1N1, was diagnosed on April 15, 2009. The U.S. government declared H1N1 a public health emergency on April 26. By June, approximately 18,000 cases of H1N1 had been reported in the United States. A total of 74 countries were affected by the pandemic.

The CDC estimates that 43 million to 89 million people were infected with H1N1 between April 2009 and April 2010. There were an estimated 8,870 to 18,300 H1N1 related deaths. On August 10, 2010, the World Health Organization (WHO) declared an end to the global H1N1 flu pandemic.

### *Coronavirus Disease (COVID-19), 2020-2024*

COVID-19 was caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). First identified in Wuhan, China in December 2019, the virus quickly spread throughout China and then globally. In the United States, COVID-19 was first identified in late January in Washington State and rapidly spread throughout the Country, with large epicenters on both the east and west coasts. On March 13, 2020 the U.S. entered a nationwide emergency and by March 15, 2020 U.S. states began to shut down to prevent the spread of COVID-19. Almost a year later the U.S. had administered over 100 million vaccinations. In June 2021, the first major variant, the Delta variant, became dominant in the U.S. which kicked off a third wave of infections during the summer of 2021. By December 20, 2021, Omicron, the second and most dominant variant in the U.S., was detected in most U.S. states and territories. The Omicron variant spread more easily than the original virus that caused COVID-19 and the Delta variant. As of January 2025, the COVID-19 virus has transitioned to endemic but maintains dual seasonality, with cases peaking twice a year.

According to the CDC, from the start of the pandemic to May 2023, there were over 104 million confirmed cases of COVID-19 in the U.S. resulting in over 1,187,952 deaths. In North Carolina, there were over 3.4 million confirmed cases and 28,432 deaths due to COVID-19. Between

March 2020 and May 2023, New Hanover County experienced 64,711 cases of COVID-19 and 469 deaths. Per 100,000 people, New Hanover County experienced 200 deaths, lower than the state's rate of 284.

### *Other Infectious Diseases*

For the year 2023, New Hanover County's detailed mortality statistics report, provided by the NC State Center for Health Statistics, attributed 81 deaths to certain infectious and parasitic diseases, excluding COVID-19. The majority of these deaths (51) were linked to Sepsis. While Sepsis is not an infectious disease, it is a condition that occurs when the body's immune system overreacts to an infection. Infectious diseases that caused fatalities included Infectious Gastroenteritis, Legionnaires' disease, Staph infection, Viral Hepatitis, HIV, Candidiasis, Protozoal diseases, and Pneumocystis.

## Probability of Future Occurrence

It is impossible to predict when the next pandemic will occur or its impact. The CDC continually monitors and assesses pandemic threats and prepares for an influenza pandemic. Novel influenza A viruses with pandemic potential include Asian lineage avian influenza A (H5N1) and (H7N9) viruses. These viruses have all been evaluated using the Influenza Risk Assessment Tool (IRAT) to assess their potential pandemic risk. Because the CDC cannot predict how severe a future pandemic will be, advance planning is needed at the national, state and local level; this planning is done through public health partnerships at the national, state and local level.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster.

*Probability: 2 – Possible*

## Vulnerability Assessment

### People

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. As an example, the unusually deadly 1918 H1N1 influenza pandemic had a mortality rate of

20%. If an influenza pandemic does occur, it is likely that many age groups would be seriously affected. The greatest risks of hospitalization and death—as seen during the two pandemics in 1957 and 1968 and COVID-19, as well as during annual outbreaks of influenza—will be to infants, the elderly, and those with underlying health conditions. However, in the 1918 pandemic, most deaths occurred in young adults. Few people, if any, would have immunity to a new virus.

### Property

For the most part, property itself would not be impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Furthermore, staffing shortages could affect the function of critical facilities.

### Environment

A widespread pandemic would not have an impact on the natural environment unless the disease was transmissible between humans and animals. However, affected areas could result in denial or delays in the use of some areas, and may require remediation.

## Changes in Development

With enrollment increasing since the last plan, the number of students and employees on campus has grown. In 2024, student enrollment surpassed 18,800, the highest level of enrollment in UNC-W's history. If enrollment continues to increase, it is more likely that a pandemic could spread.

## Problem Statement

- Based on the recent COVID-19 pandemic, it is clear the UNC-W campus population is susceptible to the infectious disease pandemic.
- UNC-W has a pandemic influenza plan in place to provide a guide for the University to follow in the event of an influenza pandemic in North Carolina.

# I.5.11 Terrorism

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Terrorism | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.5 |

## Location

Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR Section 0.85). The threat of terrorism, both international and domestic, is ever present, and an attack is likely to occur when least expected. A terror threat could occur at any location in the area, but are more likely to target highly populated areas, critical infrastructure, or symbolic locations.

Before the September 11, 2001 attacks in New York and the Pentagon, most terrorist incidents in the United States have been bombing attacks, involving detonated and un-detonated explosive devices, tear gas, and pipe and firebombs. The effects of terrorism can vary significantly from loss of life and injuries to property damage and disruptions in services such as electricity, water supply, public transportation and communications. The U.S. government has attempted to reduce vulnerability to terrorist incidents by developing infrastructure protection programs for critical infrastructure and key resource facilities and increased security at airports.

While we can never predict what target a terrorist will choose, we do know some of the factors they use when selecting a target. Terrorists want to achieve one or more of the following:

- Produce a large number of victims,
- Attack places that have a symbolic value,
- Get the greatest possible media attention, and
- Produce mass panic.

Terrorists also select targets best suited for the type of material being used. For example, some biological agents are not effective in sunlight. Most chemical agents are more effective indoors with limited airflow. A radioactive material will be most effective where large numbers of people will pass close by without detecting it. Terrorists are likely to target heavily populated, enclosed areas like stadiums, government buildings, sporting events, airport terminals, subways, shopping malls and industrial manufacturing facilities. For this reason, it is critical that employers and local government agencies have some type of anti-terrorism plan in place should a terrorist act occur.

A terrorist attack can take several forms, depending on the technological means available to the terrorist, the nature of the political issue motivating the attack, and the points of weakness of the terrorist's target. Bombings have been the most frequently used terrorist method in the United States. Other possibilities include an attack at transportation facilities, an attack against utilities or other public services or an incident involving chemical or biological agents.

Facilities on the UNC-W campus could be potential terrorism targets include, but are not limited to:

- Burney Center Energy Plant
- Congdon Hall
- Hanover Hall

*Spatial Extent: 2 – Small*

## Extent

The extent of a terrorist incident is tied to many factors, including the attack vector, location, time of day, and other circumstances; for this reason, it is difficult to assess a single definition or conclusion of the extent of "terrorism." As a general rule, terrorism incidents are targeted to where they can do the most damage and have the maximum impact possible, though this impact is tempered by the weapon used in the attack itself.

*Impact: 3 – Critical*

## Historical Occurrences

There are no reported terrorism incidents for the UNC-W campus. However, the following shooting incidents have occurred on other university campuses within the State:

- **May 15, 1954 – UNC Chapel Hill** – Three individuals were shot (one fatally) during a fraternity house carnival at the Phi Delta Theta house at the University of North Carolina.
- **November 1, 2015 – Winston-Salem State University** - One person died, and another person was injured after someone opened fire on campus. A 21-year-old former WSSU student was charged with murder following the incident.
- **April 30, 2019 – UNC Charlotte** – A 22-year-old former history undergraduate at UNC Charlotte shot six students and killed two.

## Probability of Future Occurrence

While difficult to estimate when a deliberate act like terrorism may occur, it can be inferred that the probability of a terrorist attack in any one area in the Region is very low at any given time. When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

*Probability: 1 – Unlikely*

## Vulnerability Assessment

### People

People can suffer death or illness as a result of a terrorist attack. Symptoms of illness from a biological or chemical attack may go undetected for days or even weeks. Local healthcare

workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People will face increased risk if a biological or chemical agent is released indoors, as this may result in exposure to a higher concentration of pathogens, whereas agents that are released outdoors would disperse in the direction of the wind. Physical harm from a weapons attack or explosive device is not dependent on location, but risk is greater in areas where higher numbers of people may gather. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack could cause significant stress and anxiety.

#### Property

The potential for damage to property is highly dependent on the type of attack. Buildings and infrastructure may be damaged by an explosive device or by contamination from a biological or chemical attack. Impacts are generally highly localized to the target of the attack.

#### Environment

Environmental impacts are also dependent on the type of attack. Impacts could be negligible or could require major clean-up and remediation.

### Changes in Development

Increase in development and technology has the potential of making the planning area more of a target for a terrorist attack due to larger numbers of victims and more target areas.

### Problem Statement

- There are no records of past terrorism incidents for the UNC-W campus.
- There are active hate groups within North Carolina.
- When identified, credible threats may increase the probability of an incident; these threats are generally tracked by law enforcement.

## I.5.12 Conclusions on Hazard Risk

### Priority Risk Index

As discussed in Section I.5, the Priority Risk Index was used to rate each hazard on a set of risk criteria and determine an overall standardized score for each hazard. The conclusions drawn from this process are summarized below.

Table I.42 summarizes the degree of risk assigned to each identified hazard using the PRI method.

### Table I.42 – Summary of PRI Results

| Hazard | Probability | Impact | Spatial Extent | Warning Time | Duration | PRI Score |
|---|---|---|---|---|---|---|
| Drought | Likely | Minor | Large | More than 24 hrs | More than 1 week | 2.5 |
| Earthquake | Unlikely | Minor | Large | Less than 6 hours | Less than 6 hours | 1.9 |
| Excessive Heat | Highly Likely | Limited | Large | More than 24 hrs | Less than 1 week | 3.0 |
| Flooding | Highly Likely | Minor | Negligible | 6 to 12 hrs | Less than 1 week | 2.3 |
| Hurricanes & Coastal Hazards | Likely | Catastrophic | Large | More than 24 hrs | Less than 24 hrs | 3.2 |
| Tornadoes / Thunderstorms | Likely | Critical | Large | Less than 6 hrs | Less than 6 hrs | 3.1 |
| Wildfire | Possible | Limited | Large | More than 24 hrs | More than 1 week | 2.5 |
| Cyber Security | Possible | Critical | Large | Less than 6 hrs | More than 1 week | 3.1 |
| Hazardous Substances | Highly Likely | Minor | Negligible | Less than 6 Hrs | Less than 24 Hrs | 2.3 |
| Infectious Disease | Possible | Critical | Large | More than 24 hrs | More than 1 week | 2.8 |
| Terrorism | Unlikely | Critical | Small | Less than 6 hrs | Less than 24 hrs | 2.5 |

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table I.43:

- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.
- **Moderate Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal. This is not a priority hazard.

### Table I.43 – Summary of Hazard Risk Classification

| | |
|---|---|
| **High Risk (≥ 3.0)** | Hurricanes & Coastal Hazards<br>Tornadoes/Thunderstorms<br>Cyber Threat<br>Excessive Heat |
| **Moderate Risk (2.0 – 2.9)** | Drought<br>Wildfire<br>Flooding<br>Infectious Disease<br>Terrorism<br>Hazardous Substances |
| **Low Risk (< 2.0)** | Earthquake |

# I.6 Capability Assessment

This section discusses the mitigation capabilities, including planning, programs, policies and land management tools, typically used to implement hazard mitigation activities. It consists of the following subsections:

- I.6.1 Overview of Capability Assessment
- I.6.2 Planning and Regulatory Capability
- I.6.3 Administrative and Technical Capability
- I.6.4 Fiscal Capability

## I.6.1 Overview of Capability Assessment

The purpose of conducting a capability assessment is to determine the ability of the college to implement feasible mitigation actions based on an understanding of the capacity of the departments and staff tasked with their implementation. A capability assessment should also identify opportunities for establishing or enhancing specific mitigation policies or programs. The process of conducting a capability assessment includes developing an inventory of relevant plans, policies, or programs already in place; as well as assessing the college's ability to implement existing and/or new policies. Conclusions drawn from the capability assessment should identify any existing gaps or weaknesses in existing programs and policies as well as positive measures already in place which can and should be supported through future mitigation efforts.

## I.6.2 Planning and Regulatory Capability

Planning and regulatory capabilities include plans, policies, and programs that guide development on campus. Table I.44 lists these local resources currently in place at UNC-W.

**Table I.44 – Planning and Regulatory Capability**

| Regulatory Tool (ordinances, codes, plans) | Y/N | Comments |
|---|---|---|
| Strategic Plan | Y | Soar Higher, 2025 |
| Master Plan | Y | UNC-W Master Plan, 2024 |
| Capital improvements plan | Y | Office of Facilities; Capital Projects |
| Local emergency operations plan | Y | Emergency Operations Plan, 2020 |

More details on several relevant tools are provided below:

- **Strategic Plan** identifies a future vision, values, principals and goals for the college, determines the projected growth for the college, and identifies policies to plan, direct and accommodate anticipated growth.
- **Master Plan** guides the physical development of the campus, providing a short and long-term framework that is clear, flexible, and implementable. The 2024 campus master plan is a road map for future growth, while allowing flexibility in its implementation.

- **Capital Improvement Plan** provides an outlook for anticipated capital projects designed to facilitate decision makers in the replacement of capital assets. Each UNC Campus creates and maintains a 6-year CIP, which helps inform the University of North Carolina System's CIP.
- **Emergency Operations Plan** outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

## I.6.3 Administrative and Technical Capability

Administrative and technical capability refers to the college's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. It also refers to the ability to access and coordinate these resources effectively. The personnel should be considered as well as the level of knowledge and technical expertise of these resources. Resources include engineers, planners, emergency managers, GIS analysts, building inspectors, grant writers, floodplain managers, and more. Table I.45 provides a summary of the administrative and technical capabilities for UNC-W.

**Table I.45 – Administrative and Technical Capability**

| Personnel Resources | Yes/No | Department/Position |
|---|---|---|
| Planner/Engineer with knowledge of land development/land management practices | Yes | Office of Facilities |
| Engineer/Professional trained in construction practices related to buildings and/or infrastructure | Yes | Office of Facilities |
| Planner/Engineer/Scientist with an understanding of natural hazards | Yes | Office of Facilities |
| Personnel skilled in GIS | Yes | Office of Facilities |
| Grant Writer | No | |
| Public Information Officer | Yes | Office of University Relations |
| Student Engagement | Yes | Division of Student Affairs |
| Warning Systems | Yes | University Police<br>5 Outdoor sirens |

Additional resources include the following:

- **Information Technology System** provides information technology support across campus including disaster recovery services for information technology.
- **Environmental Health and Safety** provides leadership in maintaining a safe and healthy environment; conducts facility and equipment inspections; coordinates university management activities.
- **Campus Space Planning** provides support, analysis, and accurate inventory information for the strategic use of UNC-W campus spaces.
- **Office of Facilities** provides planning and project management for major capital projects.

## I.6.4 Fiscal Capability

Financial capabilities are the resources that an entity has access to or is eligible to use to fund mitigation actions. The costs associated with implementing mitigation activities vary. Some mitigation actions such as building assessment or outreach efforts require little to no costs other than staff time and existing operating budgets. Other actions, such as structural projects, could require a substantial monetary commitment from local, State, and Federal funding sources. Table I.46 provides a summary of the fiscal resources at UNC-W.

**Table I.46 – Fiscal Resources**

| Resource | Ability to Use for Mitigation Projects? Y/N |
|---|---|
| Capital improvements project funding | Y |
| In-Kind Services | Y |
| Tuition & Fees | Y |
| Federal funding with HMA grants | Y |
| Revenue Bonds | Y |
| State Appropriations | Y |
| Sales & Services | Y |
| Other Sources (Gifts, Investment Income, Permanent Endowments) | Y |

# I.7 Mitigation Strategy

## I.7.1 Implementation Progress

Progress on the mitigation strategy developed in the previous plan is documented in this plan update. Table I.47 summarizes the status of mitigation actions from the previous plan. Table I.48 on the following pages details all completed and deleted actions from the 2021 plan. More details on the actions being carried forward are provided in Section I.7.2 in the Mitigation Action Plan.

**Table I.47 – Status of Previous Mitigation Actions**

| Campus | Completed | Deleted | Carried Forward |
|---|---|---|---|
| UNC-W | 16 | 6 | 31 |

## Table I.48 – Completed and Deleted Actions from the 2021 Plan

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNCW1 | Campus-Wide – Major mechanical systems (HVAC equipment, heat pumps, chillers, generators, fuel tanks, gas cylinders, and boilers) should be anchored to their foundations. This includes, but is not limited to, the following campus buildings: Cornerstone Hall; Galloway Residence Hall; Randall Library; and Warwick Center. | Delete | Will discuss with Facilities and proceed when funding/time is available. This is a maintenance activity. |
| UNCW3 | Belk Residence Hall - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be maintained and inspected regularly, especially prior to forecasted heavy rain events to prevent clogging. Ensure consistent inspection and maintenance of roof drains. | Delete | All campus flat roofs are on scheduled maintenance plans which include roof drains |
| UNCW5 | Belk Residence Hall - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW6 | Center for Marine Science (Myrtle Grove) - A noise reduction screen-wall was erected around mechanical equipment. Design plans for this addition were not available. It is unclear if this screen-wall could withstand high winds associated with a major hurricane. Failure of the screen wall could lead to progressive roof failure or become wind-borne debris causing damage to other portions of the building. Evaluate screen-wall to ensure ability to withstand hurricane forces winds. Retrofit if needed. | Completed | Screen wall was designed by engineer |
| UNCW8 | Cornerstone Hall - Located within the Category 5 Hurricane Surge Zone. Although the probability of an event of this magnitude occurring is low, the potential for damages does exist. In the event the building is inundated with floodwaters, extensive damage is possible. Due to the low probability of impact, substantial mitigation measures may not be cost effective. Develop a plan for active mitigation measures including sand bagging and temporary flood barriers to be instituted immediately prior to impact of a major hurricane event. | Completed | Hurricane preparation plans are in place |
| UNCW10 | Galloway Residence Hall - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be maintained and inspected regularly, especially prior to forecasted heavy rain events to prevent clogging. Ensure consistent inspection and maintenance of roof drains | Delete | Building no longer exists. Galloway Hall has been demolished. |
| UNCW11 | Galloway Residence Hall - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to utilize safety glass or other impact-resistant material. | Delete | Building no longer exists. Galloway Hall has been demolished. |

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNCW12 | Galloway Residence Hall - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Delete | Building no longer exists. Galloway Hall has been demolished. |
| UNCW13 | Hoggard Hall - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW15 | Leutze Hall - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW17 | Psychopharmacology Lab - At the time of the site inspections, this building was not in use. Typically, the building houses ongoing research activities, which are usually funded through some form of grant funding. If the building is used for this purpose in the future, the potential for substantial loss of research exists. If building is used again for research purposes, develop a plan to relocate critical research components to another facility prior to a moderate or severe wind event. | Completed | Research relocation plans in place by researchers in case of high wind event |
| UNCW18 | Psychopharmacology Lab - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW19 | Randall Library - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be maintained and inspected regularly, especially prior to forecasted heavy rain events to prevent clogging. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | All campus flat roofs are on scheduled maintenance plans which include roof drains |
| UNCW20 | Randall Library - Building is not located in a flood zone or hurricane surge zone. The potential of flooding to the building is low. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW24 | Telecommunications - Building should be periodically inspected. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Buildings are inspected for these items during routine maintenance visits |
| UNCW25 | Trask Coliseum - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be inspected regularly, especially prior to forecasted heavy rain events to prevent clogging. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | All campus flat roofs are on scheduled maintenance plans which include roof drains |

| Action # | Action | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|
| UNCW28 | Warwick Center - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be inspected regularly, especially prior to forecasted heavy rain events to prevent clogging. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | All campus flat roofs are on scheduled maintenance plans which include roof drains |
| UNCW30 | Westside Hall - The potential exists for clogged roof drains leading to increased loads on roof and potential for failure. Roof drains should be inspected and maintained regularly, especially prior to forecasted heavy rain events to prevent clogging. Institute periodic building envelope inspection program with emphasis on rooftop mechanical equipment, roof flashing, and roof coping. | Completed | Building renamed to DePaolo Hall. All campus flat roofs are on scheduled maintenance plans which include roof drains |
| UNCW32 | Westside Hall - The Student Health Center is located on the second floor of Westside Hall. The windows in this area are not protected by impact-resistant glass. The higher than typical contents value in this area, as well as the presence of medical records, would result in greater losses should window damage occur. Protect medical records and equipment. | Completed | Building renamed to DePaolo Hall. Issue will be submitted for one-time fund request by associated department |
| UNCW33 | Develop a process for identifying and cataloging the research undertaken at the university to better understand the support needs | Delete | Identification and cataloging process is underway by individual departments |
| UNCW35 | Develop continuity of operations plan | Completed | COOP plans developed |
| UNCW41 | Congdon Hall - Air conditioner system for critical infrastructure has no redundancy. Assess options for ceiling mount air conditioning system on a separate circuit | Completed | Redundant system installed |

## I.7.2 Mitigation Action Plan

**Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include an] action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.**

The following table comprises the mitigation action plan for UNC-W. Each mitigation action recommended for implementation is listed in these tables along with detail on the hazards addressed, the goal and objective addressed, the priority rating, the lead agency responsible for implementation, potential funding sources for the action, a projected implementation timeline, and the 2026 status and progress toward implementation for actions that were carried forward from the 2021 plan.

**Table I.49 – Mitigation Action Plan, UNC-W**

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCW1 | Acquire generators or other forms of redundant power supply to ensure that critical facilities and infrastructure remain operational where normal power supply is not available. | All Hazards | 3.2 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Resiliency plans for previously listed campus buildings are underway or complete. Action revised to support back power for additional campus facilities. |
| UNCW2 | Belk Residence Hall - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to utilize safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW3 | Center for Marine Science (Myrtle Grove) - The primary function of the CMS building is as a marine research facility. Portions of the research conducted at this facility require fresh seawater, which is pumped from the Intercoastal Waterway via an above-ground piping system. Because it is above ground, this system has the potential to be damaged, which could cause a loss of research. Upgrade seawater piping system to higher quality insulated piping system and install bollards or other protective measures in areas of high vehicular traffic. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.2 | L | Structural Projects | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | State/Federal Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW4 | Cornerstone Hall - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to utilize safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW5 | Leutze Hall - Windows/doors are not fitted with impact–resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to utilize safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW6 | Psychopharmacology Lab - Pre-engineered metal buildings of this type often fail when exposed to wind speeds greater than the design wind speed. Based on general building type, this building has the highest risk to potential structural damages during severe wind events. The dense tree load around the building may offer some protection from wind forces, but also increases the potential of building damage as a result of adjacent tree failure. Retrofit existing building to increase wind resistance by adding additional bracing and connectors for roofing system. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCW7 | Telecommunications - Pre-engineered metal buildings of this type often fail when exposed to wind speeds greater than the design wind speed. Based on general building type, this building has the highest risk to potential structural damages during severe wind events. Retrofit building to increase wind resistance by adding additional bracing and connectors for roofing system. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW8 | Telecommunications - This building houses the critical communications equipment for the campus. A loss of this building would currently result in a full loss of communication ability for the campus. There is an on-going project to install a redundant server in Hoggard Hall to allow for continuation of service should this building be damaged. However, the potential for damages to valuable contents of this building still exists. Look for opportunities during overall campus expansion to relocate Telecommunication Services out of pre-engineered metal building. | All Hazards | 1.2 | H | Structural Projects, Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | State/Federal Grants | 2026-2030 | Carry Forward | We will look for opportunities to relocate during future campus expansions |
| UNCW9 | Telecommunications - Telecommunications building is located within the Category 5 hurricane surge zone. Although the probability of an event of this magnitude occurring is low, the potential for damages exists. In the event the building is inundated with floodwaters, extensive damage is possible. Due to the low probability of impact, substantial mitigation measures may not be cost effective; however, best practices such as protecting contents is recommended. Develop a plan to relocate contents and transfer communication functions in advance of forecasted moderate to severe hurricanes. Begin to elevate sensitive contents above the first floor when possible. | Hurricanes & Coastal Hazards | 1.2 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Conversations with IT department head are currently in progress |
| UNCW10 | Trask Coliseum - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW11 | University Police - The University Police Building is made up of three separate buildings, two of which are manufactured buildings or trailers. Buildings of this type often fail when exposed to wind speeds greater than the design wind speed. Based on general building type, this building has the highest risk to potential structural damages during severe wind events. Look for opportunities during overall campus expansion to relocate University Police out of manufactured buildings and out of the Category 5 surge zone. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.2 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Will look for opportunities to add to campus master plan |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCW12 | Warwick Center - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW13 | DePaolo Hall - Windows/doors are not fitted with impact-resistant glass or other protection. Potential for damage during hurricane events could lead to substantial internal water damage. Upgrade windows to safety glass or other impact-resistant material. | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Update & Carry Forward | Building renamed to DePaolo Hall. Issue will be submitted for one-time fund request by associated department |
| UNCW14 | For buildings with critical contents or functions, install emergency generators and/or generator hook-ups and consider the portability of these generators. Needs would, in part, be based on information gathered in Action B. Generators would be purchased through phased approach. | All Hazards | 1.2 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; Environmental Health & Safety | ~$90,000-$250,000 per generators | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Many buildings have generators or generator hook ups, further future infrastructure is planned as funds allow |
| UNCW15 | Develop a Stormwater Master Plan | Flooding | 3.1 | H | Prevention | Associate Vice Chancellor for Business Affairs - Facilities | $100,000 | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Stormwater master plan is being developed |
| UNCW16 | Build hardened facilities to house critical university functions such as police and emergency response operations, telecommunications, electrical substation, etc. as well as an Emergency Operations Center (EOC) in times of disaster | All Hazards | 1.1 | H | Property Protection | Associate Vice Chancellor for Business Affairs-Facilities, University Police, Vice Chancellor for IT | $200/sq. ft. | Federal/State Grants | 2026-2030 | Carry Forward | Added to future masterplan |
| UNCW17 | Hoggard - Emergency operations space is woefully inadequate for housing staff and provide for coordination efforts. Reassess operating space. Identify larger space and upgrade | All Hazards | 1.2 | M | Emergency Services | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW18 | Telecommunications - Other data centers on campus have a secondary roof called a "rain shield." This data center does not. Install a "rain shield" | Flooding, Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.2 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW19 | Congdon Hall - Other data centers on campus have a secondary roof called a "rain shield." This data center does not. Install a "rain shield" | Flooding, Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW20 | Energy Plant (each) - Energy plants do not have capability for rapid backup generator connections. Install generator quick connects at each energy plant | All Hazards | 1.2 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Federal/State Grants | 2026-2030 | Carry Forward | In Planning Phase |
| UNCW21 | Alderman Hall - The current windows in Alderman Hall are vulnerable to high winds and water intrusion and can cause the loss of the building envelope if not replaced. Replace windows in Alderman Hall with a higher wind rating | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW22 | Hanover Gymnasium - This facility serves as a coordination location for disaster recovery. It does not have impact resistant windows. Install impact resistant windows for upper levels | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.2 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |

| Action # | Action Description | Hazard(s) Addressed | Goal & Objective Addressed | Priority | Mitigation Category | Lead Agency / Department | Estimated Cost | Potential Funding Source | Implementation Timeline | 2026 Status | 2026 Implementation Status Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCW23 | UNCW Police non-dispatch area - The entire University Police building is not hardened. Harden remaining areas of the University Police Facility | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.2 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW24 | UNCW Library - Randall Hall - The library is reliant on continuous HVAC operations to prevent mold growth on vulnerable items. Install quick connect for chilled water | All Hazards | 1.2 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW25 | Center for Marine Science Main Building - The outside air intake is vulnerable to flooding. Relocate air intake | Flooding | 1.1 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW26 | Center for Marine Science Main Building - The current backup generator is old and underpowered. Install appropriately sized generator | All Hazards | 1.1 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW27 | Center for Marine Science Main Building - The current cooling tower is on top of the building and is vulnerable to high winds. Relocate cooling tower apparatus | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | M | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW28 | Center for Marine Science Main Building - The current roof of the main building needs replacement and upgrades to a higher wind rating. Fortify the roof structure and replace roofing materials | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Project is currently in design |
| UNCW29 | Center for Marine Science Main Building - The current windows are vulnerable to breakage from flying objects and high wind. Install impact resistant windows | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW30 | Campus wide power grid - Currently power supply comes from three locations into campus but if city wide power is out backup power is provided by generators. Subscribe to backup generation service provided by Duke/Progress energy | All Hazards | 1.1 | H | Emergency Services | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW31 | Campus wide power grid - Currently backup power is provided by generators that must be hard wired into the target building. Install power taps on all key structures on campus | All Hazards | 1.1 | H | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities; | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | Carry Forward | Issue will be submitted for one-time fund request by associated department |
| UNCW32 | Improve drainage conditions through the identification and implementation of capital improvements projects | Flooding, Hurricane & Coastal Hazards | 1.1 | M | Structural Projects | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | New | |
| UNCW33 | Decrease impervious surface; install low impact development techniques | Flooding, Hurricane & Coastal Hazards | 1.3 | M | Structural Projects | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | New | |
| UNCW34 | Increase shade in parking lots and public spaces | Excessive Heat | 2.1 | M | Structural Projects | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | New | |
| UNCW35 | Retrofit facilities to withstand high winds | Hurricanes & Coastal Hazards, Tornadoes & Thunderstorms | 1.1 | L | Property Protection | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | New | |
| UNCW36 | Develop an online (website) and social media campaign to promote information, facts and procedures for various hazards to enhance the preparedness and education of students, faculty, and staff. | All Hazards | 2.1 | H | Public Education | Associate Vice Chancellor for Business Affairs - Facilities | To be determined | Operating Budget, Federal/State Grants | 2026-2030 | New | |

# Appendix A – Plan Review Tool

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# Local Mitigation Plan Review Tool

## Cover Page

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

*For greater clarification of the elements in the Plan Review Checklist, please see Section 4 of this guide. Definitions of the terms and phrases used in the PRT can be found in Appendix E of this guide.*

| Plan Information | |
|---|---|
| **Jurisdiction(s)** | East Carolina University (ECU), Elizabeth City State University (ECSU), Fayetteville State University (FSU), North Carolina Central University (NCCU), North Carolina School of Science and Math (NCSSM), North Carolina State University (NCSU), University of North Carolina Chapel Hill (UNC-CH), University of North Carolina Pembroke (UNC-P), University of North Carolina Wilmington (UNC-W) |
| **Title of Plan** | UNC Eastern Campuses Hazard Mitigation Plan |
| **New Plan or Update** | Update |
| **Single- or Multi-Jurisdiction** | Multi-jurisdiction |
| **Date of Plan** | 4/15/2026 |
| **Local Point of Contact** | |
| **Title** | Abby Moore |
| **Agency** | WSP |
| **Address** | 4021 Stirrup Creek Drive, Suite 100, Durham, NC 27703 |
| **Phone Number** | 919-767-1112 |
| **Email** | abigail.moore@wsp.com |

| Additional Point of Contact | |
|---|---|
| **Title** | David Stroud |
| **Agency** | WSP |
| **Address** | 4021 Stirrup Creek Drive, Suite 100, Durham, NC 27703 |
| **Phone Number** | 919-325-6497 |
| **Email** | david.stroud@wsp.com |

| Review Information | |
|---|---|
| **State Review** | |
| **State Reviewer(s) and Title** | Click or tap here to enter text. |
| **State Review Date** | Click or tap to enter a date. |
| **FEMA Review** | |
| **FEMA Reviewer(s) and Title** | Click or tap here to enter text. |
| **Date Received in FEMA Region** | Click or tap to enter a date. |
| **Plan Not Approved** | Click or tap to enter a date. |
| **Plan Approvable Pending Adoption** | Click or tap to enter a date. |
| **Plan Approved** | Click or tap to enter a date. |

# Multi-Jurisdictional Summary Sheet

In the boxes for each element, mark if the element is met (Y) or not met (N).

| # | Jurisdiction Name | A. Planning Process | B. Risk Assessment | C. Mitigation Strategy | D. Plan Maintenance | E. Plan Update | F. Plan Adoption | G. HHPD Requirements | H. State Requirements |
|---|---|---|---|---|---|---|---|---|---|
| 1 | East Carolina University (ECU) | | | | | | | | |
| 2 | Elizabeth City State University (ECSU) | | | | | | | | |
| 3 | Fayetteville State University (FSU) | | | | | | | | |
| 4 | North Carolina Central University (NCCU) | | | | | | | | |
| 5 | North Carolina School of Science and Math (NCSSM) | | | | | | | | |
| 6 | North Carolina State University (NCSU) | | | | | | | | |
| 7 | University of North Carolina Chapel Hill (UNC-CH) | | | | | | | | |
| 8 | University of North Carolina Pembroke (UNC-P) | | | | | | | | |
| 9 | University of North Carolina Wilmington (UNC-W) | | | | | | | | |
| | | | | | | | | | |

# Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. 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." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

## Element A: Planning Process

| Element A Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))** | | |
| A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved? | Section 2, p.19-31; Appendix B | Choose an item. |
| A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process? | Section 1.1, p.2; Section 1.3, p.4; Section 2.3-2.4, p.20-28; Appendix B | Choose an item. |

| Element A Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))** | | |
| A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity? | Section 2.4, p.23-28; Section 2.6-2.7, p.28-30; Appendix B | Choose an item. |
| **A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))** | | |
| A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan? | Section 2.5-2.6, p.28-30; | Choose an item. |
| **A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))** | | |
| A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document? | Annexes Section 1; Appendix C | Choose an item. |

| ELEMENT A REQUIRED REVISIONS |
|---|
| Required Revision**:**<br>Click or tap here to enter text. |

## Element B: Risk Assessment

| Element B Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))** | | |
| B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area? | Section 3.2, p.33-34; Annexes Section 4 | Choose an item. |
| B1-b. Does the plan include information on the location of each identified hazard? | Annexes Section 4 ("Location" subheadings) | Choose an item. |
| B1-c. Does the plan describe the extent for each identified hazard? | Annexes Section 4 ("Extent" subheadings) | Choose an item. |
| B1-d. Does the plan include the history of previous hazard events for each identified hazard? | Annexes Section 4 ("Historical Occurrences" subheadings) | Choose an item. |
| B1-e. Does the plan include the probability of future events for each identified hazard, including the type, location and range of anticipated intensities? | Annexes Section 4 ("Probability of Future Occurrence" subheadings) | Choose an item. |
| B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area? | Annexes Section 4 | Choose an item. |
| **B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))** | | |
| B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards? | Annexes Section 4 (Exposure); Annexes Section 5 (Vulnerability) | Choose an item. |

| Element B Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction? | Annexes, Section 4 ("Vulnerability Assessment" and "Consequence Analysis" subheadings) | Choose an item. |
| B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods? | N/A (Section 3.4.5, p.54) | Choose an item. |

| ELEMENT B REQUIRED REVISIONS |
|---|
| Required Revision:<br>Click or tap here to enter text. |

## Element C: Mitigation Strategy

| Element C Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))** | | |
| C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations? | Annexes Section 6 | Choose an item. |
| C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation? | Annexes Section 6 | Choose an item. |
| **C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))** | | |
| C2-a. Does the plan contain a narrative description or a table/list of their participation activities? | N/A | Choose an item. |

| Element C Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))** | | |
| C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan? | Section 4.1, p.93-94 | Choose an item. |
| **C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))** | | |
| C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment? | Section 4.2, p.94-95; Annexes Section 7; Appendix B (HMPC Meeting 3) | Choose an item. |
| C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment? | Annexes Section 7.2 | Choose an item. |
| **C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))** | | |
| C5-a. Does the plan describe the criteria used for prioritizing actions? | Section 4.2, p. 95-96 | Choose an item. |
| C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame? | Annexes Section 7.2 | Choose an item. |

| **ELEMENT C REQUIRED REVISIONS** |
|---|
| Required Revision**:**<br>Click or tap here to enter text. |

## Element D: Plan Maintenance

| Element D Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))** | | |
| D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved? | Section 5.2, p.101-102 | Choose an item. |
| **D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))** | | |
| D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process? | Section 5.2, p.97-101 | Choose an item. |
| D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible. | Section 5.2, p.99-101 | Choose an item. |
| D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process? | Section 5.2, p.99-101 | Choose an item. |
| **D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))** | | |
| D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms? | Section 5.1, p.97-99 | Choose an item. |
| D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated? | Section 5.1, p.97-99 | Choose an item. |
| D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms? | Section 5.1, p.97-99 | Choose an item. |

| ELEMENT D REQUIRED REVISIONS |
|---|
| Required Revision:<br>Click or tap here to enter text. |

## Element E: Plan Update

| Element E Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))** | | |
| E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved? | Annexes Section 2; Annexes Section 3; Annexes Section 5 | Choose an item. |
| **E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))** | | |
| E2-a. Does the plan describe how it was revised due to changes in community priorities? | Section 4 p.93-96; Annexes Section 7 | Choose an item. |
| E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan? | Annexes Section 7.1 (Completed & Deleted actions); Annexes Section 7.2 (Carried Forward actions) | Choose an item. |
| E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms? | Section 5.1, p.97-99 | Choose an item. |

| ELEMENT E REQUIRED REVISIONS |
|---|
| Required Revision:<br>Click or tap here to enter text. |

## Element F: Plan Adoption

| Element F Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))** | | |
| F1-a. Does the participant include documentation of adoption? | Section 6, p.103-115 | Choose an item. |
| **F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))** | | |
| F2-a. Did each participant adopt the plan and provide documentation of that adoption? | Section 6, p.103-115 | Choose an item. |

| **ELEMENT F REQUIRED REVISIONS** | | |
|---|---|---|
| Required Revision:<br>Click or tap here to enter text. | | |

## Element G: High Hazard Potential Dams (Optional)

| HHPD Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?** | | |
| HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency? | N/A | Choose an item. |
| HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners? | N/A | Choose an item. |
| **HHPD2. Did the plan address HHPDs in the risk assessment?** | | |
| HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs? | N/A | Choose an item. |
| HHPD2-b. Does the plan document the limitations and describe how to address deficiencies? | N/A | Choose an item. |

| HHPD Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?** | | |
| HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies? | N/A | Choose an item. |
| HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals? | N/A | Choose an item. |
| **HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?** | | |
| HHPD4-a. Does the plan describe specific actions to address HHPDs? | N/A | Choose an item. |
| HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs? | N/A | Choose an item. |
| HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs? | N/A | Choose an item. |

| HHPD Required Revisions |
|---|
| Required Revision**:**<br>Click or tap here to enter text. |

## Element H: Additional State Requirements (Optional)

| Element H Requirements | Location in Plan (section and/or page number) | Met / Not Met |
|---|---|---|
| **This space is for the State to include additional requirements.** | | |
| Click or tap here to enter text. | Click or tap here to enter text. | Choose an item. |

# Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

## Element A. Planning Process

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element B. Risk Assessment

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element C. Mitigation Strategy

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element D. Plan Maintenance

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element E. Plan Update

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element G. HHPD Requirements (Optional)

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

## Element H. Additional State Requirements (Optional)

**Strengths**

- [insert comments]

**Opportunities for Improvement**

- [insert comments]

# Appendix B – Planning Process Documentation

## B.1 Planning Step 1: Organize to Prepare the Plan

**Table B.1 – HMPC Meeting Topics, Dates, and Locations**

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| **Meeting #1 - Kickoff** | | | |
| All Campuses HMPC | 1) Introduction to DMA, CRS, and FMA requirements and the planning process<br>2) Review of HMPC responsibilities and the project schedule<br>3) Preliminary hazard identification | July 22, 2025, 1 PM | Microsoft Teams |
| **Meeting #2** | | | |
| ECU | 1) Review Draft Hazard Identification & Risk Assessment | October 17, 2025, 1 PM | Microsoft Teams |
| ECSU | | November 17, 2025, 2 PM | Microsoft Teams |
| FSU | | November 24, 2025, 1 PM | Microsoft Teams |
| NCCU | | November 11, 2025, 3 PM | Microsoft Teams |
| NCSSM | | December 16, 2025, 10 AM | Microsoft Teams |
| NCSU | | October 29, 2025, 10 AM | Microsoft Teams |
| UNC-CH | | November 5, 2025, 1 PM | Microsoft Teams |
| UNC-P | | November 3, 2025, 10 AM | Microsoft Teams |
| UNC-W | | January 22, 2026, 3pm | Microsoft Teams |
| **Meeting #3** | | | |
| ECU | 1) Update Goals and Objectives<br>2) Review Capability Assessment<br>3) Update Mitigation Action Plans<br>4) Review Mitigation Alternatives | March 4, 2026, 3pm | Microsoft Teams |
| ECSU | | February 18, 2026, 3pm | Microsoft Teams |
| FSU | | March 4, 2026, 11am | Microsoft Teams |
| NCCU | | February 25, 2026, 11am | Microsoft Teams |
| NCSSM | | March 27, 2026 10am | Microsoft Teams |

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| NCSU | | February 19, 2026, 2pm | Microsoft Teams |
| UNC-CH | | March 5, 2026, 1:30pm | Microsoft Teams |
| UNC-P | | February 26, 2026, 3pm | Microsoft Teams |
| UNC-W | | February 6, 2026, 2:30pm | Microsoft Teams |
| **Meeting #4** | | | |
| All Campuses HMPC | 1) Review the Draft Hazard Mitigation Plan<br>2) Solicit comments and feedback | March 31, 2026, 3pm | Microsoft Teams |

# B.1.1 HMPC Meeting Agendas, Minutes, and Sign-in Sheets

## HMPC Kickoff: All Campuses – July 22, 2025

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #1

July 22, 2025, 1 pm, Microsoft Teams

ATTENDANCE

There were 50 attendees. The following individuals were in attendance:
Nick Agresta, EM Specialist, ECU
John Albrechtsen, Lead Business Systems and Data Analytics Specialist, UNC-Chapel Hill
Andrea Jacobs, Athletics Business Manager, UNC-Pembroke
Griffin Avin, Director of Facilities Services for Health Sciences Campus, ECU
Bill Bagnell, Campus Operations, ECU
Cathy Brennan, Executive Director of Environmental Health and Safety, UNC-CH
Gretchen Brockmann, Director of Housing Operations, ECU
Lauren Brunell, Assistant Director of Networking for ITS, UNC-Wilmington
Kristy Burnette, Risk Management UNC-Wilmington
Laurie Burroughs, Budget Manager, UNC-Chapel Hill
Charles Chavis, Environmental Health and Safety, UNC- Pembroke
Michael Cherry, Associate Athletic Director of Facilities & Event Management, UNC-Wilmington
Danny Clipper, Environmental Health & Safety Professional, ECSU
Dennis Leary, Director of Facilities Management, ECSU
Ernest Cuthbertson, Director of Public Safety, ECSU
George Earl Johnson, Chief of Police, UNC-Pembroke
Jerry Guerrier, Assistant Director Facilities Planning and Design, UNC-Chapel Hill
Ricky Hill, Facilities Services Director, ECU
Undi Hoffler, Director, Research Compliance and Technology Transfer, NCCU
Brigitte Ironside, Budget Analyst, UNC-Chapel Hill
Darrell Jeter, Emergency Management, UNC-Chapel Hill
Kevin Kupietz, Department Chair of Aviation and Emergency Management, ECSU
Bill Koch, Campus Safety, ECU
Kyle Smith, Associate Vice Chancellor & Dean of Student, UNC-Pembroke
Aspen Lawrence, Emergency Manager, ECU
Phill Lewis, Director of Environmental Health and Safety, ECU
Mark Vesely, Director of Operation and Maintenance, UNC-Pembroke
Ondin Mihalcescu, Director of Design and Construction, NCCU
Mark Morgan, AVC Facilities, UNCW
Gregory Moyd, Assistant Vice Chancelor of Student Affairs
Beatrice Muganda, Energy Services Project Manager, UNC-Chapel Hill
Michael O'Driscoll, Department of Coastal Studies, ECU
Rhonda Olson, Emergency Manager, UNC-Wilmington
Brittany Philbert, Housing and Residence Life, UNC-Wilmington
Abbas Piran, Facilities Technology Group, UNC-Chapel Hill

Polina Chemishanova, Assistant Vice Chancellor for Academic Planning and Accreditation, UNC-Pembroke
Rondall Rice, Associate Vice Chancellor for Administration, NCCU
Robert Thibeault, Vice Chancellor for Business and Finance, ECSU
Sabrina Kellogg, Director of Housing & Residence Life & Transportation Services, ECSU
Kelly Shook, Assistant Director, Environmental Health and Safety, ECU
Park Moran, Director of Networks and IT Operations, UNC-Wilmington
Steven Still, Director of Emergency Management, New Hanover County
Jason Sugg, Police Chief, ECU
Chris Sutton, Deputy Chief of Police, ECU
Todd Becker, Emergency Management and Mission Continuity, NC State
Victor Deese, Assistant Vice Chancellor for Facilities, UNC-Pembroke
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
Abby Moore, WSP
Ranger Ruffins, WSP

## AGENDA

- NCEM Introduction
- Why Plan?
- Project Overview
- Planning Process
- Project Schedule
- Next Steps
- Q & A

## NCEM INTRODUCTION

NCEM Plans Manager, Carl Baker, provided a brief overview of the Hazard Mitigation Plan (HMP) update process and the role of each participant. Carl explained that North Carolina plan updates are funded through the HMGP and State funds. He noted that while NCEM has appointed consultants to facilitate the plan updates, NCEM is available to provide support throughout the planning process. Once the draft plan is completed, NCEM will review the plan for accuracy and compliance with federal guidance. They will also submit the plan to FEMA for approval.

## WHY PLAN?

Abby began the presentation with why we plan in the first place. She discussed the Disaster Mitigation Act (DMA) of 2000, which is codified in 44 CFR 201.6 and requires local government to update their hazard mitigation plans every five years to be eligible for pre- and post-disaster grant funding through FEMA's Hazard Mitigation Assistance programs. Mitigation funding available through FEMA includes the Hazard Mitigation Grant Program (HMGP). Abby noted that each campus is eligible for HMGP funding whenever a disaster is declared in the state of North Carolina, even if it does not directly impact your campus, as there is often funding left over after projects have been completed in affected areas.

Abby reviewed trends in disasters that support the need for mitigation planning. In FY2024 there were 27 billion-dollar disasters. There's an increasing trend in recent years in the number of billion-dollar disasters. This may be in part because we now have more frequent and intense hazard events and greater exposure to risk (people, property and critical infrastructure). Abby explained that hazard mitigation is a priority for multiple reasons, including that the cost of doing nothing is too high, many events are predictable and repetitive, loss reduction can be effective, cost-beneficial, and environmentally-sound, there are legal and moral responsibilities to prevent disasters, and there are federal funds available to

support mitigation. The average benefit-cost ratio (BCR) for federally funded projects is 6:1 and is even higher for flood mitigation.

PROJECT OVERVIEW

Abby explained that we must follow the DMA four-phase planning process to meet the requirements. The DMA process provides continued eligibility for mitigation funding and guides mitigation activities in a coordinated and economical manner. The plan will include all required elements as defined in the FEMA Local Mitigation Plan Review Guide and follow guidance in FEMA's Building a Disaster Resistant University guide. Overall, the WSP planning team will ensure that the updated hazard mitigation plan meets all FEMA planning requirements.

PLANNING PROCESS

**PHASE 1**

Abby described the planning process in more detail. Phase 1, organize resources, is already underway. The HMPC has been reconvened, and new staff members and stakeholders were identified for involvement. Please contact Abby if you need additional updates to your communities' HMPC representatives.

The HMPC will be asked to attend four meetings (including this one), provide input on risk and capability, update mitigation actions, and review plan drafts. HMPC members, especially staff, will also be asked to support public involvement efforts throughout the planning process.

Abby noted that more stakeholders can still join the HMPC. We can also invite additional stakeholders to provide data and input without having to commit to participating on the HMPC. In particular, we should look to involve stakeholders that can provide input specific to each campus so the plan captures more detailed information beyond was is gathered from federal or state resources.

**PHASE 2: ASSESS RISKS**

Phase 2 covers the risk assessment, which includes the hazard identification and the vulnerability assessment. All of the hazards that were addressed in the previous plan will be carried over into this plan update. The identified hazards area s follows: Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Geological (Landslide & Sinkhole), Hurricane & Tropical Storm, Severe Winter Weather, Tornado/Thunderstorm, Wildfire, Cyber Threat, Hazardous Materials, Infectious Diseases, Terrorism, Vandalism/Theft. Not every hazard is covered for each campus. You can review each campuses hazards and Priority Risk Index results in the figure below or on slide 23. It was discussed and determined that extreme heat would be evaluated for each campus. UNC-Wilmington will also evaluate drought. Please contact WSP if you would like to make any changes to the assessed hazards.

| Hazard | ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|---|
| Dam Failure | | | | | | | 2.4 | | |
| Drought | | | | | | | 2.5 | | |
| Earthquake | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Extreme Heat | | | | | | | | 3.1 | |
| Flood | 2.5 | 2.5 | 2.2 | 1.8 | 1.8 | 2.8 | 1.8 | 2.1 | 2.1 |
| Geological | 1.1 | | 1.1 | 1.3 | 1.3 | | 1.3 | 1.1 | 1.9 |
| Hurricane | 3.2 | 3.2 | 2.9 | 2.9 | 2.9 | 2.9 | 2.3 | 2.9 | 3.2 |
| Severe Winter Weather | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | |
| Tornado/Thunderstorm | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Wildfire | 2.5 | 2.5 | 2.5 | 2.0 | 1.5 | 2.8 | 2.5 | 2.8 | 3.1 |
| Cyber | 3.1 | 3.1 | | 3.1 | | 3.1 | | 3.1 | 3.1 |
| Hazardous Materials | 2.3 | 2.0 | | 2.3 | 2.3 | 2.3 | 2.0 | 2.2 | 2.3 |
| Infectious Disease | 2.8 | 2.8 | | 2.8 | | 2.8 | | 2.8 | 2.8 |
| Terrorism | | | | | | 2.8 | | | 2.8 |
| Vandalism/Theft | | | | | 2.5 | | | | |

To conduct the vulnerability assessment, NCEM iRisk data, and data from UNC System Division of IT and NC Department of Insurance will be used to provide loss estimates for several hazards. Additional qualitative, quantitative, and spatial analysis will be used as appropriate. Campuses were asked to send a list of updated facilities to the WSP team. Abby noted that critical facilities will be categorized by FEMA lifeline in the plan update, which may be helpful when preparing FEMA grant applications.

**PHASE 3: DEVELOP A MITIGATION STRATEGY**

Phase 3 involves developing a mitigation strategy by reviewing and updating the plan goals and objectives, evaluating mitigation alternatives including existing and new projects, and drafting an action plan with prioritized projects.

Abby reviewed the goals and objectives from the existing HMP, which are as follows (can also be viewed on slide 27):

**Goal 1: Reduce the impact of hazards on campus buildings, critical facilities, and critical infrastructure.**

- Objective 1.1: Retrofit or otherwise protect critical facilities and infrastructure.
- Objective 1.2: Protect critical research and campus operations.
- Objective 1.3: Preserve and protect natural systems and resources that provide hazard mitigation benefits.

**Goal 2: Protect the public health, safety, and welfare of people on campus from hazard risk.**

- Objective 2.1: Implement outreach activities to create a culture of preparedness by educating campus communities on local risks, property protection, and personal protection.
- Objective 2.2: Improve hazard monitoring and warning systems to enable earlier response actions.
- Objective 2.3: Create or update existing campus evacuation and shelter in place procedures.

**Goal 3: Build campus resilience to minimize interruption and ensure speedy recovery from hazard events.**

- Objective 3.1: Develop or revise plans, policies, and regulations to reduce vulnerability of new construction on campus.
- Objective 3.2: Improve campus mitigation and response capabilities.

No one suggested any amendments. Rhonda Olson, asked if each campus would develop their own goals, noting that each campus has varying capabilities. Abby explained that the goals are applied to all participating campuses, but that each campus will have their own mitigation actions that speak to each campus' capabilities.

The mitigation action plan will identify criteria to support monitoring and implementation, including the responsible department or agency, timeline for completion, and potential funding sources. Abby explained that each participating campus will need to provide a status update for each of the projects included in the previous plan. It should be indicated if each project has been completed, deleted, or carried forward. If the project is carried forward a progress update will need to be provided.

Abby also reviewed different approaches to mitigation based on the six FEMA mitigation categories: prevention, property, structural projects, emergency services, natural resources protection, and public education. FEMA requires the community to have at least one action for each of the identified hazards. Abby reminded the HMPC that projects must be in the hazard mitigation plan to be eligible for FEMA HMA funding.

### PHASE 4: ADOPTION AND IMPLEMENTATION

Phase 4 is where the campuses must adopt and implement the plan. Each of the participating school must adopt the plan by resolution. Abby noted that the HMPC will need to meet at least annually to review the action plan and look for funding and opportunities to implement projects. The plan will continue to be updated every five years.

PROJECT SCHEDULE

Abby presented the schedule for the planning process. The second and third HMPC meetings will be individual campus meetings, the entire Eastern Campus HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

NEXT STEPS

### PUBLIC OUTREACH

Abby discussed public outreach efforts which include public meetings facilitated by WSP, a public survey, and a plan website (https://www.NCEastCampusHMP.com). Campus staff will be asked to post outreach on school websites and social media. A public survey has been created and can be shared with campus staff, students, and stakeholders. WSP will provide some language to publicize the plan website and survey. Community staff were also asked to think about additional stakeholders to involve in the planning process – please send any relevant contact to the WSP team.

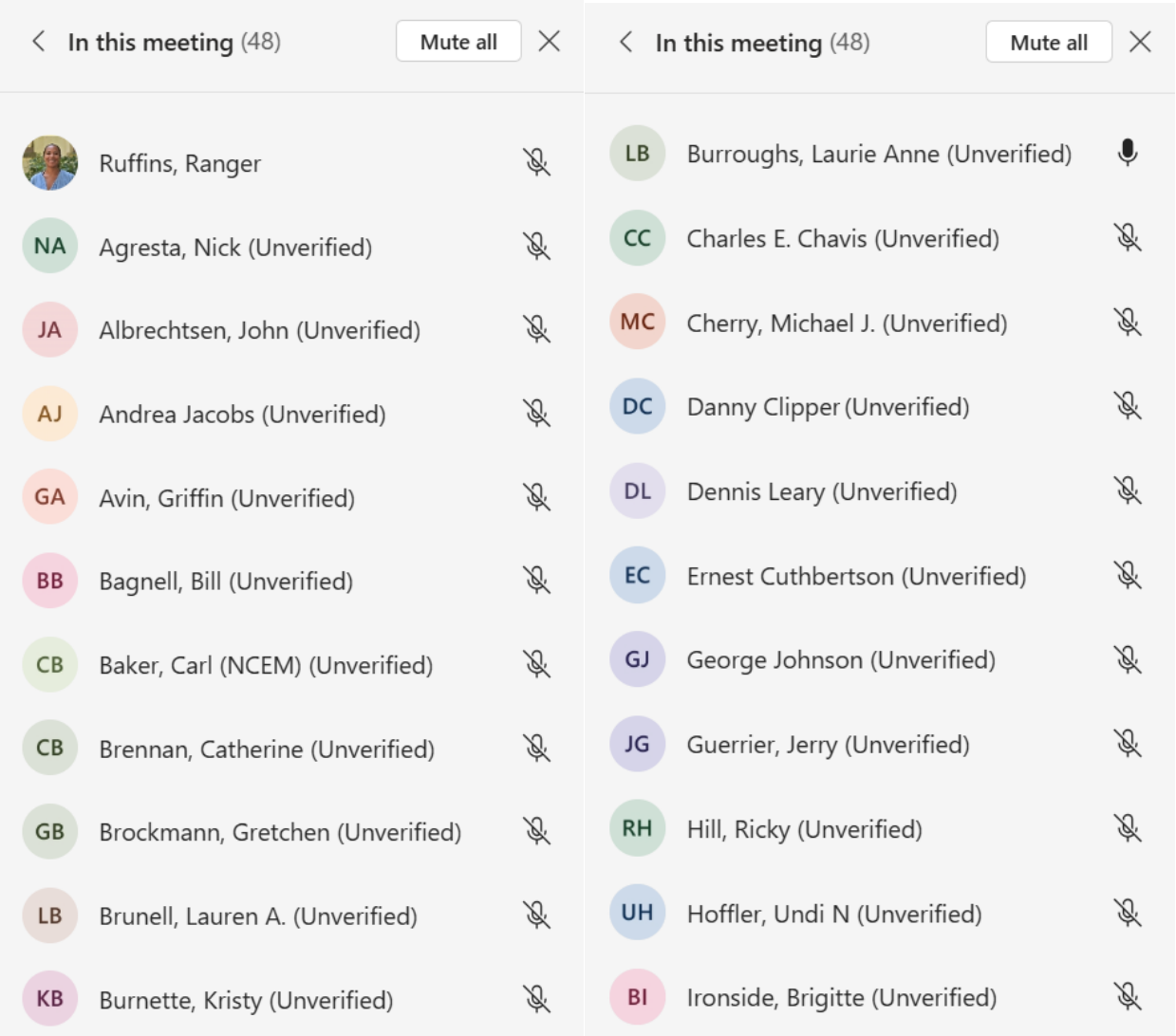
### WHAT'S NEXT

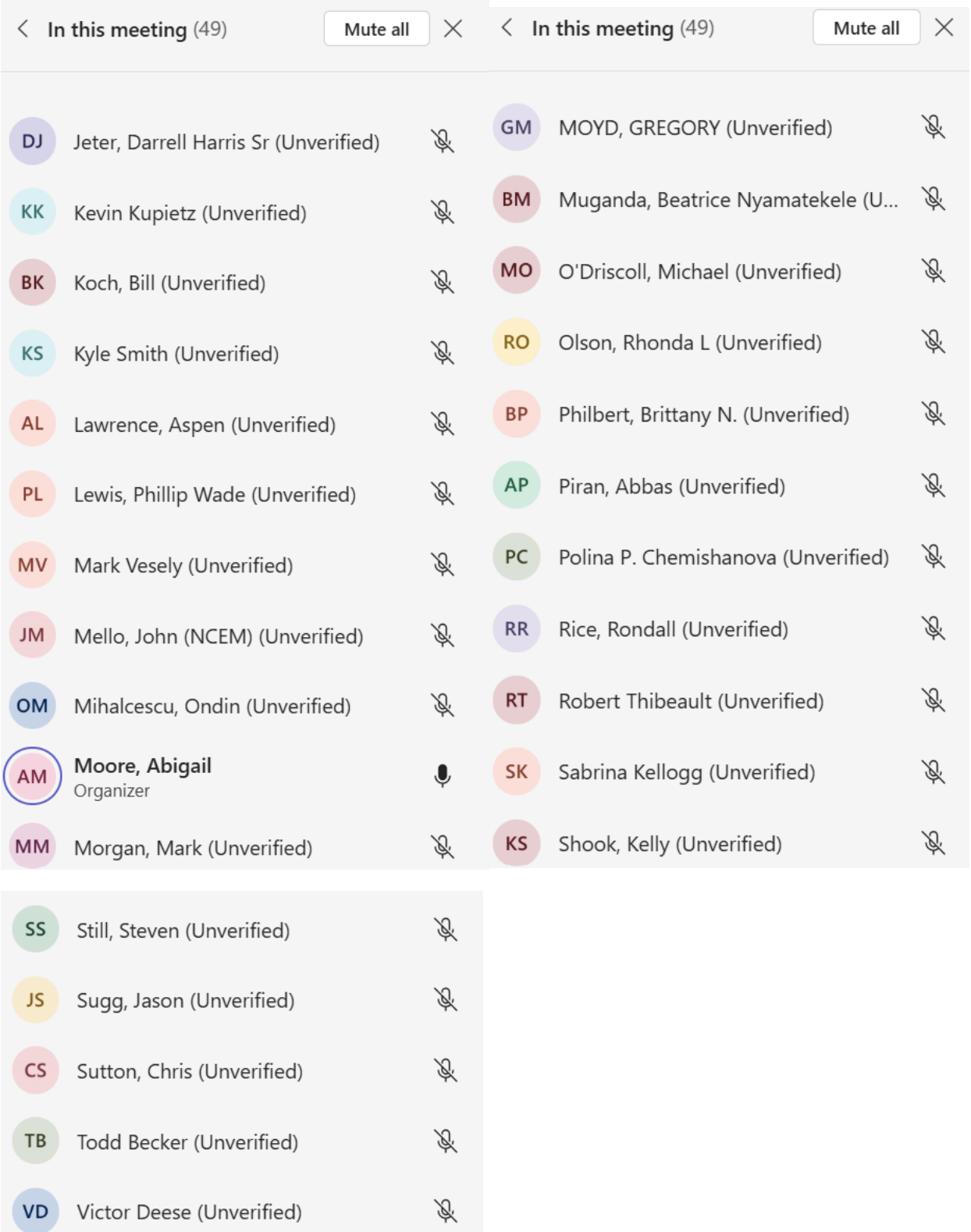
WSP is working on the risk and vulnerability assessment update and will reach out to community representatives on the HMPC for updates on local capability. WSP will provide language for advertising the plan website and survey.

WSP will select a date in late September to hold the first public kickoff meeting. They will also reach out to each campus to schedule the next HMPC meeting in late September or October.

The HMPC was asked to review the existing mitigation strategy to provide action status updates. WSP will send existing projects to each campus for review.

Each school was also asked to advertise the plan website, survey, and public meeting once a date has been selected.


In this meeting (48)
Mute all
Ruffins, Ranger
NA Agresta, Nick (Unverified)
JA Albrechtsen, John (Unverified)
AJ Andrea Jacobs (Unverified)
GA Avin, Griffin (Unverified)
BB Bagnell, Bill (Unverified)
CB Baker, Carl (NCEM) (Unverified)
CB Brennan, Catherine (Unverified)
GB Brockmann, Gretchen (Unverified)
LB Brunell, Lauren A. (Unverified)
KB Burnette, Kristy (Unverified)
In this meeting (48)
Mute all
LB Burroughs, Laurie Anne (Unverified)
CC Charles E. Chavis (Unverified)
MC Cherry, Michael J. (Unverified)
DC Danny Clipper (Unverified)
DL Dennis Leary (Unverified)
EC Ernest Cuthbertson (Unverified)
GJ George Johnson (Unverified)
JG Guerrier, Jerry (Unverified)
RH Hill, Ricky (Unverified)
UH Hoffler, Undi N (Unverified)
BI Ironside, Brigitte (Unverified)


In this meeting (49)
Mute all
DJ Jeter, Darrell Harris Sr (Unverified)
KK Kevin Kupietz (Unverified)
BK Koch, Bill (Unverified)
KS Kyle Smith (Unverified)
AL Lawrence, Aspen (Unverified)
PL Lewis, Phillip Wade (Unverified)
MV Mark Vesely (Unverified)
JM Mello, John (NCEM) (Unverified)
OM Mihalcescu, Ondin (Unverified)
AM Moore, Abigail Organizer
MM Morgan, Mark (Unverified)
SS Still, Steven (Unverified)
JS Sugg, Jason (Unverified)
CS Sutton, Chris (Unverified)
TB Todd Becker (Unverified)
VD Victor Deese (Unverified)
In this meeting (49)
Mute all
GM MOYD, GREGORY (Unverified)
BM Muganda, Beatrice Nyamatekele (U...
MO O'Driscoll, Michael (Unverified)
RO Olson, Rhonda L (Unverified)
BP Philbert, Brittany N. (Unverified)
AP Piran, Abbas (Unverified)
PC Polina P. Chemishanova (Unverified)
RR Rice, Rondall (Unverified)
RT Robert Thibeault (Unverified)
SK Sabrina Kellogg (Unverified)
KS Shook, Kelly (Unverified)

## HMPC Meeting 2: ECU – October 27, 2025

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

ECU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

October 27, 2025, 1 pm, Microsoft Teams

### ATTENDANCE

There were 18 attendees. The following individuals were in attendance:
Nick Agresta, EM Specialist, ECU
Griffin Avin, Director of Facilities Services for Health Sciences Campus, ECU
Merrill Flood, Director of Research and Innovation Campus Development, ECU
Gretchen Brockmann, Director of Housing Operations, ECU
Ricky Hill, Facilities Services Director, ECU
Bill Koch, Campus Safety, ECU
Aspen Lawrence, Emergency Manager, ECU
Phillip Lewis, Director of Environmental Health and Safety, ECU
Michael O'Driscoll, Department of Coastal Studies, ECU
Kelly Shook, Assistant Director, Environmental Health and Safety, ECU
Jason Sugg, Police Chief, ECU
Chris Sutton, Deputy Chief of Police, ECU
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently on Phase 2 when the Risk Assessment is developed, and hazards are identified and evaluated.

### HAZARD IDENTIFICATION

Abby reviewed the hazard profiles that were included in the previous HMP and their PRI scores.

- As discussed in HMPC meeting #1, Extreme Heat was added as a new hazard profile.
- Based on historical records and data, the ECU campus faces very low risk to geological threats and the HMPC agreed to remove this hazard from the plan update.

## ASSET INVENTORY

Abby reviewed the ECU campus asset inventory and critical facility locations.

- The current asset inventory includes 108 buildings on the main campus, valued at approximately $640 million according to NCEM's IRISK database. Ricky noted that the value estimate or replacement cost for main campus was very low compared to reports from Higher Education that valued main campus at over $1 billion. Abby noted this discrepancy and will continue to use IRISK data for the vulnerability analysis but will note the university replacement cost figures for context in the plan update.
- Committee members raised the need to include the Health Science campus and West Research campus in the asset inventory. Griffin will provide GIS data or campus maps to delineate boundaries, and Abby confirmed these campuses would be incorporated once data is received.
- The HMPC identified missing or duplicate critical facilities, such as the grounds operation complex and chiller plants, and discussed criteria for designating buildings as critical. Aspen volunteered to coordinate updates, including which dining halls and residence halls should be classified as critical based on emergency operations plans.
- Gretchen noted that a building listed was not owned by ECU and agreed to follow up with details for removal. Abby requested participants to review the presentation and provide corrections or updates to ensure the asset inventory accurately reflects campus facilities.

## HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazard evaluated on ECU's campus, including Excessive Heat, Flooding, Hurricanes and Coastal Hazards, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 18.

- The HMPC provided information about additional flood-prone areas on campus such as Green Mill Run, College of Engineering and Technology, and the North Campus recreation area.
- As elevation of the Tar River rises the campus often experiences additional flooding.

## PROJECT SCHEDULE

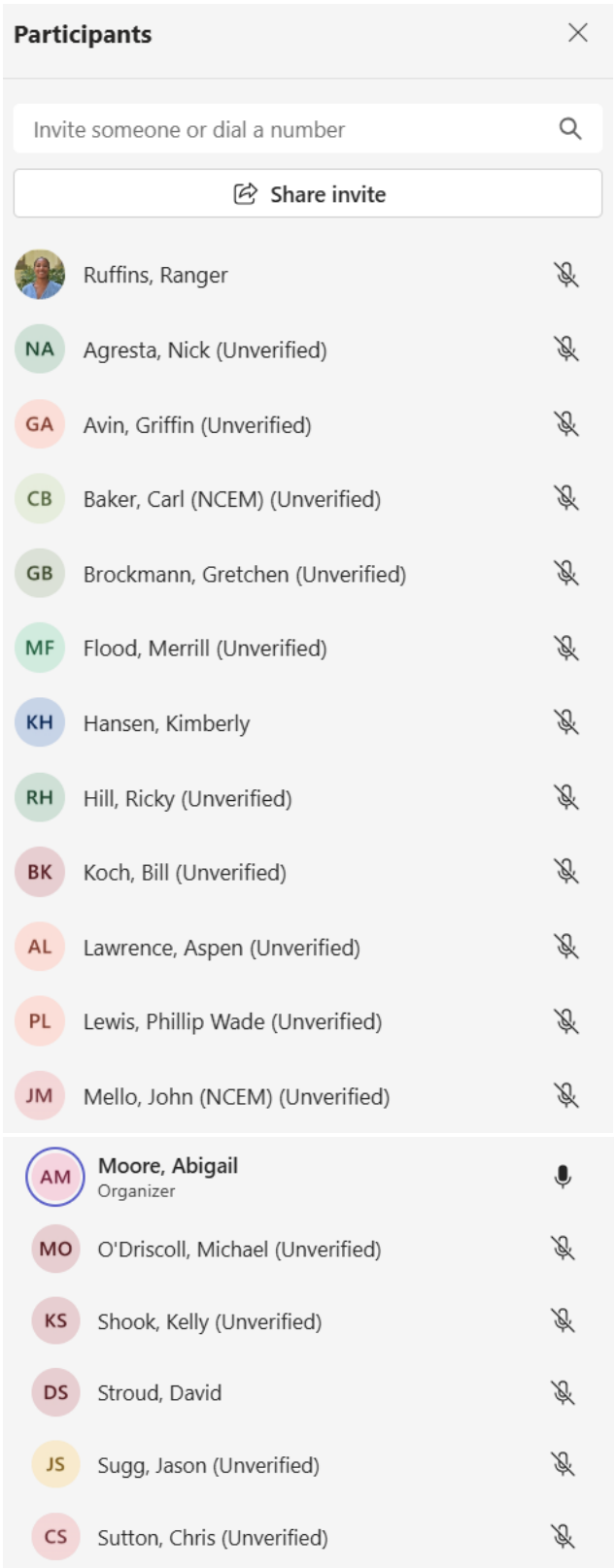
Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campus HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

## PUBLIC OUTREACH

- So far, the survey has received 279 responses from the public overall, but only three of those responses were from ECU.
- Abby encouraged the committee to continue posting the public survey to get more participation from their campus specifically.

## NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


Participants
Invite someone or dial a number
Share invite
Ruffins, Ranger
NA Agresta, Nick (Unverified)
GA Avin, Griffin (Unverified)
CB Baker, Carl (NCEM) (Unverified)
GB Brockmann, Gretchen (Unverified)
MF Flood, Merrill (Unverified)
KH Hansen, Kimberly
RH Hill, Ricky (Unverified)
BK Koch, Bill (Unverified)
AL Lawrence, Aspen (Unverified)
PL Lewis, Phillip Wade (Unverified)
JM Mello, John (NCEM) (Unverified)
AM Moore, Abigail
Organizer
MO O'Driscoll, Michael (Unverified)
KS Shook, Kelly (Unverified)
DS Stroud, David
JS Sugg, Jason (Unverified)
CS Sutton, Chris (Unverified)

## HMPC Meeting 2: ECSU – November 17, 2025

ECSU
ELIZABETH CITY STATE UNIVERSITY
FOUNDED 1891

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

ECSU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

November 17, 2025, 2pm, Microsoft Teams

#### ATTENDANCE

There were ten attendees. The following individuals were in attendance:
Amanda Brooks, Interim AVC Design & Construction, ECSU
Danny Clipper, EM/EHS Coordinator, ECSU
Dennis Leary, Director of Facilities Management, ECSU
Lee Brown, Chief of Staff, ECSU
Kevin Wade, Associate Vice Chancellor, ECSU
Sabrina Kellogg, Director of Housing and Residence Life, ECSU
Carl Baker, NCEM Plans Manager
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
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- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores. As discussed in HMPC meeting #1, Extreme Heat was added as a new hazard profile.

#### ASSET INVENTORY

Abby reviewed the ECSU campus asset inventory and critical facility locations. The asset inventory was compiled using updated building footprints from North Carolina Emergency Management's iRisk database, with structure values assigned using parcel data from 2022. Any data gaps wee filled with data and values from the previous plan.

- Dennis noted that a few buildings were missing from the current inventory. He will provide a list via email to Abby. Abigail explained that building values could likely be sourced from iRisk or, if unavailable, Dennis could provide building values for the additional buildings.

- Abby will also send Lee the previous web map of campus buildings to review

HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazards evaluated on ECSU's campus, including Excessive Heat, Flooding, Hurricanes, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 18.

- Dennis and Danny explained that while localized flooding can occur on campus due to heavy storm, there are no major persistent problem areas or recent significant damages.
- Excessive Heat, Hurricanes, Severe Winter Weather, Tornadoes & Thunderstorms, and Cyber Threat were rated as high-risk hazards for ECSU.
- Lee inquired about the inclusion of academic labs with chemical storage in the hazardous materials hazard profile. Abby explained that the existing inventory comes from the EPA toxic release inventory and may not capture off the campus-specific lab chemicals. David clarified that campus buildings with chemicals should be listed as critical facilities. Abby asked Lee to review the critical facilities list to ensure that buildings with chemical storage are included.

PROJECT SCHEDULE

Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

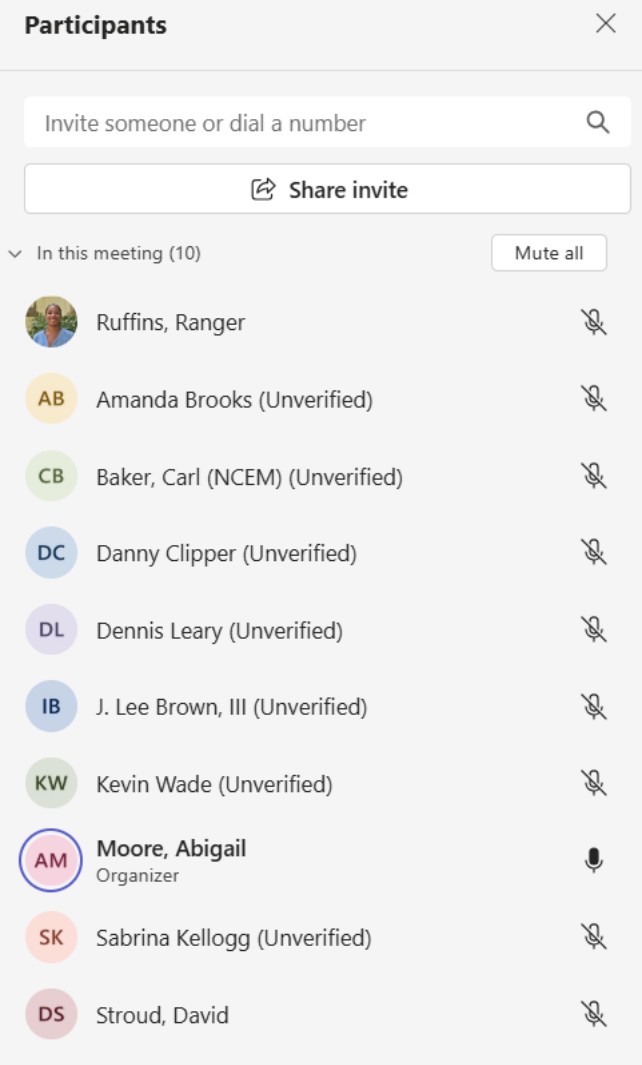
- Lee asked if the plan needs to be presented at the UNC Board of Governors risk management subcommittee summer meeting. Abby and Carl did not think this would be necessary but will look into it and confirm.

PUBLIC OUTREACH

- ECSU contributed 68 out of 367 total survey responses so far, with respondents identifying extreme heat, flooding, and winter weather as top hazards.
- Abby suggested another survey push to get any additional feedback

NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


Participants
Invite someone or dial a number
Share invite
In this meeting (10)
Mute all
Ruffins, Ranger
AB
Amanda Brooks (Unverified)
CB
Baker, Carl (NCEM) (Unverified)
DC
Danny Clipper (Unverified)
DL
Dennis Leary (Unverified)
IB
J. Lee Brown, III (Unverified)
KW
Kevin Wade (Unverified)
AM
Moore, Abigail
Organizer
SK
Sabrina Kellogg (Unverified)
DS
Stroud, David

## HMPC Meeting 2: FSU – November 24, 2025

FAYETTEVILLE STATE UNIVERSITY

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

FSU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

November 24, 2025, 1pm, Microsoft Teams

ATTENDANCE

There were 13 attendees. The following individuals were in attendance:
Abiodun Awoyemi, EM Director, FSU
Elizabeth Hunt, Assistant Vice Chancellor, Office of Risk and Compliance, FSU
Alpha Clowney, Chief of Police, FSU
Harold Miller, Facilities Management, FSU
Gregory Moyd, Associate Vice Chancellor for Student Affairs
Andrea Cortez, Environmental Health & Safety, FSU
Daniel Core, Environmental Health & Safety, FSU
Benita Powell, Assistant General Counsel, FSU
Carl Dean, Associate Vice Chancellor, Human Resources, FSU
John Mello, NCEM Hazard Mitigation Planner
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP

AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

PROJECT OVERVIEW

Abby Moore and Ranger Ruffins facilitated the meeting. Abby updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores. As discussed in HMPC meeting #1, extreme heat was added as a new hazard profile; Elizabeth was supportive of this change and noted heightened risk on campus during the summer with summer camps and visitors. Abby proposed removing landslide from the plan due to lack of local risk, which Abiodun, with a geophysics background, confirmed as appropriate. Abiodun questioned the absence of cyber, hazardous materials, and infectious disease hazards; these hazards may not have been a priority to the previous committee, and while these hazards are not reviewed or required by FEMA they will be added to the plan for FSU.

ASSET INVENTORY

Abby reviewed the FSU campus asset inventory and critical facility locations. The asset inventory was compiled using updated building footprints from North Carolina Emergency Management's iRisk database, with structure values assigned using parcel data from 2022. It includes 49 buildings valued at approximately $191 million.

- Andrea volunteered to coordinate with the campus facility planner to provide an updated building inventory.
- Harold, Gregory, and Benita identified recent changes, such as the demolition of Bryant Hall and the construction of a new Health and Wellness Center and School of Education, highlighting the need to update maps and include new structures in the risk assessment.
- Gregory questioned whether residence halls should be added to the critical facility list. Abiodun emphasized the need for university leadership to review and finalize the list of critical facilities before the vulnerability assessment is completed.
- Abby will send the previous critical facility scoring sheet to help committee members determine any new critical facility locations based on the criteria that were previously considered.

HAZARD PROFILES

Abigail explained the use of the Priority Risk Index (PRI), which scores hazards based on probability, impact, spatial extent, warning time, and duration, with weighted categories to determine low, moderate, and high risk hazards for prioritization.

Ranger presented the details for each moderate and high-risk hazard evaluated for FSU's campus, including Excessive Heat, Flooding, Hurricanes, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 17.

- Excessive Heat, Severe Winter Weather, and Tornadoes & Thunderstorms were rated as high-risk hazards for FSU.
- Flood risk was assessed using FEMA flood insurance rate maps; Harold noted recent floodplain changes due to new mapping and noted that this has affected campus construction. Harold mentioned significant past flood events, including a major incident around 2011 that damaged multiple buildings and infrastructure.
- Gregory raised concerns about basements and mechanical equipment in flood-prone areas, which the current analyses may not fully capture.
- Gregory noted past damages from frozen pipes and subsequent water damage.

PROJECT SCHEDULE

Ranger presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

PUBLIC OUTREACH

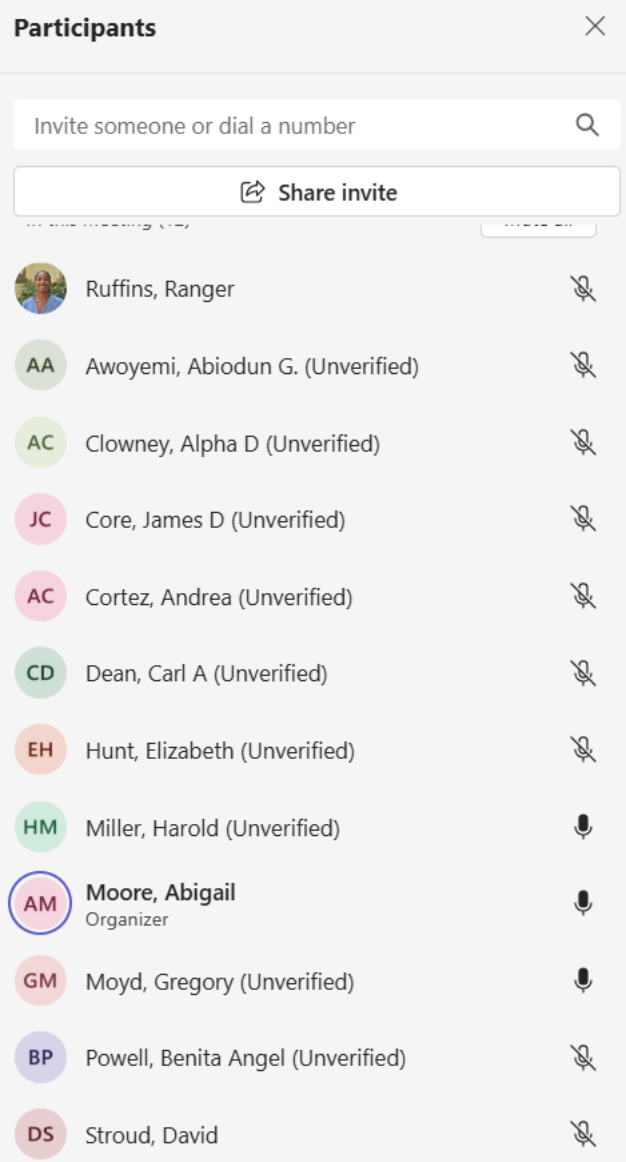
Ranger reported that we have 396 survey responses but none from FSU yet; Abiodun will seek permission for broader distribution and will share the survey with the EOC and potentially the full campus community.

NEXT STEPS

- **WSP will** coordinate with the committee and FSU's facilities planner to gather updated building and critical facility information to ensure the risk and vulnerability assessments are accurate.

WSP will then complete the draft risk and vulnerability assessment and share it with the HMPC for review and feedback.

- WSP will schedule HMPC Meeting #3 to review and update the mitigation strategy; this meeting will likely be in January. Prior to this meeting, Ranger asked committee members to review the status of current mitigation actions, identify completed projects, and suggest new initiatives or updates to be included in the next plan iteration.
- Abby will share a link to the existing 2021 hazard mitigation plan for committee members to review and use as a reference for the current planning process.


Participants
Invite someone or dial a number
Share invite
Ruffins, Ranger
AA
Awoyemi, Abiodun G. (Unverified)
AC
Clowney, Alpha D (Unverified)
JC
Core, James D (Unverified)
AC
Cortez, Andrea (Unverified)
CD
Dean, Carl A (Unverified)
EH
Hunt, Elizabeth (Unverified)
HM
Miller, Harold (Unverified)
AM
Moore, Abigail
Organizer
GM
Moyd, Gregory (Unverified)
BP
Powell, Benita Angel (Unverified)
DS
Stroud, David

## HMPC Meeting 2: NCCU – November 11, 2025

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NCCU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

November 11, 2025, 3pm, Microsoft Teams

#### ATTENDANCE

There were eight attendees. The following individuals were in attendance:

Rondall Rice, Associate Vice Chancellor for Administration, NCCU
Ondin Mihalcescu, Director of Design, Planning, and Construction, NCCU
Jerry Guerrier, Associate Vice Chancellor for Facilities Management, NCCU
Steven Alas, Emergency Management Coordinator, NCCU
Damon Williams, Campus Chief of Police, NCCU
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores.

- As discussed in HMPC meeting #1, Extreme Heat was added as a new hazard profile.
- The HMPC discussed whether to retain geological hazards, specifically related to landslides and sinkholes, as a profile in the risk assessment. The HMPC discussed the evidence of small sinkholes and high ground water levels in one area of campus and decided to keep the hazard profile in the plan but to reclassify it as a sinkhole risk rather than landslide.

#### ASSET INVENTORY

Abby reviewed the NCCU campus asset inventory and critical facility locations.

- Committee members identified several buildings that were missing from the asset inventory map found on slide 6 of the presentation, including the new Lawson Street Residential Complex,

Miller Morgan Building, Latham Parking Deck, the Bowling Alley, Central Receiving building off George St, O'Kelly-Riddicks Stadium, and the CRLC building which is under construction.

- The HMPC also noted that the campus boundary lines have changed slightly as new properties have been acquired across from Alston Ave and where Fayetteville St and Lawson St intersect. Abby agreed to update the campus map and submit for further review by the committee.
- Abby requested the structural values for the buildings that were not present in the IRISK database, with Rondall and Ondin agreeing to source this information from insurance records.
- The HMPC updated the list of critical facilities, adding the School of Law as a Tier 1 facility, updating the name of McLean to Deborah Saunders-White Residence Hall, and removing Bayne Hall as it no longer exists.

### HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazards evaluated on NCCU's campus, including Excessive Heat, Flooding, Hurricanes, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 17.

- The HMPC reported frequent basement flooding in multiple buildings during heavy rain events, leading Abby to request a map of affected buildings and agreeing to elevate the flood risk rating to moderate.
- Excessive Heat, Severe Winter Weather, Tornadoes & Thunderstorms, and Cyber Security were rated as high risk hazards for NCCU.
- The HMPC noted that the spatial extent of Flooding and the probability of Cyber Security should both be adjusted higher due to recent occurrences on campus.

### PROJECT SCHEDULE

Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

### PUBLIC OUTREACH

- NCCU contributed 112 out of 352 total survey responses so far, with respondents identifying extreme heat, flooding, cybersecurity, and winter weather as top hazards, and expressing varying levels of preparedness, prompting Abby to suggest further education and outreach.

### NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


KH
Hansen, Kimberly
SA
Alas, Steven (Unverified)
JG
Guerrier, Jerry (Unverified)
OM
Mihalcescu, Ondin (Unverified)
AM
Moore, Abigail
Organizer
RR
Rice, Rondall (Unverified)
DS
Stroud, David
DW
Williams, Damon (Unverified)

## HMPC Meeting 2: NCSSM – December 16, 2025

North Carolina School of Science and Mathematics

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NCSSM HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

December 16, 2025, 10 am, Microsoft Teams

#### ATTENDANCE

There were 8 attendees. The following individuals were in attendance:

Nathan Harmer, Director of IT Infrastructure and Operations, NCSSM
Robert Allen, Vice Chancellor for Finance & Operations, NCSSM
Bryan Wiggs, Director of Campus Safety, NCSSM
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore and Ranger Ruffins facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores.

- As discussed in HMPC meeting #1, Extreme Heat was added as a new hazard profile.
- Based on historical records and data, the NCSSM campus faces very low risk to geological threats and the HMPC agreed to remove this hazard from the plan update.
- The HMPC debated whether to keep wildfire as a hazard profile, noting its low risk to the campus but agreeing to keep it for this update for potential mitigation justification and potential smoke and air quality impacts from wildfires occurring in other regions of the state.
- Abby clarified that infectious disease and cybersecurity, though not natural hazards, are included in the risk assessment due to their relevance for the campus, especially given the close quarters of students and the importance of IT infrastructure.

ASSET INVENTORY

Abby reviewed the NCSSM campus asset inventory and critical facility locations.

- The HMPC clarified that there are currently 680 beds for students on the Durham campus and around 330 temporary and full-time employees.
- Robert discussed the inclusion of modular buildings used for temporary student housing during residence hall renovations, agreeing to add these structures to the asset inventory and update building footprint data as needed. These buildings may be used for the next five years during renovations.
- Brian reviewed the classification of campus buildings and recommended the removal of a picnic shelter from the critical facilities list and reclassifying the cottage as administrative.
- Brian identified buildings housing hazardous materials, including the chemistry department in Brian Hall, the maintenance and facilities area with fertilizers and gasoline, and the boiler house, ensuring these are noted in the risk assessment for emergency planning.
- Robert informed the group about ongoing renovations, specifically the expansion of the chiller plant, and agreed to provide updated footprint information for inclusion in the plan.

HAZARD PROFILES

Ranger presented the details for each moderate and high-risk hazards evaluated on NCSSM's campus, including Excessive Heat, Flooding, Hurricanes and Tropical Storms, Severe Winter Weather, and Tornadoes & Thunderstorms as shown in slides 10 through 16.

- The HMPC confirmed that flooding is not a significant issue on campus, however wind and power outages from hurricanes and thunderstorms have been a relevant risk in the past.
- Excessive Heat, Severe Winter Weather, and Tornadoes & Thunderstorms were rated as high risk hazards for NCSSM.
- The HMPC agreed with the hazard profile evaluations and current PRI scores.

PROJECT SCHEDULE

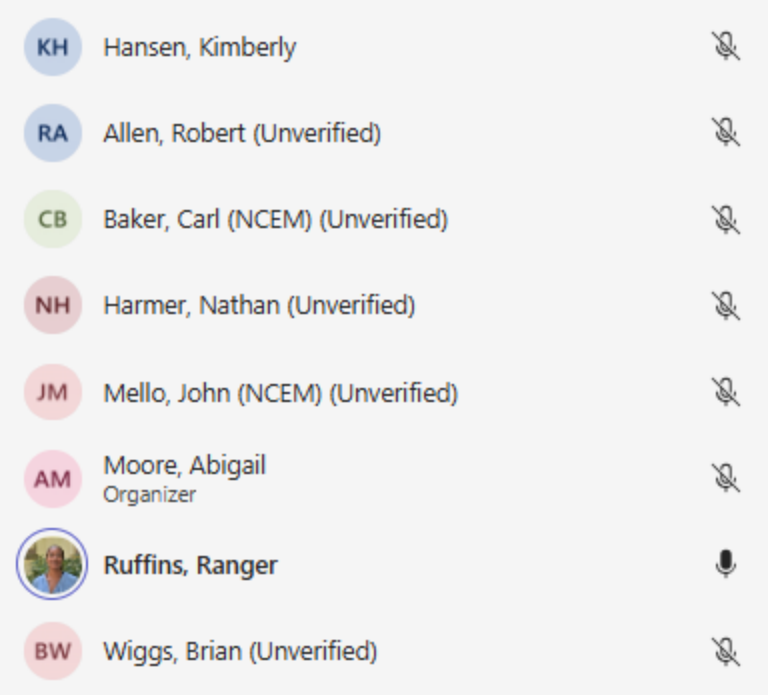
Ranger presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 419 responses from the public overall, but only five of those responses was from NCSSM.
- Ranger encouraged the committee to continue posting the public survey to get more participation from their campus specifically.

NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Ranger asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


KH
Hansen, Kimberly
RA
Allen, Robert (Unverified)
CB
Baker, Carl (NCEM) (Unverified)
NH
Harmer, Nathan (Unverified)
JM
Mello, John (NCEM) (Unverified)
AM
Moore, Abigail
Organizer
Ruffins, Ranger
BW
Wiggs, Brian (Unverified)

## HMPC Meeting 2: NCSU – October 29, 2025

NC STATE UNIVERSITY

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NCSU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

October 29, 2025, 10 am, Microsoft Teams

#### ATTENDANCE

There were 10 attendees. The following individuals were in attendance:
Todd Becker, Director of Emergency Preparedness, NCSU
Greg Sparks, Director of Communication Technologies, NCSU
Allen Boyette, Senior Director of Energy Systems, NCSU
Chris Octetree, Emergency Manager, NCSU
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores.

- As discussed in HMPC meeting #1, Extreme Heat was added as a new hazard profile.
- Todd noted that there are two campus-owned dams at NCSU and agreed to follow up with details on the dam locations and their existing Emergency Preparedness Plans. The committee agreed to add Dam Failure as a hazard profile which will be included in the updated risk assessment.

#### ASSET INVENTORY

Abby reviewed the NCSU campus asset inventory and critical facility locations.

- Committee members noted that Poe Hall should be removed from the critical facilities list due to reconstruction.
- The HMPC confirmed the overall accuracy of the asset inventory presented in slides 6 and 7 but agreed to review the maps and data further and follow up with any necessary changes.

HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazards evaluated on NCSU's campus, including Excessive Heat, Flooding, Hurricanes and Coastal Hazards, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 17.

- The HMPC noted that there are some locations where minor flooding has occurred historically on campus during severe storm events. Allen agreed to notify the WSP team of these locations to be included in the plan update. Todd will check insurance records and provide any relevant information on past flood-related damages. Todd noted that there was a big push about 10 years ago to implement flood mitigation project on campus which has largely reduce flood risk.
- Excessive Heat, Severe Winter Weather, Tornadoes & Thunderstorms, and Cyber Security were rated as high risk hazards for NCSU.
- The HMPC agreed with the hazard profile evaluations and current PRI scores.

PROJECT SCHEDULE

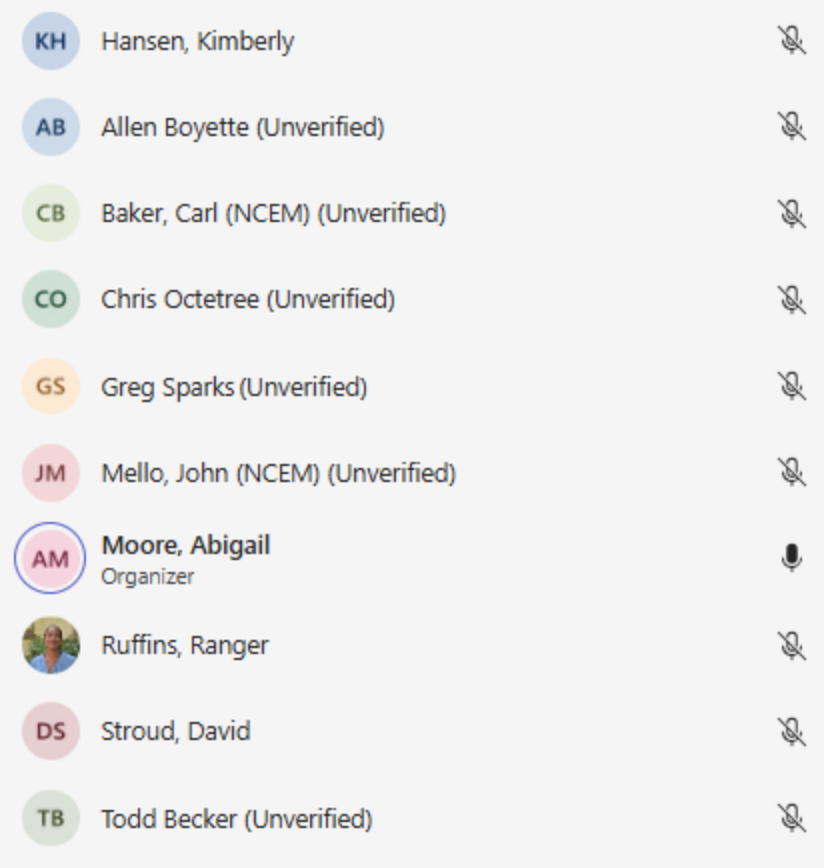
Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 281 responses from the public overall, but only one of those responses was from NCSU.
- Abby encouraged the committee to continue posting the public survey to get more participation from their campus specifically.

NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


KH Hansen, Kimberly
AB Allen Boyette (Unverified)
CB Baker, Carl (NCEM) (Unverified)
CO Chris Octetree (Unverified)
GS Greg Sparks (Unverified)
JM Mello, John (NCEM) (Unverified)
AM Moore, Abigail
Organizer
Ruffins, Ranger
DS Stroud, David
TB Todd Becker (Unverified)

## HMPC Meeting 2: UNC Chapel Hill – November 5, 2025

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC CHAPEL HILL HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

November 5, 2025, 1:00 pm, Microsoft Teams

#### ATTENDANCE

There were 11 attendees. The following individuals were in attendance:

John Albrechtsen, Lead Business Systems and Data Analytics Specialist, UNC-CH
Crystal Dondaldson, Community & Resilience Planner, Emergency Management and Planning, UNC-CH
Captain Rahsheem Holland, Campus Police, UNC-CH
Darrell Jeter, Director of Emergency Management and Planning, UNC-CH
Abbas Piran, Director Facilities Technology Group, UNC-CH
Joe Magura, Director of Facilities Engineering, UNC-CH
Laurie Burroughs, Budget Manager, UNC-CH
Carl Baker, NCEM Plans Manager
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores.

- Abby noted the addition of excessive heat as a high-risk hazard and updates to flood risk, which is now also high-risk due to expanded campus boundaries and recent events like Tropical Storm Chantal.

#### ASSET INVENTORY

Abby reviewed the UNC-CH campus asset inventory and critical facility locations.

- Abby explained that building data and values were sourced from the North Carolina Emergency Management's (NCEM) iRisk database, which has been updating building footprints between

2020-2025. Carl explained that values are based on RS Means construction costs, which may not reflect true replacement costs. Abbas noted that this estimating tool tends to understate values. WSP will provide a building inventory for Abbas the other staff to review.

- Abby and Carl further explained that loss estimates are based on iRisk and will reflect the structure values included in that database. However, WSP can discuss adding a quantifier or in text caveat to explain the underestimate. Carl noted that the campus will not be held to these specific values when pursuing future grant funding.
- Abby explained that critical facilities are identified based on factors such as operational importance, health and safety, hazardous materials storage, and cultural or educational significance, with the list being updated through committee input and recent campus changes.
- Abbas and Darrell highlighted the need to update the critical facilities list and agreed to follow up internally to refine the list.
- Crystal highlighted the importance of including outdoor spaces and non-building facilities in the asset inventory, especially those with significant financial risk, such as finished outdoor spaces damaged during events like Chantal. Abby agreed to include these in hazard profiles and asset inventory updates.

HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazards evaluated including dam failure, drought, excessive heat, flood, hurricanes, severe winter weather, tornadoes, thunderstorms, and wildfire as shown in slides 10 through 20.

- The HMPC emphasized the importance of capturing Tropical Storm Chantal in the flood and hurricane hazards. Abby confirmed that Chantal's impacts are being considered, even if some data sources have cutoff dates prior to the event. Crystal will work with staff to provide WSP with specific impacts from Chantal.
- Abbas noted flash flooding due to inadequate or blocked stormwater infrastructure and will put WSP in touch with Jamie who can provide data on problem areas.

PROJECT SCHEDULE

Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 287 responses. Seven have been from the UNC-CH campus community. Abby encouraged the committee to continue publicizing the public survey.

NEXT STEPS

- WSP will share a spreadsheet with current building inventory. HMPC will review inventory list internally and provide missing structures and identify critical facilities
- Share data on known stormwater and localized flooding problem areas and impacts from Tropical Storm Chantal
- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement

AM Abigail Moore
Organizer

DJ Darrell Harris Sr Jeter

AP Abbas Piran

CD Crystal Donaldson

JM Joe Magura

CB Carl Baker (NCEM)

DS David Stroud

LB Laurie Anne Burroughs

 Ranger Ruffins
You

JA John Albrechtsen

RH Rahsheem Dadece Holland

## HMPC Meeting 2: UNC Pembroke – November 3, 2025

UNC PEMBROKE

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC PEMBROKE HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

November 3, 2025, 10 am, Microsoft Teams

#### ATTENDANCE

There were 14 attendees. The following individuals were in attendance:

Charles Chavis, Environmental, Health, and Safety Office Professional, UNC-P
Dr. Christie Poteet, Assistant Vice Chancellor for Student Affairs, UNC-P
George Earl Johnson, Chief of Police, UNC-P
Joshua Johnson, Director of Student Health Services, UNC-P
Dr. Kyle Smith, Associate Vice Chancellor of Student Affairs and Dean of Students, UNC-P
Michael Bullard, Environmental, Health, and Safety Officer, UNC-P
Christopher Scott, Environmental Health and Safety Professional, UNC-P
Victor Deese, Assistant Vice Chancellor for Facilities, UNC-P
Katina Blue, Associate Vice Chancelor for Information Resources/Chief Information Officer, UNC-P
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore facilitated the meeting and updated the HMPC on where we are in the planning process. The planning process is currently in Phase 2 which involves identification and evaluation of hazards to develop the risk assessment.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) scores.

- Based on historical records and data, the UNC-P campus faces very low risk to geological threats and the HMPC agreed to remove this hazard from the plan update.

#### ASSET INVENTORY

Abby reviewed the UNC-P campus asset inventory and critical facility locations.

- Michael requested the addition of Thomas Hall and the removal of Village Apartments from the building inventory and recommended WSP follow up with facilities representatives Mark Vesley and Victor Deese for further verification.
- Abby explained that critical facilities are identified based on factors such as operational importance, health and safety, hazardous materials storage, and cultural or educational significance, with the list being updated through committee input and recent campus changes.
- The HMPC identified discrepancies between the critical facilities map and list, noting missing or outdated buildings (Oak and Pine Halls, North Hall, Belk Hall, and the Thomas College of Business and Economics), and agreed to update the GIS inventory and facility names accordingly.

HAZARD PROFILES

Abby presented the details for each moderate and high-risk hazards evaluated on UNC-P's campus, including Excessive Heat, Flooding, Hurricanes, Severe Winter Weather, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 17.

- Michael reported ongoing flooding in low-lying areas of campus, with improvements made to Prospect Road and downstream canals to enhance water drainage and reduce flood risk.
- Facilities installed flood barriers on buildings previously affected by hurricane events, and raised transformers to reduce vulnerability, with the Auxiliary Services Building, Locklear Hall, and the guest house behind the chancellor's residence specifically mentioned.
- Victor agreed to provide a comprehensive list of problem areas and mitigation strategies to Abby after the meeting, and Abby committed to reviewing previous plans to ensure all measures are documented and progress is tracked.
- The HMPC agreed with the final hazard profile evaluations and PRI scores.

PROJECT SCHEDULE

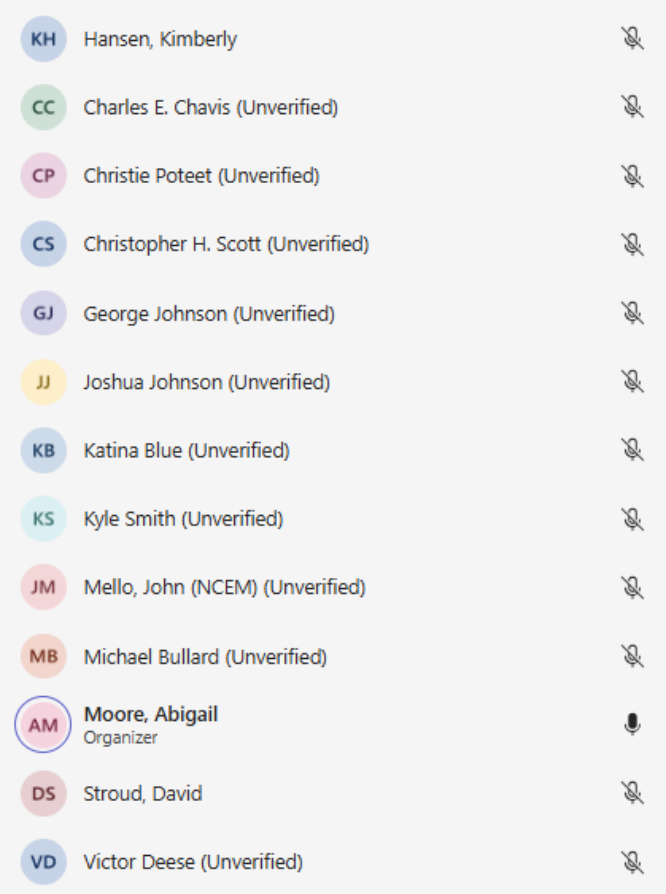
Abby presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campuses HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 287 responses from the public overall, and 151 of those responses have been from the UNC-P campus community.
- Survey respondents identified extreme heat, flood, hurricane, tornado, thunderstorm, and cyber threat as top hazards, and prioritized public education, prevention, and emergency services as key mitigation actions, with specific locations such as Oxendine Science Building and certain residence halls highlighted for attention.
- Although UNC-P has already received great engagement, Abby encouraged the committee to continue publicizing the public survey.

NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment and schedule the HMPC Meeting #3.
- Abby asked the HMPC to review the draft risk assessment, provide status updates on existing mitigation actions, and continue to support public engagement.


KH Hansen, Kimberly
CC Charles E. Chavis (Unverified)
CP Christie Poteet (Unverified)
CS Christopher H. Scott (Unverified)
GJ George Johnson (Unverified)
JJ Joshua Johnson (Unverified)
KB Katina Blue (Unverified)
KS Kyle Smith (Unverified)
JM Mello, John (NCEM) (Unverified)
MB Michael Bullard (Unverified)
AM Moore, Abigail
Organizer
DS Stroud, David
VD Victor Deese (Unverified)

## HMPC Meeting 2: UNC Wilmington – January 22, 2026

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC-WILMINGTON HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #2

January 22, 2026, 3pm, Microsoft Teams

#### ATTENDANCE

There were 11 attendees. The following individuals were in attendance:

Jeffrey Campbell, Director of Environmental Health and Safety, UNC-W
Kevin Meaney, Executive Director of Housing and Residence Life, UNC-W
Mark Morgan, Associate Vice Chancellor of Business Affairs, UNC-W
Steve Perry, Governance, Risk, and Compliance Officer, UNC-W
Larry Wray, Executive Director of Campus Life, UNC-W
Rhonda Olson, Emergency Manager, UNC-W
Carl Baker, NCEM Plans Manager
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Hazard Identification
- Asset Inventory
- Hazard Profiles
- Discussion
- Next Steps

#### PROJECT OVERVIEW

Abby Moore and Ranger Ruffins facilitated the meeting. Abby updated the HMPC on where we are in the planning process. The planning process is currently on Phase 2 when the Risk Assessment is developed, and hazards are identified and evaluated.

#### HAZARD IDENTIFICATION

Abby reviewed the hazards that were included in the previous HMP and their Priority Risk Index (PRI) rating.

- As discussed in HMPC meeting #1, Excessive Heat and Drought were added as new hazards.
- Based on the low number of historical occurrences, the committee noted we should remove the geological/sinkhole hazard and note any risks of sinkholes due to drainage issues in the flood profile.

ASSET INVENTORY

Abby reviewed the UNC-W campus asset inventory and critical facility locations.

- The current asset inventory includes 121 buildings on campus, valued at approximately $442.5 million according to NCEM's IRISK database.
- Kevin noted that Galloway Hall no longer exists and will be replaced by a new residence hall; Abby requested an updated footprint and value information for the new building.
- Kevin identified inconsistencies in building classifications for buildings the auxiliary support to residence halls. These will be classified as educational/extracurricular based on Kevin's description of their use.
- Rhonda and Steve questioned why certain buildings were included or designated as critical facilities. Abby and David clarified that all permanent structures are included, with critical facility status based on past committee decisions. Abby may have score sheets from the last planning process to provide context.
- Jeff agreed to review the building list to provide updates, and will coordinate with Abby for any corrections, including removing outdated buildings and adding missing ones like Discovery Hall. Rhonda noted that Shore Hall is missing. Facilities and GIS staff may be able to support this effort.
- Rhonda suggested updating the list of critical facilities to reflect current campus needs, such as replacing Randall Library with Discovery Hall due to its special collections. She also suggested adding buildings with hazardous materials, labs, or live animals including Dobo Hall, Veterans Hall, and teaching lab.

HAZARD PROFILES

Ranger presented the details for each moderate and high-risk hazard evaluated on UNC-W's campus, including Drought, Excessive Heat, Flooding, Hurricanes and Coastal Hazards, Tornadoes & Thunderstorms, and Wildfire as shown in slides 10 through 19.

- While the campus is not in a designated flood zone, the HMPC noted localized flooding occurring in parking lots and the amphitheater on campus and agreed to send these locations to WSP.
- Mark noted that the City of Wilmington recently completed a Floodway Improvement Plan to monitor outfalls and retention areas near the UNC-W campus.
- Mark noted that grounds staff are particularly vulnerable to extreme heat events.

PROJECT SCHEDULE

Ranger presented the schedule for the planning process. The third HMPC meetings will be individual campus meetings, and the entire Eastern Campus HMPC will reconvene for the fourth meeting. The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

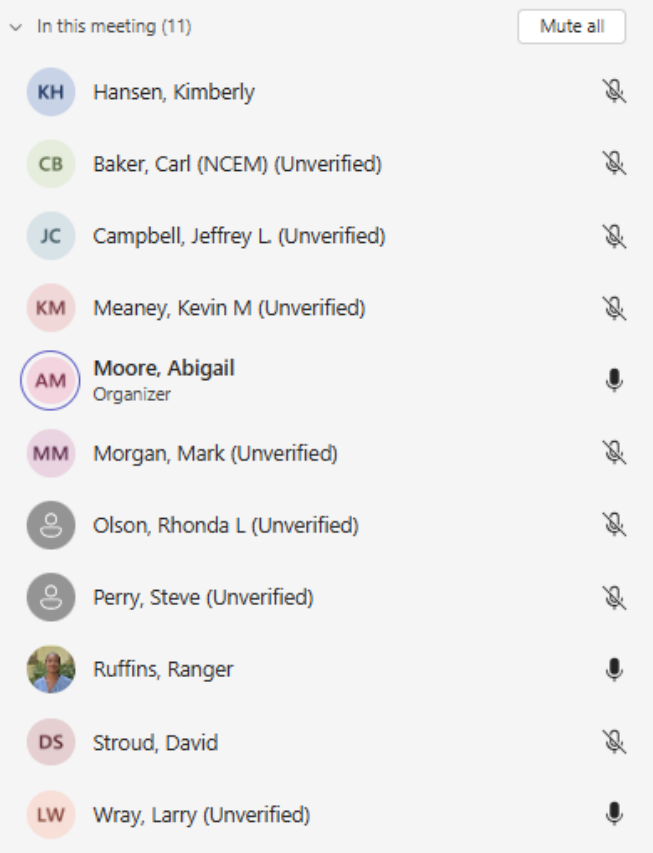
PUBLIC OUTREACH

- So far, the survey has received 525 responses from the public overall, but only one of those responses was from UNC-W.
- Abby noted that the public survey will be closing soon but encouraged the committee to push for more participation from their campus specifically in the next two weeks.

NEXT STEPS

- The WSP team will share the draft risk and vulnerability assessment.

- The HMPC Meeting #3 is scheduled for Friday February 6th at 2:30 pm.
- Ranger asked the HMPC to review the draft risk assessment once shared, provide status updates on existing mitigation actions by the end of next week, and continue to support public engagement.
- WSP will provide updated language to support outreach on the survey.


In this meeting (11)
Mute all
KH Hansen, Kimberly
CB Baker, Carl (NCEM) (Unverified)
JC Campbell, Jeffrey L. (Unverified)
KM Meaney, Kevin M (Unverified)
AM Moore, Abigail
Organizer
MM Morgan, Mark (Unverified)
Olson, Rhonda L (Unverified)
Perry, Steve (Unverified)
Ruffins, Ranger
DS Stroud, David
LW Wray, Larry (Unverified)

## HMPC Meeting 3: ECU – March 4, 2026

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

ECU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

March 4, 2026, 3:00pm, Microsoft Teams

ATTENDANCE

There were 13 attendees. The following individuals were in attendance:

Nick Agresta, EM Specialist, ECU
Gretchen Brockmann, Director of Housing Operations, ECU
Ricky Hill, Facilities Services Director, ECU
Peter Groenedyk, Associate Vice Chancellor of Campus Living, ECU
Bill Koch, Campus Safety, ECU
Aspen Lawrence, Emergency Manager, ECU
Phillip Lewis, Director of Environmental Health and Safety, ECU
Kelly Shook, Assistant Director, Environmental Health and Safety, ECU
Jason Sugg, Police Chief, ECU
Carl Baker, NCEM Plans Manager
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for ECU are posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has removed the Geological hazard profile.
- Cyber Threat, Hazardous Materials, and Infectious Disease hazard profiles were all added to the Risk Assessment.
- The HMPC had no additional comments or concerns with the updated asset inventory for ECU.

CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.

- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on ECU's campus found on slides 7-9 of the presentation.
- The HMPC noted that the ECU Campus Master Plan may have been updated and will follow up with WSP.
- Aspen and Bill noted that the "News and Communications" title under administrative resources should be changed to "University Communications."

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 11 and 12 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.
- The committee didn't note interest in adding any new mitigation strategies at this time. However, Abby encouraged them to review the actions further and notify the WSP team so they can help draft new mitigation actions with them if desired.
- Of the 27 mitigation actions in the 2021 plan, 15 were completed, 9 carried forward, and 3 deleted.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, flooding, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.

PROJECT SCHEDULE

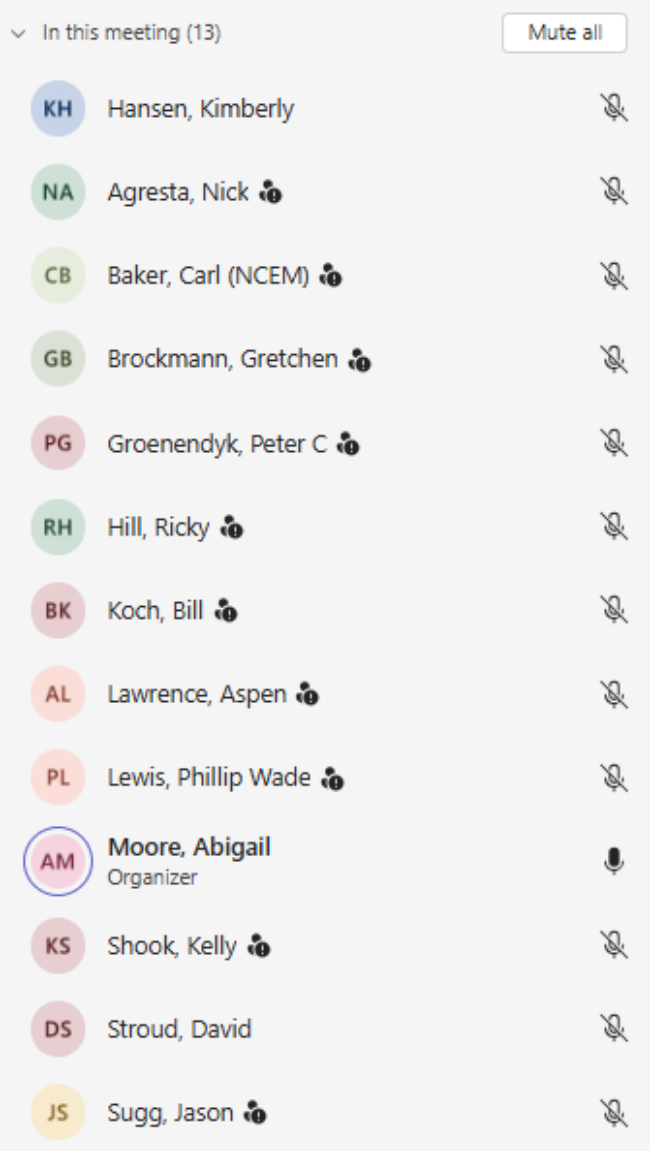
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with only 3 of those responses coming from ECU.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP by March 13.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


In this meeting (13)
Mute all
KH Hansen, Kimberly
NA Agresta, Nick
CB Baker, Carl (NCEM)
GB Brockmann, Gretchen
PG Groenendyk, Peter C
RH Hill, Ricky
BK Koch, Bill
AL Lawrence, Aspen
PL Lewis, Phillip Wade
AM Moore, Abigail
Organizer
KS Shook, Kelly
DS Stroud, David
JS Sugg, Jason

## HMPC Meeting 3: ECSU – February 18, 2026

ECSU
ELIZABETH CITY STATE UNIVERSITY
FOUNDED 1891

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

ESLIZABETH CITY STATE UNIVERSITY HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

February 18, 2026, 3:00pm, Microsoft Teams

#### ATTENDANCE

There were 10 attendees. The following individuals were in attendance:
Danny Clipper, EM/EHS Coordinator, ECSU
Kevin Wade, Associate Vice Chancellor, ECSU
Ernest Cuthbertson, Director of Public Safety, ECSU
Kevin Wade, Associated Vice Chancellor, ECSU
Keith Hargrove, Chancellor, ECSU
John Mello, NCEM
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for ECSU is posted on the plan website for review: https://www.nceastcampushmp.com/
- WSP did not receive any additional updates for the campus' building and critical facilities inventory. Danny agreed that the current inventory is accurate.

#### CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on ECU's campus found on slides 6-8 of the presentation.

- The HMPC noted that a new Strategic Plan for 2025 – 2030 has been developed and they will send the plan to WSP. Danny is also working on an update to the Emergency Operations Plan (EOP). WSP will note these updates in the capability assessment.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than ongoing maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary.
- Danny noted that the campus will be improving its monitoring and warning systems which align with objective 2.2. Abby suggested ECSU add a mitigation strategy relevant to this upcoming work.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazard, and that actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants.
- Based on the previous 2021 mitigation actions, ECSU will carry forward 12 actions, completed 10, and will provide updates on actions 11, 12, 13, 14, and 16 (shown on slide 14).
- Danny will coordinate with IT and Facilities Management to finalize the status updates and will send project updates to Ranger by the first week of March.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, flooding, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
- Abby noted gaps in public education and natural resource protection actions and suggested formalizing public education campaigns and consider projects like wetland preservation and retention ponds.

PROJECT SCHEDULE

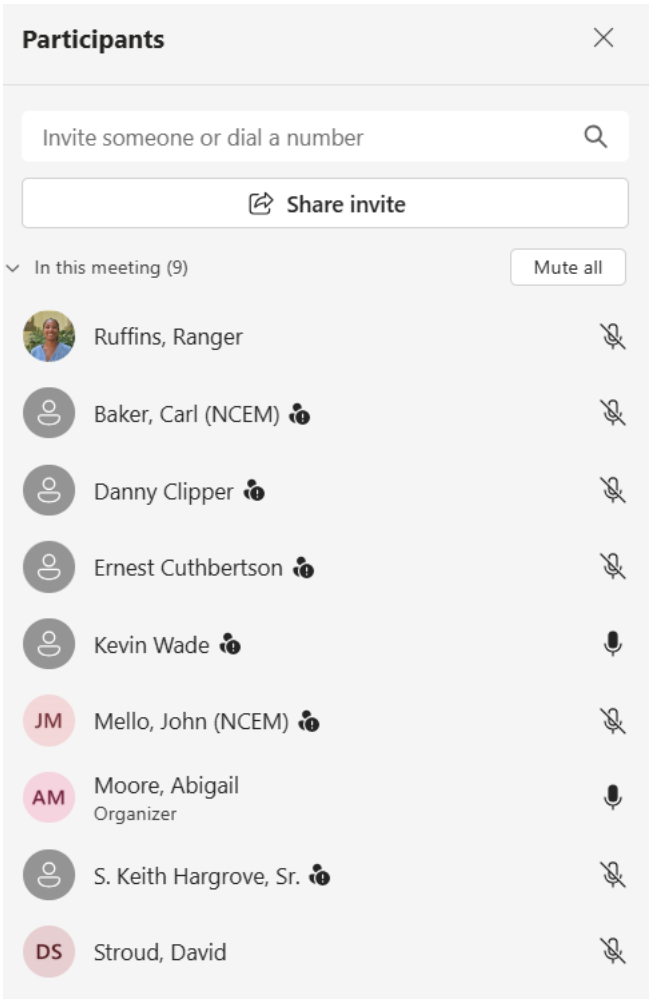
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 86 of those responses coming from ECSU.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by the first week of March.


Participants
Invite someone or dial a number
Share invite
In this meeting (9)
Mute all
Ruffins, Ranger
Baker, Carl (NCEM)
Danny Clipper
Ernest Cuthbertson
Kevin Wade
JM
Mello, John (NCEM)
AM
Moore, Abigail
Organizer
S. Keith Hargrove, Sr.
DS
Stroud, David

## HMPC Meeting 3: FSU – March 4, 2026

FAYETTEVILLE STATE UNIVERSITY™

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

FSU HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

March 4, 2026, 11:00am, Microsoft Teams

ATTENDANCE

There were 11 attendees. The following individuals were in attendance:
Abiodun Awoyemi, EM Director, FSU
Alpha Clowney, Chief of Police, FSU
Gretchen Cobb, Director of Business Services, FSU
Harold Miller, Facilities Management, FSU
Benita Powell, Assistant General Counsel, FSU
John Mello, NCEM Hazard Mitigation Planner
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

AGENDA

- Project Overview & Where we are in the Planning Process
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  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for FSU are posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has removed the Geological hazard profile.
- Cyber Threat, Hazardous Materials, and Infectious Disease hazard profiles were all added to the Risk Assessment.
- The HMPC noted that the updated FSU building inventory map did not have the correct building footprints for the new Health and Wellness Center, the School of Education, Bronco Pride Hall, and the new parking deck. WSP will update to match the footprints shown on the FSU campus website.

CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.

- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on FSU's campus found on slides 6-8 of the presentation.
- Below is a summary of status updates to the capability assessment provided by the HMPC:
    - Campus has a newly updated strategic plan for 2022-2027
    - Abiodun confirmed that FSU has a Cyber Incidents Assessment Plan which he will share with the WSP team.
    - Harold noted that the Facilities Management Department does not have someone skilled in GIS. However, WSP will note that the Planning and Construction and Emergency Management Departments do have staff who can work in GIS.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.
- The committee noted interest in updating all doors on campus buildings to lock down in the event of an emergency or active shooter. Abby explained that this is outside the scope of the plan and wouldn't be considered as mitigation for natural hazards.
- Ranger noted there are 17 existing projects requiring status updates for FSU. Abby and Ranger requested the HMPC review these projects and provide updates and discussed new action ideas for high-priority hazards such as excessive heat, severe winter weather, and wind-related events.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, severe winter weather, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.

- Severe Winter Weather: Recommendations included burying distribution lines, harden overhead power lines and poles against ice damage, ensure alternate transportation facilities are available to maintain access to campus, and provide education on carbon monoxide poisoning.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
- The committee noted that they are interested in updating their emergency notification system and would like to add this as a mitigation action.
- The HMPC asked if adding generators and backup power for critical facilities would be a good mitigation action item to add. Abby noted that this is a great mitigation action item and WSP will add this to all campus strategies.

PROJECT SCHEDULE

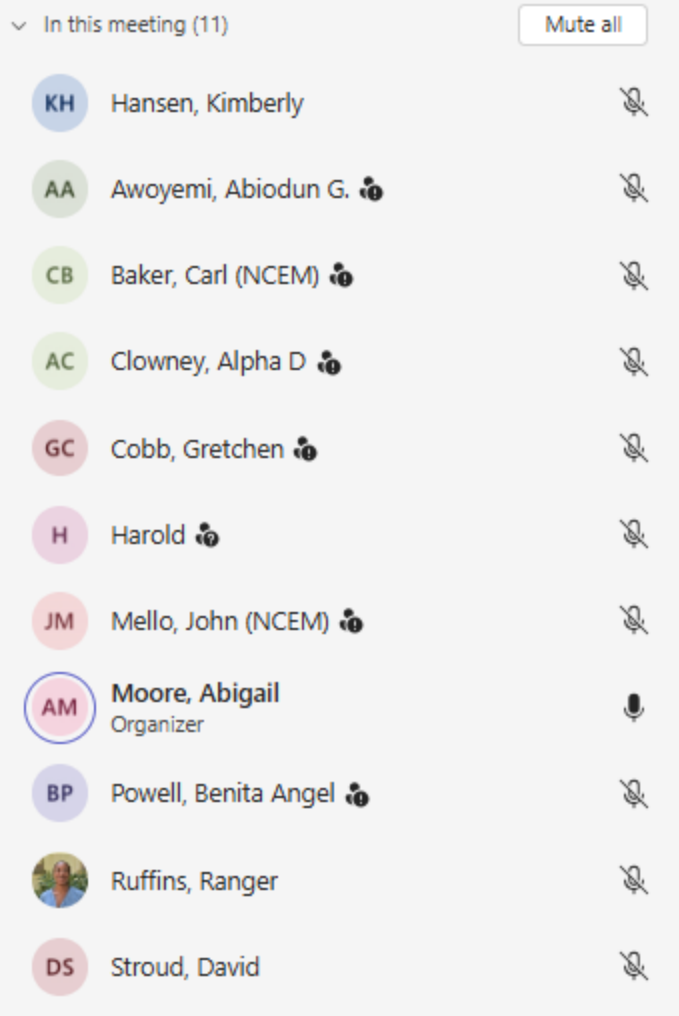
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 111 of those responses coming from FSU.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP by March 13.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


In this meeting (11)
Mute all
KH
Hansen, Kimberly
AA
Awoyemi, Abiodun G.
CB
Baker, Carl (NCEM)
AC
Clowney, Alpha D
GC
Cobb, Gretchen
H
Harold
JM
Mello, John (NCEM)
AM
Moore, Abigail
Organizer
BP
Powell, Benita Angel
Ruffins, Ranger
DS
Stroud, David

## HMPC Meeting 3: NCCU – February 25, 2026

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NORTH CAROLINA CENTRAL UNIVERSITY HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

February 25, 2026, 11:00am, Microsoft Teams

#### ATTENDANCE

There were 13 attendees. The following individuals were in attendance:

Steven Alas, Emergency Management Coordinator, NCCU
Gregory Hughes, Administrative Captain, NCCU Police Department
Rondall Rice, Associate Vice Chancellor for Administration, NCCU
Chris Russell, Director of Environmental Health and Safety, NCCU
Tyra Slade, Assistant University Legal Counsel, NCCU
Matthew Tulchin, Chief Legal Counsel, NCCU
Jerry Guerrier, Associate Vice Chancellor for Facilities Management, NCCU
John Mello, NCEM
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
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- Next Steps

#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for NCCU is posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has reclassified the Geological hazard profile to evaluate sinkholes instead of landslide.
- WSP updated the campus boundary line to show newly acquired properties near Fayetteville Street and Lawson Street.
- The School of Law was added as a Tier 1 facility and Bayne Hall was removed from the critical facilities list.

- The HMPC recommended removing New Residence Hall 1 from the critical facility list due to it currently being unoccupied and is unlikely to be renovated in the near future.
- Lawson Street Apartments and the Walker Complex will be added to the critical facility list.

CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on NCCU's campus found on slides 6-8 of the presentation.
- The HMPC noted that there are no formal stormwater management program and current practices are reactive rather than proactive. WSP will add a new mitigation action that aims to formalize stormwater management practices for NCCU.
- The Committee also noted that EHS oversees the Emergency Operation Plan (EOP), which was updated in 2022 and is currently being updated with scheduled completion in 2027.
- It was also noted that EHS regularly conducts tabletop exercises which will continue to occur annually.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby and Carl stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.
- The HMPC discussed if a mitigation checklist for new construction or major renovations exists. Carl and Abby suggested using FEMA handbooks and considering the development of a campus-specific checklist or policies for new development on campus as a new mitigation action.
- Abby noted that carried forward actions for NCCU do not include any Public Education, Prevention, or Natural Resource Protection projects. These actions are not required but should be considered if applicable.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, flooding, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
    - The HMPC supported including all suggested actions related to Excessive Heat into the mitigation action plan with the understanding that the lack of funding or incomplete projects would not penalize the campus.
- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
    - Abby and Carl confirmed that nature-based solutions are currently emphasized in grant funding programs.
    - The HMPC noted areas across campus that collect water during heavy rains and asked if rain gardens, retention ponds, or curb updates are eligible for funding. Abby confirmed that drainage improvement projects like these can be funded and should be included as mitigation actions as they focus on green infrastructure.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
- The HMPC noted that retrofitting existing facilities to withstand high winds should be included as a new mitigation action.
- The HMPC will also include an action to retrofit building doorways and critical equipment to protect facilities from falling ice during winter storm events.
- WSP will draft language for an action that standardizes the stormwater management program and an action that creates a checklist or policies that integrate mitigation and risk reduction into development guidelines.

FUNDING GUIDANCE

- Abby clarified that campuses could begin preparing grant applications now under the existing plan, but actions added in the new plan require approval before funding can be pursued.
- Grant applications are submitted to the state, which reviews and assists with the application before forwarding it to FEMA. Carl recommended prioritizing projects due to the detailed requirements for cost estimates and benefit analysis.
- Carl advised checking for funding opportunities quarterly, noting that major federal disaster declarations often trigger new funding streams, and eligibility is statewide regardless of direct impact.

PROJECT SCHEDULE

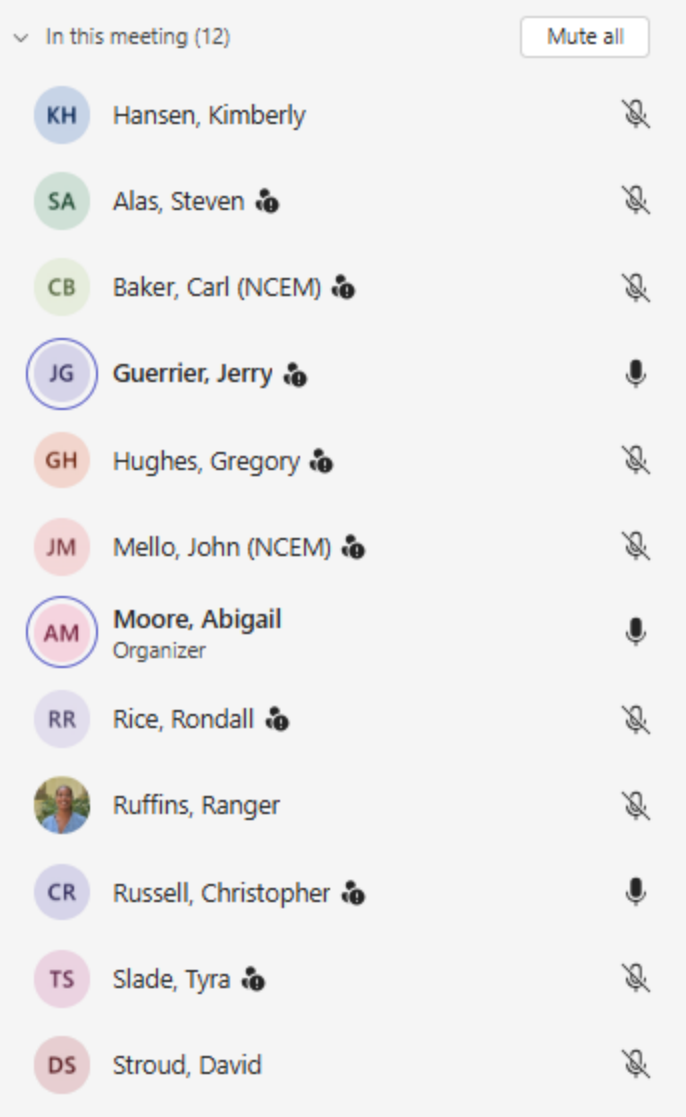
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 154 of those responses coming from NCCU.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


In this meeting (12)
Mute all
KH
Hansen, Kimberly
SA
Alas, Steven
CB
Baker, Carl (NCEM)
JG
Guerrier, Jerry
GH
Hughes, Gregory
JM
Mello, John (NCEM)
AM
Moore, Abigail
Organizer
RR
Rice, Rondall
Ruffins, Ranger
CR
Russell, Christopher
TS
Slade, Tyra
DS
Stroud, David

## HMPC Meeting 3: NCSSM – March 27, 2026

North Carolina School of Science and Mathematics

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NCSSM HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

March 27, 2026, 10:00am, Microsoft Teams

#### ATTENDANCE

There were 8 attendees. The following individuals were in attendance:

Nathan Harmer, Director of IT Infrastructure and Operations, NCSSM
Jonathan McDowell, Executive Director of Facilities Operations, NCSSM
Bryan Wiggs, Director of Campus Safety, NCSSM
John Mello, NCEM Hazard Mitigation Planner
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

#### AGENDA

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#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for NCSSM are posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has removed the Geological hazard profile.
- The building inventory was updated by removing the picnic shelter, reclassifying the Cottage as administrative, and adding the building footprints for the modular buildings that are being used for temporary student housing during renovations over the next few years.

#### CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on NCSSM's campus found on slides 6-8 of the presentation.
- Below is a summary of status updates to the capability assessment provided by the HMPC:
  - The campus EOP is updated annually

- Jonathan clarified that stormwater management is handled case-by-case for new structures, but a formal program has not technically been finalized.
- The Capital Projects Department, run by Jonathan, should be listed as the department responsible for the "Professional trained in construction practices related to buildings and/or infrastructure" resource under administrative and technical capabilities.
- NCSSM does not have staff skilled in GIS and they usually hire a third party when needed.
- The Chief Research Officer, Central Administration, or a hired third party would be responsible for grant writing.
- They now have three outdoor warning sirens instead of two.
- NCSSM hasn't participated in tabletop exercises recently but have plans to in the future so this additional resource should remain in the plan.
- The HMPC noted that the Morganton NCSSM campus staff and administrative resources could be used when needed by Durham NCSSM campus.
- The HMPC confirmed the use of capital improvements, state appropriations, and fundraising initiatives, while noting the absence of tuition, fees, revenue bonds, and sales/services as funding sources; federal grants are available but have not been used historically.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.
- The committee briefly reviewed the status of the 26 existing actions pulled from the previous plan and made the following changes:
  - Action 7: Remove as it is just a maintenance action
  - Action 9: They are working on this project this summer; keep as a current project

- Action 10: Completed
- Action 11: Completed in 2025
- Action 19: Completed
- Action 26: Carry forward but remove Watts Hall
- Actions 3,6,13, and 26 need to be consolidated into one action that addresses the need for snow guards. Currently no buildings on campus have snow guards installed.
- Nathan noted confusion behind the description of "ITS" in the previous plan actions. It could be referring to the department or the building which would be the Cottage on campus. Abby noted that this may have been pulled from older previous plans.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, severe winter weather, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
- Severe Winter Weather: Recommendations included burying distribution lines, harden overhead power lines and poles against ice damage, ensure alternate transportation facilities are available to maintain access to campus, and provide education on carbon monoxide poisoning.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
- Brian suggested adding shade structures to athletic fields such as the baseball dugouts or soccer fields on campus to address excessive heat.
- Nathan proposed adding backup generators for critical facilities and inclusion of burring communication lines in wind protection actions
- The committee discussed the inclusion of mitigation actions for cybersecurity and human-caused hazards and asked to see examples from other UNC schools.

Note: Abby will update the list of Mitigation Actions for NCSSM based on what was discussed in this meeting and send the updated list to the HMPC for a detailed review. However, Abby needs the list of updates and revisions to be sent back to WSP by March 31.

- Jonathan asked if installing a stormwater sand filter would qualify for grant funding; Abby and Carl explained that grants must point to hazard mitigation and usually are used for upgrading existing systems on campus. It is unlikely for a stormwater sand filter to qualify for a HMA grant.
- Nathan inquired about funding for backup generators, and Carl confirmed that HMGP funding is available for generators in any buildings NCSSM has classified as critical facilities on campus.

PROJECT SCHEDULE

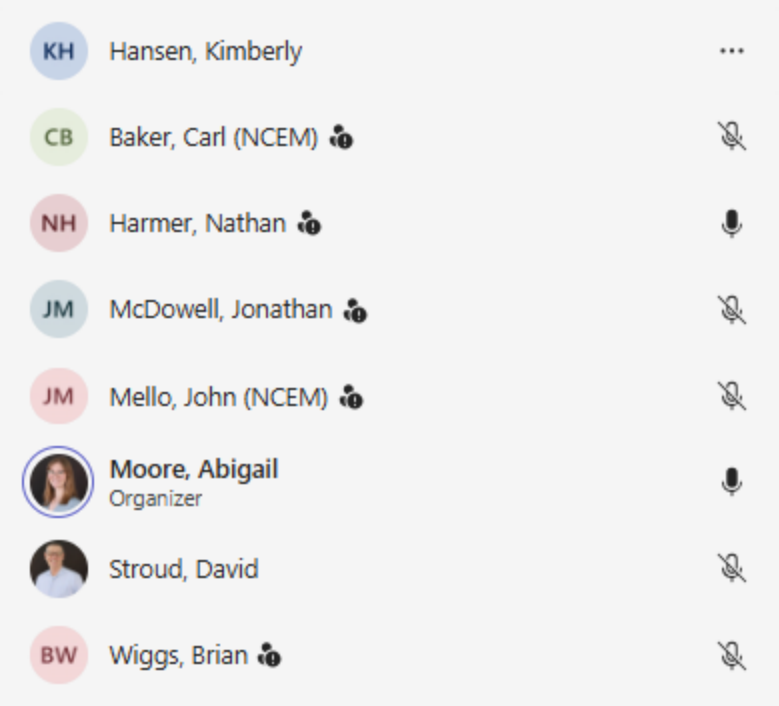
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- The survey has received 570 responses from the public overall, with no responses coming from NCSSM.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- The final HMPC meeting is scheduled for Tuesday, March 31 at 3pm.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP by March 31.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 31.


KH
Hansen, Kimberly
CB
Baker, Carl (NCEM)
NH
Harmer, Nathan
JM
McDowell, Jonathan
JM
Mello, John (NCEM)
Moore, Abigail
Organizer
Stroud, David
BW
Wiggs, Brian

## HMPC Meeting 3: NCSU – February 19, 2026

NC STATE UNIVERSITY

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

NORTH CAROLINA STATE UNIVERSITY HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

February 19, 2026, 1:00pm, Microsoft Teams

#### ATTENDANCE

There were 7 attendees. The following individuals were in attendance:
Todd Becker, Director of Emergency Preparedness, NCSU
Chris Octetree, Emergency Manager, NCSU
John Mello, NCEM
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for NCSU is posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has added Dam Failure as a hazard. The planning team was able to identify some inundation data which has been included in the plan.
- Poe Hall was removed from the critical facilities list
- There are two building values used in iRisk data – structure value and building replacement value. Replacement value is higher across the board, so WSP will use this value to estimate building value which more accurately reflects the values identified by the campus.

#### CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on NCSU's campus found on slides 6-8 of the presentation.

- The HMPC noted that the Emergency Operations Plan (EOP) is updated annually.
- The campus has an Infectious Disease Plan included in the EOP annex
- The HMPC also noted that Academic Departments will spearhead their own facilities upgrades if they have leftover budget at the end of the year. Projects may be coordinated with facilities department, but college department will lead the projects.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazard, and that actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants.
- Abby reviewed NCSU's mitigation actions. Below is a summary of status updates provided by the HMPC:
    - Project 8 is completed
    - Project 7 has been completed
    - Project 1 – the facilities included in the project description have been upgraded. The project will be revised and carried forward to address upgrades to additional campus facilities
    - Project 5 will be carried forward as the project area is apart of a larger upcoming drainage improvement project
- Todd will coordinate with IT and Facilities Management to finalize the status updates and will send project updates to Ranger by the first week of March 13.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, flooding, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.

- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
- Abby noted gaps in natural resource protection, prevention, and emergency services projects and suggested exploring projects within these categories.
- Todd explained that Duke Energy power outages or reductions impact and interrupt activities on campus like key research. The campus would like to explore alternative energy sources for research buildings in order to ensure consistent power and prevent interruptions. WSP will create a project for the campus to review.

PROJECT SCHEDULE

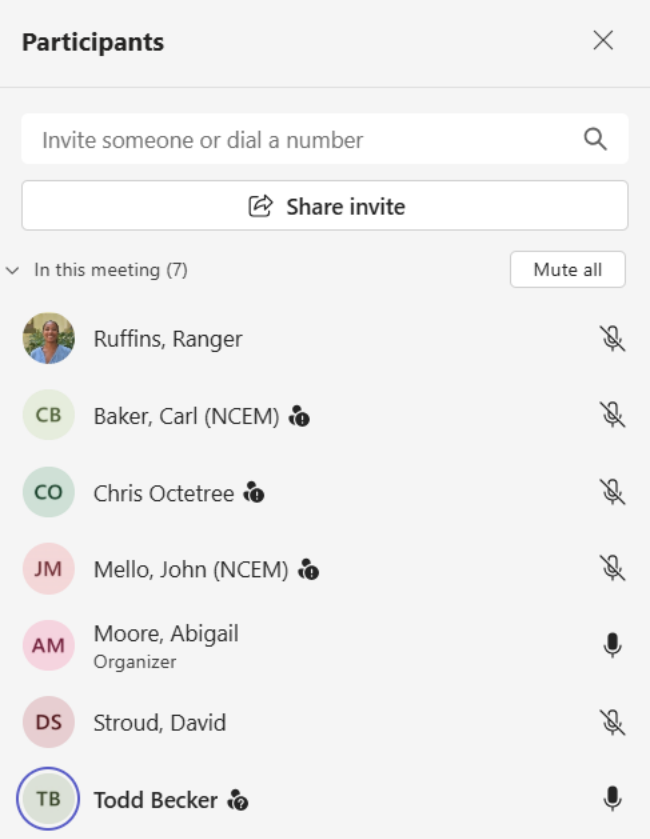
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 5 of those responses coming from NCSU.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


Participants
Invite someone or dial a number
Share invite
In this meeting (7)
Mute all
Ruffins, Ranger
CB
Baker, Carl (NCEM)
CO
Chris Octetree
JM
Mello, John (NCEM)
AM
Moore, Abigail
Organizer
DS
Stroud, David
TB
Todd Becker

## HMPC Meeting 3: UNC Chapel Hill – March 5, 2026

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC CHAPEL HILL HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

March 5, 2026, 1:30pm, Microsoft Teams

#### ATTENDANCE

There were 10 attendees. The following individuals were in attendance:

John Albrechtsen, Lead Business Systems and Data Analytics Specialist, UNC-CH
Crystal Donaldson, Community & Resilience Planner, Emergency Management and Planning, UNC-CH
Darrell Jeter, Director of Emergency Management and Planning, UNC-CH
Abbas Piran, Director Facilities Technology Group, UNC-CH
Joe Magura, Director of Facilities Engineering, UNC-CH
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for UNC-CH are posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has updated the critical facilities list and added outdoor spaces and non-building facilities in the asset inventory.
- Abby noted that based on feedback from the HMPC, WSP has expanded the campus area boundary to include all campus assets and properties.

#### CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on UNC-CH's campus found on slides 6-8 of the presentation.

- Below is a summary of status updates to the capability assessment provided by the HMPC:
    - Campus may have an updated strategic plan. Crystal and Darrell will follow up.
    - Abbas clarified that master plans exist for libraries, residence halls, and athletics, and mentioned the upcoming update to the biannual six-year capital plan.
    - The previous plan had "various faculty" written as grant writers. Abby suggested narrowing this down to include the specific administrative grant writers for mitigation projects. Darrell to follow up with the specific grant writing departments.
    - The Department of Public Safety should be changed to UNC Police.
    - The committee confirmed the list of funding sources for UNC-CH and described the use of both state and internal funds for capital projects, particularly for state-supported buildings.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.
- Regarding goal 1, the committee asked how intentional they should be with the term "campus buildings" as there are lots of buildings on campus and this may be too broad. Abby noted that the emphasis for this goal can be focused more on critical facilities as shown in objective 1.
- Carl noted that the plan goals are meant to be broad as the mitigation actions are meant to cover specifics on campus.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.
- Abby noted that there was a total of 62 mitigation actions in the 2021 UNC-CH plan. Additionally, carried forward actions do not include any Prevention or Natural Resource Protection projects.
- The committee asked how many mitigation actions are necessary and were looking to trim down their list from the previous 2021 plan.

- Abby responded that there is no limit on projects you can include in the plan and that the HMPC should focus on what they want to pursue in the next five years.
- Additionally, the HMPC should use broad mitigation actions that can cover future vulnerabilities that may appear during a natural disaster.
- David noted that eliminating building maintenance projects will also help trim down the list of actions.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, severe winter weather, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
  - The committee noted that many campus activities are held outside during the summer months and requested examples of excessive heat mitigation from other campuses.
  - Carl provided a link to the NCDEQ Heat Action Plan Toolkit resource for developing a heat action plan. https://www.deq.nc.gov/energy-climate/state-resilience-office/resilience-resources-local-communities/heat-action-plan-toolkit
  - Abby noted that NCCU has been working to construct permanent shade structures on campus and can follow up with other campus examples.
- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.

PROJECT SCHEDULE

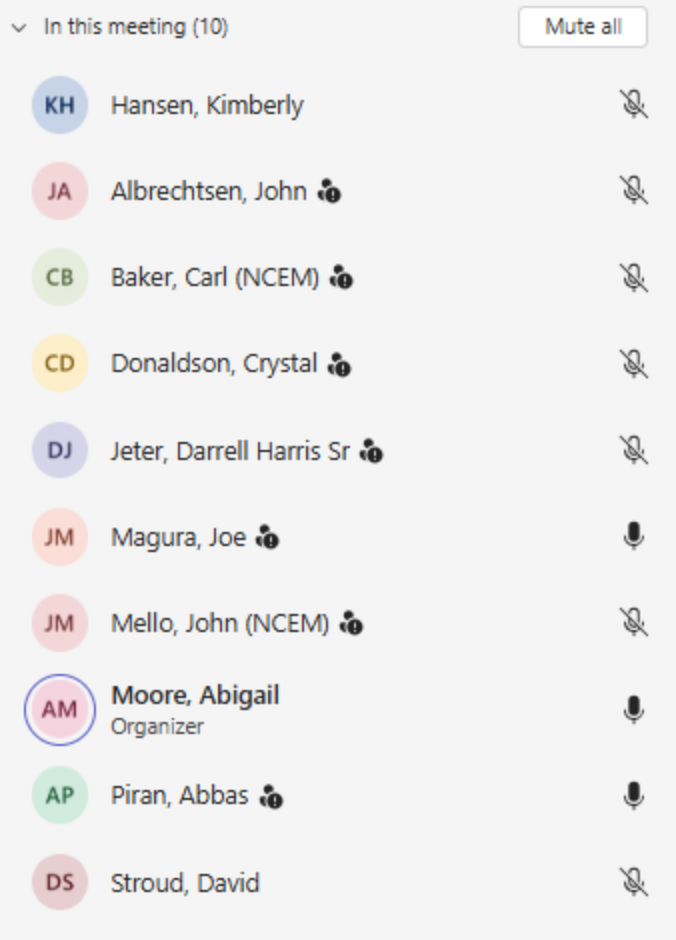
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 14 of those responses coming from UNC-CH.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP by March 13.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


In this meeting (10)
Mute all
KH
Hansen, Kimberly
JA
Albrechtsen, John
CB
Baker, Carl (NCEM)
CD
Donaldson, Crystal
DJ
Jeter, Darrell Harris Sr
JM
Magura, Joe
JM
Mello, John (NCEM)
AM
Moore, Abigail
Organizer
AP
Piran, Abbas
DS
Stroud, David

## HMPC Meeting 3: UNC Pembroke – February 26, 2026

UNC PEMBROKE

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC PEMBROKE HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

February 26, 2026, 3:00pm, Microsoft Teams

#### ATTENDANCE

There were 13 attendees. The following individuals were in attendance:

Charles Chavis, Environmental, Health, and Safety Office Professional, UNC-P
George Earl Johnson, Chief of Police, UNC-P
Joshua Johnson, Director of Student Health Services, UNC-P
Michael Bullard, Environmental, Health, and Safety Officer, UNC-P
Christopher Scott, Environmental Health and Safety Professional, UNC-P
Mark Vessely, Director of Operation and Maintenance, UNC-P
Victor Deese, Assistant Vice Chancellor for Facilities, UNC-P
John Mello, NCEM
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

#### AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

#### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment, Campus Profile, and Capability Assessment for UNC Pembroke is posted on the plan website for review: https://www.nceastcampushmp.com/
- Based on discussion at the last meeting, WSP has removed the Geological hazard profile from the Risk Assessment.
- Village Apartments was removed from the building inventory list and Thomas Hall was added.
- The committee had no additional feedback or changes to the UNCP building inventory map shown on slide 4 of the presentation.

CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.
- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on UNC Pembroke's campus found on slides 6-8 of the presentation.
- Below is a summary of status updates to the capability assessment provided by the HMPC:
    - The Emergency Operation Plan (EOP) was revised in March 2025 and will be updated on an annual basis moving forward.
    - The 2026-2031 UNCP Strategic Plan was recently finished, and the Campus Master Plan update is currently underway for 2026.
    - The Capital Improvements Plan was updated in 2025 by Plan Infrastructure and Design. Abby noted that the CIP is a good source for new projects to include in the mitigation strategy actions.
    - The Emergency Manager role now falls under finance and administration (Michael).
    - The Planning and Engineering services were previously provided by Insight (now Holland), but the HMPC agreed to verify if this is still the current provider.
    - LiveSafe is being phased out in the coming months and will be replaced with AppArmor.
    - Michael noted a new Community Engagement and Student Affairs division that may change the personnel resources for administrative and technical capabilities on campus.
    - State funding was used to renovate the auxiliary services building to house the Police Department, EHS, and a new regional EOC.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on slide 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary. No additional feedback.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazards.
- Actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants. Abby stressed the importance of including any potential project to avoid having to add eligible actions via plan amendments.

- Abby reviewed UNCP's mitigation actions. Below is a summary of status updates provided by the HMPC:
    - Action 2 will be carried forward for any facilities that still need generators.
    - Action 3 will be carried forward as it is still under development.
    - Action 23 will be carried forward as they wait for funding to complete this project.
- Abby noted that carried forward actions for UNCP do not include any Natural Resource Protection projects. These actions are not required but should be considered if applicable.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, severe winter weather, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
    - The HMPC supported including a new mitigation action to conduct outreach campaigns to raise awareness about heat-related and severe winter weather risks.
- Severe Winter Weather: Recommendations included burying distribution lines, harden overhead power lines and poles against ice damage, ensure alternate transportation facilities are available to maintain access to campus, and provide education on carbon monoxide poisoning.
    - The committee noted that it may be helpful to conduct cold weather awareness training to prevent injuries. This may already be covered in Mitigation Action #3, but WSP will expand language to cover this if necessary.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.

PROJECT SCHEDULE

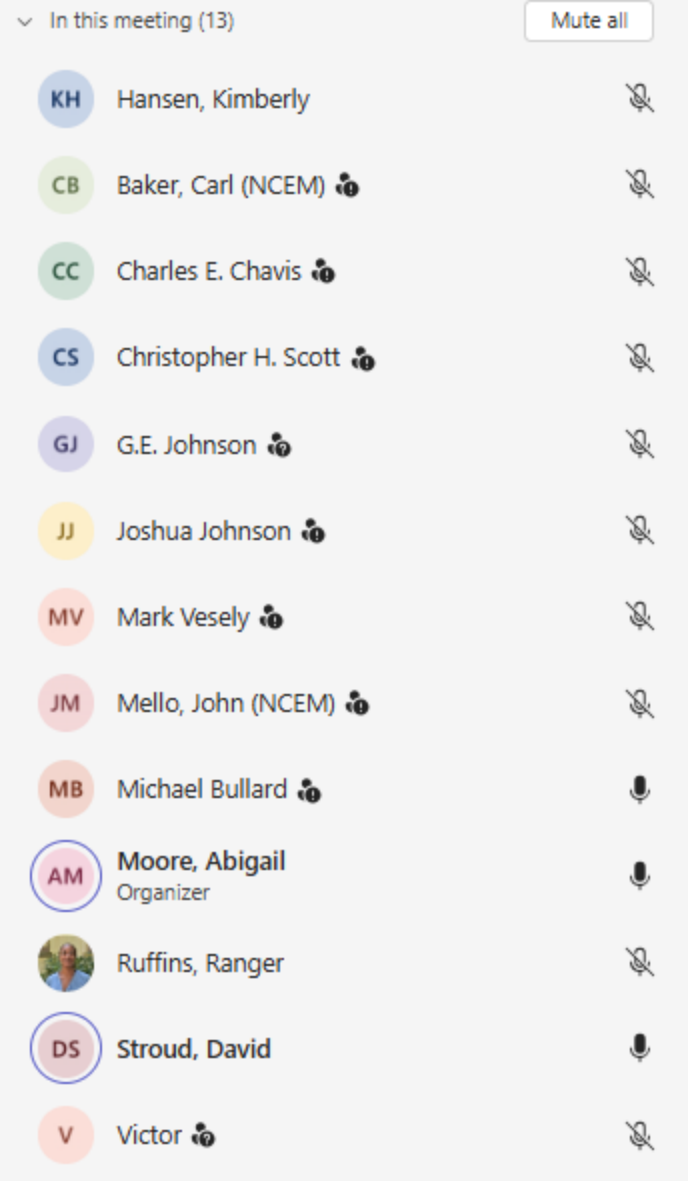
- The entire Eastern Campus HMPC will reconvene for the fourth meeting. The final meeting will involve reviewing the draft plan with all campuses before submission to NCEM and FEMA.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 151 of those responses coming from UNC Pembroke.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings in March.
- Abby asked the HMPC to review the draft risk assessment, capability assessment, and community profile and provide feedback to WSP.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com) by March 13.


In this meeting (13)
Mute all
KH Hansen, Kimberly
CB Baker, Carl (NCEM)
CC Charles E. Chavis
CS Christopher H. Scott
GJ G.E. Johnson
JJ Joshua Johnson
MV Mark Vesely
JM Mello, John (NCEM)
MB Michael Bullard
AM Moore, Abigail
Organizer
Ruffins, Ranger
DS Stroud, David
V Victor

## HMPC Meeting 3: UNC Wilmington – February 6, 2026

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

UNC-WILMINGTON HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #3

February 6, 2026, 2:30pm, Microsoft Teams

### ATTENDANCE

There were 11 attendees. The following individuals were in attendance:

Jeffrey Campbell, Director of Environmental Health and Safety, UNC-W
Kevin Meaney, Executive Director of Housing and Residence Life, UNC-W
Mark Morgan, Associate Vice Chancellor of Business Affairs, UNC-W
Kristy Burnette, Enterprise Risk Management Coordinator, UNC-W
Larry Wray, Executive Director of Campus Life, UNC-W
John Mello, NCEM
Carl Baker, NCEM
David Stroud, WSP
Abby Moore, WSP
Ranger Ruffins, WSP
Kimmy Hansen, WSP

### AGENDA

- Project Overview & Where we are in the Planning Process
- Updates Since Last Meeting
- Capability Assessment
  - New Capabilities
- Mitigation Strategy
  - Goals & Objectives
  - Mitigation Action Plan Updates
- Next Steps

### UPDATES SINCE LAST MEETING

- Abby announced that the draft Risk Assessment for UNC-W is posted on the plan website for review: https://www.nceastcampushmp.com/
- Geological hazard profile was removed from the Risk Assessment.
- The campus map and critical facilities information was updated based on HMPC feedback in the last meeting.

### CAPABILITY ASSESSMENT UPDATES

- The capability assessment measures local resources and tools available to support or implement mitigation projects.

- Abby reviewed the campus's planning and regulatory capabilities, administrative and technical resources, and fiscal resources available for mitigation on UNC-W's campus found on slides 6-8 of the presentation.
- The HMPC confirmed the relevance of existing plans and funding sources and confirmed that revenue bonds have been used in the past for capital projects but not for mitigation projects specifically.
- Kristy asked about including insurance money as a fiscal capability. Abby suggested it could be included if used for mitigation-related repairs; it was decided this is not the case.

MITIGATION STRATEGY

- Mitigation strategies reduce the impacts of hazards on existing development and ensure future development occurs in a way that minimizes vulnerability.
- Abby noted that mitigation projects should be different than on-going maintenance actions on campus. Ongoing maintenance can reduce overall risk but should not be included in the mitigation strategy actions.

**Goals & Objectives**

Abby presented the region-wide Eastern Campus HMP goals and objectives from the previous planning process found on page 10 and 11 of the presentation.

- The goals and objectives are broader than the actual mitigation projects and focus on reducing hazard impacts on campus buildings, protecting public health and safety, and building campus resilience.
- The HMPC was invited to suggest adjustments or additions if necessary.

**Mitigation Action Requirements**

- Abby explained that FEMA requires at least one mitigation action for each identified natural hazard, and that actions must be included in the approved plan to be eligible for Hazard Mitigation Assistance grants.
- Based on the previous 2021 mitigation actions, UNC-W will carry forward 33 actions, completed 17, and deleted 3.
- Ranger, who has been collecting and tracking mitigation action progress, confirmed that all updates received from the HMPC were satisfactory.

**New Mitigation Action Ideas**

Abby reviewed potential new projects to address excessive heat, flooding, and high winds.

- Excessive Heat: Abby discussed actions such as developing heat emergency response procedures, increasing utility infrastructure redundancy, establishing cooling centers, increasing shade in public spaces, and conducting outreach campaigns.
    - David reminded the HMPC that trees won't generate shade on campus until after several years of growth and that it may be beneficial to consider shade structures that can be built to provide immediate shade in public areas.
    - Jeffrey noted that some measures are already informally in place, and Mark described plans for shaded structures along Chancellor's Walk.

- Flooding: Abby discussed actions included elevating at-risk structures, increasing storm drainage capacity, installing low-impact development techniques, and improving drainage in parking lots and campus roads.
    - Mark asked if funding was available for elevating a new structure on campus. Abby clarified that elevation grants typically do not apply to new construction.
    - John explained that for any new construction that would be considered a shelter or critical facility, you can get funding for a backup generator.
- High Winds: Recommendations included retrofitting existing facilities, protecting power lines and traffic signs, strengthening building codes, and burying distribution lines.
    - Mark explained that most utilities are already below ground and that newer buildings exceed current wind code standards, while retrofitting older facilities remains a priority.
- Abby noted gaps in public education and natural resource protection actions and suggested formalizing public education campaigns and consider projects like wetland preservation and retention ponds.
- Controlled burns were discussed as prevention rather than natural resource protection

PROJECT SCHEDULE

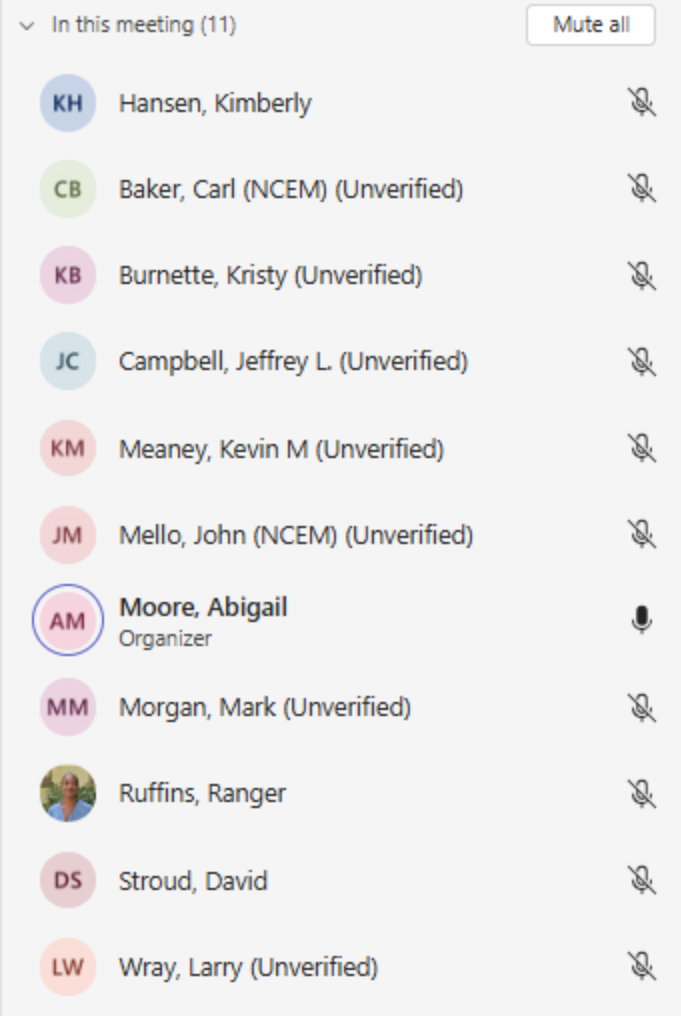
- The entire Eastern Campus HMPC will reconvene for the fourth meeting.
- The plan must be approved by NCEM and FEMA and adopted by all campuses before the current plan expires in July 2026.

PUBLIC OUTREACH

- So far, the survey has received 570 responses from the public overall, with 41 of those responses coming from UNC-W.
- WSP will send the final public survey data to the HMPC.

NEXT STEPS

- WSP will schedule the final HMPC and public meetings.
- Abby asked the HMPC to review the draft risk assessment and provide feedback to WSP.
- HMPC should send mitigation action status updates and new mitigation action ideas to Ranger. (ranger.ruffins@wsp.com)


In this meeting (11)
Mute all
KH Hansen, Kimberly
CB Baker, Carl (NCEM) (Unverified)
KB Burnette, Kristy (Unverified)
JC Campbell, Jeffrey L. (Unverified)
KM Meaney, Kevin M (Unverified)
JM Mello, John (NCEM) (Unverified)
AM Moore, Abigail
Organizer
MM Morgan, Mark (Unverified)
Ruffins, Ranger
DS Stroud, David
LW Wray, Larry (Unverified)

## HMPC Meeting 4: All Campuses – March 31, 2026



### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

HAZARD MITIGATION PLANNING COMMITTEE (HMPC) MEETING #4

March 31, 2026, 3 pm, Microsoft Teams

#### ATTENDANCE

There were 35 attendees. The following individuals were in attendance:
Nick Agresta, EM Specialist, ECU
Steven Alas, Emergency Management Coordinator, NCCU
Griffin Avin, Director of Facilities Services for Health Sciences Campus, ECU
Bill Bagnell, Campus Operations, ECU
Charles Chavis, Environmental Health and Safety, UNCP
Christopher Scott, Environmental Health and Safety, UNCP
Gretchen Cobb, Director of Business Services, FSU
James Core, Director of Environmental Health and Safety, FSU
Danny Clipper, Environmental Health & Safety Professional, ECSU
Dennis Leary, Director of Facilities Management, ECSU
Darrell Jeter, Emergency Management, UNC-Chapel Hill
Katina Blue, Associate Vice Chancellor and Chief Information Officer, UNCP
Kevin Wade, Associate Vice Chancellor for Student Affairs, ECSU
Kyle Smith, Associate Vice Chancellor & Dean of Student, UNCP
Aspen Lawrence, Emergency Manager, ECU
Jerry Guerrier, Assistant Director Facilities Planning and Design, UNC-Chapel Hill
Peter Groenendyk, Associate Vice Chancellor of Campus Living, ECU
Mark Vesely, Director of Operation and Maintenance, UNCP
Michael Bullard, Director of Environmental Health and Safety Office, UNCP
Harold Miller, Director Planning & Construction, FSU
Rondall Rice, Associate Vice Chancellor for Administration, NCCU
Richard Smith, Facilities Superintendent, UNCP
Christopher Russell, Director of Environmental Health and Safety, NCCU
Sabrina Kellogg, Director of Housing & Residence Life & Transportation Services, ECSU
Kelly Shook, Assistant Director, Environmental Health and Safety, ECU
Jason Sugg, Police Chief, ECU
Todd Becker, Emergency Management and Mission Continuity, NCSU
Brian Wiggs, Director Campus Safety, NCSSM
Ondin Mihalcescu, Director of Design and Construction, NCCU
George Johnson, Chief of Police, UNCP
Carl Baker, NCEM Plans Manager
John Mello, NCEM Mitigation Specialist
David Stroud, WSP
Abby Moore, WSP
Kimmy Hansen, WSP

## AGENDA

- Planning Process Update
- Structure of the Plan
- Review of Key Plan Components
  - Planning Process
  - Risk Assessment
  - Mitigation Strategy
- Next Steps
- Discussion and Feedback on Draft Plan

## PROJECT OVERVIEW

Abby provided an overview of the four-phase planning process for updating the UNC Eastern Campuses Hazard Mitigation Plan, detailing committee organization, risk assessment, mitigation strategy development, and adoption steps, with participation from representatives of all nine campuses and stakeholders.

## STRUCTURE OF THE PLAN

Abby described the structure of the hazard mitigation plan, including the main plan, campus-specific annexes, and appendices, and outlined the content and purpose of each section, emphasizing how information is organized for review and compliance. Below is a summary of each plan section.

- The Main Plan – This portion of the plan contains broad information relevant to all campuses, including introduction, planning process, hazard identification and profiles, mitigation strategy, implementation and maintenance procedures, and plan adoption documentation.
- Campus Annexes – Each campus has an annex with a campus profile, asset inventory, hazard risk and vulnerability assessment, capability assessment, and a mitigation action plan detailing progress and new actions for the next five years.
- Appendices – Appendices document FEMA planning requirements, planning process details, meeting minutes, attendance records, outreach efforts, survey results, and references used in the plan.

## KEY PLAN COMPONENTS

- Committee Coordination and Public Engagement – The Hazard Mitigation Planning Committee (HMPC) included representatives from all nine campuses and conducted four meetings, two of which were campus specific meetings. Public outreach efforts included a plan website, public survey, and opportunity for draft document reviews.
- Public Survey – The public survey received 570 responses with feedback from all nine campuses. Survey results informed the vulnerability assessment and mitigation strategy updates. Detailed survey responses can be found in the plan appendices.
- Risk Assessment - Hazard profiles in the main plan provide descriptions, priority risk index summaries, climate change impacts, consequence analysis, and problem statements. Campus annexes offer granular risk and vulnerability data, including asset inventories and spatial analyses. Varied risk assessment methodologies were used for different hazards, including quantitative, qualitative, statistical, and GIS spatial analyses. The priority risk index (PRI) was used to categorize hazards by campus as low, moderate, or high risk, shown below.

| Hazard | ECU | ECSU | FSU | NCCU | NCSSM | NCSU | UNC-CH | UNC-P | UNC-W |
|---|---|---|---|---|---|---|---|---|---|
| Dam Failure | n/a | n/a | n/a | n/a | n/a | 2.4 | 2.4 | n/a | n/a |
| Drought | n/a | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | 2.5 |
| Earthquake | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Excessive Heat | 3.3 | 3.0 | 3.0 | 3.0 | 3.0 | 3.3 | 3.0 | 3.0 | 3.0 |
| Flooding | 2.8 | 2.5 | 2.5 | 3.1 | 1.5 | 2.8 | 3.0 | 2.3 | 2.3 |
| Geological | n/a | n/a | n/a | 1.9 | n/a | n/a | 1.7 | n/a | n/a |
| Hurricanes & Coastal Hazards | 3.2 | 3.2 | 2.9 | 2.9 | 2.9 | 2.9 | 2.3 | 2.9 | 3.2 |
| Severe Winter Weather | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | n/a |
| Tornadoes & Thunderstorms | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Wildfire | 2.2 | 2.2 | 2.5 | 2.2 | 1.8 | 2.2 | 2.2 | 2.8 | 2.5 |
| Cyber Security | 3.1 | 3.1 | n/a | 3.7 | n/a | 3.1 | n/a | 3.1 | 3.1 |
| Hazardous Substances | 2.3 | 1.7 | n/a | 2.3 | 2.3 | 2.3 | 2.0 | 2.2 | 2.3 |
| Infectious Disease | 2.8 | 2.8 | n/a | 2.8 | 2.8 | 2.8 | n/a | 2.8 | 2.8 |
| Terrorism | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | n/a | 2.5 |

- Goals and Objectives – The existing plan goals were reviewed and updated by the HMPC and are presented in graphic below and on slide 27 of the presentation. The only change that occurred was editing the language of Goal 1 to be more concise.
- Mitigation Action Review – Each campus reviewed actions from the 2021 plan, marking them as completed, deleted, or carried forward. Maintenance activities were removed to focus on true mitigation projects, and new actions were identified for the 2026 plan. WSP has the Mitigation Action Plans from all campuses except for NCSSM.

## Goals & Objectives

**Goal 1 – Reduce the impact of hazards on campus buildings and infrastructure.**

- **Objective 1.1:** Retrofit or otherwise protect critical facilities and infrastructure.
- **Objective 1.2:** Protect critical research and campus operations.
- **Objective 1.3:** Preserve and protect natural systems and resources that provide hazard mitigation benefits.



**Goal 2 – Protect the public health, safety, and welfare of people on campus from hazard risk.**

- **Objective 2.1:** Implement outreach activities to create a culture of preparedness by educating campus communities on local risks, property protection, and personal protection.
- **Objective 2.2:** Improve hazard monitoring and warning systems to enable earlier response actions.
- **Objective 2.3:** Create or update existing campus evacuation and shelter in place procedures.



**Goal 3 – Build campus resilience to minimize interruption and ensure speedy recovery from hazard events.**

**Objective 3.1:** Develop or revise plans, policies, and regulations to reduce vulnerability of new construction on campus.

**Objective 3.2:** Improve campus mitigation and response capabilities.



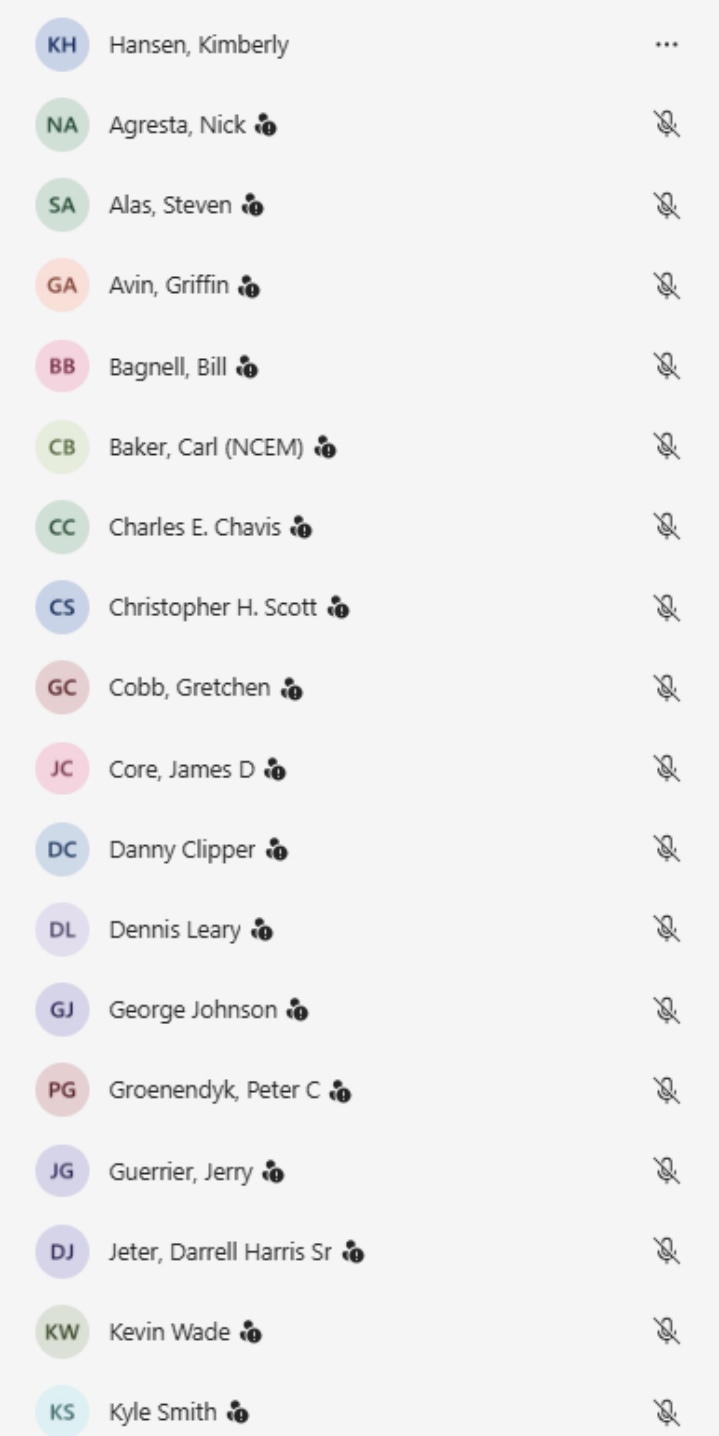
ADOPTION AND NEXT STEPS

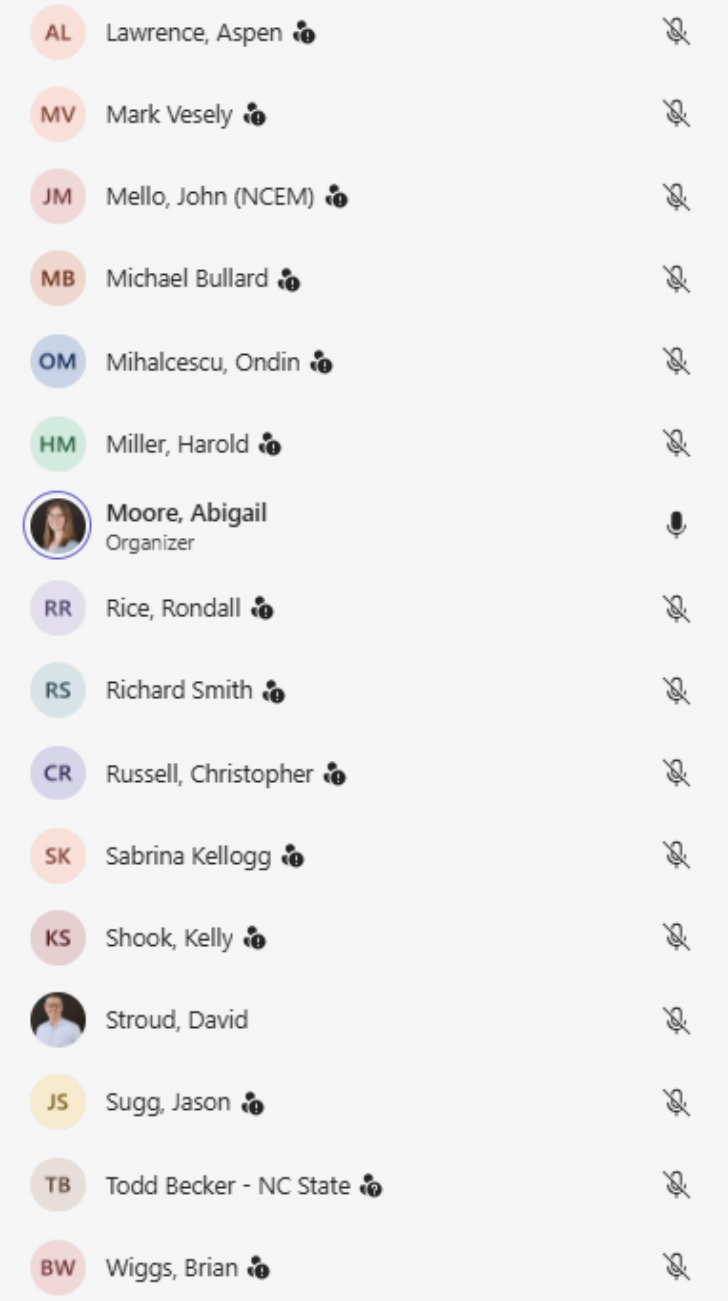
- Adoption Process and Template – Carl noted that he is updating the adoption resolution template to reflect recent state legal changes. Campuses will receive the new template and are encouraged to adopt the plan before FEMA approval to expedite the process. Abby will send a notice to the committee when NCEM has approved the plan and campuses can move forward with adoption.
- Submission and Approval Timeline – A two-week comment period on the draft plan is open until April 14th. The draft will be submitted to NCEM on April 15th, then forwarded to FEMA. Adoption is expected in May-June, with final approval from FEMA targeted by July 15th.

- Ongoing Implementation and Review – The committee will meet annually to review implementation progress and recommend updates. Campus leads are responsible for initiating annual reviews, and the plan will be updated every five years.
- Document Access and Distribution – The final plan will be distributed to all campuses and posted on the NCEM and project websites. Campuses are encouraged to download and host the plan on their own websites, as the project website will not be maintained over the next five years.

PROJECT SCHEDULE

- The planning process kicked off in July 2025. The draft plan will be completed and sent for review in May and final plan approval will be completed before the current plan expires in July.
- Please visit the plan website www.NCEastCampusHMP.com to review the draft plan. You can submit feedback via a comment box on the website. Comments on the draft plan are due by April 14th.


KH Hansen, Kimberly
NA Agresta, Nick
SA Alas, Steven
GA Avin, Griffin
BB Bagnell, Bill
CB Baker, Carl (NCEM)
CC Charles E. Chavis
CS Christopher H. Scott
GC Cobb, Gretchen
JC Core, James D
DC Danny Clipper
DL Dennis Leary
GJ George Johnson
PG Groenendyk, Peter C
JG Guerrier, Jerry
DJ Jeter, Darrell Harris Sr
KW Kevin Wade
KS Kyle Smith


AL Lawrence, Aspen
MV Mark Vesely
JM Mello, John (NCEM)
MB Michael Bullard
OM Mihalcescu, Ondin
HM Miller, Harold
Moore, Abigail
Organizer
RR Rice, Rondall
RS Richard Smith
CR Russell, Christopher
SK Sabrina Kellogg
KS Shook, Kelly
Stroud, David
JS Sugg, Jason
TB Todd Becker - NC State
BW Wiggs, Brian

# B.2 Planning Step 2: Involve the Public

### Table B.2 – Public Meeting Topics, Dates, Locations

| Meeting Title | Meeting Topic | Meeting Date | Meeting Location |
|---|---|---|---|
| Public Meeting #1 | 1) Introduction to DMA, CRS, and FMA requirements and the planning process<br>2) Review of planning process, hazards identified, public survey and website, and the project schedule. | September 29, 2025 1:00p.m. & September 30, 2025 5:00 p.m. | Microsoft Teams |
| Public Meeting #2 | 1) Review “Draft” Hazard Mitigation Plan<br>2) Solicit comments and feedback | March 31, 2026 5:00 p.m. | Microsoft Teams |

# B.2.1 Public Meeting Minutes, Attendance, & Outreach

## Public Meeting 1: September 29, 2025 & September 30, 2025

UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

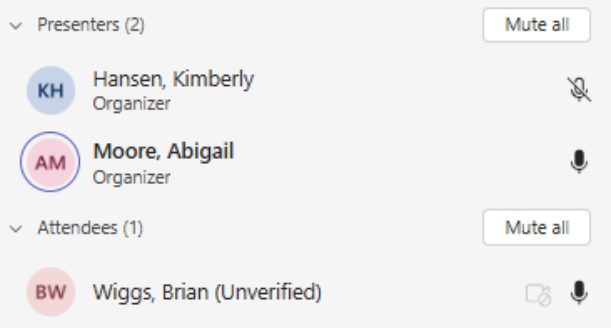
PUBLIC MEETING #1

September 29, 2025, 1 pm, Microsoft Teams

Abby Moore and Kimmy Hansen from WSP, NCEM's consultant for this plan update, facilitated a public meeting to discuss the topics outlined in the following agenda:

1. Why Plan?
2. Project Overview
3. Planning Process
4. Project Schedule
5. Next Steps
6. Q & A

In addition to the WSP team, there was only one attendee, Brian Wiggs, who is a member of the Hazard Mitigation Planning Committee. Brian is the Director of Campus Safety at the North Carolina School of Science and Mathematics in Durham, NC. In lieu of reviewing the prepared presentation, Abby addressed questions and discussed several topics with Brian concerning the specific needs of NCSSM. The discussion covered updates to hazard profiles included within the risk assessment, inclusion of NCSSM Morganton campus, review of the PRI formula, and the future meeting schedule.


Presenters (2)
Mute all
KH
Hansen, Kimberly
Organizer
AM
Moore, Abigail
Organizer
Attendees (1)
Mute all
BW
Wiggs, Brian (Unverified)

## UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

PUBLIC MEETING #1

September 30, 2025, 5 pm, Microsoft Teams

Abby Moore, David Stroud, and Ranger Ruffins from WSP, NCEM's consultant for this plan update, facilitated a public meeting to discuss the topics outlined in the following agenda:

1. Why Plan?
2. Project Overview
3. Planning Process
4. Project Schedule
5. Next Steps
6. Q & A

In addition to the WSP team, there were only two attendees, Crystal Donaldson and Danny Clipper, who are members of the Hazard Mitigation Planning Committee. Crystal is the Continuity and Resilience Planner at UNC-Chapel Hill, and Danny is the Emergency Management Coordinator and Health and Safety Professional at Elizabeth City State University (ECSU).

Abby first addressed questions and discussed several topics with Crystal and Danny concerning the specific needs their respective campuses. Discussion topics covered updates to the UNC-Chapel Hill boundary, coordinating feedback from ECSU on boundary updates and critical facilities, and plan publicity through ECSU's communications team.

Abby proceeded with the presentation according to the agenda, above.

### WHY PLAN?

Abby began the presentation with why we plan in the first place. She discussed the Disaster Mitigation Act (DMA) of 2000, which is codified in 44 CFR 201.6 and requires local government to update their hazard mitigation plans every five years to be eligible for pre- and post-disaster grant funding through FEMA's Hazard Mitigation Assistance programs. Mitigation funding available through FEMA includes the Hazard Mitigation Grant Program (HMGP) and Flood Mitigation Assistance (FMA) program. Abby noted that every community in the state is eligible for HMGP funding whenever a disaster is declared in the state of North Carolina, even if it does not directly impact the campus, as there is often funding left over after projects have been completed in affected areas.

Other reasons to plan are to understand changings risks and to increase community resilience. Abby reviewed trends in disasters that support the need for mitigation planning. In FY2024 there were 27 billion-dollar disasters. There's an increasing trend in recent years in the number of billion-dollar disasters. This may be in part because we now have more frequent and intense hazard events and greater exposure to risk (people, property and critical infrastructure). Abby explained that hazard mitigation is a priority for multiple reasons, including that the cost of doing nothing is too high, many events are predictable and repetitive, loss reduction can be effective, cost-beneficial, and environmentally-sound, there are legal and moral responsibilities to prevent disasters, and there are federal funds available to support mitigation. The average benefit-cost ratio (BCR) for federally funded projects is 6:1 and is even higher for flood mitigation.

Abby explained that mitigation is a sustained or permanent action taken to reduce or eliminate long-term risk to people and/or property. Mitigation helps to break the damage/rebuild cycle. Basic approaches to mitigation include altering the hazard, averting the hazard, adapting to the hazard, or avoiding the hazard.

## PLANNING PROCESS

### PHASE 1

Abby described the planning process in more detail. Phase 1, organize resources, is already underway. The HMPC has been reconvened, and new staff members and stakeholders were identified for involvement. The HMPC will meet four times to provide input on risk and capability, update mitigation actions, and review plan drafts. HMPC meetings are open to the public, but there will also be two public meetings, this meeting and a meeting at the end of the planning process to review the draft plan.

It will also be important to involve stakeholders (additional faculty, staff, students, neighbors) in the planning process in other ways. WSP will work with the HMPC to reach out to stakeholders to solicit input on the plan.

### PHASE 2: ASSESS RISKS

Phase 2 covers the risk assessment, which includes the hazard identification and the vulnerability assessment. This plan reviewed the hazard included in the State Hazard Mitigation Plan (HMP) and previous plan. The identified hazards are as follows: Hurricane & Coastal Hazards, Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Geological, Severe Winter Weather, Tornado/Thunderstorm, Wildfire, Cyber, Hazardous Materials, Infectious Disease, Terrorism, Vandalism/Theft. The HMPC also decided to address extreme heat across all the campuses in this plan update. Abby also explained that the hazards groupings and nomenclature will be updated to align with the State Hazard Mitigation Plan.

To conduct the vulnerability assessment, qualitative, quantitative, and spatial analysis will be used as appropriate. Abby explained that while this is regional plan, there will be an annex for each campus that evaluates the hazards at a more granular level.

### PHASE 3: DEVELOP A MITIGATION STRATEGY

Phase 3 involves developing a mitigation strategy by reviewing and updating the plan goals and objectives, evaluating mitigation alternatives including existing and new projects, and drafting an action plan with prioritized projects. The action plan will identify criteria to support monitoring and implementation, including the responsible department or agency, timeline for completion, and potential funding sources.

### PHASE 4: ADOPTION AND IMPLEMENTATION

Phase 4 is where the campuses must adopt and implement the plan. Each of the participating campuses must adopt the plan by resolution and the committee will meet at least annually to review the action plan and look for funding and opportunities to implement projects. The plan will continue to be updated every five years.

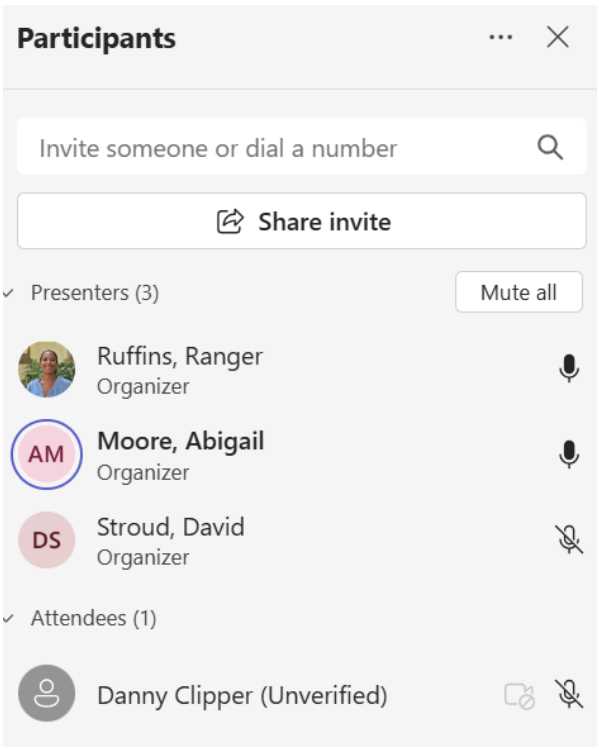
## PROJECT SCHEDULE

Abby presented the schedule for the planning process. The HMPC will meet again in October. The final public meeting will be held in February. The plan must be approved by NCEM and FEMA and adopted by all communities before the current plan expires in July 2026.

## NEXT STEPS

Abby discussed opportunities for the public to stay involved in the plan update, including attending the public meetings, responding to the public survey, and reviewing meetings materials and draft documents on the plan website (https://www.NCEastCampusHMP.com).

WSP is working on the risk and vulnerability assessment update and responses to the public survey will be extremely helpful in identifying local risks and vulnerabilities as well as local priorities for mitigation.




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# Public Notice: The UNC System Eastern Campuses Regional Hazard Mitigation Plan update is underway

PUBLISHED SEP 23, 2025 BY ECU NEWS SERVICES
FILED UNDER: NEWS RELEASE

This plan covers the main campuses of the following UNC System schools: East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Central University, North Carolina School of Science and Math, North Carolina State University, UNC-Chapel Hill, UNC-Pembroke, and UNC-Wilmington. This plan update is required for the participating schools to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. The plan will also help us to identify hazard risks, understand vulnerability, and develop ways to proactively reduce risk on our campuses.

To kick off the planning process, two virtual public meetings will be held to discuss the plan update process, review the identified hazards, and gather feedback from the public. We're interested in your experiences with past hazards and your ideas for reducing risk. These public meeting sessions will be held on the following dates and times:

- Monday, September 29th at 1pm: Register Here
- Tuesday, September 30th at 5pm: Register Here

If you can't attend a meeting but still want to contribute to the planning process, we encourage you to complete the public survey (see website link or QR code).

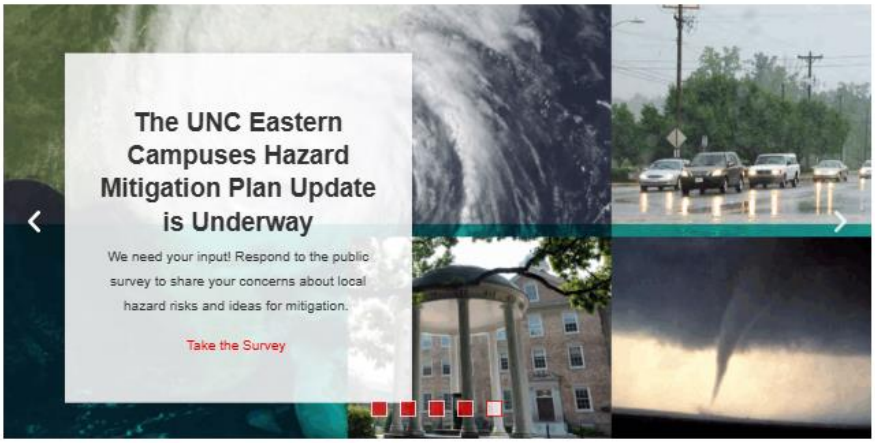
To learn more about the planning process and to register to attend one of these meetings, visit www.NCEastCampusHMP.com. On this site you will find information about upcoming and past Hazard Mitigation Planning Committee meetings and public meetings, a link for the public survey, draft documents, and other mitigation planning resources.

###

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## NC STATE CURRENT WEATHER

Current Temperature: 68.4°F
Current Humidity: 94%
Current Rainfall: in/hr
Current Dew Point: 66.6°F
Current Pressure: 30.057 inHg



Visit the NC State WeatherSTEM page

FOLLOW US!

## The UNC System Eastern Campuses Regional Hazard Mitigation Plan Update is Underway

And we need your input! This plan covers the main campuses of the following UNC System schools:

- North Carolina State University
- East Carolina University
- Elizabeth City State University
- Fayetteville State University
- North Carolina School of Science and Math
- North Carolina Central University
- UNC-Chapel Hill
- UNC-Pembroke
- UNC-Wilmington

This plan update is required for the participating schools to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. The plan will also help us identify hazard risks, understand vulnerability, and develop ways to proactively reduce risk on our campuses.

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To learn more about the planning process and to register to attend these meetings, visit www.NCEastCampusHMP.com. On this site you will find information about upcoming and past Hazard Mitigation Planning Committee meetings, public meetings, a link for the public survey, draft documents, and other mitigation planning resources.

## Public Meeting 2: March 31, 2026

### UNC EASTERN CAMPUSES HAZARD MITIGATION PLAN UPDATE

PUBLIC MEETING #2

March 31, 2026, 5 pm, Microsoft Teams

ATTENDANCE

There were 13 attendees. The following individuals were in attendance:
Robert Ables
Abi Awoyemi
Brandon Frye
Anthony Burnette
Cherly Godwin
Leslie Billotte
Anthony Nelson
Paige Hendrickson
Catherine Quinlan
Jonathan Allan Rose
Joani Zary
Abby Moore, WSP
Ranger Ruffins, WSP

AGENDA

- Planning Process Update
- Structure of the Plan
- Review of Key Plan Components
  - Planning Process
  - Risk Assessment
  - Mitigation Strategy
- Next Steps
- Discussion and Feedback on Draft Plan

PROJECT OVERVIEW

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STRUCTURE OF THE PLAN

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- Appendices – Appendices document FEMA planning requirements, planning process details, meeting minutes, attendance records, outreach efforts, survey results, and references used in the plan.

KEY PLAN COMPONENTS

- Committee Coordination and Public Engagement – The Hazard Mitigation Planning Committee (HMPC) included representatives from all nine campuses and conducted four meetings, two of which were campus specific meetings. Public outreach efforts included a plan website, public survey, and opportunity for draft document reviews.
- Public Survey – The public survey received 570 responses with feedback from all nine campuses. Survey results informed the vulnerability assessment and mitigation strategy updates. Detailed survey responses can be found in the plan appendices.
- Risk Assessment - Hazard profiles in the main plan provide descriptions, priority risk index summaries, climate change impacts, consequence analysis, and problem statements. Campus annexes offer granular risk and vulnerability data, including asset inventories and spatial analyses. Varied risk assessment methodologies were used for different hazards, including quantitative, qualitative, statistical, and GIS spatial analyses. The priority risk index (PRI) was used to categorize hazards by campus as low, moderate, or high risk, shown below.

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| Drought | n/a | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | 2.5 |
| Earthquake | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Excessive Heat | 3.3 | 3.0 | 3.0 | 3.0 | 3.0 | 3.3 | 3.0 | 3.0 | 3.0 |
| Flooding | 2.8 | 2.5 | 2.5 | 3.1 | 1.5 | 2.8 | 3.0 | 2.3 | 2.3 |
| Geological | n/a | n/a | n/a | 1.9 | n/a | n/a | 1.7 | n/a | n/a |
| Hurricanes & Coastal Hazards | 3.2 | 3.2 | 2.9 | 2.9 | 2.9 | 2.9 | 2.3 | 2.9 | 3.2 |
| Severe Winter Weather | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | n/a |
| Tornadoes & Thunderstorms | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Wildfire | 2.2 | 2.2 | 2.5 | 2.2 | 1.8 | 2.2 | 2.2 | 2.8 | 2.5 |
| Cyber Security | 3.1 | 3.1 | n/a | 3.7 | n/a | 3.1 | n/a | 3.1 | 3.1 |
| Hazardous Substances | 2.3 | 1.7 | n/a | 2.3 | 2.3 | 2.3 | 2.0 | 2.2 | 2.3 |
| Infectious Disease | 2.8 | 2.8 | n/a | 2.8 | 2.8 | 2.8 | n/a | 2.8 | 2.8 |
| Terrorism | n/a | n/a | n/a | n/a | n/a | 2.5 | n/a | n/a | 2.5 |

- Goals and Objectives – The existing plan goals were reviewed and updated by the HMPC and are presented in graphic on the following page and on slide 27 of the presentation.
- Mitigation Action Review – Each campus reviewed actions from the 2021 plan, marking them as completed, deleted, or carried forward. Maintenance activities were removed to focus on true mitigation projects, and new actions were identified for the 2026 plan.

## Goals & Objectives

**Goal 1 – Reduce the impact of hazards on campus buildings and infrastructure.**

- **Objective 1.1:** Retrofit or otherwise protect critical facilities and infrastructure.
- **Objective 1.2:** Protect critical research and campus operations.
- **Objective 1.3:** Preserve and protect natural systems and resources that provide hazard mitigation benefits.



**Goal 2 – Protect the public health, safety, and welfare of people on campus from hazard risk.**

- **Objective 2.1:** Implement outreach activities to create a culture of preparedness by educating campus communities on local risks, property protection, and personal protection.
- **Objective 2.2:** Improve hazard monitoring and warning systems to enable earlier response actions.
- **Objective 2.3:** Create or update existing campus evacuation and shelter in place procedures.



**Goal 3 – Build campus resilience to minimize interruption and ensure speedy recovery from hazard events.**

**Objective 3.1:** Develop or revise plans, policies, and regulations to reduce vulnerability of new construction on campus.

**Objective 3.2:** Improve campus mitigation and response capabilities.

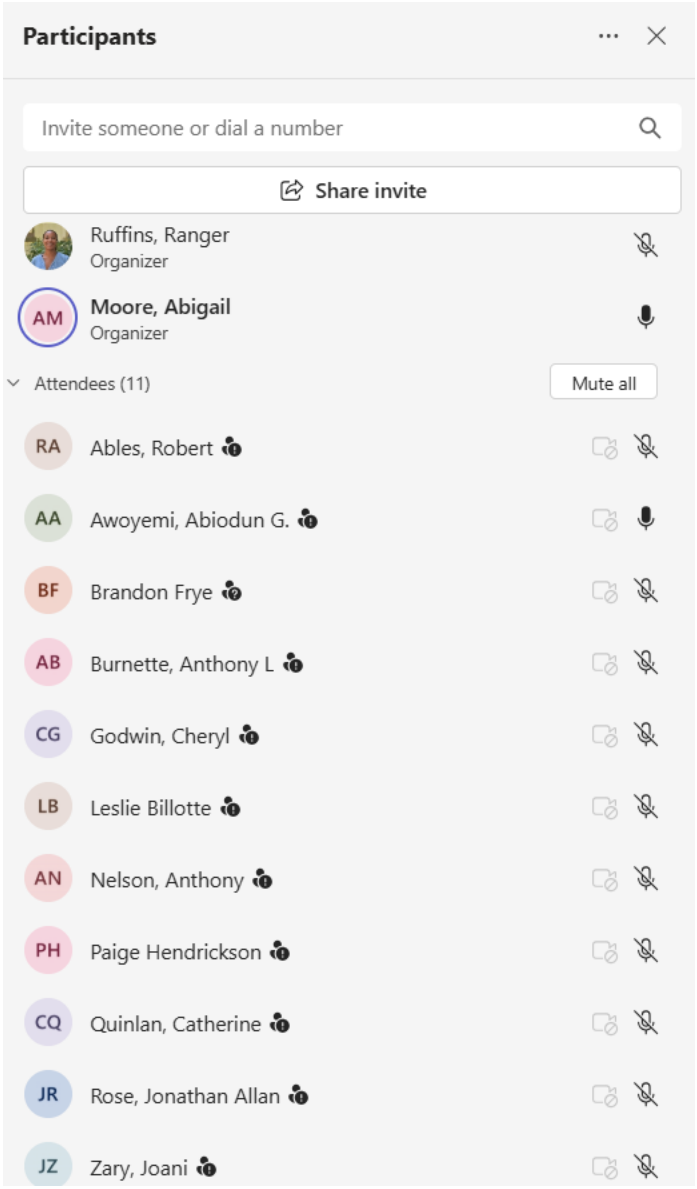


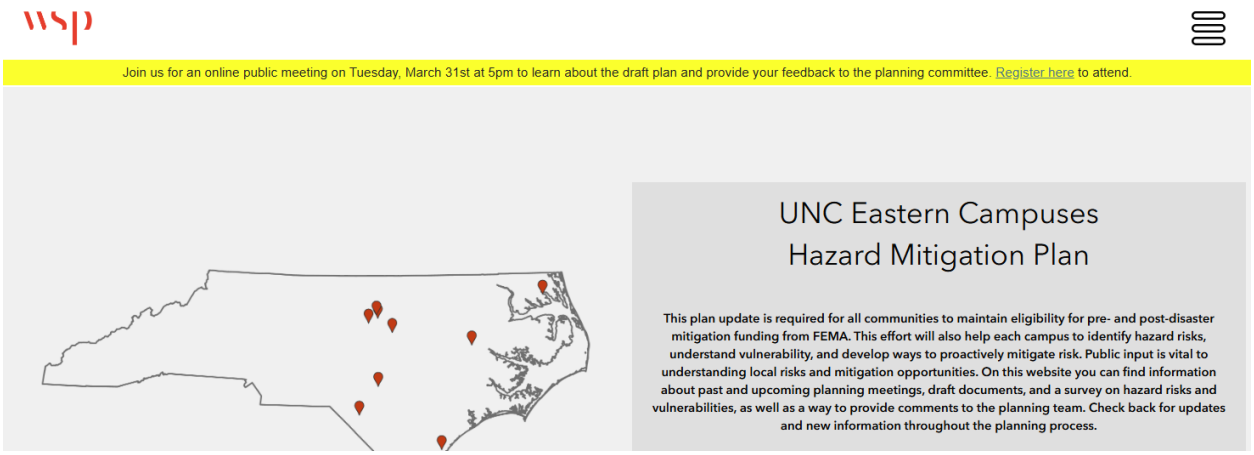
### PROJECT SCHEDULE

The planning process kicked off in July 2025. The draft plan will be completed and sent for review in May and final plan approval will be completed before the current plan expires in July.

Share Your Feedback

Please visit the plan website www.NCEastCampusHMP.com to review the draft plan. You can submit feedback via a comment box on the website. Comments on the draft plan are due April 14th.


Participants
Invite someone or dial a number
Share invite
Ruffins, Ranger
Organizer
AM
Moore, Abigail
Organizer
Attendees (11)
Mute all
RA Ables, Robert
AA Awoyemi, Abiodun G.
BF Brandon Frye
AB Burnette, Anthony L
CG Godwin, Cheryl
LB Leslie Billotte
AN Nelson, Anthony
PH Paige Hendrickson
CQ Quinlan, Catherine
JR Rose, Jonathan Allan
JZ Zary, Joani


Join us for an online public meeting on Tuesday, March 31st at 5pm to learn about the draft plan and provide your feedback to the planning committee. Register here to attend.
UNC Eastern Campuses
Hazard Mitigation Plan
This plan update is required for all communities to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. This effort will also help each campus to identify hazard risks, understand vulnerability, and develop ways to proactively mitigate risk. Public input is vital to understanding local risks and mitigation opportunities. On this website you can find information about past and upcoming planning meetings, draft documents, and a survey on hazard risks and vulnerabilities, as well as a way to provide comments to the planning team. Check back for updates and new information throughout the planning process.

Stay resilient, be Mission Ready!

## Resources for Plan Administrators




The UNC System Eastern Campuses Regional Hazard Mitigation Plan update is nearly complete! This plan identifies hazard risks, evaluates vulnerability, and presents mitigation action plans to reduce risk.

To learn more about the draft plan and provide your feedback to the planning committee, join us for an online public meeting on Tuesday, March 31st at 5pm. Register to attend.

If you can't attend this meeting but still want to contribute to the planning process, visit the NC East Campus HMP website to review the draft plan and submit feedback.



Need Help? Whether you need assistance with plan development, risk assessment, or creating your own Risk Matrix, don't hesitate to contact Crystal Donaldson. She can help you schedule a review of your Mission Continuity Plan to ensure your strategies are effective and up-to-date.

### Contact

**Emergency Management and Planning**
1120 Estes Drive Ext.
Campus Box #1600
Chapel Hill, NC 27599
**Phone:** 919-445-1730

Contact Information

Campus Safety

### Mission Continuity Newsletter

Stay up-to-date by subscribing to our monthly Mission Continuity newsletter, designed provide information and updates related to mission continuity, preparedness and planning.

### Links of Interest

- Alert Carolina
- Carolina Ready
- Safety App
- Adverse Weather
- Active Assailant



**UNC System Eastern Campuses Hazard Mitigation Plan Public Meeting**

**Details**

The UNC System Eastern Campuses Regional Hazard Mitigation Plan update identifies hazard risks, evaluates vulnerability, and presents mitigation action plans to reduce risk for East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Central University, North Carolina School of Science and Math, North Carolina State University, UNC-Chapel Hill, UNC-Pembroke, and UNC-Wilmington.

Join us for a public meeting to learn about the draft plan and provide feedback to the planning team.

You can also visit www.NCEastCampusHMP.com to review the draft plan and submit feedback online.

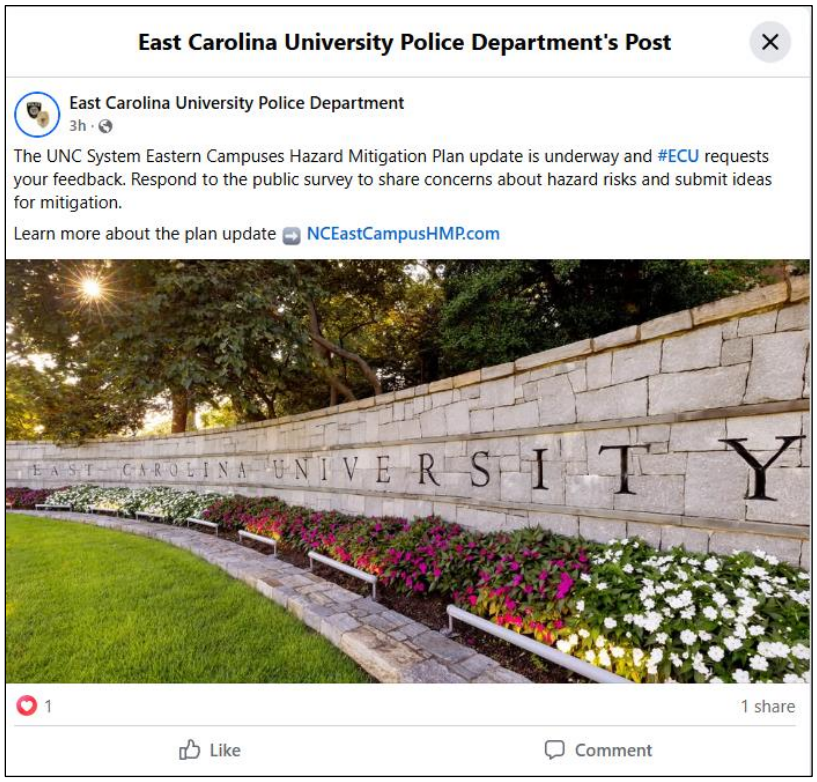
Register

Tue, Mar 31
5:00 PM - 6:00 PM EDT
Online event

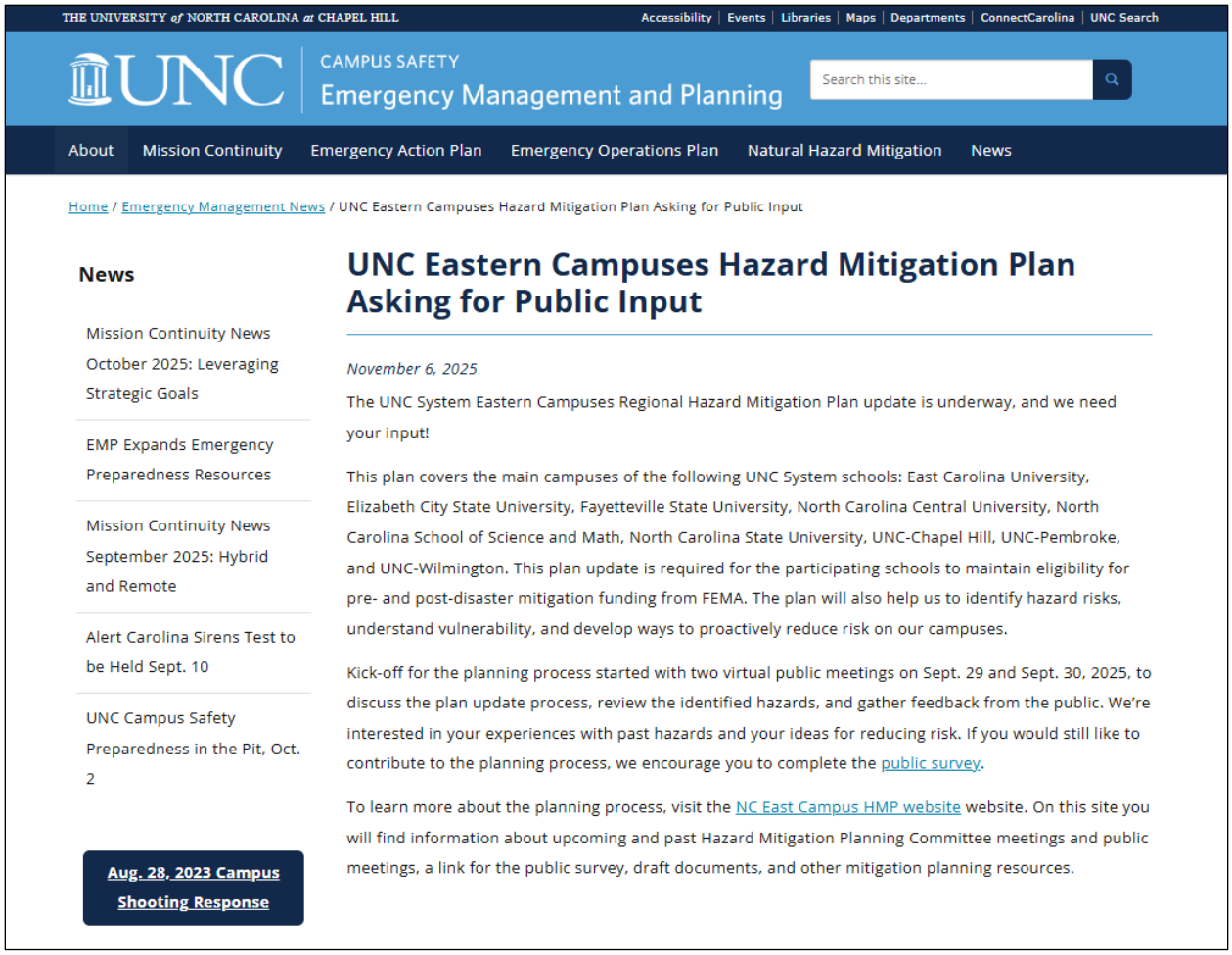
Microsoft Privacy Policy. Privacy Policy.

# B.2.2 Additional Public Outreach

## Plan Website Outreach





THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Accessibility | Events | Libraries | Maps | Departments | ConnectCarolina | UNC Search

UNC CAMPUS SAFETY Emergency Management and Planning

Search this site...

About | Mission Continuity | Emergency Action Plan | Emergency Operations Plan | Natural Hazard Mitigation | News

Home / Emergency Management News / UNC Eastern Campuses Hazard Mitigation Plan Asking for Public Input

**News**

- Mission Continuity News October 2025: Leveraging Strategic Goals
- EMP Expands Emergency Preparedness Resources
- Mission Continuity News September 2025: Hybrid and Remote
- Alert Carolina Sirens Test to be Held Sept. 10
- UNC Campus Safety Preparedness in the Pit, Oct. 2

**Aug. 28, 2023 Campus Shooting Response**

## UNC Eastern Campuses Hazard Mitigation Plan Asking for Public Input

*November 6, 2025*

The UNC System Eastern Campuses Regional Hazard Mitigation Plan update is underway, and we need your input!

This plan covers the main campuses of the following UNC System schools: East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Central University, North Carolina School of Science and Math, North Carolina State University, UNC-Chapel Hill, UNC-Pembroke, and UNC-Wilmington. This plan update is required for the participating schools to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. The plan will also help us to identify hazard risks, understand vulnerability, and develop ways to proactively reduce risk on our campuses.

Kick-off for the planning process started with two virtual public meetings on Sept. 29 and Sept. 30, 2025, to discuss the plan update process, review the identified hazards, and gather feedback from the public. We're interested in your experiences with past hazards and your ideas for reducing risk. If you would still like to contribute to the planning process, we encourage you to complete the public survey.

To learn more about the planning process, visit the NC East Campus HMP website website. On this site you will find information about upcoming and past Hazard Mitigation Planning Committee meetings and public meetings, a link for the public survey, draft documents, and other mitigation planning resources.



THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Accessibility | Events | Libraries | Maps | Departments | ConnectCarolina | UNC Search

UNC CAMPUS SAFETY Emergency Management and Planning

Search this site...

About | Tar Heel Mission Ready | Emergency Action Plan | Emergency Operations Plan | Natural Hazard Mitigation | News

Home / Emergency Management News / Community Survey: Hazard Mitigation Plan

**News**

- Mission Continuity News August 2025: Succession Planning
- Tar Heel Mission Ready Gets an Upgrade
- Mission Continuity News July 2025: Continuity Culture
- Alert Carolina Sirens Test to be Held July 16

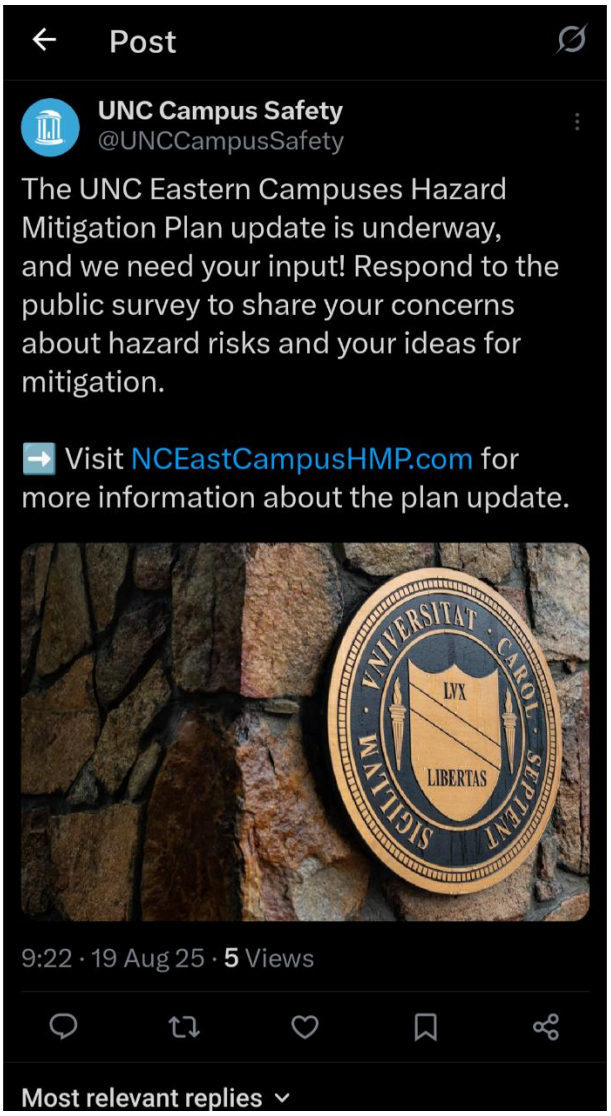
## Community Survey: Hazard Mitigation Plan

*August 18, 2025*

UNC-Chapel Hill is updating the UNC Eastern Campuses Hazard Mitigation Plan and are seeking public input on changes in risks, vulnerabilities, and opportunities for mitigation. This plan update is required for the campus to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. This effort will also help our university to understand vulnerability and develop ways to proactively reduce risk.

Public input is critical to the planning process. Please take a few minutes to complete a brief public survey to provide your input on hazard risks and mitigation options.

For more information about the plan update, visit the NC East Campus HMP website. On this site you will find information about upcoming and past Hazard Mitigation Planning Committee meetings and public meetings, a link for the public survey, draft documents, and other mitigation planning resources.




**From:** Jennifer McCarrel <Jennifer.McCarrel@uncp.edu>
**Sent:** Thursday, August 28, 2025 7:40 AM
**Subject:** Survey for UNCP's Hazard Mitigation Plan [official] [student_all]

BraveNation,

UNC Pembroke is updating the UNC Eastern Campuses Hazard Mitigation Plan and seeking public input on changes in risks, vulnerabilities and mitigation opportunities. This plan update is **required** for the campus to maintain eligibility for pre- and post-disaster mitigation funding from FEMA. This effort will also help our university understand vulnerability and develop ways to reduce risk proactively.

**How You Can Help**
Input from students, faculty and staff is **critical** to the planning process. Please take a few minutes to complete a brief public survey to provide your input on hazard risks and mitigation options.

Survey link: https://forms.office.com/e/SXEAJqTesC

For more information about the plan update, visit the project website at www.NCEastCampusHMP.com. On this site, you will find information about upcoming and past Hazard Mitigation Planning Committee meetings, public meetings, a link for the public survey, draft documents and other mitigation planning resources.

Thank you.

**Michael Bullard, ASC/MESH**
Director - Environmental Health and Safety
1 University Drive | P.O. Box 1510 | Pembroke, NC 28372
UNC PEMBROKE

## Draft Documents

Example of ECU page on plan website with draft documents for review




East Carolina University

**Submit comments on the Draft Plan**

FEEDBACK FORM

Please provide your comments here to help us improve the final version of this plan update.

**Project Timeline**

| | |
|---|---|
| HMPC Meeting 1 | July 22, 2025 |
| HMPC Meeting 2 | September-October 2025 |
| HMPC Meeting 3 | December 2025 - January 2026 |
| HMPC Meeting 4 | February 2026 |
| Plan Adoptions | April-June 2026 |
| Current Plan Expiration | July 15, 2026 |

**Meeting Materials**

HMPC Meeting 1: Minutes and Presentation

Public Meeting 1: Minutes (9/29) & (9/30) and Presentation

HMPC Meeting 2: Minutes and Presentation

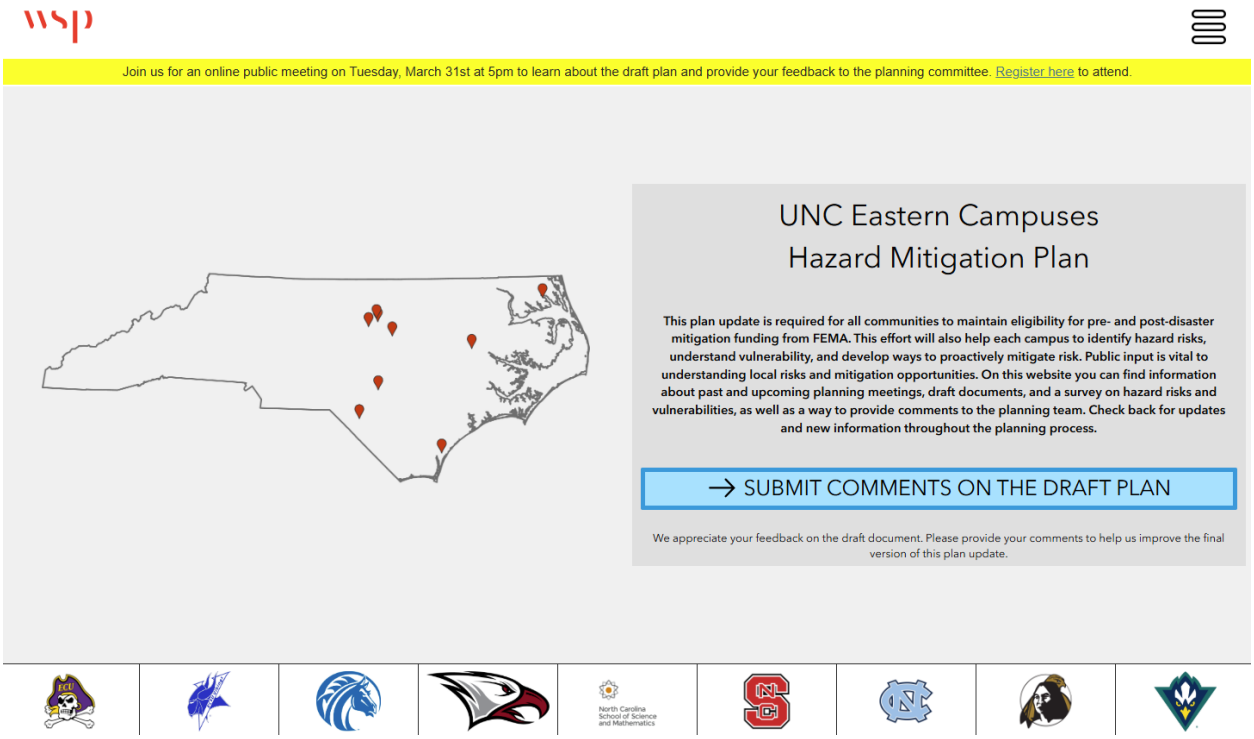
**Draft Documents**

*Check back for updates throughout the planning process.*

ECU ANNEX - FINAL DRAFT

MAIN DOCUMENT - FINAL DRAFT

Example of Plan Feedback Submission Link for comments on plan drafts




## Public Comments on Draft Plan

The following two comments were received:

- It appears that the majority of the efforts for the plan were directed toward physical assets (buildings, etc), and that's fine. But Cyber Security was one of the risks that was assessed, while most of the campus's committees which were listed on the Annex documents didn't include a single IT person from that campus. I'm curious how it was possible to perform a Cyber Security risk assessment without the involvement of IT personnel on the campus specific committees.
- The plan is very comprehensive. Extreme heat (3.4.4) is a timely addition to the plan. In section 3.4.11 on cyber security, would it be beneficial to add language about cyber-crime or disinformation attacks? This is a threat that tends to manifest in conjunction with other disasters and can harm survivors and disrupt the work of responders - similar to what happened after Hurricane Helene in 2024 or the Maui Fires in 2023. Potential consequences include the public receives incorrect or incomplete information for protective actions or disaster recovery, responders have to divert resources to deal with cyber-crime and disinformation, a loss of trust for first responders and local government by the public, a loss of trust and social cohesion among members of the public. The plan did not mention compounding hazards. Since specific compounding hazards tend to emerge in the moment, it may not merit a full section, but historically common hazard parings can lead to conflicting protective actions (like when a thunderstorm brings both a flood and tornado) or one hazard puts first responders and the public in danger for the next (hurricane relief as a heat wave begins).

## Public Survey

The UNC Eastern Campuses distributed a public survey, shown below, that requested public input into the Hazard Mitigation Plan planning process and the identification of mitigation activities that could lessen the risk and impact of future hazard events. The survey was announced at the first public meeting, provided via a link on the plan website and shared through various campus web and social media accounts.

### UNC Eastern Campuses Hazard Mitigation Plan Public Survey

The UNC Eastern Campuses are beginning to update the Hazard Mitigation Plan to identify and assess our communities' risks from hazards such as flooding, drought, extreme heat, hurricane, winter storms, and other hazards. This plan will help determine how to best minimize or manage those risks.

This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand local hazard risks and problems and can lead to mitigation activities that help lessen the impacts of future hazards.

1. What school/campus are you associated with?

- ◯ East Carolina University
- ◯ Elizabeth City State University
- ◯ Fayetteville State University
- ◯ North Carolina Central University
- ◯ North Carolina School of Science and Math
- ◯ North Carolina State University
- ◯ UNC Chapel Hill
- ◯ UNC Pembroke
- ◯ UNC Wilmington

2. Have you ever experienced or been impacted by a hazard or disaster on or around campus?

- ◯ Yes
- ◯ No

3. If you answered "Yes" to question 2, please explain your experience and where it occurred.

Enter your answer

4. On a scale of 1-5, how concerned are you about the possibility of your school/campus being impacted by a hazard event?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

Not at all concerned Very concerned

5. How prepared do you feel for a hazard event impacting your school/campus?

- ◯ Very prepared
- ◯ Somewhat prepared
- ◯ Somewhat unprepared
- ◯ Very unprepared

6. Please review the list of hazards below and rate each hazard based on how much risk you think it poses to your school/campus.

| | No risk | Low risk | Moderate risk | High risk |
|---|---|---|---|---|
| Dam Failure | ◯ | ◯ | ◯ | ◯ |
| Drought | ◯ | ◯ | ◯ | ◯ |
| Earthquake | ◯ | ◯ | ◯ | ◯ |
| Extreme Heat | ◯ | ◯ | ◯ | ◯ |
| Flood | ◯ | ◯ | ◯ | ◯ |
| Hurricane & Tropical Storm | ◯ | ◯ | ◯ | ◯ |
| Landslides & Sinkholes | ◯ | ◯ | ◯ | ◯ |
| Severe Winter Weather | ◯ | ◯ | ◯ | ◯ |
| Tornadoes & Thunderstorms | ◯ | ◯ | ◯ | ◯ |
| Wildfire | ◯ | ◯ | ◯ | ◯ |
| Cyber Threat | ◯ | ◯ | ◯ | ◯ |
| Hazardous Materials Incidents | ◯ | ◯ | ◯ | ◯ |
| Infectious Disease | ◯ | ◯ | ◯ | ◯ |
| Terrorism | ◯ | ◯ | ◯ | ◯ |
| Vandalism/Theft | ◯ | ◯ | ◯ | ◯ |

7. Describe any specific hazard issue/problem areas that you would like the planning committee to consider.

Enter your answer

8. Many community-wide activities can reduce our risk from hazards. These activities generally fall into one of the following six broad categories:

- **Prevention:** administrative and regulatory actions, plans, policies, and ordinances that influence how land is developed and buildings are built. *Examples include planning and zoning, building codes, open space preservation, land use, and floodplain regulations.*
- **Property Protection**: actions that involve the modification of existing buildings to protect them from a hazard or remove them from a hazardous area. *Examples include acquisition, relocation, elevation, structural retrofits, and storm shutters.*
- **Natural Resource Protection**: actions that minimize hazard losses and preserve or restore the functions of natural systems. *Examples include floodplain protection, habitat preservation, slope stabilization, stream buffers, wetland and marsh protection, and forest management.*
- **Structural Projects**: actions that lessen the impact of a hazard by modifying the natural progression of a hazard. *Examples include dams, levees, floodwalls, berms, drainage infrastructure, detention/retention basins, channel modifications, retaining walls, and storm sewers.*
- **Emergency Services**: actions that protect people and property during and immediately after a hazard event. *Examples include warning systems, evacuation planning, emergency response training, and protection of critical emergency facilities or systems.*
- **Public Education and Awareness**: actions to inform the public about hazards and techniques they can use to protect themselves and their property. *Examples include outreach projects, school education programs, library materials, and demonstration events.*

Please rank these categories by how important you think each one is for your school/campus to consider pursuing.

| | 1 - Most Important | 2 | 3 | 4 | 5 | 6 - Least Important |
|---|---|---|---|---|---|---|
| Prevention | ○ | ○ | ○ | ○ | ○ | ○ |
| Property Protection | ○ | ○ | ○ | ○ | ○ | ○ |
| Natural Resource Protection | ○ | ○ | ○ | ○ | ○ | ○ |
| Structural Projects | ○ | ○ | ○ | ○ | ○ | ○ |
| Emergency Services | ○ | ○ | ○ | ○ | ○ | ○ |
| Public Education | ○ | ○ | ○ | ○ | ○ | ○ |

9. Do you know where storm shelters are located at your school/campus?

○ Yes

○ No

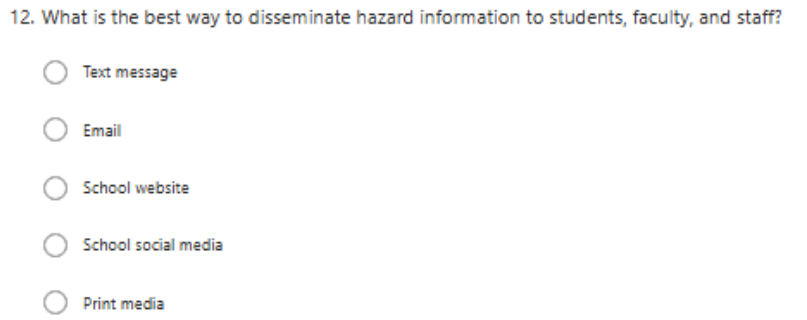
10. Do you know where/how to get more information on hazard risk and preparedness?

○ Yes

○ No

11. Share any specific buildings/locations on campus that may be at heightened risk or should be prioritized for mitigation.

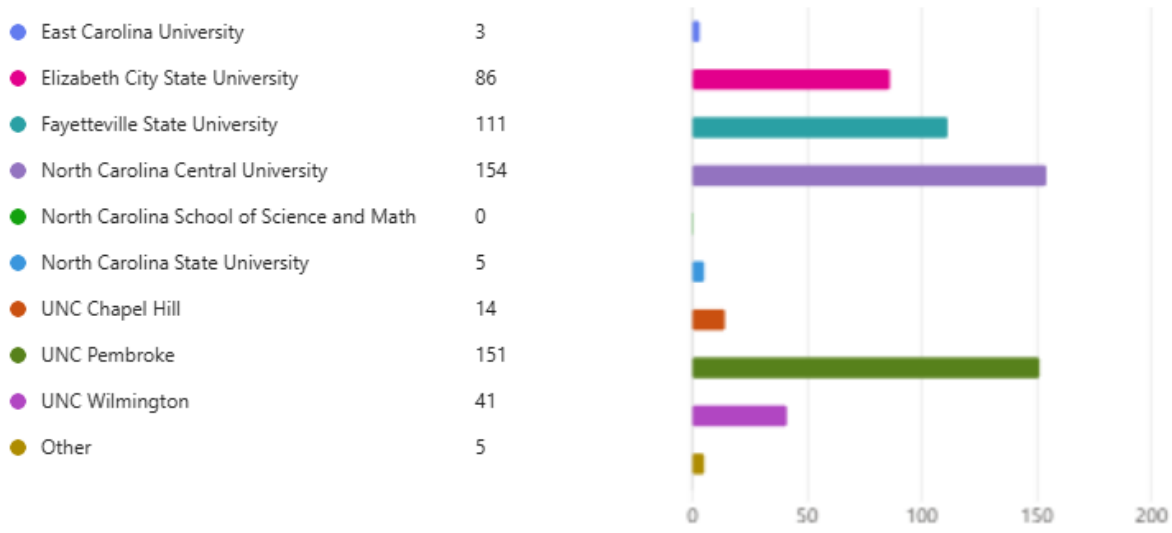
Enter your answer




The UNC Eastern Campuses received 570 responses to the survey. The following bullet points summarize significant findings from the survey. Key questions and responses are detailed in the figures below.

- Responses were received from all nine campuses; NCCU, UNC-P, FSU, and ECSU accounting for 87% of responses.
- Over a third of respondents have experienced a hazard on or around campus; most of these experiences involved flooding and hurricanes.
- Over half of respondents feel at least somewhat prepared for a hazard impacting their school or campus.
- Across all campuses, respondents consider hurricanes & tropical storms, flooding, extreme heat, tornadoes & thunderstorms, and cyber threat the highest risk hazards.
- Respondents favored prevention and emergency service activities for mitigation; the least favored option was structural projects.
- Text message and email were the most preferred methods of communication for information on hazard events.

1. What school/campus are you associated with?




2. Have you ever experienced or been impacted by a hazard or disaster on or around campus?

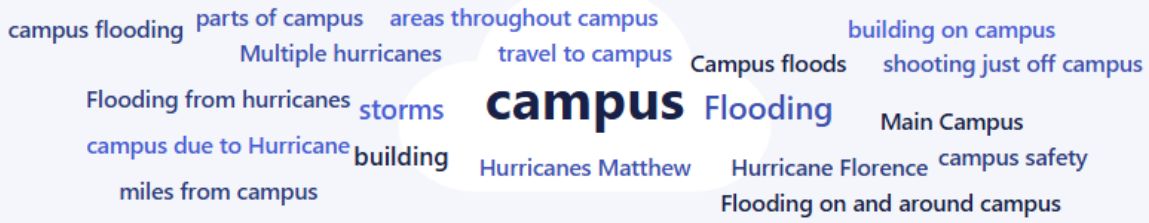


3. If you answered "Yes" to question 2, please explain your experience and where it occurred. More details

221
Responses

Latest Responses
"Hurricane closures from Florence, Michael, Dorian; ice closures from various ..."
"Major Flooding from multiple hurricanes and flashfloods from major storms...."
"Hurricane Florence, ice storms,"
...

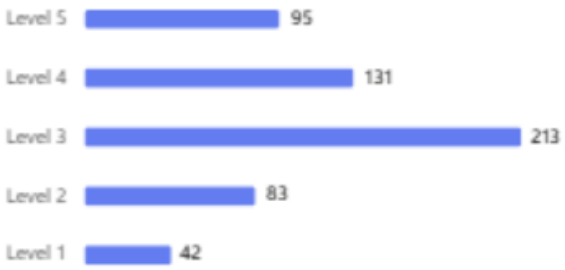
63 respondents (29%) answered campus for this question.




4. On a scale of 1-5, how concerned are you about the possibility of your school/campus being impacted by a hazard event?

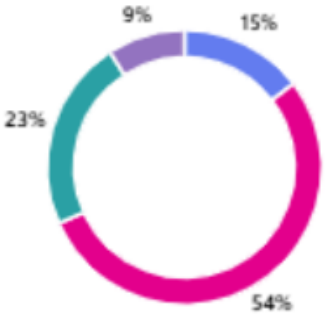
3.27
Average Rating



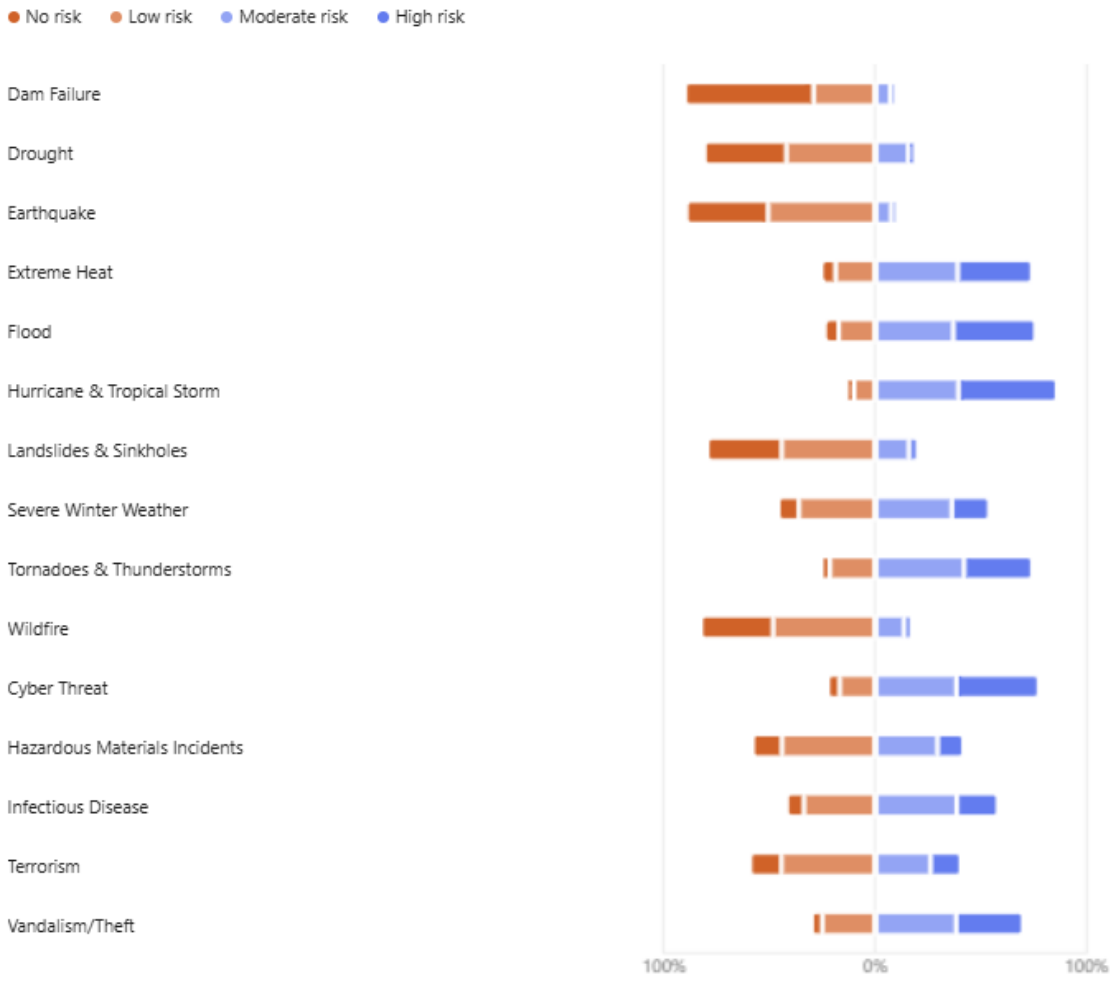




5. How prepared do you feel for a hazard event impacting your school/campus?

| | |
|---|---|
| Very prepared | 83 |
| Somewhat prepared | 305 |
| Somewhat unprepared | 128 |
| Very unprepared | 52 |



6. Please review the list of hazards below and rate each hazard based on how much risk you think it poses to your schoo l/campus. More details



7. Describe any specific hazard issue/problem areas that you would like the planning committee to consider. More details

260
Responses

Latest Responses
"don't know what you can do to better prepare the community to prevent im..."
"My biggest concern is crossing MacMillan Road to get from the campus par..."
...

56 respondents (22%) answered campus for this question.

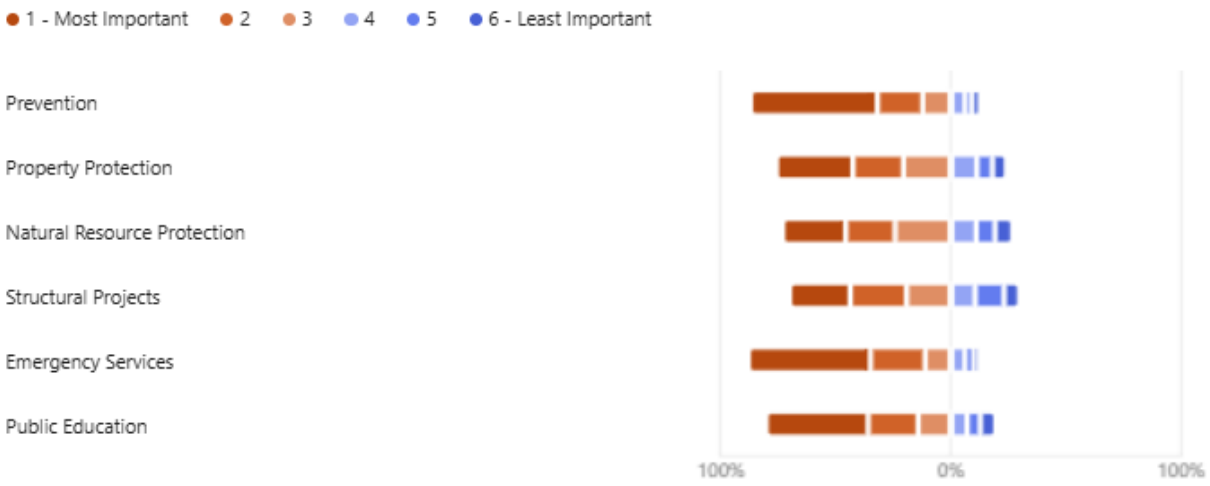


8. Many community-wide activities can reduce our risk from hazards. These activities generally fall into one of the followi ng six broad categories:

- **Prevention:** administrative and regulatory actions, plans, policies, and ordinances that influence how land is dev eloped and buildings are built. *Examples include planning and zoning, building codes, open space preservation, la nd use, and floodplain regulations.*
- **Property Protection**: actions that involve the modification of existing buildings to protect them from a hazard or remove them from a hazardous area. *Examples include acquisition, relocation, elevation, structural retrofits, an d storm shutters.*
- **Natural Resource Protection**: actions that minimize hazard losses and preserve or restore the functions of natu ral systems. *Examples include floodplain protection, habitat preservation, slope stabilization, stream buffers, wetla nd and marsh protection, and forest management.*
- **Structural Projects**: actions that lessen the impact of a hazard by modifying the natural progression of a hazar d. *Examples include dams, levees, floodwalls, berms, drainage infrastructure, detention/retention basins, channel modifications, retaining walls, and storm sewers.*
- **Emergency Services**: actions that protect people and property during and immediately after a hazard event. *Ex amples include warning systems, evacuation planning, emergency response training, and protection of critical eme rgency facilities or systems.*
- **Public Education and Awareness**: actions to inform the public about hazards and techniques they can use to p rotect themselves and their property. *Examples include outreach projects, school education programs, library mat erials, and demonstration events.*

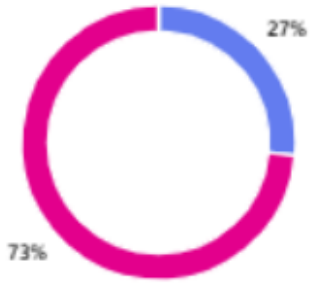
M

Please rank these categories by how important you think each one is for your school/campus to consider pursuing.



9. Do you know where storm shelters are located at your school/campus?

| | |
|---|---|
| Yes | 150 |
| No | 416 |




10. Do you know where/how to get more information on hazard risk and preparedness?

| | |
|---|---|
| Yes | 298 |
| No | 266 |



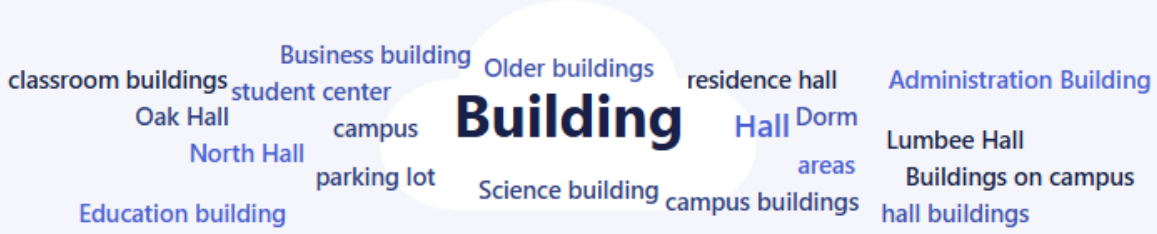

11. Share any specific buildings/locations on campus that may be at heightened risk or should be prioritized for mitigation.

More details

225
Responses

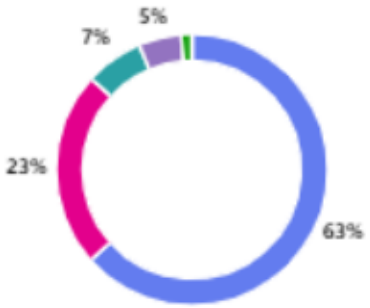
Latest Responses
...

62 respondents (28%) answered Building for this question.



12. What is the best way to disseminate hazard information to students, faculty, and staff?

| | |
|---|---|
| Text message | 359 |
| Email | 132 |
| School website | 39 |
| School social media | 29 |
| Print media | 7 |



# B.3 Planning Step 3: Coordinate

This planning step credits the incorporation of other plans and other agencies' efforts into the development of the Hazard Mitigation Plan. Other agencies and organizations must be contacted to determine if they have studies, plans and information pertinent to the Hazard Mitigation Plan, to determine if their programs or initiatives may affect the community's program, and to see if they could support the community's efforts. To incorporate stakeholder input into the plan, a variety of stakeholders were identified by the HMPC and sent an email inviting them to attend a public meeting, review the draft plan, and provide feedback and comments. The coordination letter sent via email is provided below. A list of stakeholders detailing their involvement is provided in Table B.3.

Stakeholders were also involved through specific requests for data to support the development of the plan.

## Table B.3 – Stakeholder List

| First Name | Last Name | Organization, Title |
|---|---|---|
| | | ***Student Organizations*** |
| Jasmine | Jackson | SGA President, ECSU |
| Kaylie | Williams | Point of Contact for Student Planners Action Network |
| Daniel | Walker | Student Body President, ECU SGA |
| Latoya | Harper | Student Body Point of Contact, FSU |
| Cameron | Emery | Student Body President, NCCU |
| Olivia | Vila | HazNerds President, NCSU |
| Isaac | Carreno | Student President, NCSU Student Government |
| Adolfo | Alvarez | Student Body President, UNC |
| Kerina | Patel | President, Carolina Urbanists |
| John | Squier | SGA President, UNCP |
| Skyler | Stein | Student Body President, UNCW |
| | | ***Surrounding Municipalities*** |
| Rebekah | Roth | Interim Planning Director, New Hanover County |
| Glenn | Harbeck | Director, Planning and Development, City of Wilmington |
| Steven | Still | Director, New Hanover County Emergency Management |
| Tanner | Deisch | Coordinator, Town of Chapel Hill Emergency Management |
| Grant | Smith | EM Coordinator, Orange County |
| Mark | Lockhart | Director, Emergency Services Director, City of Durham |
| Nathan | Sanders | Senior Emergency Management Coordinator, City of Durham |
| Laura | Smith | Coordinator, Fayetteville Emergency Management |
| Amanda | Sheck | Coordinator, Cumberland County Emergency Management |
| Joshua | Creighton | Wake County Emergency Management Deputy Director |
| Dylan | Lloyd | Senior Planner, Elizabeth City |
| Brian | Parnell | Coordinator, Pasquotank-Camden-Elizabeth City Emergency Management |
| Randy | Gentry | Emergency Manager, Pitt County |
| Chantae | Gooby | Chief Planner, City of Greenville |
| Patrick | Young | Planning and Development Director, City of Raleigh |
| Tyler | Thomas | Town Manager, Planning Lead, Pembroke, NC |
| | | ***Federal Government*** |
| Jason | Hunter | FEMA Region 4, Chief, Floodplain Management & Insurance Branch |
| Valerie | Anderson | FEMA Region 4, Natural Hazards Program Specialist |
| Kymberly | Kudla | FEMA Mitigation Planning Specialist |
| Katherine | Smith | USGS Climate Adaptation Science Center |
| | | ***State Government*** |
| Steve | Garrett | State NFIP Coordinator |
| Steve | McGugan | State Hazard Mitigation Officer |
| Linda | Culpepper | DEQ Division of Water Resources, Director |
| C.W. "Win" | Bridgers | NCDOT Division 1, Division Engineer |
| Hannah | Thompson-Welch | NC Forest Service, Wildfire Mitigation Specialist |

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