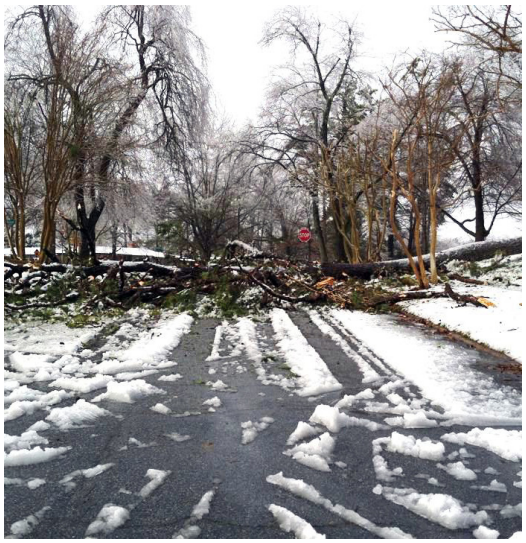
ATKINS

Guilford County, NC

Guilford County Multi-Jurisdictional Hazard Mitigation Plan

FINAL



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SECTION 1
INTRODUCTION

This section provides a general introduction to the Guilford County Multi-Jurisdictional Hazard Mitigation Plan. It consists of the following five subsections:

- 1.1 Background
- 1.2 Purpose
- 1.3 Scope
- 1.4 Authority
- 1.5 Summary of Plan Contents

1.1 BACKGROUND

Natural and man-made hazards, such as floods, hurricanes and hazardous materials incidents are a part of the world around us. In some cases, their occurrence is natural and inevitable, and there is little we can do to control their force and intensity. In others, we have more power to control the intensity and probability, but can never truly eliminate the threat entirely. In either case, we must consider these hazards to be legitimate and significant threats to human life, safety, and property.

Guilford County is located in the Piedmont area of North Carolina. The County includes the Town of Gibsonville, City of Greensboro, City of High Point, Town of Jamestown, Town of Oak Ridge, Town of Pleasant Garden, Town of Sedalia, Town of Stokesdale, Town of Summerfield, Town of Whitsett, and all unincorporated areas within the county. This area is vulnerable to a wide range of natural hazards such as hurricanes, floods, severe thunderstorms, and tornados. It is also vulnerable to human-caused hazards, including nuclear accidents and hazardous material spills. These hazards threaten the life and safety of residents in Guilford County and have the potential to damage or destroy both public and private property, disrupt the local economy, and impact the overall quality of life of individuals who live, work, and vacation in Guilford County.

While the threat from hazardous events may never be fully eliminated, there is much we can do to lessen their potential impact upon our community and our citizens. By minimizing the impact of hazards upon our built environment, we can prevent such events from resulting in disasters. The concept and practice of reducing risks to people and property from known hazards is generally referred to as *hazard mitigation*.

FEMA Definition of Hazard Mitigation:
"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards."

Hazard mitigation techniques include both structural measures (such as strengthening or protecting buildings and infrastructure from the destructive forces of potential hazards) and non-structural measures (such as the adoption of sound land use policies and the creation of public awareness

programs). It is widely accepted that the most effective mitigation measures are implemented at the local government level, where decisions on the regulation and control of development are ultimately made. A comprehensive mitigation approach addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, it is essential that projected patterns of future development are evaluated and considered in terms of how that growth will increase or decrease a community's overall hazard vulnerability.

A key component in the formulation of a comprehensive approach to hazard mitigation is to develop, adopt, and update a local hazard mitigation plan as needed. A hazard mitigation plan establishes the broad community vision and guiding principles for reducing hazard risk, and further proposes specific mitigation actions to eliminate or reduce identified vulnerabilities.

The county and ten municipalities participating in the Guilford County Multi-Jurisdictional Hazard Mitigation Plan have an existing hazard mitigation plan that has evolved over the years, as described in Section 2: *Planning Process*. This update of the plan draws from the previous plan to document the efforts of each jurisdiction to incorporate hazard mitigation principles and practices into routine government activities and functions. At its core, the Plan recommends specific actions to minimize hazard vulnerability and protect residents from losses to those hazards that pose the greatest risk. These mitigation actions go beyond simply recommending structural solutions to reduce existing vulnerability, such as elevation, retrofitting, and acquisition projects. Local policies on community growth and development, incentives for natural resource protection, and public awareness and outreach activities are examples of other actions considered to reduce Guilford County's vulnerability to identified hazards. The Plan remains a living document, with implementation and evaluation procedures established to help achieve meaningful objectives and successful outcomes over time.

1.1.1 The Disaster Mitigation Act and the Flood Insurance Reform Acts

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) in order to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 322 of DMA 2000 emphasizes the need for state, local and Tribal 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 or Tribal government applying for federal mitigation grant funds. In short, if a jurisdiction is not covered by an approved mitigation plan, it will not be eligible for mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) program, both of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Communities with an adopted and federally-approved hazard mitigation plan thereby become pre-positioned and more apt to receive available mitigation funds before and after the next disaster strikes.

In addition to federal requirements for hazard mitigation planning, the state of North Carolina also requires a hazard mitigation plan be in place for jurisdictions to receive mitigation and public assistance funds after a state-declared disaster. This requirement is codified in NC Senate Bill 300, which lays out the need for mitigation planning and ties it to disaster funding at the state level.

Additionally, the Flood Insurance Reform Act of 2004 (P.L. 108-264) created two new grant programs, Severe Repetitive Loss (SRL) and Repetitive Flood Claim (RFC), and modified the existing Flood Mitigation Assistance (FMA) program. One of the requirements of this Act is that a FEMA-approved Hazard Mitigation Plan is now required if communities wish to be eligible for these FEMA mitigation programs.

However, as of early 2014, these programs have been folded into a single Flood Mitigation Assistance (FMA) program.

This change was brought on by new, major federal flood insurance legislation that was passed in 2012 under the Biggert-Waters Flood Insurance Reform Act (P.L. 112-141) and the subsequent Homeowner Flood Insurance Affordability Act in 2014 which revised Biggert-Waters. These acts made several changes to the way the National Flood Insurance Program is to be run, including raises in rates to reflect true flood risk and changes in how Flood Insurance Rate Map (FIRM) updates impact policyholders. These acts further emphasize Congress' focus on mitigating vulnerable structures.

The Guilford County Multi-Jurisdictional Hazard Mitigation Plan has been prepared in coordination with FEMA Region IV and the North Carolina Division of Emergency Management (NCEM) to ensure that the Plan meets all applicable FEMA and state requirements for hazard mitigation plans. A *Local Mitigation Plan Review Tool*, found in Appendix C, provides a summary of federal and state minimum standards and notes the location where each requirement is met within the Plan.

1.2 PURPOSE

The purpose of the Guilford County Multi-Jurisdictional Hazard Mitigation Plan is to:

- Reduce risk to people, property, and the critical infrastructure;
- Increase public awareness and education about the plan and the planning process;
- Maintain grant eligibility for participating jurisdictions; and
- Maintain compliance with state and federal legislative requirements for local hazard mitigation plans.

1.3 SCOPE

The focus of the Guilford County Multi-Jurisdictional Hazard Mitigation Plan is on those hazards determined to be "high" or "moderate" risks to Guilford County, as determined through a detailed hazard risk assessment. Other hazards that pose a "low" or "negligible" risk will continue to be evaluated during future updates to the Plan, but they may not be fully addressed until they are determined to be of high or moderate risk. This enables the participating jurisdictions to prioritize mitigation actions based on those hazards which are understood to present the greatest risk to lives and property.

The geographic scope (i.e., the planning area) for the Plan includes all of Guilford County including all of its incorporated jurisdictions (see below) and unincorporated areas. **Table 1.1** indicates the participating jurisdictions.

TABLE 1.1: PARTICIPATING JURISDICTIONS IN THE GUILFORD COUNTY HAZARD MITIGATION PLAN

Guilford County	
Gibsonville	Pleasant Garden
Greensboro	Sedalia
High Point	Stokesdale
Jamestown	Summerfield
Oak Ridge	Whitsett

1.4 AUTHORITY

The Guilford County Multi-Jurisdictional Hazard Mitigation Plan has been developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans and has been adopted by each participating jurisdiction in accordance with standard local procedures. Copies of the adoption resolutions for each participating jurisdiction are provided in Appendix A. The Plan shall be routinely monitored and revised to maintain compliance with the following provisions, rules, and legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390);
- FEMA's Final Rule published in the Federal Register, at 44 CFR Part 201 (201.6 for local mitigation planning requirements and 201.7 for Tribal planning requirements); and
- Flood Insurance Reform Act of 2004 (P.L. 108-264), Biggert-Waters Flood Insurance Reform Act of 2012 (P.L. 112-141) and the Homeowner Flood Insurance Affordability Act.

1.5 SUMMARY OF PLAN CONTENTS

The contents of this Plan are designed and organized to be as reader-friendly and functional as possible. While significant background information is included on the processes used and studies completed (i.e., risk assessment, capability assessment), this information is separated from the more meaningful planning outcomes or actions (i.e., mitigation strategy, mitigation action plan).

Section 2, ***Planning Process***, provides a complete narrative description of the process used to prepare the Plan. This includes the identification of participants on the planning team and describes how the public and other stakeholders were involved. It also includes a detailed summary for each of the key meetings held, along with any associated outcomes.

The ***Community Profile***, located in Section 3, provides a general overview of Guilford County, including prevalent geographic, demographic, and economic characteristics. In addition, building characteristics and land use patterns are discussed. This baseline information provides a snapshot of the planning area and helps local officials recognize those social, environmental, and economic factors that ultimately play a role in determining the region's vulnerability to hazards.

The Risk Assessment is presented in three sections: Section 4, ***Hazard Identification***; Section 5, ***Hazard Profiles***; and Section 6, ***Vulnerability Assessment***. Together, these sections serve to identify, analyze,

and assess hazards that pose a threat to Guilford County. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect specific areas of Guilford County.

The Risk Assessment begins by identifying hazards that threaten Guilford County. Next, detailed profiles are established for each hazard, building on available historical data from past hazard occurrences, spatial extent, and probability of future occurrence. This section culminates in a hazard risk ranking based on conclusions regarding the frequency of occurrence, spatial extent, and potential impact highlighted in each of the hazard profiles. In the vulnerability assessment, FEMA's Hazus®MH loss estimation methodology is used in conjunction with GIS analysis to evaluate known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as the participating jurisdictions in Guilford County seek to determine the most appropriate mitigation actions to pursue and implement—enabling them to prioritize and focus their efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risk(s).

The ***Capability Assessment***, found in Section 7, provides a comprehensive examination of Guilford County's capacity to implement meaningful mitigation strategies and identifies opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the use of a detailed survey questionnaire and an inventory and analysis of existing plans, ordinances, and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses, or conflicts in programs or activities that may hinder mitigation efforts and to identify those activities that should be built upon in establishing a successful and sustainable local hazard mitigation program.

The *Risk Assessment*, and *Capability Assessment* collectively serve as a basis for determining the goals for the Guilford County Multi-Jurisdictional Hazard Mitigation Plan, each contributing to the development, adoption, and implementation of a meaningful and manageable *Mitigation Strategy* that is based on accurate background information.

The ***Mitigation Strategy***, found in Section 8, consists of broad goal statements as well as an analysis of hazard mitigation techniques for the jurisdictions participating in the Guilford County Multi-Jurisdictional Hazard Mitigation Plan to consider in reducing hazard vulnerabilities. The strategy provides the foundation for a detailed ***Mitigation Action Plan***, found in Section 9, which links specific mitigation actions for each jurisdiction to locally-assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic, through the identification of long-term goals, and functional, through the identification of immediate and short-term actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make Guilford County less vulnerable to the damaging forces of hazards while improving the economic, social, and environmental health of the community. The concept of multi-objective planning was emphasized throughout the planning process, particularly in identifying ways to link, where possible, hazard mitigation policies and programs with complimentary community goals related to disaster recovery, housing, economic development, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

Plan Maintenance, found in Section 10, includes the measures that the jurisdictions participating in the plan will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.

SECTION 2
PLANNING PROCESS

This section describes the planning process undertaken to develop the Guilford County Multi-Jurisdictional Hazard Mitigation Plan. It consists of the following eight subsections:

- 2.1 Overview of Hazard Mitigation Planning
- 2.2 History of Hazard Mitigation Planning in Guilford County
- 2.3 Preparing the 2015 Plan
- 2.4 The Guilford County Hazard Mitigation Planning Team
- 2.5 Community Meetings and Workshops
- 2.6 Involving the Public
- 2.7 Involving the Stakeholders
- 2.8 Documentation of Plan Progress

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44 CFR Requirement
44 CFR Part 201.6(c)(1): The plan shall include 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.

2.1 OVERVIEW OF HAZARD MITIGATION PLANNING

Local hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to best minimize or manage those risks. This process culminates in a hazard mitigation plan that identifies specific mitigation actions, each designed to achieve both short-term planning objectives and a long-term community vision.

To ensure the functionality of a hazard mitigation plan, responsibility is assigned for each proposed mitigation action to a specific individual, department, or agency along with a schedule or target completion date for its implementation (see Section 10: *Plan Maintenance*). Plan maintenance procedures are established for the routine monitoring of implementation progress, as well as the evaluation and enhancement of the mitigation plan itself. These plan maintenance procedures ensure that the Plan remains a current, dynamic, and effective planning document over time that becomes integrated into the routine local decision making process.

Communities that participate in hazard mitigation planning have the potential to accomplish many benefits, including:

- saving lives and property,
- saving money,
- speeding recovery following disasters,
- reducing future vulnerability through wise development and post-disaster recovery and reconstruction,

- expediting the receipt of pre-disaster and post-disaster grant funding, and
- demonstrating a firm commitment to improving community health and safety.

Typically, communities that participate in mitigation planning are described as having the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that the investments made before a hazard event will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery, and reconstruction. Furthermore, mitigation practices will enable local residents, businesses, and industries to re-establish themselves in the wake of a disaster, getting the community economy back on track sooner and with less interruption.

The benefits of mitigation planning go beyond solely reducing hazard vulnerability. Mitigation measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health, and enhancing recreational opportunities. Thus, it is vitally important that any local mitigation planning process be integrated with other concurrent local planning efforts, and any proposed mitigation strategies must take into account other existing community goals or initiatives that will help complement or hinder their future implementation.

2.2 HISTORY OF HAZARD MITIGATION PLANNING IN GUILFORD COUNTY

Each of the eleven participating jurisdictions has a previously adopted hazard mitigation plan. The FEMA approval dates for each of these plans are listed below:

- *Guilford County Hazard Mitigation Plan* (1/20/2016)
  - City of Gibsonville
  - City of Greensboro
  - City of High Point
  - Town of Jamestown
  - Town of Oak Ridge
  - Town of Pleasant Garden
  - Town of Sedalia
  - Town of Stokesdale
  - Town of Summerfield
  - Town of Whitsett

The plan was developed using the multi-jurisdictional planning process recommended by the Federal Emergency Management Agency (FEMA).

2.3 PREPARING THE 2015 PLAN

Hazard mitigation plans, are required to be updated every five years to remain eligible for federal mitigation funding. To simplify planning efforts, the jurisdictions in Guilford County decided to join

together to create the *Guilford County Multi-Jurisdictional Hazard Mitigation Plan*. This allows resources to be shared amongst the participating jurisdictions and eases the administrative duties of all of the participants.

To prepare the Plan, a team led by the consulting firm called Atkins was hired to provide professional mitigation planning services. To meet planning requirements of the Community Rating System, the county ensured that the planning process was facilitated under the direction of a professional planner. The Project Manager from Atkins served as the lead planner for this project and is a member of the American Institute of Certified Planners (AICP). Further, CRS planning requirements from section 510 of the 2013 Coordinator's Manual are addressed throughout this plan. The intent is to try to maximize the number of CRS points for those jurisdictions that currently participate in the CRS program (City of Greensboro and Guilford County) and those that may wish to join in the future.

Per the contractual scope of work, the consultant team followed the mitigation planning process recommended by FEMA (Publication Series 386 and Local Mitigation Plan Review Guide) and recommendations provided by North Carolina Division of Emergency Management (NCEM) mitigation planning staff[1]. The Local Mitigation Plan Review Tool, found in Appendix C, provides a detailed summary of FEMA's current minimum standards of acceptability for compliance with DMA 2000 and notes the location where each requirement is met within this Plan. These standards are based upon FEMA's Final Rule as published in the Federal Register in Part 201 of the Code of Federal Regulations (CFR). The planning team used FEMA's Local Mitigation Plan Review Guide (October 2011) for reference as they completed the Plan.

Additionally, the planning team determined that it was important to include and analyze technological and man-made hazards in the plan to provide a more comprehensive approach to hazard management within the county. Although this is not a requirement as per regulations regarding hazard mitigation planning at the state or federal level, it is a noteworthy step in the direction of an all-hazards approach to risk analysis and management.

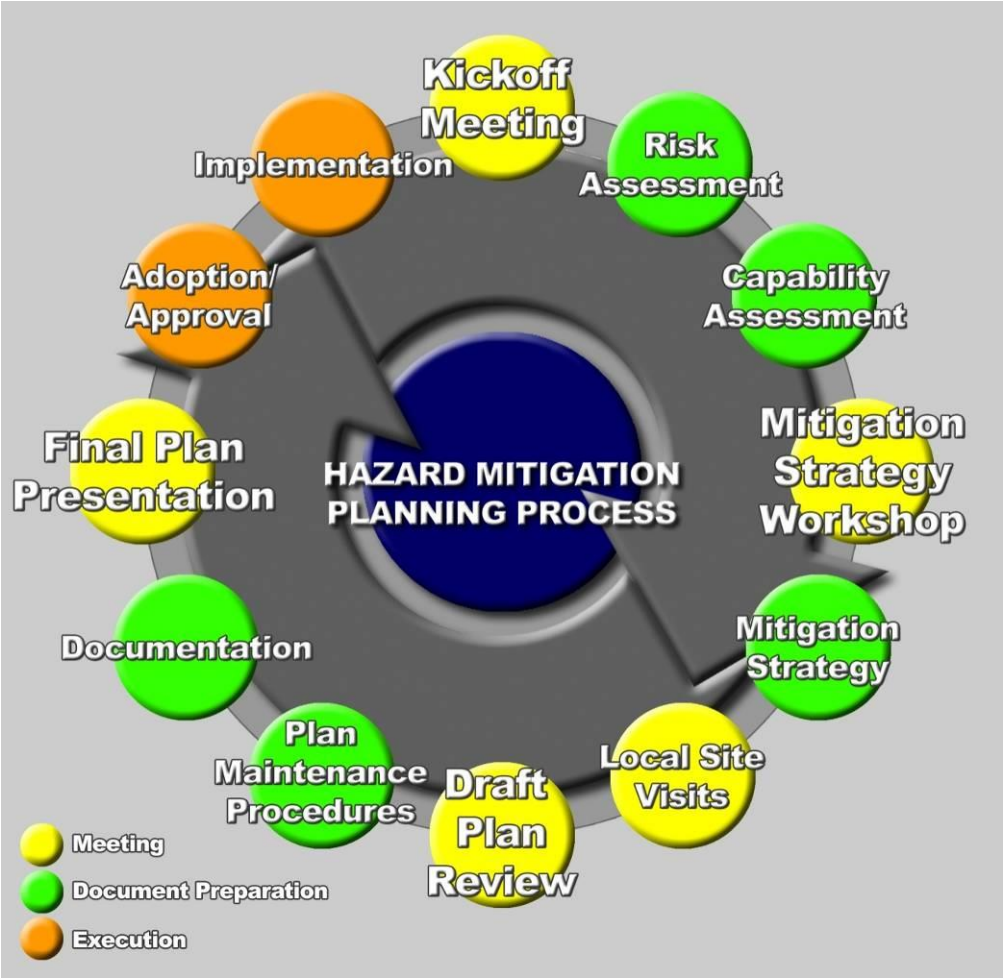
Key elements from the previously approved plan are referenced throughout the document (e.g., existing actions) and required a discussion of changes made. For example, all of the risk assessment elements needed to be updated to include most recent information. It was also necessary to review the goals for the county. The Capability Assessment section includes updated information for all of the participating jurisdictions and the Mitigation Action Plan provides implementation status updates for all of the actions identified in the previous plans.

The process used to prepare this Plan included twelve major steps that were completed over the course of approximately six months beginning in January 2015. Each of these planning steps (illustrated in **Figure 2.1**) resulted in critical work products and outcomes that collectively make up the Plan. Specific plan sections are further described in Section 1: *Introduction*.

Over the past five years, each participating jurisdiction has been actively working to implement the existing plan. This is documented in the Mitigation Action Plan through the implementation status updates for each of the Mitigation Actions. The Capability Assessment also documents changes and improvements in the capabilities of each participating jurisdiction to implement the Mitigation Strategy.

[1] A copy of the negotiated contractual scope of work between Guilford County and Atkins is available through Guilford County upon request.

FIGURE 2.1: MITIGATION PLANNING PROCESS FOR GUILFORD COUNTY



As is further detailed below, the planning process was conducted through Hazard Mitigation Planning Team meetings comprised primarily of local government staff from each of the participating jurisdictions and advisory stakeholders.

2.4 THE GUILFORD COUNTY HAZARD MITIGATION PLANNING TEAM

In order to guide the development of this Plan, Guilford County and its jurisdictions created the Guilford County Hazard Mitigation Planning Team (Hazard Mitigation Planning Team or Planning Team). The Hazard Mitigation Planning Team represents a community-based planning team made up of representatives from various county and municipal departments, and other key stakeholders identified to serve as critical partners in the planning process.

Beginning in January 2015, the Hazard Mitigation Planning Team members engaged in regular discussions as well as local meetings and planning workshops to discuss and complete tasks associated with preparing the Plan. This working group coordinated on all aspects of plan preparation and provided valuable input to the process. In addition to regular meetings, committee members routinely communicated and were kept informed through an e-mail distribution list.

Specifically, the tasks assigned to the Hazard Mitigation Planning Team members included:

- participate in Hazard Mitigation Planning Team meetings and workshops
- provide best available data as required for the risk assessment portion of the Plan
- provide information that will help complete the Capability Assessment section of the plan and provide copies of any mitigation or hazard-related documents for review and incorporation into the Plan
- support the development of the Mitigation Strategy, including the design and adoption of countywide goal statements
- help design and propose appropriate mitigation actions for their department/agency for incorporation into the Mitigation Action Plan
- review and provide timely comments on all study findings and draft plan deliverables
- support the adoption of the 2015 *Guilford County Hazard Mitigation Plan*

Table 2.1 lists the members of the Hazard Mitigation Planning Team who were responsible for participating in the development of the Plan. Committee members are listed in alphabetical order by first name.

TABLE 2.1: MEMBERS OF THE GUILFORD COUNTY HAZARD MITIGATION PLANNING TEAM

POSITION	DEPARTMENT / AGENCY
Officer	City of Greensboro Police
Water Quality Specialist	City of Greensboro Water
Electric Engineering Manager	City of High Point Electric
Preparedness Manager	Guilford County DPH
Officer	City of Greensboro PD
Planner	Town of Gibsonville Planning
Mitigation Planner	North Carolina Emergency Management
Lieutenant	Guilford County SO
GDOT Manager	City of Greensboro
Town Council Member	Town of Pleasant Garden
GIS Specialist	City of Greensboro GIS
Sergeant	Guilford County SO
Operations Manager	Piedmont Authority for Regional Transportation
Planner	Guilford County Planning
Director	Guilford County EM
Mayor Pro Tem	Town of Stokesdale Council Member
Chief Plans Examiner	Guilford County P&D
Administrator	Town of Whitsett
Deputy Sheriff	City of Greensboro SO

POSITION	DEPARTMENT / AGENCY
Management Coordinator	City of High Point EM
Planning Director	Guilford County P&D
Operations Assistant	Piedmont Authority for Regional Transportation
CEM Coordinator	Guilford County EM
Director	UNCG EM
Operations Manager	Town of Jamestown
Assistant Fire Marshal	Guilford County FMO
Director	Guilford County ES
Assistant Director	City of High Point Public Services
Coordinator	City of Greensboro Fire/EM
Town Council Member	Town of Stokesdale Council Member
Planner	Town of Summerfield
Stormwater Administrator	Guilford County
GIS Anaylst	City of Greensboro FD
Director	City of High Point Engineering
Planning Board Member	Town of Sedalia Planning Board
Water Resources Coordinator	City of Greensboro
Clerk	Town of Jamestown
Captain	City of High Point PD
Officer	City of Greensboro Police
Chemical Planning Coordinator	Guilford County EM
Public Services Director	Town of Jamestown
Water Quality Supervisor	City of Greensboro WR
Continuity Planning Coordinator	Guilford County EM
Captain	Guilford County SO
Clerk	Town of Oak Ridge
Town Administrator	Town of Pleasant Garden
Town Manager	Town of Summerfield
GIS Manager	Guilford County GIS
Planning Manager	City of Greensboro Planning
Public Services Director	City of High Point
Fire Chief	City of High Point FD
EM Coordinator	NC A&T EM
Town Council Member	Town of Stokesdale
Stormwater Supervisor	City of Greensboro Water Resources
EM Coordinator	Guilford County EM

As noted above, a number of representatives outside of municipal and county level government participated directly on the planning team during this process. These representatives were from state

agencies (NCEM), regional agencies (PART), and other stakeholder groups, such as the university community. All of these stakeholders were invited to participate in the process via email along with many other stakeholders who did not directly participate on the planning team. A list of stakeholders who were invited to participate in the planning process via email, but were not representatives on the planning team can be found in **Table 2.2.** These members all provided valuable information to the planning process, for example, the Piedmont Together Regional Consortium provided data on climate change which was utilized throughout the risk assessment section of the plan.

TABLE 2.2: STAKEHOLDERS NOT PARTICIPATING DIRECTLY ON PLANNING TEAM BUT WHO WERE INVITED

POSITION	DEPARTMENT / AGENCY
Risk Manager	Guilford Technical Community College
Project Assistant	Piedmont Together Regional Consortium
Manager	Electric Utilities
Deputy Director	Guilford Planning
County Manager	Guilford County
Stormwater Administrator	Guilford County
Town Manager	Town of Oak Ridge
Council Member	Town of Stokesdale
Manager	Greensboro Water Resources
Fire Chief	Greensboro Fire
Occupational Safety and Health Officer	Greensboro
Director	Greensboro Field Operations
Manager	Greensboro Stormwater
Section Chief	Greensboro Building Inspections
Director	Greensboro IT
Division Commander	Greensboro Police
Director	Greensboro Engineering
Manager	Greensboro Water Resources
Planner	Greensboro Planning
Officer	Greensboro Police
Supervisor	Greensboro Construction/Maintenance
Supervisor	Greensboro Water Quality
Manager	Greensboro Business/Parking
GIS Analyst	Greensboro GIS
Director	Greensboro Water Resources
Manager	Greensboro Planning
Engineer	Greensboro Engineering
Assistant City Manager	Greensboro

Finally, it should be noted that many neighboring communities were offered the opportunity to participate in the planning process by being invited to meetings, through phone conversations, and in-person discussions. Among those invited to participate were representatives from Emergency Management offices in several of the counties that surround Guilford County including Forsyth, Davidson, Stokes, Rockingham, and Caswell Counties. During these discussions, no major comments or suggestions were received concerning the plan.

2.4.1 Multi-Jurisdictional Participation

The *Guilford County Multi-Jurisdictional Hazard Mitigation Plan* includes Guilford County and its ten incorporated municipalities. To satisfy multi-jurisdictional participation requirements, the county and its participating jurisdictions were required to perform the following tasks:

- Participate in mitigation planning workshops;
- Identify completed mitigation projects, if applicable; and
- Develop and adopt (or update) their local Mitigation Action Plan.

Each jurisdiction participated in the planning process and has developed a local Mitigation Action Plan unique to their jurisdiction. Each jurisdiction will adopt the plan which includes the individual Mitigation Action Plan that provides the means for jurisdictions to monitor and update their Plan on a regular basis.

2.5 COMMUNITY MEETINGS AND WORKSHOPS

The preparation of this Plan required a series of meetings and workshops 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 following is a summary of the key meetings and community workshops held during the development of the plan update.[2] In many cases, routine discussions and additional meetings were held by local staff to accomplish planning tasks specific to their department or agency, such as the approval of specific mitigation actions for their department or agency to undertake and include in the Mitigation Action Plan.

January 13, 2015 Guilford County HMPC Meeting

January 13, 2015
First Hazard Mitigation Planning Team Meeting – Deep River Event Center

The Guilford County Emergency Management Director, started the meeting by welcoming the representatives from the County, participating municipal jurisdictions, and other stakeholders. He then introduced the Project Manager from the project consulting team, Atkins.

[2] Copies of agendas, sign-in sheets, minutes, and handout materials for all meetings and workshops can be found in Appendix D.

The Project Manager led the kickoff meeting and began by providing an overview of the items to be discussed at the meeting and briefly reviewed each of the handouts that were distributed in the meeting packets (agenda, project description, and presentation slides). He then provided a brief overview of mitigation and discussed the Disaster Mitigation Act of 2000 and NC Senate Bill 300.

He gave a list of the participating jurisdictions for the multi-jurisdictional plan, noting all local governments in the county are participating in the existing county-level hazard mitigation plan. This plan expires in January of 2016, so the planning team will plan to develop a draft to submit to FEMA by June of 2015.

The Risk Consultant from Atkins then explained the six different categories of mitigation techniques (emergency services; prevention; natural resource protection; structural projects; public education and awareness; and property protection) and gave examples of each. This explanation culminated with an Ice Breaker Exercise for the attendees.

The Risk Consultant instructed attendees on how to complete the exercise. Attendees were divided into small groups and given an equal amount of fictitious FEMA money and asked to spend it in the various mitigation categories. Money could be thought of as grant money that communities received towards mitigation. Attendees were asked to target their money towards areas of mitigation that are of greatest concern for their community. Ideally, the exercise helps pinpoint areas of mitigation that the community may want to focus on when developing mitigation grants. The Project Manager from Atkins also presented the Ice Breaker Exercise results which were:

- Public Education and Awareness- 97
- Prevention- 82
- Property Protection- 77
- Emergency Services- 72
- Structural Projects- 47
- Natural Resource Protection- 40

The Risk Consultant then discussed the key objectives and structure of the planning process, explaining the specific tasks to be accomplished for this project, including the planning process, risk assessment, vulnerability assessment, capability assessment, mitigation strategy and action plan, plan maintenance procedures, and documentation. The project schedule was presented along with the project staffing chart, which demonstrates the number of experienced individuals that will be working on this project. The data collection needs and public outreach efforts were also discussed.

The Risk Consultant then reviewed the roles and responsibilities of Atkins, participating jurisdictions, and stakeholders. The presentation concluded with a discussion of the next steps to be taken in the project development, which included discussing data collection efforts, continuing public outreach, and the next meeting for the HMPT.

The meeting was opened for questions and comments and several topics were raised, including public survey availability and distribution.

The Emergency Management Coordinator thanked everyone for attending and identified himself as the first point of contact for any questions or issues. The meeting was adjourned.

April 30, 2015
Second Hazard Mitigation Planning Team Meeting – Guilford County 911 Center

The Emergency Management Coordinator with Guilford County Emergency Services welcomed everyone to the meeting and went over safety and administrative topics. He then passed the meeting over to the Project Manager to discuss the findings and information that Atkins pulled together.

The Project Manager initiated the meeting with a review of the meeting handouts, which included an agenda, presentation slides, proposed goals for the plan, mitigation actions from the county's existing plan, and mitigation action worksheets for collecting information for any new mitigation actions The Project Manager reviewed the project schedule and stated that a draft of the Hazard Mitigation Plan would be presented to the Hazard Mitigation Planning team at the end of May.

He then presented the findings of the risk assessment, starting with a review of the Presidential Disaster Declarations that have impacted the county. He then explained the process for preparing Hazard Profiles and discussed how each hazard falls into one of four categories: Natural, Biological, Technological, and Intentional. He indicated that each hazard must be evaluated and then profiled and assessed to determine a relative risk for each hazard.

The Project Manager reviewed the Hazard Profiles and the following bullets summarize the information presented:

Natural Hazards

- DROUGHT. There have been eight years (out of the past fourteen, 2000-2013) where drought conditions have been reported as moderate to extreme in Guilford County and future occurrences are likely.

- EARTHQUAKES. There have been 5 recorded earthquake events in Guilford County since 1852. The strongest had a recorded magnitude of IV MMI. Future occurrences are possible.

- EXTREME COLD. There has been 1 recorded extreme cold event reported by the National Climatic Data Center (NCDC) since 1996. However, heat extents of -8 degrees indicate that extreme cold is a hazard of concern for the county. Future occurrences are possible.

- EXTREME HEAT. There have been 2 recorded extreme heat events reported by the NCDC since 1998. Heat extents of 106 degrees indicate that extreme heat is a hazard of concern for the county. Future occurrences are possible.

- FIRE/WILDFIRE. There is an average of 33 fires per year reported in Guilford County. Future occurrences are likely, but major events are not common.

- FLOOD. There have been 73 flood events recorded in Guilford County since 1996, resulting in $2.6 million in property damage per NCDC. There have been 372 NFIP losses since 1978 and approximately $4.9 million in claims. Nine severe repetitive loss properties in the county account for 55 of the recorded losses. Future occurrences are highly likely.

- HAILSTORM. There have been 164 recorded events since 1967. Future occurrences are highly likely.

- HURRICANES AND TROPICAL STORMS. NOAA data shows that 59 storm tracks have come within 75 miles of Guilford County since 1854. Future occurrences are likely.

- THUNDERSTORM WIND. There have been 254 severe thunderstorm events reported since 1956 with $2.0 million in reported property damages. Two deaths have been reported. Future occurrences are highly likely.

- THUNDERSTORM LIGHTNING. There have been 9 recorded lightning events since 1997. There has been $2.5 million in reported property damages. Future occurrences are highly likely.

- TORNADOES. There have been 13 recorded tornado events reported in the county since 1954. $19.9 million in property damages. One death and 5 injuries have been reported. Future occurrences are likely.

- WINTER STORM. There have been 54 recorded winter weather events in Guilford County since 1996 resulting in $8.2 million in reported property damages. Future occurrences are highly likely.

Biological Hazards

- BIOTERRORISM. There have not been any major bioterrorism incidents in the county but future occurrences are possible and may cause major impacts to hospitals and loss of economic productivity.

- PUBLIC HEALTH/EMERGING DISEASE. There have been several disease outbreaks in the county, notably in 1999 (SARS) and 2003 (West Nile). Impacts could be widespread, affecting thousands.

Technological Hazards

- BUILDING/STRUCTURE COLLAPSE. Few past incidents have been recorded. Future occurrences are possible but damage would be highly localized.

- COMMUNICATIONS SYSTEMS DISRUPTION/FAILURE. At least one past event occurred in 2011 and there would potentially be delays in emergency service response time during these events as a result of diminished in-building radio coverage due to the building's construction.

- ENERGY/POWER/UTILITY FAILURE. These events are often caused by ice storms and are likely to happen in the future, causing downed power lines and traffic lights as well as loss of power to homes and businesses.

- HAZARDOUS MATERIALS INCIDENTS. There have been 2,220 reported hazardous materials events reported in the county. Forty serious events were reported with 1 death and 28 injuries. Future occurrences are highly likely.

- NUCLEAR ACCIDENT. Some of the county falls within the 50 mile buffer of Shearon Harris Nuclear Plant, but there have been no major incidents and future occurrences are unlikely.

- PIPELINE FAILURE. During Hurricane Katrina, the county experienced disruptions to the distribution network, but there have been no failures in the county itself. A failure would cause downtime and loss of services as well as the danger of fire and explosions.

- RESOURCE SHORTAGE (WATER/FUEL). Several water and fuel shortages have impacted the county and future occurrences are likely in the future. This could have major impacts on businesses and consumers.

- TRANSPORTATION INCIDENT. Several plane and train incidents have occurred in the county in past years in addition to numerous car incidents. Future occurrences are likely, though the impacts would be very localized.

Man-Made/Intentional Hazards

- CIVIL DISTURBANCE. Few recent events but future occurrences are possible and may occur in prominent locations causing work stoppages and loss of productivity.

- CYBERTERRORISM. No large-scale cyber-attacks have been recorded in Guilford County, but these could occur anywhere and may result in theft, loss of IT functions, or dissemination of misinformation.

- TERROR THREAT. There have been no historic terror events in the county, but several facilities were identified as potential targets and confirmed by the planning team. The likelihood of a major event is relatively low.

The results of the hazard identification process were used to generate a Priority Risk Index (PRI), which categorizes and prioritizes potential hazards as high, moderate or low risk based on probability, impact, spatial extent, warning time, and duration. The highest PRI was assigned to Winter Storm followed by Thunderstorm-Wind, Flooding, Hazardous Materials Incident, Resource Shortage, and Tornado.

Hazard Mitigation Planning Team members identified several recent events that were not captured in the data collected by Atkins including additional transportation incidents and ice events. In addition, the Planning Team recommended raising the relative risk level for Civil Disturbance and Energy/Utility Failure.

In concluding the review of Hazard Profiles, the Project Manager stated if anyone had additional information for the hazard profiles, or had concerns with any of the data presented, they should call or email him.

The Project Manager presented the Capability Assessment Findings. Atkins has developed a scoring system that was used to rank the participating jurisdictions in terms of capability in four major areas (Planning and Regulatory; Administrative and Technical; Fiscal; Political). Important capability indicators include National Flood Insurance Program (NFIP) participation, Building Code Effective Grading Schedule (BCEGS) score, Community Rating System (CRS) participation, and the Local Capability Assessment Survey conducted by Atkins.

The Project Manager reviewed the Relevant Plans and Ordinances, Relevant Staff/Personnel Resources, and Relevant Fiscal Resources. All of these categories were used to rate the overall capability of the participating counties and jurisdictions. Most jurisdictions are in the moderate to high range for

Planning and Regulatory Capability and in the limited range for Fiscal Capability. There is variation between the jurisdictions for Administrative and Technical Capability, mainly with respect to availability staff skilled in GIS. Based upon the scoring methodology developed by Atkins, it was determined that most of the participating jurisdictions have moderate to high capability to implement hazard mitigation programs and activities.

The Project Manager also discussed the results of the public participation survey that was posted on several of the participating counties' and municipal websites. As of the meeting date, 226 responses had been received. The Project Manager explained that the survey would close on May 4th, so the HMPT could make one final push to get the survey out to the public. Based on preliminary survey results, respondents felt that energy/utility failure posed the greatest threat to their neighborhood, followed by Winter Storm, and Tornado. Eighty-seven percent of the respondents were interested in making their homes more resistant to hazards. However, 54 percent don't know who to contact regarding reducing their risks to hazards.

The Project Manager then reminded team members of the results of the icebreaker exercise from the first Hazard Mitigation Team meeting, where attendees were given "money" to spend on various hazard mitigation techniques. The results were as follows:

- Public Education and Awareness $97
- Prevention $82
- Property Protection $77
- Emergency Services $72
- Structural Projects $47
- Natural Resource Protection $40

The Project Manager gave an overview of Mitigation Strategy Development and presented the existing goals for the plan and explained that Atkins recommended keeping the goals as they are. The Hazard Mitigation Team accepted the existing goals for the plan. The Project Manager then provided an overview and examples of suggested mitigation actions tailored for Guilford County. The Project Manager then asked each county and the municipalities to provide a status update for their existing mitigation actions (completed, deleted, or deferred) by May 15, 2015. The Project Manager also asked planning team members to include any new mitigation actions by May 15, 2015.

The Project Manager thanked the group for taking the time to attend and the Emergency Management Coordinator explained that if team members had any issues or questions about the planning process or their next steps, they could contact him or the Project Manager. The meeting was adjourned.

2.6 INVOLVING THE PUBLIC

44 CFR Requirement
44 CFR Part 201.6(b)(1): The planning process shall include an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

An important component of the mitigation planning process involved public participation. Individual citizen and community-based input 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 community's overall mitigation strategy aimed at making a home, neighborhood, school, business or entire city safer from the potential effects of hazards.

Public involvement in the development of the Guilford County Multi-Jurisdictional Hazard Mitigation Plan was sought using three methods: (1) public meetings were held and were advertised in local media; (2) public survey instruments were made available in hard copy and online in English and in Spanish; and (3) the draft Plan deliverables were made available on county and municipal websites and at government offices along with contact information for providing input.

The general public was provided three opportunities to be involved in the development of the county plan: (1) twice during the drafting stage of the Plan; and (2) upon completion of a final draft Plan, but prior to official Plan approval and adoption. All meetings were advertised on the county website and during the drafting stage, coordinating committee meetings that included members of the public were held on March 12, 2015 and April 9, 2015. A public coordinating committee meeting was held at the end of the planning process on June 11, 2015. After each of these meetings, members provided valuable input to the plan which was ultimately incorporated. Additional information on these meetings can be found in Appendix D. In addition, a public participation survey (discussed in greater detail in Section 2.6.1) was made available during the planning process at various locations throughout the county and on participating jurisdiction websites.

2.6.1 Public Survey

The Hazard Mitigation Planning Team was successful in getting citizens to provide input to the mitigation planning process through the use of the *Public Participation Survey*. The *Public Participation Survey* was designed to capture data and information from residents of Guilford County that might not be able to attend public meetings or participate through other means in the mitigation planning process.

Copies of the *Public Participation Survey* were distributed to the Hazard Mitigation Planning Team to be made available for residents to complete at local public offices. A link to an electronic version of the survey was also posted on the county and municipal websites. A total of 431 survey responses were received, which provided valuable input for the Hazard Mitigation Planning Team to consider in the development of the plan update. Selected survey results are presented below which include updated information that was not presented at the 2nd Hazard Mitigation Planning Team meeting.

- Approximately 48 percent of survey respondents had been impacted by a disaster, mainly winter/ice storms, power outages, hurricanes, tornadoes, and severe storms/wind.
- Respondents ranked Tornado/Damaging Wind as the highest threat to their neighborhood (20 percent), followed by Winter Storm (18 percent) and Energy/Power/Utility Failure (15 percent).
- Approximately 37 percent of respondents have taken actions to make their homes more resistant to hazards and 87 percent are interested in making their homes more resistant to hazards.

- 55 percent of respondents do not know what office to contact regarding reducing their risks to hazards.
- Emergency Services, Public Education and Awareness, and Prevention, were ranked as the most important activities for communities to pursue in reducing risks.

A copy of the survey is provided in Appendix B and a detailed summary of the survey results are provided in Appendix F.

2.7 INVOLVING THE STAKEHOLDERS

44 CFR Requirement
44 CFR Part 201.6(b)(2): The planning process shall include 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 non-profit interests to be involved in the planning process.

At the beginning of the planning process for the development of this plan, the project consultant worked with the County Emergency Management lead to initiate outreach to stakeholders to be involved in the planning process. The project consultant sent out a list of recommended stakeholders provided from FEMA Publication 386-1 titled **Getting Started: Building Support for Mitigation Planning**. The list of recommended stakeholders is found in Appendix C of that publication (Worksheet #1: Build the Planning Team) and has been included in Appendix B of this plan to demonstrate the wide range of stakeholders that were considered to participate in the development of this plan. The County Emergency Management lead used that list for reference as they invited stakeholders to participate in the planning process.

In addition to the efforts described above, the Hazard Mitigation Planning Team encouraged more open and widespread participation in the mitigation planning process by designing and distributing the *Public Participation Survey*. These opportunities were provided for local officials, residents, businesses, academia, and other private interests in the county to be involved and offer input throughout the local mitigation planning process.

2.8 DOCUMENTATION OF PLAN PROGRESS

Progress in hazard mitigation planning for the participating jurisdictions in Guilford County is documented in this plan update. Since hazard mitigation planning efforts officially began in the participating counties with the development of the initial Hazard Mitigation Plans in the late 1990s and early 2000s, many mitigation actions have been completed and implemented in the participating jurisdictions. These actions will help reduce the overall risk to natural hazards for the people and property in Guilford County. The actions that have been completed are documented in the Mitigation Action Plan found in Section 9.

In addition, community capability continues to improve with the implementation of new plans, policies and programs that help to promote hazard mitigation at the local level. The current state of local capabilities for the participating jurisdictions is captured in Section 7: *Capability Assessment*. The participating jurisdictions continue to demonstrate their commitment to hazard mitigation and hazard

mitigation planning and have proven this by developing the Hazard Mitigation Planning Team to update the Plan and by continuing to involve the public in the hazard mitigation planning process.

SECTION 3
COMMUNITY PROFILE

This section of the Plan provides a general overview of Guilford County and its participating municipalities. It consists of the following four subsections:

- 3.1 Geography and the Environment
- 3.2 Population and Demographics
- 3.3 Housing, Infrastructure, and Land Use
- 3.4 Employment and Industry

3.1 GEOGRAPHY AND THE ENVIRONMENT

Guilford County is located in the Piedmont area of North Carolina, centered along the piedmont industrial crescent stretching from Raleigh to Charlotte. For the purposes of this plan, Guilford County includes the Town of Gibsonville, City of Greensboro, City of High Point, Town of Jamestown, Town of Oak Ridge, Town of Pleasant Garden, Town of Sedalia, Town of Stokesdale, Town of Summerfield, Town of Whitsett, and all unincorporated areas within the county. An orientation map is provided as **Figure 3.1**.

Guilford County contains multiple university and higher learning facilities advocating higher education. The Cities of Greensboro and High Point each have an operational courthouse allowing Guilford County to be one of the few counties within the nation that have a dual court system. Various companies and businesses operate within the county, including the region's largest furniture merchandising, retail, and service industries.

Guilford County is included in the Piedmont Triad within the north-central region of North Carolina. The Triad consists of areas within Alamance, Davidson, Forsyth, Guilford, Randolph, Rockingham, and Surry Counties. Areas within and surrounding the three major cities and Greensboro, High Point, and Winston-Salem make up the base for of the Piedmont Triad. The Triad has an extensive freeway network consisting of four interstate highways and numerous secondary Interstate routes and US routes. This allows the area to support a mixed economy consisting of industry and manufacturing along with technology and biotechnology. The area also contains prominent regional shopping facilities.

The total land area of each of the participating jurisdictions is presented in **Table 3.1**.

TABLE 3.1: TOTAL LAND AREAS OF PARTICIPATING JURISDICTIONS

Jurisdiction	Total Land Area
Guilford County	**645.7 square miles**
Gibsonville*	3.5 square miles
Greensboro	126.5 square miles
High Point*	53.8 square miles
Jamestown	2.9 square miles

Jurisdiction	Total Land Area
Oak Ridge	15.4 square miles
Pleasant Garden	15.3 square miles
Sedalia	2.1 square miles
Stokesdale	19.2 square miles
Summerfield	26.6 square miles
Whitsett	2.6 square miles

*Portions of land that make up Gibsonville and High Point are located in neighboring counties. Note: these areas are not included in the Guilford County total.

Source: United States Census Bureau

Guilford County enjoys a moderate climate that is characterized by mild winters and hot, humid summers. In general, the spring months are marked by unpredictable weather and changes can occur rapidly with sunny skies yielding to severe thunderstorms in just a few hours.

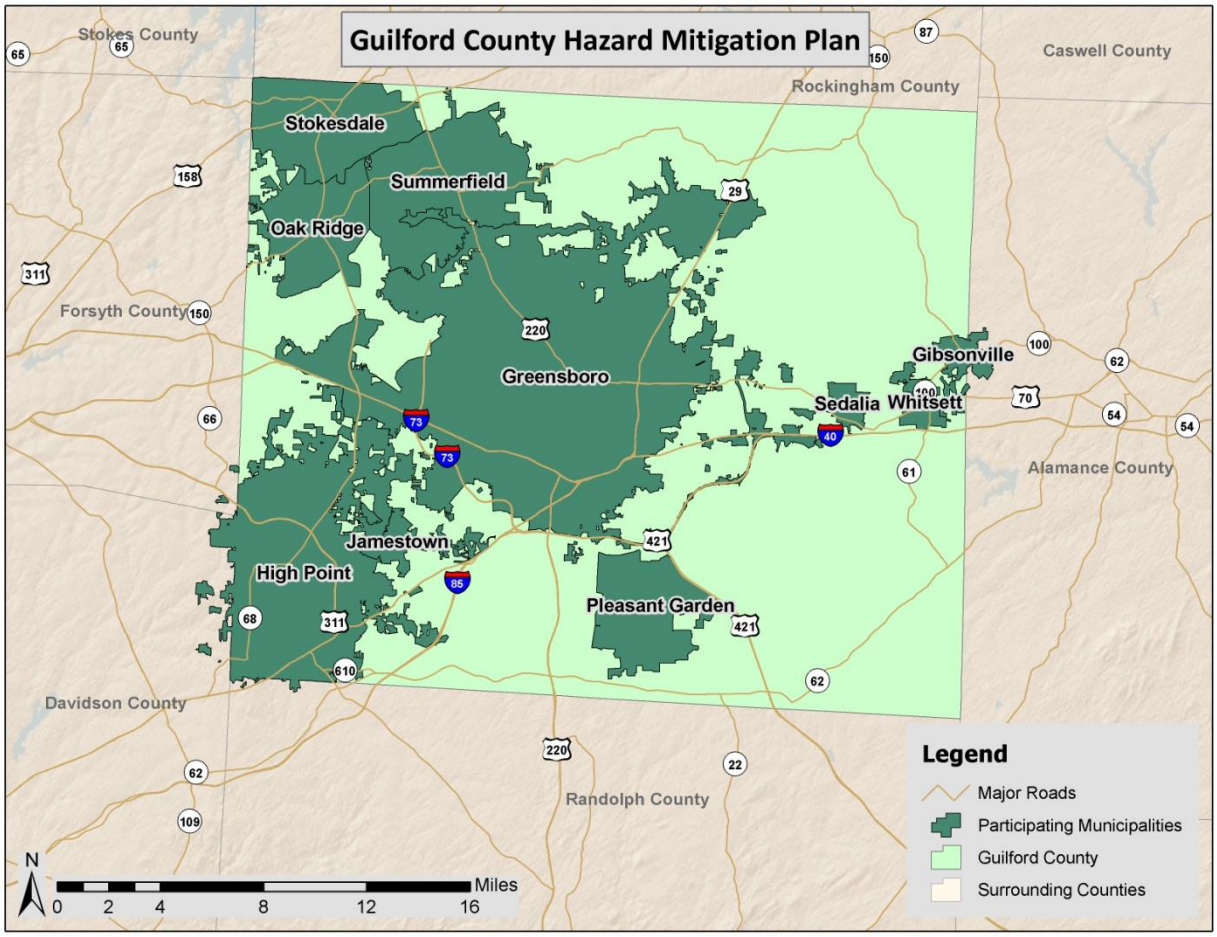
From March through May, temperatures have an average high in the mid 70s˚F with lows in the 40s˚F. Typically, the weather is milder by late March and warm by late April.

In the summer, afternoon showers and thunderstorms are common and average temperatures increase with afternoon highs reaching the high 80s˚F in July and August. These months are also the most common for rain in Guilford County.

September through mid-November is typified by clear skies and cooler weather that alternates between warm days and cool nights. Highs and lows are usually similar to those experienced in the spring, with November days cooling off considerably.

Winter in Guilford County is generally moderate but extremes do occur. High temperatures are usually in the lower 50s˚F and winter lows in the higher 20s˚F. Snow and ice do tend to occur. The most received snow in Guilford County was 20 inches in March 1927.

FIGURE 3.1: GUILFORD COUNTY ORIENTATION MAP



3.2 POPULATION AND DEMOGRAPHICS

Greensboro is the largest participating municipal jurisdiction by area and it also has the largest population. Between 2000 and 2010, the majority of participating jurisdictions experienced population growth. Oak Ridge had the highest county growth rate at around 36%. Population counts from the US Census Bureau for 1990, 2000, and 2010 for each of the participating jurisdictions are presented in **Table 3.2**.

TABLE 3.2: POPULATION COUNTS FOR PARTICIPATING JURISDICTIONS

Jurisdiction	1990 Census Population	2000 Census Population	2010 Census Population	% Change 2000-2010
Guilford County	**347,420**	**421,048**	**488,406**	**13.8%**
Gibsonville*	3,441	4,372	6,410	31.8%
Greensboro	183,521	223,891	269,666	16.9%
High Point*	69,496	85,839	104,371	17.8%
Jamestown	2,600	3,088	3,382	8.7%
Oak Ridge	4,716	3,988	6,185	35.5%

Jurisdiction	1990 Census Population	2000 Census Population	2010 Census Population	% Change 2000-2010
Pleasant Garden	2,228	4,714	4,489	-5.0%
Sedalia	--	618	623	0.8%
Stokesdale	2,134	3,267	5,047	35.3%
Summerfield	2,051	7,018	10,232	31.4%
Whitsett	--	686	590	-16.3%

*The population counts of Gibsonville and High Point include population residing in neighboring counties. Note: these populations are not included in the Guilford County total.
Source: United States Census Bureau

Based on the 2010 Census, the median age of residents in Guilford County is 36.3. The racial characteristics of the participating jurisdictions are presented in **Table 3.3**. Generally, whites make up the majority of the population in the county accounting for over 57 percent of the population in overall. However, Sedalia has a much higher minority population.

TABLE 3.3: DEMOGRAPHICS OF PARTICIPATING JURISDICTIONS

Jurisdiction	White, Percent (2010)	Black or African American, Percent (2010)	American Indian or Alaska Native, Percent (2010)	Asian, Percent (2010)	Native Hawaiian or Other Pacific Islander, Percent (2010)	Other Race, Percent (2010)	Two or More Races, percent (2010)	Persons of Hispanic Origin, Percent (2010)*
Guilford County	**57.0%**	**32.5%**	**0.5%**	**3.9%**	**0.0%**	**3.6%**	**2.3%**	**7.1%**
Gibsonville	79.4%	14.6%	0.2%	1.1%	0.1%	3.1%	1.5%	5.9%
Greensboro	48.4%	40.6%	0.5%	4.0%	0.1%	3.8%	2.6%	7.5%
High Point	53.6%	33.0%	0.6%	6.1%	0.0%	4.4%	2.3%	8.5%
Jamestown	80.6%	13.6%	0.4%	2.5%	0.1%	1.2%	1.6%	3.2%
Oak Ridge	88.9%	5.2%	0.4%	3.4%	0.0%	1.1%	1.0%	3.0%
Pleasant Garden	83.0%	10.7%	0.6%	0.7%	0.0%	3.2%	1.7%	4.7%
Sedalia	20.9%	76.1%	0.3%	0.2%	0.0%	0.2%	2.4%	1.8%
Stokesdale	90.9%	4.7%	0.4%	1.4%	0.0%	1.3%	1.3%	3.5%
Summerfield	89.9%	4.4%	0.4%	2.2%	0.0%	1.5%	1.5%	4.3%
Whitsett	91.0%	6.8%	0.0%	0.0%	0.0%	1.9%	0.3%	2.9%

*Hispanics may be of any race, so also are included in applicable race categories
Source: United States Census Bureau

3.3 HOUSING, INFRASTRUCTURE, AND LAND USE

3.3.1 Housing

According to the 2010 US Census, there were 218,017 housing units in Guilford County, the majority of which are single family homes or multiple unit homes. Housing information for the ten participating jurisdictions is presented in **Table 3.4**. As shown in the table, Guilford County has a very low percentage of seasonal housing across the jurisdictions; however, Whitsett has a slightly higher rate compared to the other municipalities.

TABLE 3.4: HOUSING CHARACTERISTICS OF PARTICIPATING JURISDICTIONS

Jurisdiction	Housing Units (2000)	Housing Units (2010)	Seasonal Units, Percent (2010)	Median Home Value (2009-2013)
Guilford County	**180,391**	**218,017**	**0.4%**	**$156,000**
Gibsonville*	1,822	2,798	0.2%	$159,500
Greensboro	99,305	124,074	0.3%	$147,400
High Point*	35,952	46,677	0.6%	$147,400
Jamestown	1,293	1,517	0.5%	$212,100
Oak Ridge	1,462	2,226	0.5%	$333,700
Pleasant Garden	1,874	1,819	0.3%	$149,700
Sedalia	240	279	0.0%	$140,000
Stokesdale	1,268	1,955	0.6%	$196,500
Summerfield	2,653	3,756	0.2%	$331,000
Whitsett	308	279	1.1%	$154,200

*The housing unit counts for Gibsonville and High Point include units located in neighboring counties. Note: these housing units are not included in the Guilford County total.
Source: United States Census Bureau

3.3.2 Infrastructure

Transportation

There are several major highways that cross through Guilford County. The county is connected to the other counties in the region by Interstates 40, 73, 74, and 85. Interstate 40 runs through the state of North Carolina from the Tennessee state line. Interstate 73 runs into the county directly from the south and into Greensboro. Interstate 74 is partially completed within the state of North Carolina. The first section in the Piedmont Triad starts at the Virginia state line running through the southwest corner of Guilford County. Interstate 85 runs northeast-southwest through the state of North Carolina and is the second longest interstate in North Carolina (behind Interstate 40). Within Guilford County, multiple transportation routes run in concurrency throughout the state.

The Piedmont Triad International Airport services Guilford County. The airport has six airlines that service it with flights daily. Residents within the town also use the Charlotte-Douglas International Airport, the largest airport in the state, and Raleigh-Durham International Airport. The Charlotte-Douglas International Airport currently offers non-stop commercial flights on nine airlines to cities around the country and the world. The Raleigh-Durham International Airport offers more than 35 domestic and international flights on nine different airlines.

In terms of other transportation services, Guilford County provides a public transit system that serves residents without access to additional public transportation services in Greensboro or High Point. Transportation is provided for medical appointments, employment, education, senior services, nutrition sites, and senior citizen care. The Piedmont Authority for Regional Transportation (PART) also provides bus services throughout the Triad.

Utilities

Electrical power in Guilford County is provided by Duke Power, High Point City Electric, and Energy United. Duke Power is a major provider in many areas of North Carolina. High Point City Electric is

namely focused within the City of High Point and Energy United is an electric cooperative that supplies electric services to multiple counties within North Carolina.

Water and sewer services are provided throughout Guilford County by several municipalities including the City of Greensboro, City of High Point, Town of Jamestown, Sedgefield Sanitary District, Burlington, and Town of Stokesdale. Services not provided by a municipality are managed under the Guilford County Planning Department.

Community Facilities

There are a number of public buildings and community facilities located throughout Guilford County. According to the data collected for the vulnerability assessment (Section 6.4.1), there are 68 fire stations, 22 law and justice facilities, 107 public schools, and 33 private schools located within the study area.

There are five acute care hospitals in the county, which provide nearly 1,500 licensed beds. Major hospitals located in Guilford County include Moses H. Cone Memorial Hospital and High Point Regional Hospital. Cone Health Network System also operates several satellite locations throughout the county. Additionally, three nationally prominent teaching hospitals are within an hour's drive of the county.

Guilford County affords the full range of amenities of a thriving urban area, including three regional shopping malls and more than three million square feet of retail space. Guilford County is also home to several parks, including: Bur-Mil Park, Gibson Park, Guilford-Mackintosh Park, Hagan-Stone Park, Northeast Park, Southwest Park, and Triad Park. There are also a number of municipal parks located throughout the jurisdictions.

3.3.3 Land Use

Guilford County positions itself to accommodate new growth and redevelopment that is efficient and cost-effective; improves the quality of life for residents; enhances economic vitality; is respectful to citizen based areas plans; supports creativity and innovative design; and protects and preserves the natural, historic, and cultural resources and assets of the county. The county continues to utilize the future land uses depicted on citizen based area plans, in conjunction with the rezoning guidance matrix, as the basis for land use and policy recommendations. Guilford County is an active partner in the planning and implementation of large-scale multi-jurisdictional land use initiatives such as the Heart of the Triad and transit-oriented development. Local land use and associated regulations are further discussed in *Section 7: Capability Assessment.*

3.4 EMPLOYMENT AND INDUSTRY

Guilford County's traditional employment base of textiles, apparel, and furniture has diversified greatly in the last fifty years, and now encompasses more than 300 companies producing a wide range of products. An excellent transportation infrastructure, including two interstate highways, Piedmont Triad International Airport, and readily available rail and truck service, has helped solidify the county's position as a major distribution and transportation center in the Southeast.

Many corporate and regional offices are located in Guilford County, including Lincoln Financial, Volvo Trucks North America, ITG Brands, and VF Corporation. The International Home Furnishings Market in

High Point attracts some 140,000 visitors annually, generating millions of dollars in economic benefits to the community. Aggressive economic recruitment efforts by both private and public sectors have yielded many new corporate neighbors.

According to the North Carolina Employment Security Commission, in 2013, Guilford County had an average annual employment of 234,387 workers and an average unemployment rate of 8.3 percent (compared to 9.2 percent for the state). In 2013, the Health Care and Social Assistance industry employed 14.9 percent of the county's workforce followed by Manufacturing (13.5%); Retail Trade (12.4%); Administrative and Waste Services (11.0%); and Accommodation and Food Services (9.8%). From 2009 to 2013, the average annual median household income in Guilford County was $45,431 compared to $46,450 for the state of North Carolina.

SECTION 4
HAZARD IDENTIFICATION

This section describes how the planning team identified the hazards to be included in this plan. It consists of the following five subsections:

- 4.1 Overview
- 4.2 Description of Full Range of Hazards
- 4.3 Disaster Declarations
- 4.4 Hazard Evaluation
- 4.5 Hazard Identification Results

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44 CFR Requirement
44 CFR Part 201.6(c)(2)(i): The risk assessment shall include a description of the type, 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.

4.1 OVERVIEW

Guilford County is vulnerable to a wide range of natural and human-caused hazards that threaten life and property. Current FEMA regulations and guidance under the Disaster Mitigation Act of 2000 (DMA 2000) require, at a minimum, an evaluation of a full range of natural hazards. An evaluation of human-caused hazards (i.e., technological hazards, terrorism, etc.) is encouraged, though not required, for plan approval. Guilford County has included a comprehensive assessment of both types of hazards.

Upon a review of the full range of natural hazards suggested under FEMA planning guidance, the participating jurisdictions in Guilford County (Gibsonville, Greensboro, High Point, Jamestown, Oak Ridge, Pleasant Garden, Sedalia, Stokesdale, Summerfield, and Whitsett) have identified a number of hazards that are to be addressed in their Multi-Jurisdictional Hazard Mitigation Plan. These hazards were identified through an extensive process that utilized input from the Guilford County Hazard Mitigation Planning Team members, research of past disaster declarations in the county[1], and review of the North Carolina State Hazard Mitigation Plan. Readily available information from reputable sources (such as federal and state agencies) was also evaluated to supplement information from these key sources.

Table 4.1 lists the full range of hazards initially identified for inclusion in the Plan and provides a brief description for each. This table includes 24 individual hazards. Some of these hazards are considered to be interrelated or cascading, but for preliminary hazard identification purposes these individual hazards are broken out separately.

Next, **Table 4.2** lists the disaster declarations in Guilford County.

[1] A complete list of disaster declarations for Guilford County can be found below in Section 4.3.

Next, **Table 4.3** documents the evaluation process used for determining which of the initially identified hazards are considered significant enough to warrant further evaluation in the risk assessment. For each hazard considered, the table indicates whether or not the hazard was identified as a significant hazard to be further assessed, how this determination was made, and why this determination was made. The table works to summarize not only those hazards that *were* identified (and why) but also those that *were not* identified (and why not). Hazard events not identified for inclusion at this time may be addressed during future evaluations and updates of the risk assessment if deemed necessary by the Hazard Mitigation Planning Team during the plan update process.

Lastly, **Table 4.4** provides a summary of the hazard identification and evaluation process noting that 26 of the 34 initially identified hazards are considered significant enough for further evaluation through this Plan's risk assessment (marked with a "☑").

4.2 DESCRIPTION OF FULL RANGE OF HAZARDS

TABLE 4.1: DESCRIPTIONS OF THE FULL RANGE OF INITIALLY IDENTIFIED HAZARDS

Hazard	Description
NATURAL HAZARDS	
Avalanche	A rapid fall or slide of a large mass of snow down a mountainside.
Dam and Levee Failure	Dam failure is the collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam. Dam failure can result from natural events, human-induced events, or a combination of the two. The most common cause of dam failure is prolonged rainfall that produces flooding. Failures due to other natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning.
Drought	A prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. High temperatures, high winds, and low humidity can worsen drought conditions and also make areas more susceptible to wildfire. Human demands and actions have the ability to hasten or mitigate drought-related impacts on local communities.
Earthquake	A sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the surface. This movement forces the gradual building and accumulation of energy. Eventually, strain becomes so great that the energy is abruptly released, causing the shaking at the earth's surface which we know as an earthquake. Roughly 90 percent of all earthquakes occur at the boundaries where plates meet, although it is possible for earthquakes to occur entirely within plates. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Erosion	Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year.
Expansive Soils	Soils that will exhibit some degree of volume change with variations in moisture conditions. The most important properties affecting degree of volume change in a soil are clay mineralogy and the aqueous environment. Expansive soils will exhibit expansion caused by the intake of water and, conversely, will exhibit contraction when moisture is removed by drying. Generally speaking, they often appear sticky when wet, and are characterized by surface cracks when dry. Expansive soils become a problem when structures are built upon them without taking proper design precautions into account with regard to soil type. Cracking in walls and floors can be minor, or can be severe enough for the home to be structurally unsafe.
Extreme Cold	Extreme cold is generally considered to occur when the temperature is at or below freezing for a period of time. Often these events are associated with winter storms and other winter weather, but extreme cold events can occur on their own. Dangers associated with extreme cold events include frostbite and hypothermia among other impacts to people and these events can often last for several days or weeks in a row.
Extreme Heat	A heat wave may occur when temperatures hover 10 degrees or more above the average high temperature for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility. A heat wave combined with a drought can be very dangerous and have severe economic consequences on a community.
Fire	An uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.
Flooding	The accumulation of water within a water body which results in the overflow of excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream ocean, lake or other watercourse or water body that is susceptible to flooding. Most floods fall into the following three categories: riverine flooding, coastal flooding, or shallow flooding (where shallow flooding refers to sheet flow, ponding and urban drainage).
Hail	Any storm that produces hailstones that fall to the ground; usually used when the amount or size of the hail is considered significant. Hail is formed when updrafts in thunderstorms carry raindrops into parts of the atmosphere where the temperatures are below freezing.

Hurricane/Other Tropical Distrubance	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 with a diameter averaging 10 to 30 miles across. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves and tidal flooding which can be more destructive than cyclone wind. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea and Gulf of Mexico during the official Atlantic hurricane season, which extends from June through November.
Landslide	The movements of a mass of rock, debris, or earth down a slope when the force of gravity pulling down the slope exceeds the strength of the earth materials that comprise to hold it in place. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet. Slopes are also more likely to fail if vegetative cover is low and/or soil water content is high.
Land Subsidence	The gradual settling or sudden sinking of the Earth's surface due to the subsurface movement of earth materials. Causes of land subsidence include groundwater pumpage, aquifer system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost.
Nor'easter	Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their associated strong winds and heavy surf. Nor'easters are named for the winds that blow in from the northeast and drive the storm up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful. Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding.
Storm Surge	A storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to five feet in a Category 1 hurricane up to more than 30 feet in a Category 5 storm. Storm surge heights and associated waves are also dependent upon the shape of the offshore continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Storm surge arrives ahead of a storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Storm surge can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast. Further, water rise caused by storm surge can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas.

Thunderstorm (Wind and Lightning)	Thunderstorms are caused by air masses of varying temperatures meeting in the atmosphere. Rapidly rising warm moist air fuels the formation of thunderstorms. Thunderstorms may occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours. Thunderstorms may result in hail, tornadoes, or straight-line winds. Windstorms pose a threat to lives, property, and vital utilities primarily due to the effects of flying debris and can down trees and power lines. Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 73 people are killed each year by lightning strikes in the United States.
Tornado	A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. Tornadoes are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size and duration of the storm.
Tsunami	A series of waves generated by an undersea disturbance such as an earthquake. The speed of a tsunami traveling away from its source can range from up to 500 miles per hour in deep water to approximately 20 to 30 miles per hour in shallower areas near coastlines. Tsunamis differ from regular ocean waves in that their currents travel from the water surface all the way down to the sea floor. Wave amplitudes in deep water are typically less than one meter; they are often barely detectable to the human eye. However, as they approach shore, they slow in shallower water, basically causing the waves from behind to effectively "pile up", and wave heights to increase dramatically. As opposed to typical waves which crash at the shoreline, tsunamis bring with them a continuously flowing 'wall of water' with the potential to cause devastating damage in coastal areas located immediately along the shore.
Volcano	A mountain that opens downward to a reservoir of molten rock below the surface of the earth. While most mountains are created by forces pushing up the earth from below, volcanoes are different in that they are built up over time by an accumulation of their own eruptive products: lava, ash flows, and airborne ash and dust. Volcanoes erupt when pressure from gases and the molten rock beneath becomes strong enough to cause an explosion.
Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Blizzards, the most dangerous of all winter storms, combine low temperatures, heavy snowfall, and winds of at least 35 miles per hour, reducing visibility to only a few yards. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries to human life.

BIOLOGICAL HAZARDS	
Bioterrorism	Bioterrorism is defined by the Centers for Disease Control as an attack wherein there is a deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants. These agents are typically found in nature, but it is possible that they could be changed to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment.
Public Health/Emerging Disease Threat	Public health threats are often defined by an infectious disease that involves a biological agent/disease that may result in mass casualties or an outbreak of symptoms in those affected. Often emerging diseases are the greatest threat because they are new or varied iterations of existing threats and the population may not have built up a collective immunity to the disease.
TECHNOLOGICAL HAZARDS	
Building/Structure Collapse	According to the United States Department of Labor, a collapsed structure occurs when internal load bearing structural elements fail and the building collapses into itself with the exterior walls being pulled into the falling structure. This scenario may be caused by construction activity, an earthquake, or fire, and may result in a dense debris field with a small footprint. Alternatively, if the structural failure is caused by an explosion or natural forces such as weather, the building may collapse in an outward direction, resulting in a less dense and more scattered debris field.
Communications Systems Disruption/Failure	The failure or disruption of communications systems occurs when emergency response personnel or government officials are unable to utilize their existing communications equipment due to overload of the system or impacts from a hazard. These events can have a critical impact because they may result in lengthened response times and cause miscommunication among responders, resulting in additional impacts that may otherwise have been avoided.
Energy/Power/Utility Failure	Energy/power/utility failures often occur hand in hand with other hazards and are often caused by rising flood waters or high winds. These events most commonly occur when wind events knock down power lines or water treatment plants are flooded by rising waters, thereby shutting down these utilities. The impacts from these failures are often widespread and can affect thousands of people even when small areas of this infrastructure is affected.
Hazardous Materials Incident	Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways and on the water. HAZMAT incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.

Nuclear Power Plant Emergency	A nuclear and radiation accident is defined by the International Atomic Energy Agency as "an event that has led to significant consequences to people, the environment or the facility. Often, this type of incident results from damage to the reactor core of a nuclear power plant which can release radioactivity into the environment. The degree of exposure from nuclear accidents has varied from serious to catastrophic.
Pipeline Failure	In the case of this plan, a pipeline incident generally refers to a spill, explosion, or fire caused in the transport of flammable liquid or gas being carried by fixed pipes across the United States. These pipes often carry petroleum-based products that are dangerous to health and safety of people as well as the environment if exposed in large quantities.
Resource Shortage (Water/Fuel)	A resource shortage occurs whenever supplies of a resource have been depleted to the point that there is very little to none of the resource available to the public. Most commonly resource shortages occur when there has been a steady decrease in the amount of available resource over time, but these shortages can also be the result of a major event that quickly reduces supply.
Transportation Incident	Transportation incidents come in many forms in the United States, especially given the many forms of transportation available today. The most common types of transportation incidents are motor vehicle accidents, but plane, train, and watercraft accidents occur as well and often have higher magnitude impacts.
MAN-MADE/INTENTIONAL HAZARDS	
Civil Disturbance	Public unrest has been evident in society from the earliest recordings of civilization. Most of these disturbances have been related to political or social issues. Insurrection has framed much of history, dictating the governance and progression of society. In recent years, most of the publicized disturbances have been protests and riots. Rioting does not occur very often in the United States; however, marches and protests are common and could subsequently lead to riots.
Cyberterrorism	Cyberterrorism is a deliberate attack on an individual or group using the internet. In the past few decades, society has become dependent on computers and internet connections for much of daily life. This dependence has opened up the avenue for crime to be committed from afar, often from a different country. Some common examples of cyberterrorism include a hacker accessing bank accounts by hacking into a bank's website, infecting a computer system with a virus, Trojan horse, or worm to inflict damage to the information in the system, or disseminating incorrect or otherwise flawed information, also called "misinformation." Also, denial-of-service attacks could occur against prominent websites, which prevent legitimate users from accessing information or services
Terrorism	Terrorism is defined by FEMA as, "the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom." Terrorist acts may include assassinations, kidnappings, hijackings, bomb scares and bombings, cyber attacks (computer-based), and the use of chemical, biological, nuclear and radiological weapons.

4.3 DISASTER DECLARATIONS

Disaster declarations provide initial insight into the hazards that may impact the Guilford County planning area. Since 1989, 11 presidential disaster declarations have been reported in Guilford County. This includes six storms related to severe winter weather, one tornado event, and four hurricanes.

However, this list is not inclusive of many of the major disaster events that impacted the county and which ultimately resulted in Small Business Administration disaster loan assistance such the straight line wind event that occurred on May 21, 2001 and the High Point tornado (2010).

TABLE 4.2: GUILFORD COUNTY DISASTER DECLARATIONS

Year	Disaster Number	Description
1989	827	TORNADOES
1989	844	HURRICANE HUGO
1996	1087	BLIZZARD OF 96
1996	1103	WINTER STORM
1996	1134	HURRICANE FRAN
1999	1292	HURRICANE FLOYD MAJOR DISASTER DECLARATIONS
2000	1312	SEVERE WINTER STORM
2002	1448	SEVERE ICE STORM
2003	1457	ICE STORM
2004	1553	HURRICANE IVAN
2014	4167	SEVERE WINTER STORM

4.4 HAZARD EVALUATION

TABLE 4.3: DOCUMENTATION OF THE HAZARD EVALUATION PROCESS

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
NATURAL HAZARDS			
Avalanche	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of US Forest Service National Avalanche Center website	• The United States avalanche hazard is limited to mountainous western states including Alaska, as well as some areas of low risk in New England. • Avalanche hazard was removed from the North Carolina State Hazard Mitigation Plan after determining the mountain elevation in Western North Carolina did have enough snow to produce this hazard. • Avalanche is not included in the previous Guilford County hazard mitigation plan. • There is no risk of avalanche events in North Carolina.
Dam and Levee Failure	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of North Carolina Division of Land Management website	• The National Inventory of Dams shows dams are located in every state. • Dam failure is discussed in the NC State Hazard Mitigation Plan and is listed a higher hazard for the Piedmont 3 Region than many other areas of the state. The Piedmont 3 Region includes Guilford County. • The previous Guilford County hazard mitigation plan did not address dam failure. • Of the 320 dams reported on the National Inventory of Dams, 75 are high hazard (23%). (High hazard is defined as "where failure or mis-operation will probably cause loss of human life").

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Drought	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of the NC State Climate Office website	• Drought is a normal part of virtually all climatic regimes, including areas with high and low average rainfall. • Droughts are discussed in NC State Hazard Mitigation Plan as a lesser hazard. • The NC State Hazard Mitigation Plan lists drought as a relatively high hazard for the Piedmont 3 Region, which includes Guilford County. • Drought is included in the previous Guilford County hazard mitigation plan. • There are reports of moderate to extreme drought conditions in 8 of the last 14 years in Guilford County, according to the NC State Climate Office.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Earthquake	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of the National Geophysical Data Center • USGS Earthquake Hazards Program website	• Although the zone of greatest seismic activity in the United States is along the Pacific Coast, eastern regions have experienced significant earthquakes. • Earthquake events are discussed in the NC State Hazard Mitigation Plan and Guilford County is considered to be at low to moderate risk to an earthquake event. • Earthquake was not included in the previous Guilford County hazard mitigation plan. • Earthquakes have occurred in and around the State of North Carolina in the past. The state is affected by the Charleston and the New Madrid (near Missouri) Fault lines which have generated a magnitude 8.0 earthquake in the last 200 years. • 5 events are known to have occurred in the county according to the National Geophysical Data Center. The greatest MMI reported was a 4. • According to USGS seismic hazard maps, the peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Guilford County is approximately 2 to 4%g. Although FEMA recommends that earthquakes be further evaluated for mitigation purposes in areas with a PGA of 3%g or more.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Erosion	NO	• Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan	• Coastal erosion is discussed in the NC State Hazard Mitigation Plan but only for coastal areas (there is no discussion of riverine erosion). Guilford County is not located in a coastal area. • Erosion is not included as a hazard in the previous Guilford County hazard mitigation plan. • Riverine erosion remains a natural, dynamic, and continuous process that has the potential to affect Guilford County since several rivers/streams run through the county. This warrants inclusions as a potential hazard.
Expansive Soils	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of USDA Soil Conservation Service's Soil Survey	• The effects of expansive soils are most prevalent in parts of the Southern, Central, and Western U.S. • Expansive soils are identified in the NC State Hazard Mitigation Plan; however, the Piedmont 3 Region, which includes Guilford County, does not identify expansive soils as a major hazard. • Guilford County is located in an area that has little to no clay swelling potential. • The previous Guilford County Hazard Mitigation Plan did not identify expansive soils as a potential hazard.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Extreme Cold	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the North Carolina State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database	• Many areas of the United States are susceptible to extreme cold, including North Carolina. • Extreme cold was included in the previous Guilford County hazard mitigation plan under the extreme temperatures hazard. • NCDC reports one extreme heat event for Guilford County.
Extreme Heat	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the North Carolina State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database	• Many areas of the United States are susceptible to heat waves, including North Carolina. • The NC State Hazard Mitigation Plan reports the central portion of the state as having a moderate vulnerability. • Extreme heat was included in the previous Guilford County hazard mitigation plan under the extreme temperatures hazard. • NCDC reports two extreme heat events for Guilford County. These events resulted in 1 reported death.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Fire	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of Southern Wildfire Risk Assessment (SWRA) Data • Review of the NC Division of Forest Resources website	• Wildfires occur in virtually all parts of the United States. Wildfire hazard risks will increase as low-density development along the urban/wildland interface increases. • Wildfires are discussed in the state plan as a "greater" hazard of concern and the Piedmont Region, which includes Guilford County, was found to have relatively low vulnerability compared to the state. • The previous Guilford County hazard mitigation plan addressed wildfire. • A review of SWRA data indicates that there are some areas of elevated concern in Guilford County. • According to the North Carolina Division of Forest Resources, Guilford County experiences an average of 28 fires each year which burn a combined 429 acres. • Wildfire hazard risks will increase as low-density development along the urban/wildland interface increases.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Flood	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database • Review of historical disaster declarations • Review of FEMA DFIRM data • Review of FEMA's NFIP Community Status Book and Community Rating System (CRS)	• Floods occur in all 50 states and in the U.S. territories. • The flood hazard is thoroughly discussed in the NC State Hazard Mitigation Plan. Guilford County was found to have relatively high vulnerability compared to the state. • The previous Guilford County hazard mitigation plan addresses flood hazard. • NCDC reports that Guilford County has been affected by 73 flood events since 1996. In total, these events caused 1 injury and an estimated $2.6 million (2014 dollars) in property damages. • None of the county's Presidential Disaster Declarations were flood-related; however, four declarations were hurricane-related which caused flooding issues. • 7.0% of Guilford County is located in an identified floodplain (100- or 500-year). • All jurisdictions in the county participate in the NFIP and Guilford County (unincorporated area) and the City of Greensboro also participate in the CRS.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Hail	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database	• Although hailstorms occur primarily in the Midwestern states, they do occur in every state on the mainland U.S. Most inland regions experience hailstorms at least two or more days each year. • Hailstorm events are discussed in the NC State Hazard Mitigation Plan under the Severe Thunderstorm hazard. • Hail is included in the previous Guilford County hazard mitigation plan. • NCDC reports 164 hailstorm events (0.75 to 2.75 inch size hail) for Guilford County since 1967 and 2014. For these events there was almost $2,000 (2014 dollars) in property damages.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Hurricane and Tropical Storm	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Analysis of NOAA historical tropical cyclone tracks and National Hurricane Center Website • Review of NOAA NCDC Storm Events Database • Review of historical presidential disaster declarations • FEMA Hazus-MH storm return periods	• The Atlantic and Gulf regions are most prone to landfall by hurricanes and tropical storms. • Hurricane and tropical storm events are discussed in the NC State Hazard Mitigation Plan and are listed as the high hazard in the Piedmont 3 Region, which includes Guilford County. • Hurricanes and tropical weather were addressed in the previous Guilford County hazard mitigation plan. • NOAA historical records indicate 27 tropical storms and 34 tropical depressions have come within 75 miles of Guilford County since 1854. • NCDC reports 4 hurricane events since 1996 for Guilford County. • 4 out of 11 disaster declarations in Guilford County are directly related to hurricane events. • The 50-year return period peak gust for hurricane and tropical storm events in Guilford County is around 65 mph.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Landslide	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of USGS Landslide Incidence and Susceptibility Hazard Map • Review of the North Carolina Geological Survey database of historic landslides	• Landslides occur in every state in the U.S, and they are most common in the coastal ranges of California, the Colorado Plateau, the Rocky Mountains, and the Appalachian Mountains. • Landslide/debris flow events are discussed in the state plan, and the Piedmont Region, which includes Guilford County, has moderate vulnerability compared to the state. • The previous Guilford County hazard mitigation plan did not address landslides. • USGS landslide hazard maps indicate that a moderate incidence rate is found across the northwestern half of the county. • Data provided by NCGS indicate there are no recorded landslide events in the Guilford County. However, the dataset provided was incomplete.
Land Subsidence	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan	• Land subsidence affects at least 45 states, including North Carolina. However, because of the broad range of causes and impacts, there has been limited national focus on this hazard. • The state plan delineates certain areas that are susceptible to land subsidence hazards in North Carolina; however Guilford County has moderate vulnerability compared to the state. • The previous Guilford County hazard mitigation plan did not identify land subsidence as a potential hazard.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Nor'easter	NO	• Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database	• Nor'easters are discussed in the state plan. The Piedmont Region, which includes Guilford County, has relatively low vulnerability compared to the state. • Nor'easters were not identified in the previous Guilford County hazard mitigation plan. • NCDC does not report any nor'easter activity for Guilford County. However, nor'easters may have affected the area as severe winter storms. In this case, the activity would be reported under winter storm events.
Storm Surge	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database	• Given the inland location of Guilford County, storm surge would not affect the area. • Storm surge is discussed in the NC State Hazard Mitigation Plan under the hurricane hazard and indicates that the Piedmont 3 Region has zero vulnerability to storm surge. • The previous Guilford County hazard mitigation plan did not address storm surge. • No historical events were reported by NCDC.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Thunderstorm (Wind and Lightning)	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan Review of NOAA NCDC Storm Events Database • Review of Vaisala's NLDN Lightning Flash Density Map	• Severe thunderstorm events were addressed in the previous Guilford County hazard mitigation plan. • NCDC reports 254 thunderstorm/high wind events in Guilford County since 1956. These events have resulted in 2 death, 2 injuries, and $2.0 million (2014 dollars) in property damage. • The central region of the Florida has the highest density of lightning strikes in the mainland U.S.; however, lightning events are experienced in nearly every region. • Lightning events are discussed in the NC State Hazard Mitigation Plan as part of the severe thunderstorm hazard. • Lightning is included in the previous Guilford County hazard mitigation plan. • NCDC reports 9 lightning events for Guilford County since 1997. These events have resulted in $2.5 million (2014 dollars) in property damage. • According to Vaisala's U.S. National Lightning Detection Network, Guilford County is located in an area that experienced an average of 3 to 4 lightning flashes per square kilometer per year between 1997 and 2010.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Tornado	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database • Review of historical presidential disaster declarations	• From 1953 to 1993, North Carolina averaged 10 to 25 tornadoes per year. • Tornado events are discussed in the NC State Hazard Mitigation Plan. The Piedmont Region, which includes Guilford County, has relatively low vulnerability but it is the highest vulnerability in the state. • Tornado events were addressed in the previous Guilford County hazard mitigation plan. • NCDC reports 13 tornado events in Guilford County since 1954. These events have resulted in 1 recorded death, 5 injuries, and $19.9 million (2014 dollars) in property damage with the most severe being an F3. • 1 of the county's 11 disaster declarations was directly related to tornadoes.
Tsunami	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of FEMA "How-to" mitigation planning guidance (Publication 386-2, "Understanding Your Risks – Identifying Hazards and Estimating Losses).	• No record exists of a catastrophic Atlantic basin tsunami impacting the mid-Atlantic coast of the United States. • Tsunami inundation zone maps are not available for communities located along the U.S. East Coast. • Tsunamis are discussed in the state plan and described as a "greater" hazard for the state. However, the Piedmont Region, which includes Guilford County, scored a zero for tsunami hazard risk. • The previous Guilford County hazard mitigation plan did not address tsunamis. • FEMA mitigation planning guidance suggests that locations along the U.S. East Coast have a relatively low tsunami risk and need not conduct a tsunami risk assessment at this time.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Volcano	NO	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of USGS Volcano Hazards Program website	• More than 65 potentially active volcanoes exist in the United States and most are located in Alaska. The Western states and Hawaii are also potentially affected by volcanic hazards. • There are no active volcanoes in North Carolina. • There has not been a volcanic eruption in North Carolina in over 1 million years. • No volcanoes are located near Guilford County.
Winter Storm and Freeze	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NC State Hazard Mitigation Plan • Review of the previous Guilford County hazard mitigation plan • Review of NOAA NCDC Storm Events Database • Review of historical presidential disaster declarations	• Winter storms affect every state in the continental U.S. and Alaska. • Severe winter storms, including snow storms and ice storms, are discussed in the NC State Hazard Mitigation Plan. They are listed as a high hazard in the Piedmont 3 Region, which includes Guilford County. • Winter snow and ice storm events were addressed in the previous Guilford County hazard mitigation plan. • NCDC reports that Guilford County has been affected by 54 snow and ice events since 1996. These events resulted in $8.2 million (2014dollars) in damages but did not cause any deaths or injuries in Guilford County. • 6 of the county's 11 disaster declarations were directly related to winter storm events.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
BIOLOGICAL HAZARDS			
Bioterrorism	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include bioterrorism; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • There have been no major bioterrorism events in the county, however, these kinds of events are often unpredictable and Guilford County could be affected.
Public Health/Emerging Disease Threat	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include public health/emerging disease threat; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Public health emergencies are often unpredictable and can ramp up quickly depending on how quickly they are recognized. These threats will potentially impact the county in the future.
TECHNOLOGICAL HAZARDS			
Building/Structure Collapse	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include building/structure collapse; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Building/structure collapse is a hazard that often happens on a very localized level, but the impacts can be severe and could potentially occur anywhere.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Communications Systems Disruption/Failure	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include communications systems disruption/failure; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Communications systems disruptions can happen in any location throughout the United States and throughout the county. These will likely occur in the future.
Energy/Power/Utility Failure	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include energy/power/utility failure; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Energy/Power/Utility failures occur frequently in the county, especially during winter storms or high wind events. These will continue to impact the county going forward.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Hazardous Materials Incident	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Review EPA Toxic Release Inventory (TRI) • Review of USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA) incident database	• Cities, counties, and towns where hazardous materials fabrication, processing, and storage sites are located, and those where hazardous waste treatment, storage or disposal facilities operate are at risk for hazardous materials events. • The previous Guilford County hazard mitigation plan did not include hazardous materials incidents; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • 187 TRI facilities are located in Guilford County. • 40 of the 2,220 PHMSA-reported HAZMAT incidents in the county were classified as "serious" incidents. In total, these incidents have resulted in 1 death, 28 injuries, and over $12,000 (2014 dollars) in property damages.
Nuclear Power Plant Emergency	YES	• Review of IAEA data on the location of nuclear reactors • Review of the Guilford County HIRA • Discussion with local officials about location of nuclear power stations • Discussions with local officials	• The Shearon Harris Nuclear Power Plant is located within 50 miles of the southeastern corner of Guilford County. • The previous Guilford County hazard mitigation plan did not include nuclear power plant emergency; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • A nuclear accident is unlikely to occur, but could cause severe damage in the event of a major incident.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
Pipeline Failure	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include pipeline failure; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • There have been three pipeline failures that occurred within the county, two in 1978 on a line leading eastward from Greensboro's tank farm and one caused by digging near Lake Brandt in 1987.
Resource Shortage (Water/Fuel)	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include resource shortage; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Resource shortages of both fuel and water have occurred in the county in the past and are likely to occur again in the future.
Transportation Incident	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include transportation incident; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Given the number of transportation corridors and hubs located within Guilford County, it is highly likely that more transportation incidents will occur in the future.

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
MAN-MADE/INTENTIONAL HAZARDS			
Civil Disturbance	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include civil disturbance; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Although there have not been any major civil disturbances in the county in many years, there is some possibility that this could impact the county in the future.
Cyberterrorism	YES	• Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of the Guilford County HIRA • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include cyberterrorism; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • Cyberterrorism is a threat that can occur without regard to specific location, so it was evaluated in this plan.
Terrorism	YES	• Review of the Guilford County HIRA • Review of local official knowledge • Discussions with local officials	• The previous Guilford County hazard mitigation plan did not include terrorism; however, it is a hazard addressed in the County's Hazard Identification and Risk Assessment document. • There are several high profiles targets in the area that caused the planning team to determine that the hazard should be evaluated further.

4.5 HAZARD IDENTIFICATION RESULTS

TABLE 4.4: SUMMARY RESULTS OF THE HAZARD IDENTIFICATION AND EVALUATION PROCESS

NATURAL HAZARDS	BIOLOGICAL HAZARDS
☐ Avalanche	☑ Bioterrorism
☐ Dam and Levee Failure	☑ Public Health/Emerging Disease Threat
☑ Drought	**TECHNOLOGICAL HAZARDS**
☑ Earthquake	☑ Building/Structure Collapse
☐ Erosion	☑ Communications Systems Disruption/Failure
☐ Expansive Soils	☑ Energy/Power/Utility Failure
☑ Extreme Cold	☑ Hazardous Materials Incident
☑ Extreme Heat	☑ Nuclear Power Plant Emergency
☑ Fire	☑ Pipeline Failure
☑ Flooding	☑ Resource Shortage (Water/Fuel)
☑ Hail	☑ Transportation Incident
☑ Hurricane/Other Tropical Disturbance	**MAN-MADE/INTENTIONAL HAZARDS**
☐ Landslide	☑ Civil Disturbance
☐ Land Subsidence	☑ Cyberterrorism
☐ Nor'easter	☑ Terrorism
☐ Storm Surge	
☑ Thunderstorm (Wind and Lightning)	
☑ Tornado	
☐ Tsunami	
☐ Volcano	
☑ Winter Storm	

☑ = Hazard considered significant enough for further evaluation in the Guilford County hazard risk assessment.

SECTION 5
HAZARD PROFILES

This section includes detailed hazard profiles for each of the hazards identified in the previous section (*Hazard Identification*) as significant enough for further evaluation in the Guilford County Hazard Mitigation Plan. It contains the following subsections:

Overview

- 5.1 Overview
- 5.2 Study Area
- 5.3 Climate Adaptation

Natural Hazards

- 5.4 Drought
- 5.5 Earthquake
- 5.6 Extreme Cold
- 5.7 Extreme Heat
- 5.8 Fire
- 5.9 Flooding
- 5.10 Hail
- 5.11 Hurricane / Other Tropical Disturbance
- 5.12 Thunderstorm (Wind and Lightning)
- 5.13 Tornado
- 5.14 Winter Storm

Biological Hazards

- 5.15 Bioterrorism
- 5.16 Public Health / Emerging Disease Threat

Technological Hazards

- 5.17 Building / Structure Collapse
- 5.18 Communications Systems Disruption / Failure
- 5.19 Energy / Power / Utility Failure
- 5.20 Hazardous Materials Incident
- 5.21 Nuclear Power Plant Emergency
- 5.22 Pipeline Failure
- 5.23 Resource Shortage (Water / Fuel)
- 5.24 Transportation Incident

Man-Made / Intentional Hazards

- 5.25 Civil Disturbance
- 5.26 Cyberterrorism
- 5.27 Terrorism

Conclusion

- 5.28 Conclusions on Hazard Risk
- 5.29 Final Determinations

44 CFR Requirement
44 CFR Part 201.6(c)(2)(i): The risk assessment shall include a description of the type, 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

Overview

5.1 OVERVIEW

This section includes detailed hazard profiles for each of the hazards identified in the previous section (*Hazard Identification*) as significant enough for further evaluation in Guilford County hazard risk assessment by creating a hazard profile. Each hazard profile includes a general description of the

hazard, its location and extent, notable historical occurrences, and the probability of future occurrences. Each profile also includes specific items noted by members of the Guilford County Hazard Mitigation Planning Team as it relates to unique historical or anecdotal hazard information for Guilford County or a participating municipality within it.

The following hazards were identified:

- **Natural**
  - Drought
  - Extreme Cold
  - Extreme Heat
  - Fire
  - Flooding
  - Hail
  - Hurricane / Other Tropical Disturbance
  - Thunderstorm (wind and lightning)
  - Tornado
  - Winter Storm
- **Biological**
  - Bioterrorism
  - Public Health / Emergency Disease Threat
- **Technological**
  - Building / Structure Collapse
  - Communications Systems Disruption / Failure
  - Energy / Power / Utility Failure
  - Hazardous Materials Incident
  - Nuclear Power Plant Emergency
  - Pipeline Failure
  - Resource Shortage (Water / Fuel)
  - Transportation Incident
- **Man-Made / Intentional**
  - Civil Disturbance
  - Cyberterrorism
  - Terrorism

5.2 STUDY AREA

Guilford County includes 10 municipalities: Gibsonville, Greensboro, High Point, Jamestown, Oak Ridge, Pleasant Garden, Sedalia, Stokesdale, Summerfield, and Whitsett. **Table 5.1** provides a summary table of the participating jurisdictions. In addition, **Figure 5.1** provides a base map, for reference, of Guilford County.

TABLE 5.1: PARTICIPATING JURISDICTIONS IN THE GUILFORD COUNTY HAZARD MITIGATION PLAN

Guilford County	
Gibsonville	Pleasant Garden
Greensboro	Sedalia
High Point	Stokesdale
Jamestown	Summerfield
Oak Ridge	Whitsett

FIGURE 5.1: GUILFORD COUNTY BASE MAP

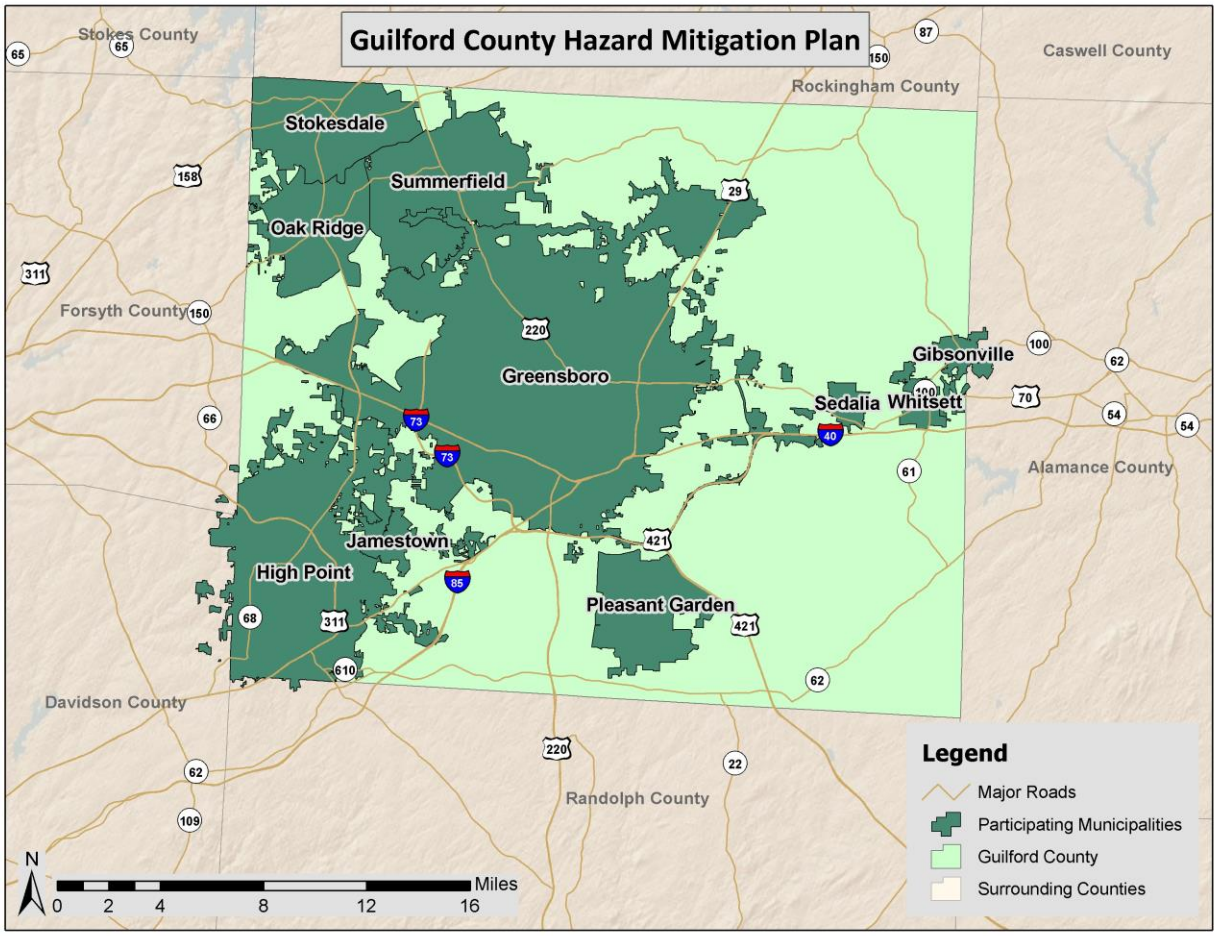


Table 5.2 lists each significant hazard for Guilford County and identifies whether or not it has been determined to be a specific hazard of concern for the 10 municipal jurisdictions and the county's unincorporated areas. This is the based on the best available data and information from the Guilford County Hazard Mitigation Planning Team. (● = hazard of concern)

TABLE 5.2 SUMMARY OF IDENTIFIED HAZARD EVENTS IN GUILFORD COUNTY

Jurisdiction	Natural												Biological	
	Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding	Hail	Hurricane / Other Tropical Disturbance	Thunderstorm – Wind	Thunderstorm – Lightning	Tornado	Winter Storm	Bioterrorism	Public Health / Emerging Disease Threat
Guilford County														
Gibsonville	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Greensboro	●	●	●	●	●	●	●	●	●	●	●	●	●	●
High Point	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Jamestown	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Oak Ridge	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pleasant Garden	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Sedalia	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Stokesdale	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Summerfield	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Whitsett	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Unincorporated Area	●	●	●	●	●	●	●	●	●	●	●	●	●	●

TABLE 5.2 SUMMARY OF IDENTIFIED HAZARD EVENTS IN GUILFORD COUNTY (CONTINUED)

Jurisdiction	Technological							Man-Made		
	Building / Structure Collapse	Communications Systems Disruption / Failure	Energy / Power/ Utility Failure	Hazardous Materials Incident	Nuclear Power Plant Emergency	Resource Shortage (Water / Fuel)	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Guilford County										
Gibsonville	●	●	●	●	●	●	●	●	●	●
Greensboro	●	●	●	●	●	●	●	●	●	●
High Point	●	●	●	●		●	●	●	●	●
Jamestown	●	●	●	●		●	●	●	●	●
Oak Ridge	●	●	●	●		●	●	●	●	●
Pleasant Garden	●	●	●	●	●	●	●	●	●	●
Sedalia	●	●	●	●	●	●	●	●	●	●
Stokesdale	●	●	●	●		●	●	●	●	●
Summerfield	●	●	●	●		●	●	●	●	●
Whitsett	●	●	●	●	●	●	●	●	●	●
Unincorporated Area	●	●	●	●	●	●	●	●	●	●

5.3 CLIMATE ADAPTATION

The *Piedmont Together Climate Adaptation Report* is a climate adaptability report that has been developed for the Piedmont Triad Region (including Guilford County) and is based upon a wealth of

information and data analysis.[1] Much of the data indicates that the primary factor in altering the global climate is greenhouse gas emissions from human activities. Guilford County appears to be fundamentally changing due to climate change which has resulted in more violent thunderstorms, higher temperatures, increased drought risk, greater winter precipitation, and more intense hurricanes. These changes are expected to continue in the foreseeable future for the county and the region. Primary public health concerns as a result of climate change impacts in the Piedmont Triad include impacts of the urban heat island effect upon city residents and outdoor workers, impacts to rural workers (primarily farmworkers), health of elderly in both rural an urban communities, and impacts to local ecosystems.

Compared to other regions of the nation and world, the impacts of climate change on Guilford County may less dramatically alter lifestyles and the environment from today's "normal," but there will be fundamental changes to the Piedmont Triad which are discussed (where applicable) in the hazard profiles found in this section.

Natural Hazards

5.4 DROUGHT

5.4.1 Background

Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. High temperatures, high winds, and low humidity can exacerbate drought conditions. In addition, human actions and demands for water resources can hasten drought-related impacts. Drought may also lead to more severe wildfires.

Droughts are typically classified into one of four types: 1) meteorological, 2) hydrologic, 3) agricultural, or 4) socioeconomic. **Table 5.3** presents definitions for these types of drought.

TABLE 5.3 DROUGHT CLASSIFICATION DEFINITIONS

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

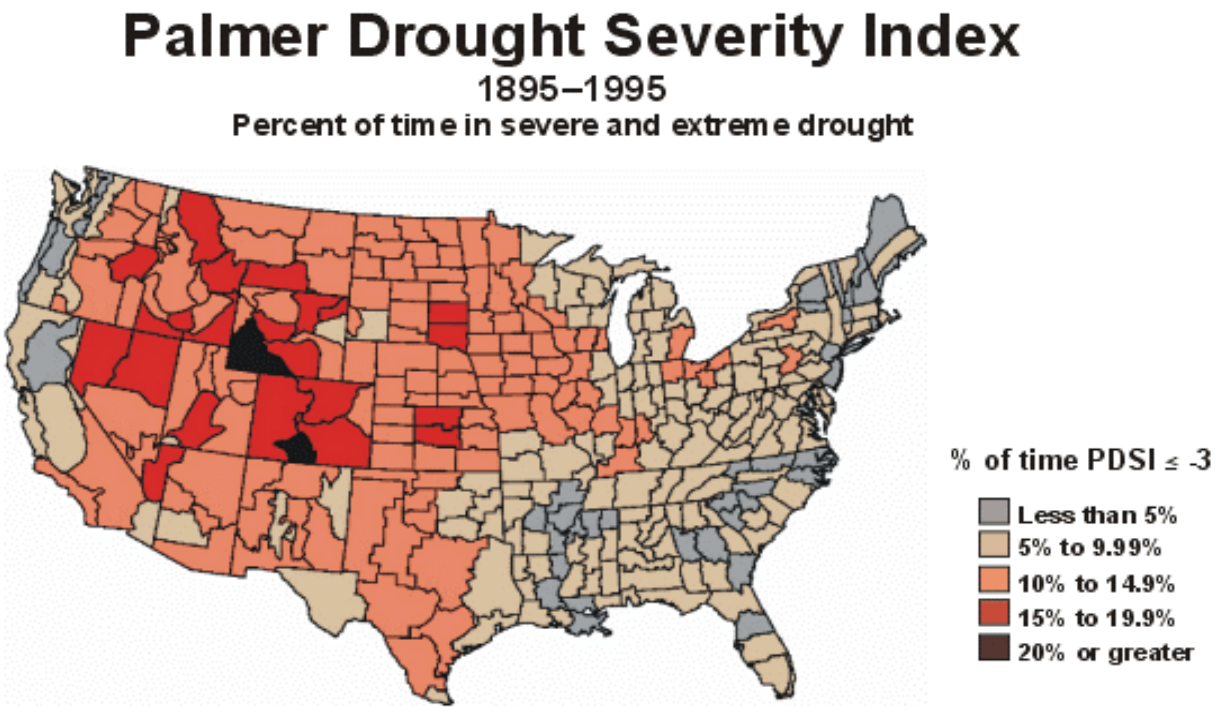
Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

Droughts are slow-onset hazards, but, over time, can have very damaging affects to crops, municipal water supplies, recreational uses, and wildlife. If drought conditions extend over a number of years, the direct and indirect economic impact can be significant.

[1] http://piedmonttogether.org/report/climate-adaptation-report

The Palmer Drought Severity Index (PDSI) is based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). Evident in **Figure 5.2**, the Palmer Drought Severity Index Summary Map for the United Stated, drought affects most areas of the United States, but is less severe in the Eastern United States.

FIGURE 5.2: PALMER DROUGHT SEVERITY INDEX SUMMARY MAP FOR THE UNITED STATES



Source: National Drought Mitigation Center

5.4.2 Location and Spatial Extent

Drought typically covers a large area and cannot be confined to any geographic or political boundaries. According to the Palmer Drought Severity Index, North Central North Carolina has a relatively low risk for drought hazard. However, local areas may experience much more severe and/or frequent drought events than what is represented on the Palmer Drought Severity Index map. Furthermore, it is assumed that Guilford County would be uniformly exposed to drought, making the spatial extent potentially widespread. It is also notable that drought conditions typically do not cause significant damage to the built environment.

5.4.3 Historical Occurrences

The North Carolina State Climate Office was used to ascertain historical drought events in Guilford County. The North Carolina State Climate Office reports PDSI data for North Carolina from 2000 to 2013. It classifies drought conditions by region on a scale of -6.00 to 6.00 where:

- 4.00 and above: Extremely Moist
- 3.00 to 3.99: Very Moist

- 2.00 to 2.99: Moderately Moist
- -1.99 to 1.99: Mid-Range
- -2.00 to -2.99: Moderate Drought
- -3.00 to -3.99: Severe Drought
- -4.00 and below: Extreme Drought

According to the North Carolina State Climate Office, Guilford County experienced moderate to extreme drought occurrences in 8 of the last 14 years (2000-2013). **Table 5.4** shows the most severe drought condition reported for each year in Guilford County, according to PDSI classifications. However, it should be noted that the most severe classification reported is based on monthly regional averages, and conditions in Guilford County may actually have been less or more severe than what is reported.

TABLE 5.4: HISTORICAL DROUGHT OCCURRENCES IN GUILFORD COUNTY

	Guilford County	
2000	**-0.40**	Mid-range
2001	**-3.25**	**Severe Drought**
2002	**-4.48**	**Extreme Drought**
2003	**-0.36**	Mid-range
2004	**-2.01**	**Moderate Drought**
2005	**-1.77**	Mid-range
2006	**-2.07**	**Moderate Drought**
2007	**-4.06**	**Extreme Drought**
2008	**-3.97**	**Severe Drought**
2009	**-1.15**	Mid-range
2010	**-1.86**	Mid-range
2011	**-2.86**	**Moderate Drought**
2012	**-2.19**	**Moderate Drought**
2013	**-0.25**	Mid-range

Source: North Carolina State Climate Office

Data from the National Climatic Data Center (NCDC) was also reviewed to obtain additional information on historical drought events in the county, but no events were reported in Guilford County. However, according to the *Piedmont Together Climate Adaptation Report*, 2012 was the year in which 64% of the continental U.S. experienced drought that directly led to over 100 deaths. Additionally, the report found that in the 2007-2008 drought, North Carolina recorded heat stress levels of almost 16 hospitalizations per 100,000 people and almost 13 deaths per 10,000, with 84% of these hospitalizations occurring between June and August.

5.4.4 Probability of Future Occurrences

Based on historical occurrence information, it is assumed that all of Guilford County has a probability level of likely (10 to 100 percent annual probability) for future drought events. This hazard may vary

slightly by location but each area has an equal probability of experiencing a drought. However, historical information also indicates that there is a much lower probability for extreme, long-lasting drought conditions. Additionally, according to the *Piedmont Together Climate Adaptation Report*, the increased likelihood of drought due to climate change will result in greater agricultural losses and more water supply shortages in the county.

5.4.5 Consequence Analysis

People (The Public and Public Confidence)

Drought can have a detrimental effect on the livelihood of farmers and agricultural producers in Guilford County. Efforts to mitigate against drought, such as using irrigation equipment, have a high initial cost, including the need for an increase in management requirements, cost of operation and maintenance, and the lack of good quality water resources—which during times of drought would be severely affected. Public confidence would likely not be impacted severely.

Responders

Although drought would have many of the same impacts on responders as it would on the public, the overall effects would be relatively limited when compared to other hazards.

Continuity of Operations

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.

Built Environment (Property, Facilities, and Infrastructure)

Water Use

Drought has the potential to affect Guilford County's water supply for residential, commercial, institutional, industrial, and government-owned areas. Drought can reduce water supply in wells and reservoirs. When drought conditions persist with no relief, local or State governments often institute water restrictions.

Irrigation

Drought would affect irrigation and outdoor landscaping efforts around residential, commercial, institutional, industrial, and government-owned land. Water conservation strategies can limit the amount of water used to maintain the aesthetic environment around buildings, businesses, and areas such as golf courses. This would include automatic and non-automatic spray irrigation systems, hose-end sprinklers, handheld hoses, bucket watering, drip irrigation, athletic field irrigation, swimming pools, car washing, pressure washing, and reuse water.

Economy

Drought can have a detrimental effect on agricultural and agribusiness industry sectors which account for more than one-fifth of North Carolina's income and employees.[2] Extreme drought has the potential to depress local businesses and industries such as landscaping, recreation and tourism, and public utilities. Nursery and landscape businesses can also face significant losses from a drought. Losses include reduction of output and sales of nursery crops, reduction in plant sales, and an increase in watering

[2] North Carolina State University College of Agriculture and Life Sciences. (2003). *Agriculture and agribusiness in Wake County*. Retrieved May 7, 2012, from http://www.cals.ncsu.edu/cfprod/apps/calswebsite/documents/County/wake.pdf

costs. This can lead to the closing of many business locations, lay-off of employees, and increases in bankruptcy filing.

Environment

Agriculture

The agriculture sector of Guilford County is particularly susceptible to drought damage. **Table 5.5** shows there are 963 farms in Guilford County, with 96,519 acres of 413,565 acres total being farmland.[3] Agricultural drought has the potential to directly affect much of the land in Guilford County. Agricultural areas at particular risk are cropland and pastures.

TABLE 5.5: GUILFORD COUNTY FARMLAND OVERVIEW

Census of Agriculture (2007)	
Total Acres in County	413,565
Number of Farms	963
Total Land in Farms, Acres	96,519
Average Farm Size, Acres	100

Crops

Prolonged periods of dry weather are the most difficult and damaging problem faced by crop growers and agricultural suppliers. Guilford County has 34,986 acres (8.45 percent) of harvested cropland.

Short- or long-term moisture deficits—even with the use of irrigation methods—during critical stages of crop development can severely reduce yields, with the amount of yield lost depending on when the drought occurs (see **Table 5.6** for a list of Guilford County crop specific information), the growth stage of the crop, the severity of dry conditions, and the amount of available water that the soil can hold.

TABLE 5.6: GUILFORD COUNTY CROP INFORMATION

Crops	Acres Harvested	Rank[4]
Corn for Grain	4,100	52
Wheat for grain, all	4,600	46
Hay, Other	14,300	14
Soybeans	9,100	50

Livestock[5]

Table 5.7 shows the type of livestock in Guilford County, including the the quantity of livestock and the county's rank compared to other counties in the state. These are at risk for being affected by drought conditions in the county.

Livestock losses from drought will most likely be confined to forage-based production systems. Losses in beef and dairy systems will potentially be of a single-season or multiyear variety. Single-season losses will include lost forage production (on both hay and grazing land), reduced weaning weights, reduced milk production, and increased mortality.

[3] Guilford *County: Census of agriculture—2007*. Retrieved May 7, 2012, from http://www.ncagr.gov/stats/codata/guilford.pdf
[4] Rank in production among North Carolina counties
[5] North Carolina Division of Water Resources. (2009). *The water connection: Water resources, drought and the hydrologic cycle in North Carolina*. Retrieved May 7, 2012, from http://www.ncwater.org/Reports_and_Publications/primer/The_Water_Connection_Booklet_9x12_150dpi.pdf

Multiyear losses could include the cost of reestablishing pastures and reduced meat or milk production in subsequent years due to forced sales in the drought year. In addition, drought conditions could result in poor pasture conditions, reduced drinking water supplies, and a critical hay shortage that directly affects livestock and poultry health.

TABLE 5.7: GUILFORD COUNTY LIVESTOCK (2012)

Livestock	Number	Rank[6]
Cattle and calves inventory	13,200	21
Beef cows	4,900	25
Milk cows	1,400	9
Hogs and pigs	3,000	49
Layers inventory	35,000	39
Broilers and other meat-type chickens sold	370,000	56

Environmental Degradation
Drought may also lead to pollution of water sources as a result of lack of rain water to dilute industrial and agricultural chemical runoff. This poses a risk to plants and animals and makes it difficult to maintain a clean drinking water supply.

Lack of water reaching the soil may also cause the ground to become dry and unstable. Erosion can increase and loss of topsoil can be severe if a high-intensity rain falls on ground lacking a ground cover of plants. As a result of these environmental impacts, habitats may be degraded through a loss of wetlands, lake capacity, and vegetation.

5.5 EARTHQUAKE

5.5.1 Background

An earthquake is movement or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site, and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses the ability to resist shear and flows much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

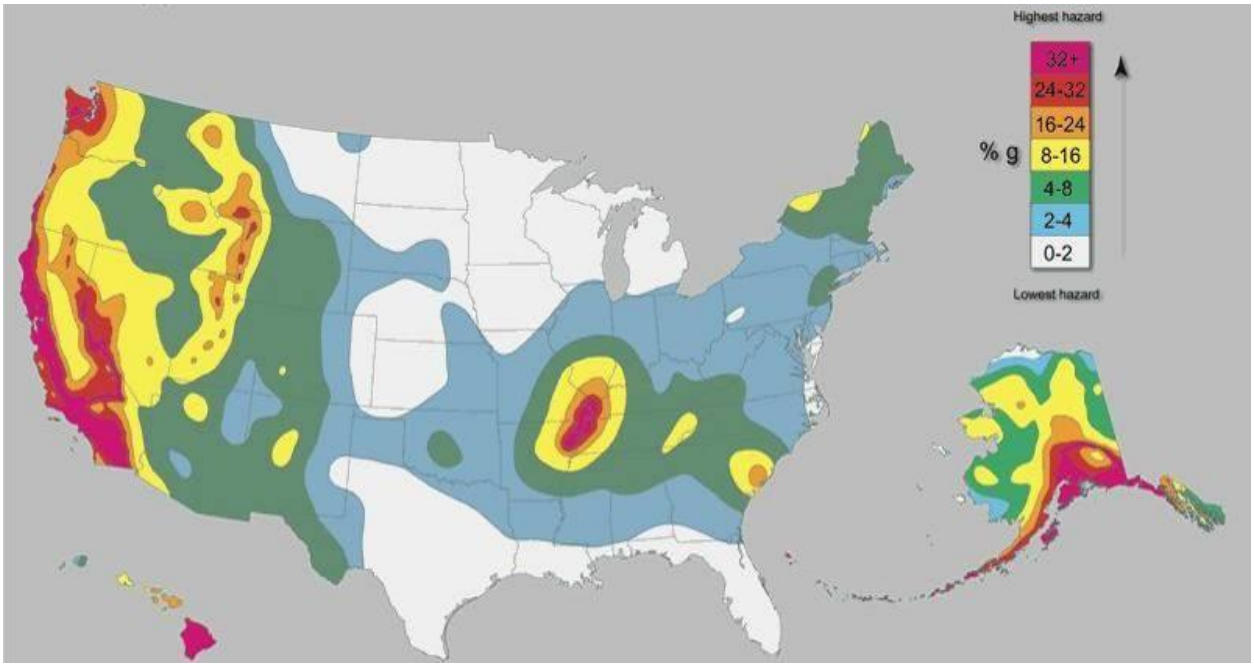
Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along

[6] Rank in production among North Carolina counties

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.

The greatest earthquake threat in the United States is along tectonic plate boundaries and seismic fault lines located in the central and western states; however, the Eastern United State does face moderate risk to less frequent, less intense earthquake events. **Figure 5.3** shows relative seismic risk for the United States.

FIGURE 5.3: UNITED STATES EARTHQUAKE HAZARD MAP



Source: United States Geological Survey

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (**Table 5.8**). Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, ranging from "I" corresponding to imperceptible (instrumental) events to "XII" for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in **Table 5.9**.

TABLE 5.8: RICHTER SCALE

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

Source: Federal Emergency Management Agency

TABLE 5.9: MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES

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

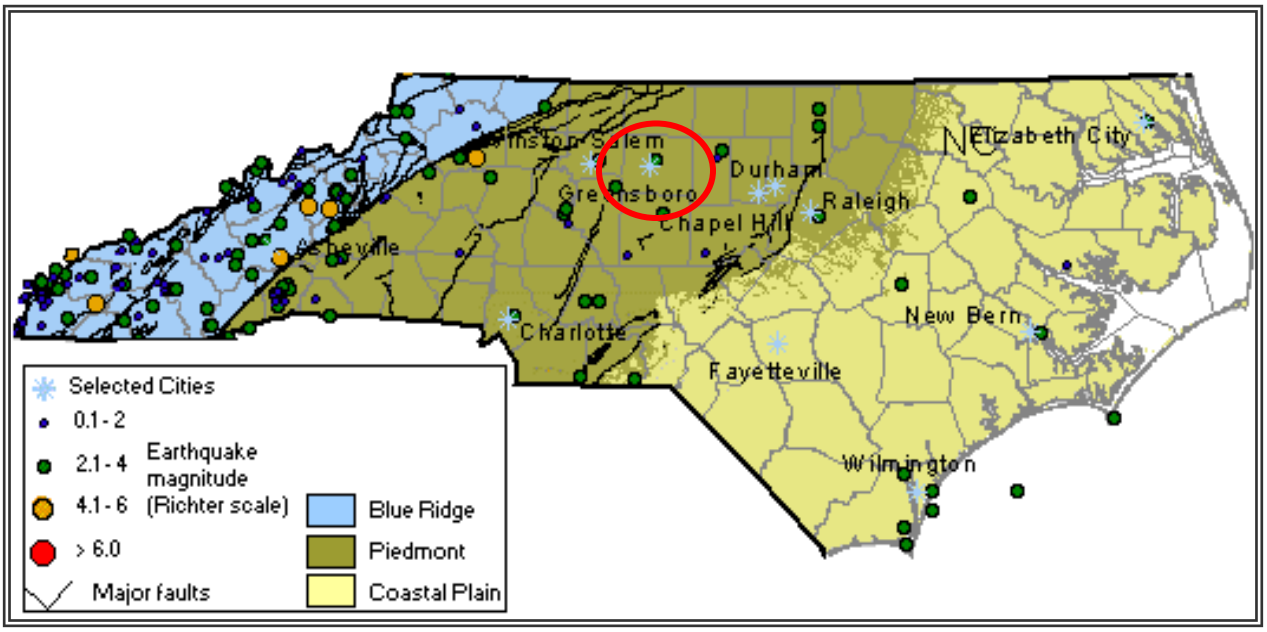
Source: Federal Emergency Management Agency

5.5.2 Location and Spatial Extent

Approximately two-thirds of North Carolina is subject to earthquakes, with the western and southeast region most vulnerable to a very damaging earthquake. The state is affected by both the Charleston Fault in South Carolina and New Madrid Fault in Tennessee. Both of these faults have generated earthquakes measuring greater than 8 on the Richter Scale during the last 200 years. In addition, there

are several smaller fault lines throughout North Carolina. **Figure 5.4** is a map showing geological and seismic information for North Carolina.

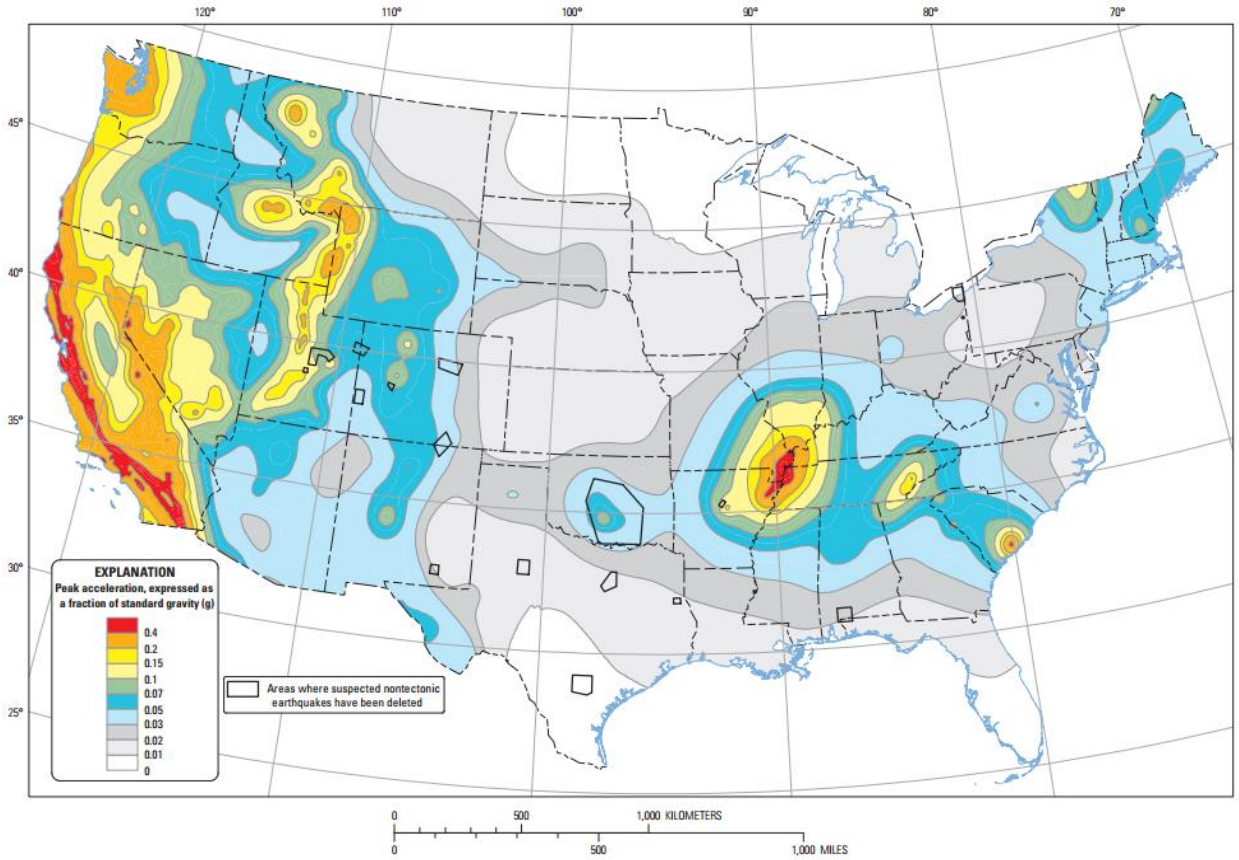
FIGURE 5.4: GEOLOGICAL AND SEISMIC INFORMATION FOR NORTH CAROLINA



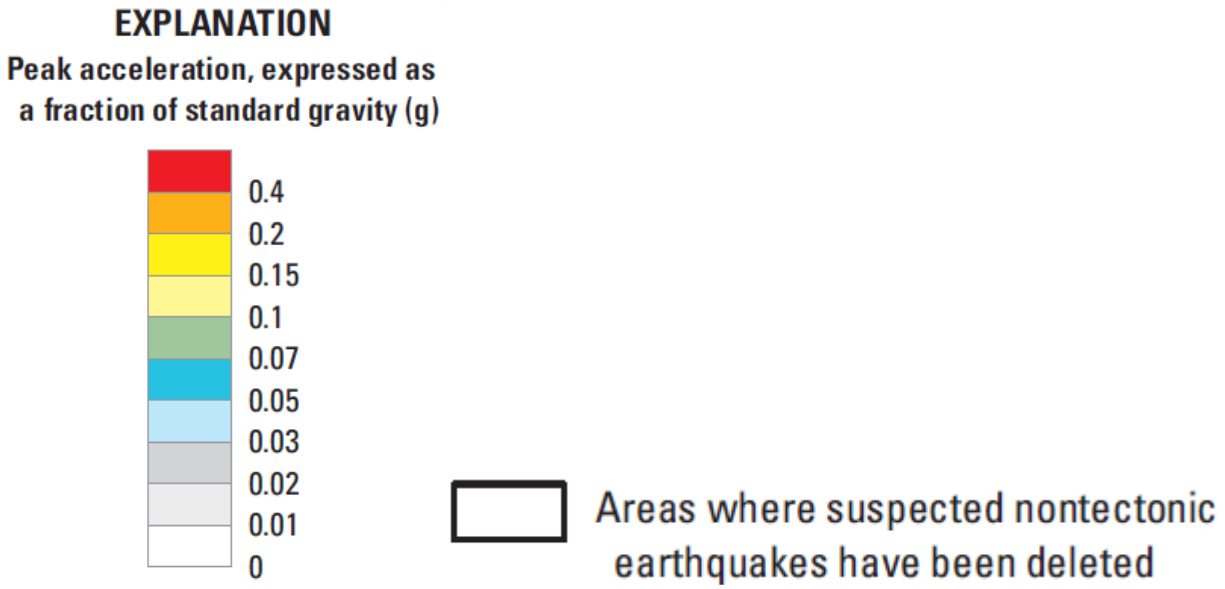
Source: North Carolina Geological Survey

Figure 5.5 shows the intensity level associated with Guilford County, based on the national USGS map of peak acceleration with 10 percent probability of exceedance in 50 years. It is the probability that ground motion will reach a certain level during an earthquake. The data show peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 10 percent probability of exceedance in 50 years. The map was compiled by the U.S. Geological Survey (USGS) Geologic Hazards Team, which conducts global investigations of earthquake, geomagnetic, and landslide hazards. According to this map, Guilford County lies within an approximate zone of 0.02 to 0.05 peak ground acceleration. This indicates that the county as a whole exists within an area of low to moderate seismic risk.

FIGURE 5.5: PEAK ACCELERATION WITH 10 PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS



Ten-percent probability of exceedance in 50 years map of peak ground acceleration



Source: United States Geological Survey, 2014

5.5.3 Historical Occurrences

At least five earthquakes are known to have affected Guilford County since 1852. The strongest of these measured a IV on the Modified Mercalli Intensity (MMI) scale. **Table 5.10** provides a summary of earthquake events reported by the National Geophysical Data Center between 1638 and 1985. **Table 5.11** presents a detailed occurrence of each event including the date, distance from the epicenter, magnitude, and Modified Mercalli Intensity (if known).[7]

TABLE 5.10: SUMMARY OF SEISMIC ACTIVITY IN GUILFORD COUNTY

Location	Number of Occurrences	Greatest MMI Reported	Richter Scale Equivalent
Gibsonville	0	--	--
Greensboro	5	IV	4.3
High Point	0	--	--
Jamestown	0	--	--
Oak Ridge	0	--	--
Pleasant Garden	0	--	--
Sedalia	0	--	--
Stokesdale	0	--	--
Summerfield	0	--	--
Whitsett	0	--	--
Unincorporated Area	0	--	--
GUILFORD COUNTY TOTAL	**5**	**IV**	**4.3**

Source: National Geophysical Data Center

TABLE 5.11: SIGNIFICANT SEISMIC EVENTS IN GUILFORD COUNTY (1638-1985)

Location	Date	Epicentral Distance	Magnitude	MMI
Gibsonville				
None Reported	--	--	--	--
Greensboro				
Greensboro	4/29/1852	--	--	III
Greensboro	12/23/1875	205.0	--	IV
Greensboro	2/21/1916	252.0	--	III
Greensboro	3/12/1960	348.0	--	IV
Greensboro	11/20/1969	183.0	4.3	IV
High Point				
None Reported	--	--	--	--
Jamestown				
None Reported	--	--	--	--
Oak Ridge				
None Reported	--	--	--	--

[7] Due to reporting mechanisms, not all earthquakes events were recorded during this time. Furthermore, some are missing data, such as the epicenter location, due to a lack of widely used technology. In these instances, a value of "unknown" is reported.

Location	Date	Epicentral Distance	Magnitude	MMI
Pleasant Garden				
None Reported	--	--	--	--
Sedalia				
None Reported	--	--	--	--
Stokesdale				
None Reported	--	--	--	--
Summerfield				
None Reported	--	--	--	--
Whitsett				
None Reported	--	--	--	--
Unincorporated Area				
None Reported	--	--	--	--

Source: National Geophysical Data Center

In addition to those earthquakes specifically affecting Guilford County, a list of earthquakes that have caused damage throughout North Carolina is presented below in **Table 5.12.**

TABLE 5.12: EARTHQUAKES WHICH HAVE CAUSED DAMAGE IN NORTH CAROLINA

Date	Location	Richter Scale (Magnitude)	MMI (Intensity)	MMI in North Carolina
12/16/1811 - 1	NE Arkansas	8.5	XI	VI
12/16/1811 - 2	NE Arkansas	8.0	X	VI
12/18/1811 - 3	NE Arkansas	8.0	X	VI
01/23/1812	New Madrid, MO	8.4	XI	VI
02/071812	New Madrid, MO	8.7	XII	VI
04/29/1852 *	Wytheville, VA	5.0	VI	VI
08/31/1861	Wilkesboro, NC	5.1	VII	VII
12/23/1875 *	Central Virginia	5.0	VII	VI
08/31/1886	Charleston, SC	7.3	X	VII
05/31/1897	Giles County, VA	5.8	VIII	VI
01/01/1913	Union County, SC	4.8	VII	VI
02/21/1916 *	Asheville, NC	5.5	VII	VII
07/08/1926	Mitchell County, NC	5.2	VII	VII
11/03/1928	Newport, TN	4.5	VI	VI
05/13/1957	McDowell County, NC	4.1	VI	VI
07/02/1957	Buncombe County, NC	3.7	VI	VI
11/24/1957	Jackson County, NC	4.0	VI	VI
10/27/1959 **	Chesterfield, SC	4.0	VI	VI
07/13/1971	Newry, SC	3.8	VI	VI
11/30/1973	Alcoa, TN	4.6	VI	VI
11/13/1976	Southwest Virginia	4.1	VI	VI
05/05/1981	Henderson County, NC	3.5	VI	VI

*This event is accounted for in the Guilford County occurrences.

** Conflicting reports on this event, intensity in North Carolina could have been either V or VI

Source: This information compiled by Dr. Kenneth B. Taylor and provided by Tiawana Ramsey of NCEM. Information was compiled from the National Earthquake Center, Earthquakes of the US by Carl von Hake (1983), and a compilation of newspaper reports in the Eastern Tennessee Seismic Zone compiled by Arch Johnston, CERI, Memphis State University (1983).

5.5.4 Probability of Future Occurrences

The probability of significant, damaging earthquake events affecting Guilford County is unlikely. However, it is possible that future earthquakes resulting in light to moderate perceived shaking and damages ranging from none to very light will affect the county. The annual probability level for the county is estimated between 1 and 10 percent (possible).

5.5.5 Consequence Analysis

People (The Public and Public Confidence)

Earthquakes in Guilford County generally are not high impact events that cause injury or death as most are moderate. The public typically experiences some shaking in these events and the greatest threat to health and well-being is often from objects falling from shelves. Public confidence would likely not be affected in the event of an earthquake.

Responders

There would be little impact on responders in the event of an earthquake, again, because Guilford County is only likely to experience a moderate earthquake magnitude at a maximum. Since there would be very little damage to infrastructure, responders would likely not be impacted in their ability to respond to an earthquake.

Continuity of Operations

During and after an earthquake, continuity of operations could relatively easily be maintained and there would likely be little disruption to services or operations.

Built Environment (Property, Facilities, and Infrastructure)

Ground shaking is the primary cause of damage to the built environment during an earthquake. There are three important variables that determine the amount of damage: the intensity of the quake, local soil characteristics, and the quality of the impacted structures. The amount of damaged caused by an earthquake is strongly influenced by soil characteristics. The velocity at which the rock or soil transmits shear waves is the main contributor to ground shaking. Shaking is increased by soft, thick, or wet soil types.

Certain building types are particularly vulnerable to earthquake damage: wood-frame multi-unit buildings, single-family homes, mobile homes, and unreinforced masonry buildings.[8] The most susceptible structures are wood-frame, multi-story, mixed-use buildings that have large openings on the first floor for garages or commercial space and housing on the upper floors. During an earthquake, these types of structures could sway or even collapse. According to HAZUS-MH, there are approximately 132,858 buildings within the county that are built of wood, which is approximately 77 percent of the total building stock.

Single-family homes built prior to the 1970s are often not bolted to their foundations, and walls surrounding crawl spaces are not braced (i.e., cripple walls). Typical earthquake damage to these

[8] Association of Bay Area Governments. (2012). *Guide to housing vulnerable resources*. Retrieved March 11, 2012, from http://quake.abag.ca.gov/housing/

structures include cracked foundations, chimneys breaking at the roof line, wood frames coming off their foundations, and racking of cripple walls.

Mobile homes that are built of light-weight metal or a combination of steel frame and wood are easily damaged by a quake. Mobile homes installed prior to 1995 were often not attached to their foundations and could shift off their supports. Based on data from HAZUS-MH, the county contains 6,883 manufactured homes, which make up approximately 4.0 percent of the county's building stock.

The last type of susceptible building material is unreinforced masonry—masonry walls that have not been reinforced with steel. These buildings were often built before 1960 in an era when reinforcing was not generally used, anchorage to floors and roofs was missing, and use of low-strength lime mortar was common. Earthquake damage to these buildings can be severe. A lack of reinforcement and tie-downs can result in substantial damage in the form of cracked or leaning walls. Damage may also occur between the walls, and separation between the framing and walls could lead to full collapse due to a lack of vertical support. HAZUS-MH reports a total of 3,374 masonry buildings within the county (2.0 percent), but the number of unreinforced buildings is unknown.

Critical Infrastructure and Key Resources
Critical infrastructure and key resources within Guilford County include assets, systems, and networks that are vital to the continued operation of government services. The incapacitation or destruction of these resources would have a debilitating effect on the county's security, economy, and/or public health. There are a handful of key resource categories that could be impacted by an earthquake including transportation systems, communication systems, and utility systems. Historically, the county has not been impacted by an earthquake with more than a moderate intensity so damage to these resources would be very minor; however, an inspection of certain features after a strongly felt earthquake may be necessary.

Economy
There are three sources of economic loss associated with an earthquake: property damage and business interruption costs; cost to repair public transportation, communication, or utility systems; and debris removal costs. Historically, there have been no economic losses from earthquakes felt within the county.

Environment
There would be no substantial impacts to the environment following a large earthquake that is felt in Guilford County with a moderate intensity. Secondary effects from the damage of the key resources mentioned above (e.g., utility systems) could impact the environment, but the probability of this type of situation is very small. There is no doubt that a ruptured pipeline would release dangerous materials that could damage the surrounding environment.

5.6 EXTREME COLD

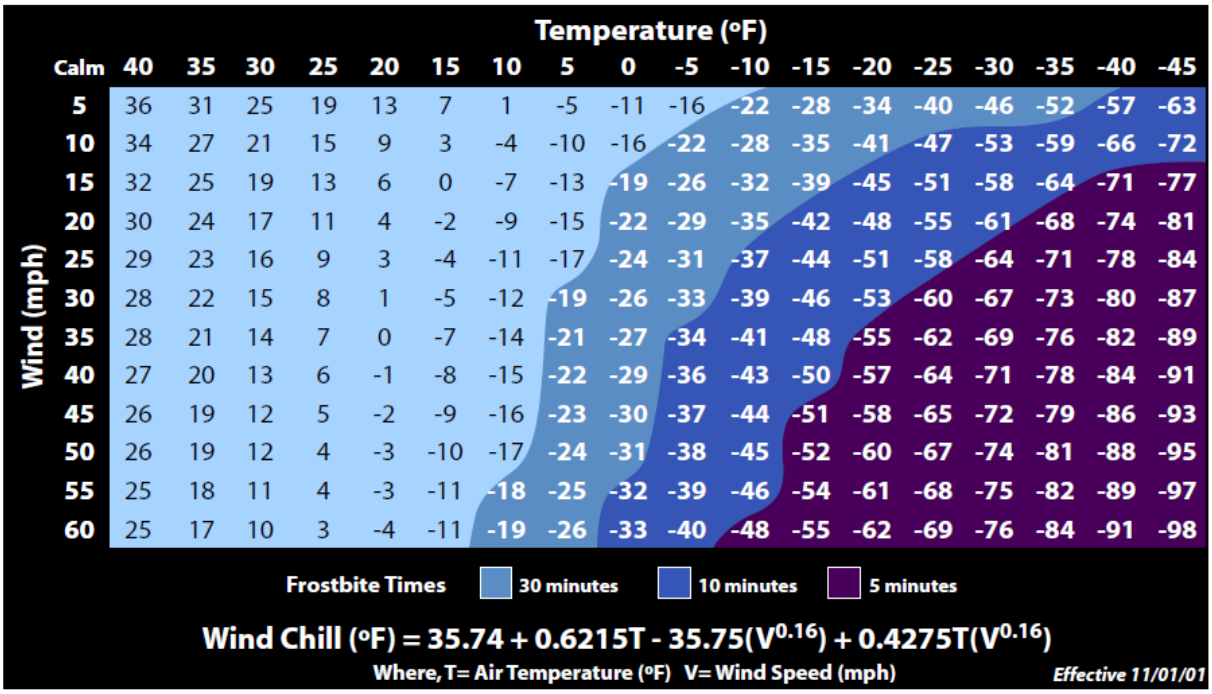
5.6.1 Background

What constitutes extreme cold and its effect varies across different regions of the United States, according to the NWS. In the South and other areas relatively unaccustomed to winter weather, temperatures near or below freezing (32°F) are considered extreme cold. Freezing temperatures in

these areas may cause damage to citrus fruit crops and other vegetation and may cause pipes to freeze and burst in homes that are poorly insulated or without heat. However, in the North, temperatures well below 0°F are considered extreme cold, and long cold spells can cause rivers to freeze, which can disrupt shipping, and ice jams to form, which can lead to flooding.

According to NOAA, frigid winter temperatures are the number two weather-related killer among natural hazards, following heat. Prolonged exposure to extreme cold temperatures can lead to serious health problems, including hypothermia, cold stress, frostbite, or freezing, and infants and the elderly are most susceptible to these conditions. Extreme cold events are most likely to occur during January and February, and even areas that normally experience mild winters can be hit with extreme cold.
Extreme cold conditions can be the result of cold temperatures and high winds, a combination known as "wind chill." The Wind Chill Temperature index, in **Figure 5.6**, shows the apparent temperature combining the effect of wind and air temperatures on exposed skin.

FIGURE 5.6: WIND CHILL TEMPERATURE INDEX



Source: National Weather Service, National Oceanic and Atmospheric Administration

The NWS issues wind chill advisories when wind chill hazards are potentially hazardous. Wind chill warnings are issued when wind chill temperatures are life threatening. Criteria for issuing wind chill warnings and advisories are set locally. For example, in Rochester, New York, wind chill advisories are issued when the wind chill temperature is expected to fall between -15°F to -24°F, and wind chill warnings are issued when wind chill temperature is expected to fall at or below -25°F. Again, this warning system should not be mistaken as describing the extent or magnitude of extreme cold; rather, it

is intended to provide advanced notice of excessive cold conditions for the protection of life and property.

5.6.2 Location and Spatial Extent

Extreme cold typically impacts a large area and cannot be confined to any geographic or political boundaries. The entire county is susceptible to extreme cold conditions.

5.6.3 Historical Occurrences

Data from the National Climatic Data Center was used to determine historical extreme cold events in Guilford County. One event was reported:

February 3, 1996 – *Cold/Wind Chill* – a cold/wind chill event impacted Guilford County for two days.
In addition, information from the State Climate Office of North Carolina was reviewed to obtain historical temperature records in the county. Temperature information has been recorded in Guilford County since 1903. The recorded minimum for the county can be found below in **Table 5.13**:

TABLE 5.13: LOWEST RECORDED TEMPERATURE IN GUILFORD COUNTY

Location	Date	Temperature (°F)
Greensboro Airport	01/21/1985	-8

Source: State Climate Office of North Carolina

The State Climate Office also reports average minimum temperatures at various stations in the county. The most centralized location is in Greensboro. **Table 5.14** shows the average minimum temperatures from 1971 to 2000 at the Greensboro Airport observation station which can be used as a general comparison for the county.

TABLE 5.14: AVERAGE MINIMUM TEMPERATURE IN GUILFORD COUNTY

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Avg. Max (°F)	28.2 °F	30.6 °F	37.8 °F	45.5 °F	54.7 °F	63.5 °F	68.1 °F	66.8 °F	60.1 °F	47.5 °F	38.6 °F	31.4 °F

Source: State Climate Office of North Carolina

5.6.4 Probability of Future Occurrences

Based on historical occurrence information, it is assumed that all of Guilford County has a probability level of possible (1 to 10 percent annual probability) for future extreme cold events to impact the county.

5.6.5 Consequence Analysis

People (The Public and Public Confidence)
Extreme cold can affect many people and to varying degrees. Often the elderly and very young are susceptible to the most detrimental impacts, but hypothermia and frostbite can plague anyone. Extreme cold events generally have minimal effects on public confidence.

Responders
Extreme cold can also affect responders who are often more susceptible to the effects of cold weather because they are forced to be exposed to the elements to complete tasks for their jobs. In these cases, responders could be negatively impacted by extreme cold.

Continuity of Operations
Extreme cold would likely have few impacts on continuity of operations as the warning time for these events is usually long and direct impacts to large numbers of personnel or other resources necessary to maintain operations are unlikely.

Built Environment (Property, Facilities, and Infrastructure)
Extreme cold would likely have a minor effect on the built environment, although low temperatures could potentially put a strain on infrastructure such as power generation due to higher demand.

Economy
An extreme cold event could potentially have a negative impact on the economy in the short term as the public may be advised to stay inside, causing them to reduce overall spending and negatively impact businesses in the community. Extended periods of extreme cold may also disrupt the local economy if agricultural, dairy, and livestock production declines, resulting in income loss for famers and others affected.

Environment
The environment would be impacted by extreme cold as many plants and animals that are not able to withstand lower temperatures may die off and crops and livestock may be impacted by unusually low temperatures, resulting in death or illness.

5.7 EXTREME HEAT

5.7.1 Background

Extreme heat, like drought, poses little risk to property. However, extreme heat can have devastating effects on health. Extreme heat is often referred to as a "heat wave." According to the National Weather Service, there is no universal definition for a heat wave, but the standard U.S. definition is any event lasting at least three days where temperatures reach ninety degrees Fahrenheit or higher. However, it may also be defined as an event at least three days long where temperatures are ten degrees greater than the normal temperature for the affected area. Heat waves are typically accompanied by humidity but may also be very dry. These conditions can pose serious health threats causing an average of 1,500 deaths each summer in the United States[9].

[9] http://www.noaawatch.gov/themes/heat.php

According to the National Oceanic and Atmospheric Administration, heat is the number one weather-related killer among natural hazards, followed by frigid winter temperatures[1]. The National Weather Service devised the Heat Index as a mechanism to better inform the public of heat dangers. The Heat Index Chart, shown in **Figure 5.7**, uses air temperature and humidity to determine the heat index or apparent temperature. **Table 5.15** shows the dangers associated with different heat index temperatures. Some populations, such as the elderly and young, are more susceptible to heat danger than other segments of the population.

FIGURE 5.7: HEAT INDEX CHART

Air Temp (in F) \ Relative Humidity (in percent)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
140	125																				
135	120	128																			
130	117	122	131																		
125	111	116	123	131	141																
120	107	111	116	123	130	139	148														
115	103	107	111	115	120	127	135	143	151												
110	99	102	105	108	112	117	123	130	137	143	150										
105	95	97	100	102	105	109	113	118	123	129	135	142	149								
100	91	93	95	97	99	101	104	107	110	115	120	126	132	138	144						
95	87	88	90	91	93	94	96	98	101	104	107	110	114	119	124	130	136				
90	83	84	85	86	87	88	90	91	93	95	96	98	100	102	106	109	113	117	122		
85	78	79	80	81	82	83	84	85	86	87	88	89	90	91	93	95	97	99	102	105	108
80	73	74	75	76	77	77	78	79	79	80	81	81	82	83	85	86	86	87	88	89	91
75	69	69	70	71	72	72	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80
70	64	64	65	65	66	66	67	67	68	68	69	69	70	70	70	70	71	71	71	71	72

Source: National Oceanic and Atmospheric Administration

TABLE 5.15: HEAT DISORDERS ASSOCIATED WITH HEAT INDEX TEMPERATURE

Heat Index Temperature (Fahrenheit)	Description of Risks
80°- 90°	Fatigue possible with prolonged exposure and/or physical activity
90°- 105°	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105°- 130°	Sunstroke, heat cramps, and heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity
130° or higher	Heatstroke or sunstroke is highly likely with continued exposure

Source: National Weather Service, National Oceanic and Atmospheric Administration

In addition, NOAA has seventeen metropolitan areas participating in the Heat HealthWatch/Warning System in order to better inform and warn the public of heat dangers. A Heat HealthWatch is issued when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A Heat Warning is issued when an excessive heat event is expected in the next 36 hours. Furthermore, a warning is issued

when the conditions are occurring, imminent, or have a high likelihood of occurrence. Urban areas participate in the Heat Health Watch/Warning System because urban areas are at greater risk to heat affects. Stagnant atmospheric conditions trap pollutants, thus adding unhealthy air to excessively hot temperatures. In addition, the "urban heat island effect" can produce significantly higher nighttime temperatures because asphalt and concrete (which store heat longer) gradually release heat at night.

5.7.2 Location and Spatial Extent

Excessive heat typically impacts a large area and cannot be confined to any geographic or political boundaries. The entire county is susceptible to extreme heat conditions. Additionally, according to the *Piedmont Together Climate Adaptation Report*, the Piedmont Triad has the state's largest elderly and aging populations—the fastest growing age demographic both nationally and regionally—making heat stress one of the leading climate adaptability priorities for the region and Guilford County.

5.7.3 Historical Occurrences

According to the *Piedmont Together Climate Adaptation Report*, the 10 warmest years in recorded history have occurred since 1997. Data from the National Climatic Data Center was used to determine historical extreme heat and heat wave events in Guilford County. Two events were reported:

July 22, 1998 –*Heat* – Excessive heat plagued central North Carolina during July 22 through July 23. Maximum temperatures reached the 98 to 103 degree range combined with dew points in the 78 to 80 degree range with little wind to give heat index values of around 110 degrees for several hours each afternoon. To make matters worse, the minimum temperatures did not fall below 80 at several locations and those that did achieved that feat for only an hour or two. Strong thunderstorms ended the 2 day excessive heat ordeal on the evening of the 23 when rain cooled the environment enough to send temperatures into the lower 70s at most locations.

May 27, 2008 –*Heat* – Senior Chad Wiley collapsed after a voluntary football workout on campus Tuesday May 27th. Chad was 22 years old.

In addition, information from the State Climate Office of North Carolina was reviewed to obtain historical temperature records in the county. Temperature information has been recorded in Guilford County since 1903. The recorded maximum for the county can be found below in **Table 5.16**:

TABLE 5.16: HIGHEST RECORDED TEMPERATURE IN GUILFORD COUNTY

Location	Date	Temperature (°F)
High Point	07/20/1926	106

Source: State Climate Office of North Carolina

The State Climate Office also reports average maximum temperatures at various stations in the county. The most centralized location is in Greensboro. **Table 5.17** shows the average maximum temperatures from 1971 to 2000 at the Greensboro Ap observation station which can be used as a general comparison for the county.

TABLE 5.17: AVERAGE MAXIMUM TEMPERATURE IN GUILFORD COUNTY

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Avg. Max (°F)	47.2 °F	51.7 °F	60.3 °F	69.7 °F	76.9 °F	83.8 °F	87.6 °F	85.7 °F	79.4 °F	69.6 °F	59.9 °F	50.6 °F

Source: State Climate Office of North Carolina

5.7.4 Probability of Future Occurrences

Based on historical occurrence information, it is assumed that all of Guilford County has a probability level of likely (10 to 100 percent annual probability) for future extreme heat events to impact the county. Additionally, according to the *Piedmont Together Climate* Adaptation Report, the average increase in annual temperature for the Piedmont Triad is estimated to be 5°F and higher annual average temperatures will likely create a longer growing season that may be supportive of agriculture. However, these hot, dry summers and wetter winter conditions could stress farms. Furthermore, the increased likelihood of heat waves due to climate change will result in a higher number of rolling brown/blackouts and decreased air quality in the county.

5.7.5 Consequence Analysis

People (The Public and Public Confidence)

Extreme heat can affect many people and to varying degrees. Often the elderly and very young are susceptible to the most detrimental impacts, but heat stroke and exhaustion can plague anyone. A heat wave would have minimal effects on public confidence.

Responders

Extreme heat can also affect responders who are often more susceptible to heat stroke and exhaustion due to the nature of their work which often forces police and emergency medical providers to be exposed to the elements. In these cases, responders could be negatively impacted by extreme heat.

Continuity of Operations

Extreme heat would likely have few impacts on continuity of operations as the warning time for these events is usually long and direct impacts to large numbers of personnel or other resources necessary to maintain operations are unlikely.

Built Environment (Property, Facilities, and Infrastructure)

Extreme heat would likely have a minor effect on the built environment, although high temperatures could potentially put a strain on infrastructure such as power generation and water systems due to higher demand.

Economy

An extreme heat event could potentially have a negative impact on the economy in the short term as the public may be advised to stay inside, causing them to reduce overall spending and negatively impact businesses in the community. Extended periods of extreme heat may also disrupt the local economy if agricultural, dairy, and livestock production declines, resulting in income loss for famers and others affected.

Environment

The environment would be impacted by extreme heat as many plants and animals that are not able to withstand the heat may die off and crops and livestock may be impacted by unusually high temperatures, resulting in death or illness.

5.8 FIRE

5.8.1 Background

A wildfire is any outdoor fire (i.e. grassland, forest, brush land) that is not under control, supervised, or prescribed.[10] Wildfires are part of the natural management of forest ecosystems, but may also be caused by human factors.

Nationally, over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning. In North Carolina, a majority of fires are caused by debris burning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildfires are usually signaled by dense smoke that fills the area for miles around.

Wildfire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural hazards (such as tornadoes, hurricanes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings.

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high wildfire hazard areas. Furthermore, the increasing demand for outdoor recreation places more people in wildlands during holidays, weekends, and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for wildfire events that can sweep through the brush and timber and destroy property within minutes.

Wildfires can result in severe economic losses as well. Businesses that depend on timber, such as paper mills and lumber companies, experience losses that are often passed along to consumers through higher prices and sometimes jobs are lost. The high cost of responding to and recovering from wildfires can deplete state resources and increase insurance rates. The economic impact of wildfires can also be felt in the tourism industry if roads and tourist attractions are closed due to health and safety concerns.

State and local governments can impose fire safety regulations on home sites and developments to help curb wildfire. Land treatment measures such as fire access roads, water storage, helipads, safety zones, buffers, firebreaks, fuel breaks, and fuel management can be designed as part of an overall fire defense

[10] Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

system to aid in fire control. Fuel management, prescribed burning, and cooperative land management planning can also be encouraged to reduce fire hazards.

5.8.2 Location and Spatial Extent

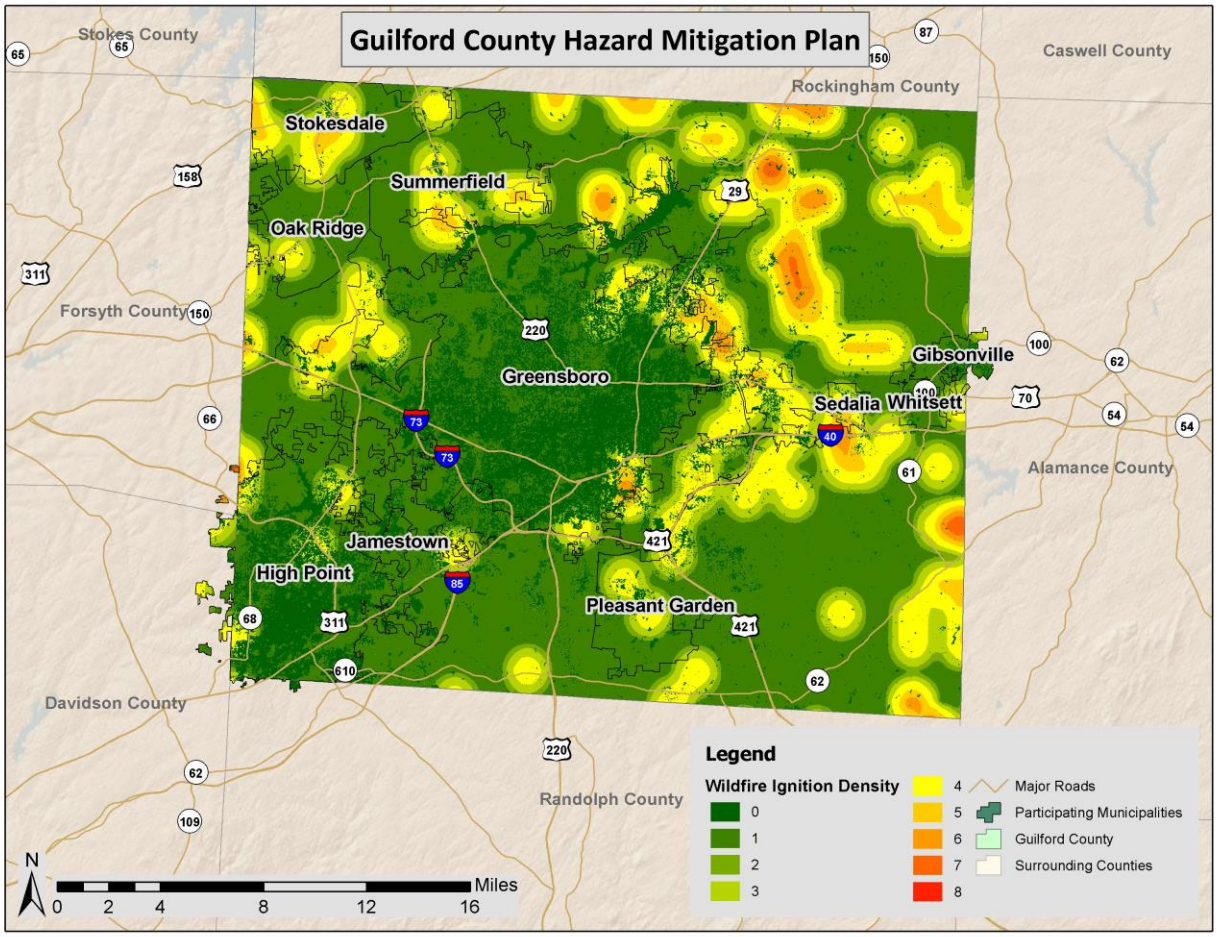
The entire county is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor, may make a wildfire more likely. Furthermore, areas in the urban-wildland interface are particularly susceptible to fire hazard as populations abut formerly undeveloped areas. The Wildfire Ignition Density data shown in the figure below gives an indication of historic location in Guilford County.

5.8.3 Historical Occurrences

Figure 5.8 shows the Wildfire Ignition Density in Guilford County based on data from the Southern Wildfire Risk Assessment. This data is based on historical fire ignitions and the likelihood of a wildfire igniting in an area. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. This is measured in the number of fires per year per 1,000 acres.[11]

[11] Southern Wildfire Risk Assessment, 2014.

FIGURE 5.8: WILDFIRE IGNITION DENSITY IN GUILFORD COUNTY



Source: Southern Wildfire Risk Assessment

Based on data from the North Carolina Division of Forest Resources (NCDFR) from 2004 to 2013, Guilford County experienced an average of 33 wildfires annually which burn a combined average of 46.7 acres per year. The data indicates that most of these fires are small, averaging 1.4 acres per fire. **Table 5.18** lists the number of reported wildfire occurrences in the county between the years 2003 and 2013.

TABLE 5.18: HISTORICAL WILDFIRE OCCURRENCES IN GUILFORD COUNTY

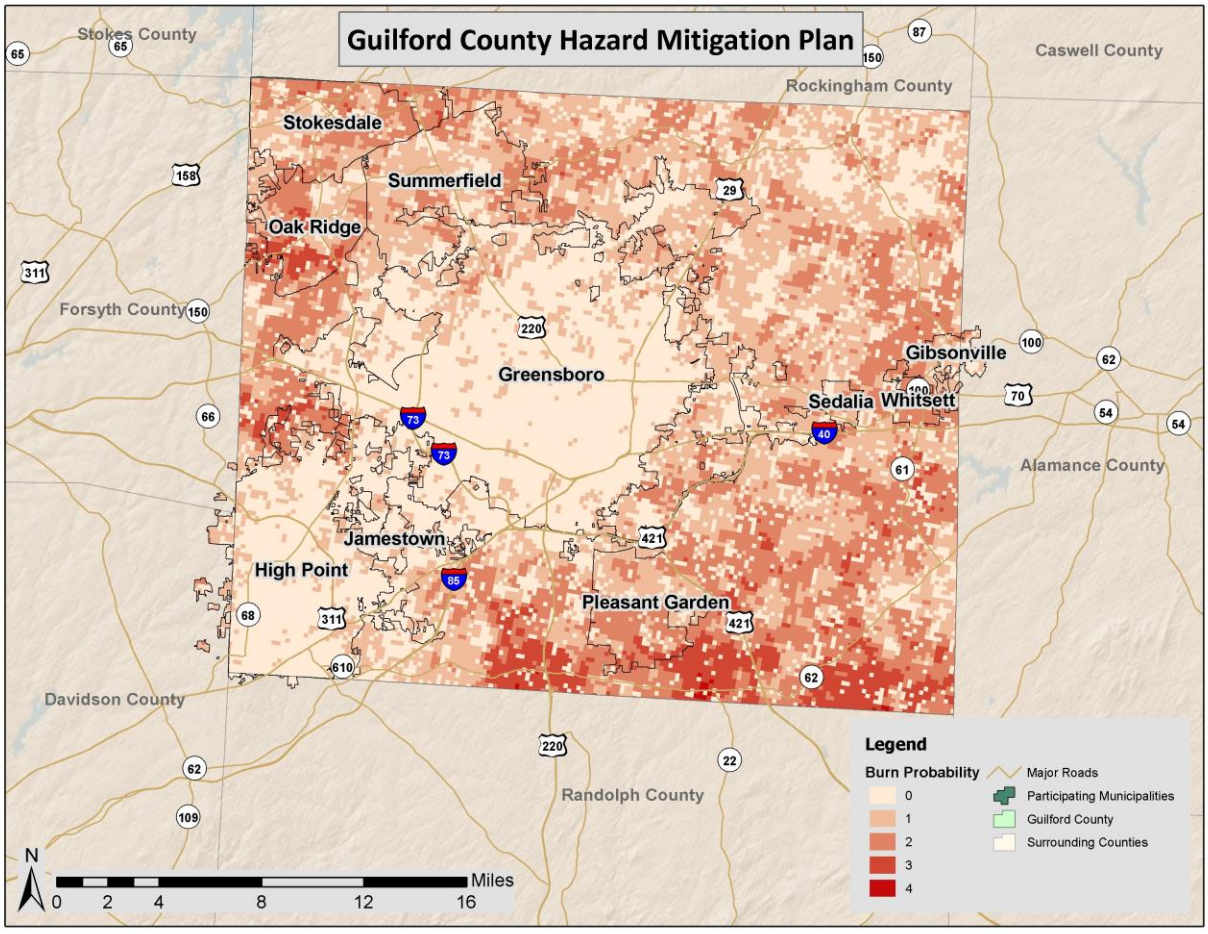
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Guilford County										
Number of Fires	23	10	34	53	15	10	27	61	41	52
Number of Acres	49.2	43.8	38.5	112.0	72.4	13.4	17.6	40.9	36.5	42.4

Source: North Carolina Division of Forest Resources

5.8.4 Probability of Future Occurrences

Wildfire events will be an ongoing occurrence in Guilford County. **Figure 5.9** shows that there is some probability a wildfire will occur throughout the county. However, the likelihood of wildfires increases during drought cycles and abnormally dry conditions. Fires are likely to stay small in size but could increase due local climate and ground conditions. Dry, windy conditions with an accumulation of forest floor fuel (potentially due to ice storms or lack of fire) could create conditions for a large fire that spreads quickly. It should also be noted that some areas do vary somewhat in risk. For example, highly developed areas are less susceptible unless they are located near the urban-wildland boundary. The risk will also vary due to assets. Areas in the urban-wildland interface will have much more property at risk, resulting in increased vulnerability and need to mitigate compared to rural, mainly forested areas. The probability assigned to Guilford County for future wildfire events is likely (10 to 100 percent annual probability). Additionally, according to the *Piedmont Together Climate Adaptation Report*, the increased likelihood of wildfire due to climate change will result in greater structural/property damage and decreased air quality in the county.

FIGURE 5.9: BURN PROBABILITY IN GUILFORD COUNTY



Source: Southern Wildfire Risk Assessment

5.8.5 Consequence Analysis

People (The Public and Public Confidence)

There are a number of potential losses from a wildland fire in Guilford County. Potential losses include human life, structures, and natural resources. Health hazards from smoke caused by wildland fires within or outside the county can include breathing difficulties and worsening of chronic breathing and/or cardiovascular disease. Smoke and air pollution pose a risk for children, the elderly, and those with respiratory and cardiovascular problems. First responders are also at risk for exposure to dangers from the initial incident and after-effects such as smoke inhalation and/or heat stroke. Wildfire tends to create some issues with public confidence because of the very visible impacts that the fire has on the community.

Responders

Responders are often at great risk when addressing fires or wildfire, especially firefighters who are responsible for putting out the blaze. All response personnel are potentially at risk when dealing with a wildfire and often changing winds and a number of other factors can cause a fire to spread rapidly. Although much of Guilford County has been urbanized and is not at a high risk to wildfire, the more rural areas that are located in the wildland urban interface may require response personnel to be ready to act.

Continuity of Operations

Since wildfire often moves quickly and can affect infrastructure that is important to maintaining continuity of operations, there is some level of concern for maintaining continuity. However, operations in Guilford County, which are generally run from urbanized areas, will probably not be impacted in a major way.

Built Environment (Property, Facilities, and Infrastructure)

Wildland fires have the potential to substantially burn forested areas as well as private residences. Damage and destruction to State, county, private, and municipal structures and facilities are major losses that are attributed to wildland fires. Private residences and communities that are located within the WUI are particularly susceptible to the threat. Population increases in North Carolina's WUI areas, for example, can create significant challenges for firefighters and residents.

Many new homes are constructed without considering community wildland fire planning. This creates neighborhoods with limited accessibility, flammable building construction, and landscaping. A lack of firewise planning can also greatly increase the probability of a wildland fire occurrence with more homes and emergency personnel being threatened.

Impacts to agricultural crops are other direct property losses that Guilford County could face in the event of a wildland fire. Some structural losses that might result include private property. These include business properties and homes, vehicles, and livestock. Damage to capital goods and equipment as well as evacuation expenses and other losses are directly related to fire and smoke damage. Additional potential losses include building and landscape maintenance expenses, firefighting equipment purchases, and fire-related business closures. Additional post-fire losses include cleanup, rehabilitation and repair expenses, equipment and capital goods replacement, drinking water pollution, smoke damage, deflated real estate values, and an increase in fire insurance premiums.

Economy

Given the fact that some homes, businesses, and infrastructure are located in areas that could be impacted by wildfire, there could be some significant economic impacts of a wildfire in Guilford County. If homes or businesses are burned, the cost of rebuilding could be substantial.

Environment

Wildland fires have the potential to damage or destroy forage on grazing lands, secondary forest products destruction, and/or degradation and loss of wildlife habitat on public lands. On private lands, vegetation losses could include agricultural crops that are either burned or impacted by wildland fire smoke. Indirect losses could include loss of growing stock as well as irrigation systems. Another potential loss includes damage and destruction to a wide variety of common or protected habitats in Guilford County.

Additional factors that contribute to wildland fire susceptibility in Guilford County include long growing seasons with frequent rainfall and wind, which can significantly affect vegetation growth.

5.9 FLOODING

5.9.1 Background

Flooding is the most frequent and costly natural hazard in the United States and is a hazard that has caused more than 10,000 deaths since 1900. Nearly 90 percent of presidential disaster declarations result from natural events where flooding was a major component.

Floods generally result from excessive precipitation and can be classified under two categories: general floods, precipitation over a given river basin for a long period of time along with storm-induced wave action, and flash floods, the product of heavy localized precipitation in a short time period over a given location. The severity of a flooding event is typically determined by a combination of several major factors, including stream and river basin topography and physiography, precipitation and weather patterns, recent soil moisture conditions, and the degree of vegetative clearing and impervious surface.

General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, and other large coastal storms. Urban flooding occurs where manmade development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. However, flash flooding events may also occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall or from a sudden release of water held by a retention basin or other stormwater control facility. Although flash flooding occurs most often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces.

The periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as a floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. Flood frequencies, such as the 100-year flood, are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1 percent chance of occurring in any given year and the 500-year flood has a 0.2 percent chance of occurring in any given year.

5.9.2 Location and Spatial Extent

There are areas in Guilford County that are susceptible to flood events. Special flood hazard areas in Guilford County were mapped using Geographic Information System (GIS) and FEMA Digital Flood Insurance Rate Maps (DFIRM).[12] This includes Zone A (1-percent annual chance floodplain), Zone AE (1-percent annual chance floodplain with elevation) and Zone X500 (0.2-percent annual chance floodplain). According to GIS analysis, of the 657.6 square miles of land that make up Guilford County, there are 41.0 square miles of land in zone A and AE (1-percent annual chance floodplain/100-year floodplain) and 5.1 square miles of land in zone X500 (0.2-percent annual chance floodplain/500-year floodplain). The county totals are presented below in **Table 5.19**.

TABLE 5.19: SUMMARY OF FLOODPLAIN AREAS IN GUILFORD COUNTY

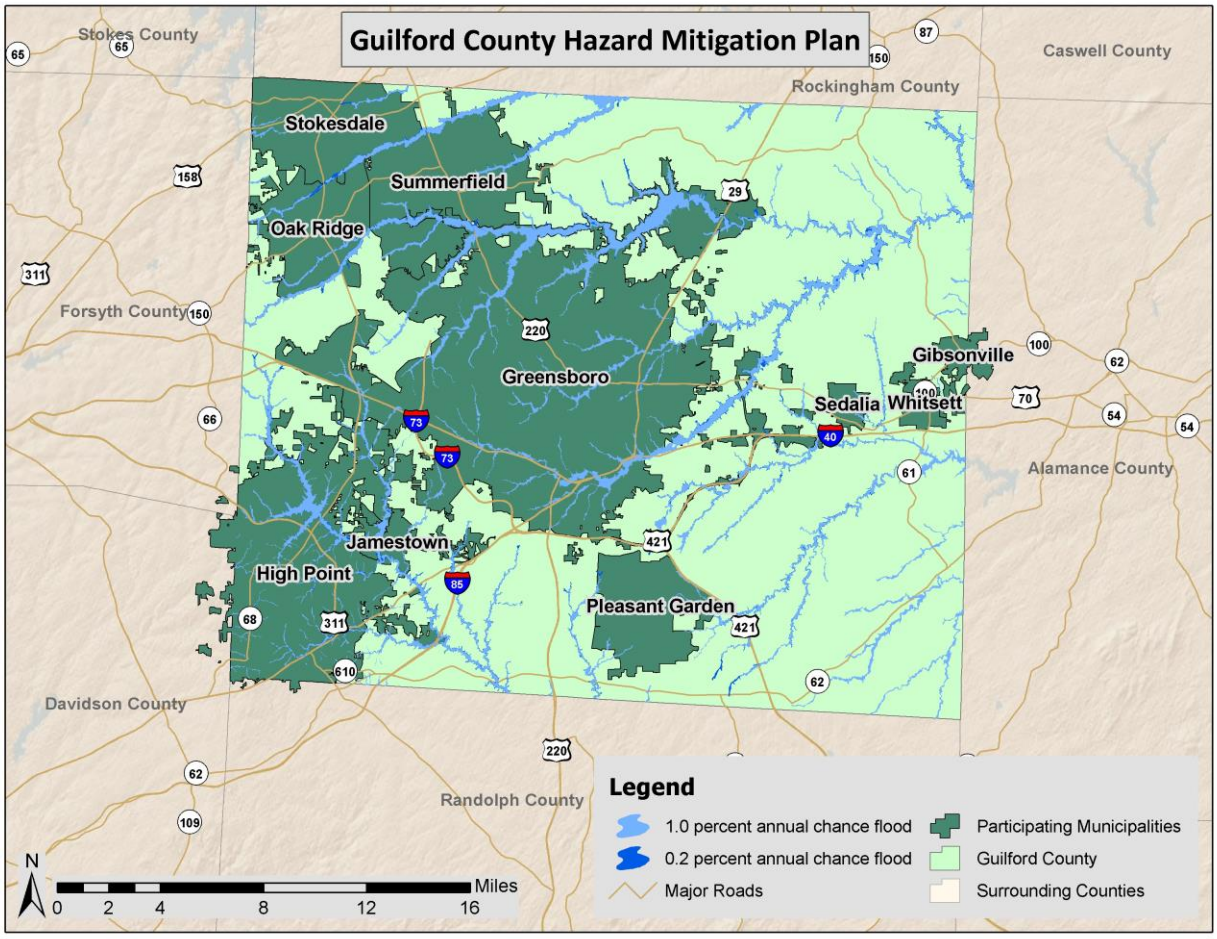
Location	100-year area (square miles)	500-year area (square miles)
Gibsonville	0.4	0.0
Greensboro	15.3	1.0
High Point	5.8	0.5
Jamestown	0.9	0.1
Oak Ridge	1.5	0.3
Pleasant Garden	0.4	0.1
Sedalia	0.1	0.0
Stokesdale	1.0	0.2
Summerfield	2.7	0.3
Whitsett	0.0	0.0
Unincorporated Area	12.9	2.6
GUILFORD COUNTY TOTAL	**41.0**	**5.1**

These flood zone values account for 7.0 percent of the total land area in Guilford County. It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas. **Figure 5.10**, **Figure 5.11**, **Figure 5.12**,

[12] The county-level DFIRM used for Guilford County was updated in 2009.

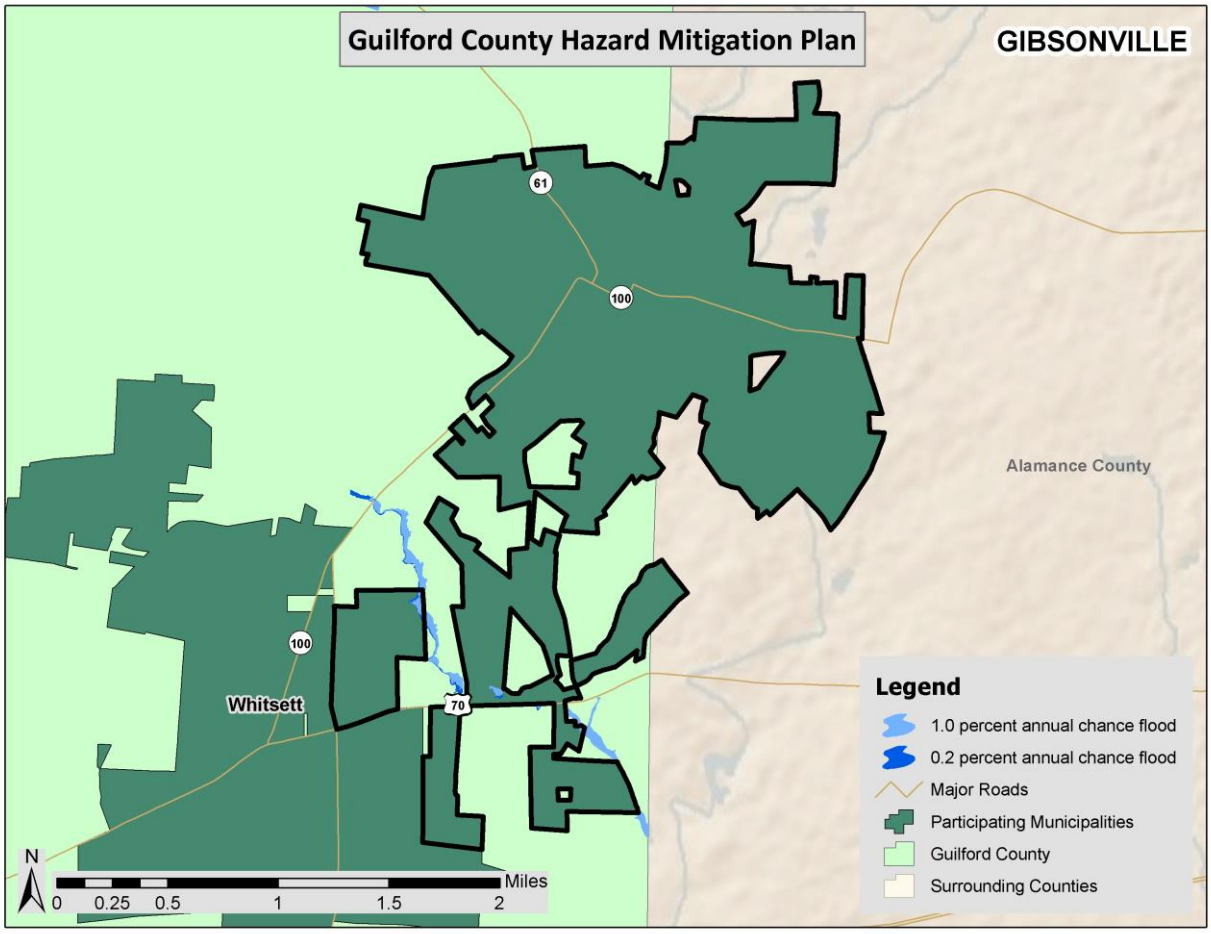
Figure 5.13, **Figure 5.14**, **Figure 5.15**,**Figure 5.16**, **Figure 5.17**, **Figure 5.18**, **Figure 5.19**, and **Figure 5.20** illustrate the location and extent of currently mapped special flood hazard areas for Guilford County and its municipalities based on best available FEMA DFIRM data.

FIGURE 5.10: SPECIAL FLOOD HAZARD AREAS IN GUILFORD COUNTY



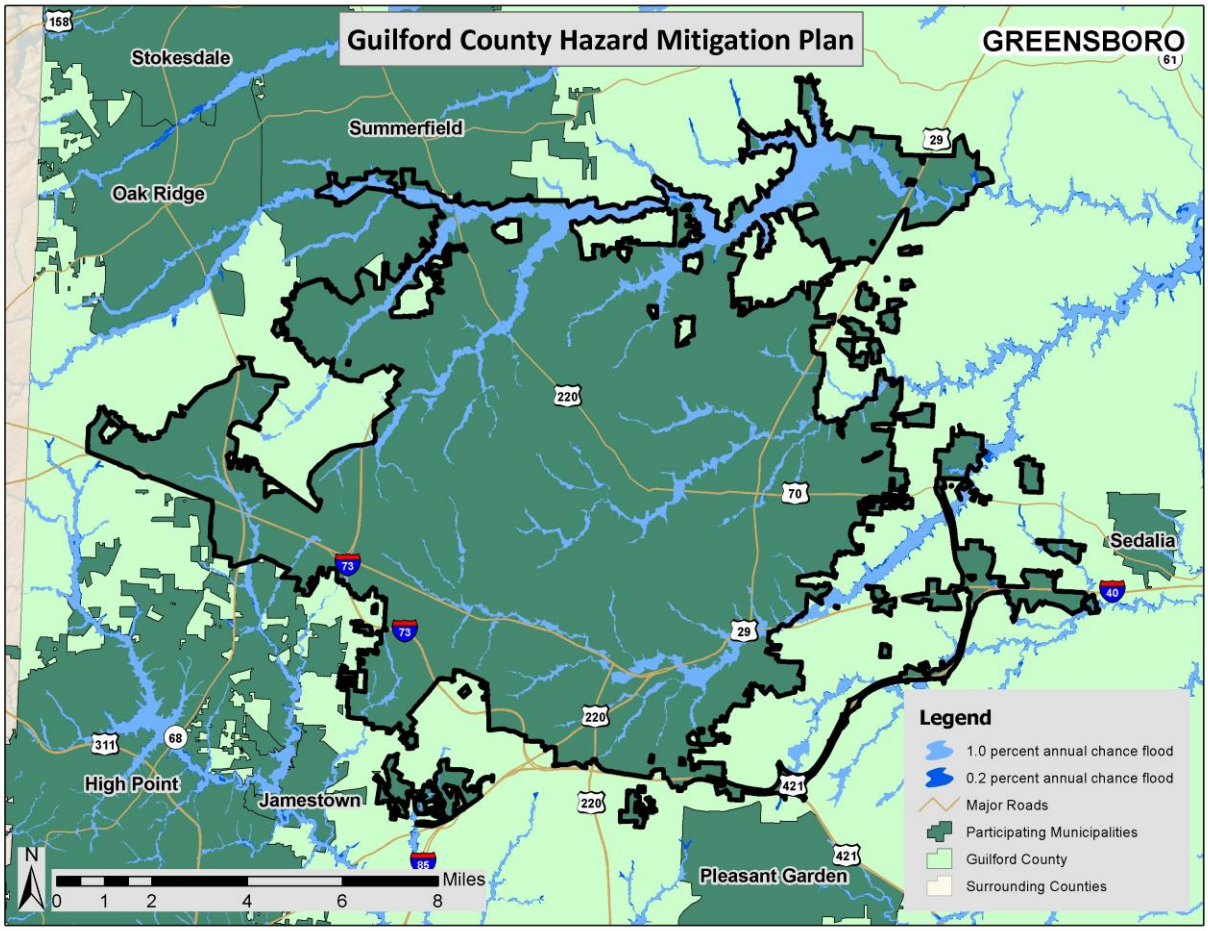
Source: Federal Emergency Management Agency

FIGURE 5.11: SPECIAL FLOOD HAZARD AREAS IN GIBSONVILLE



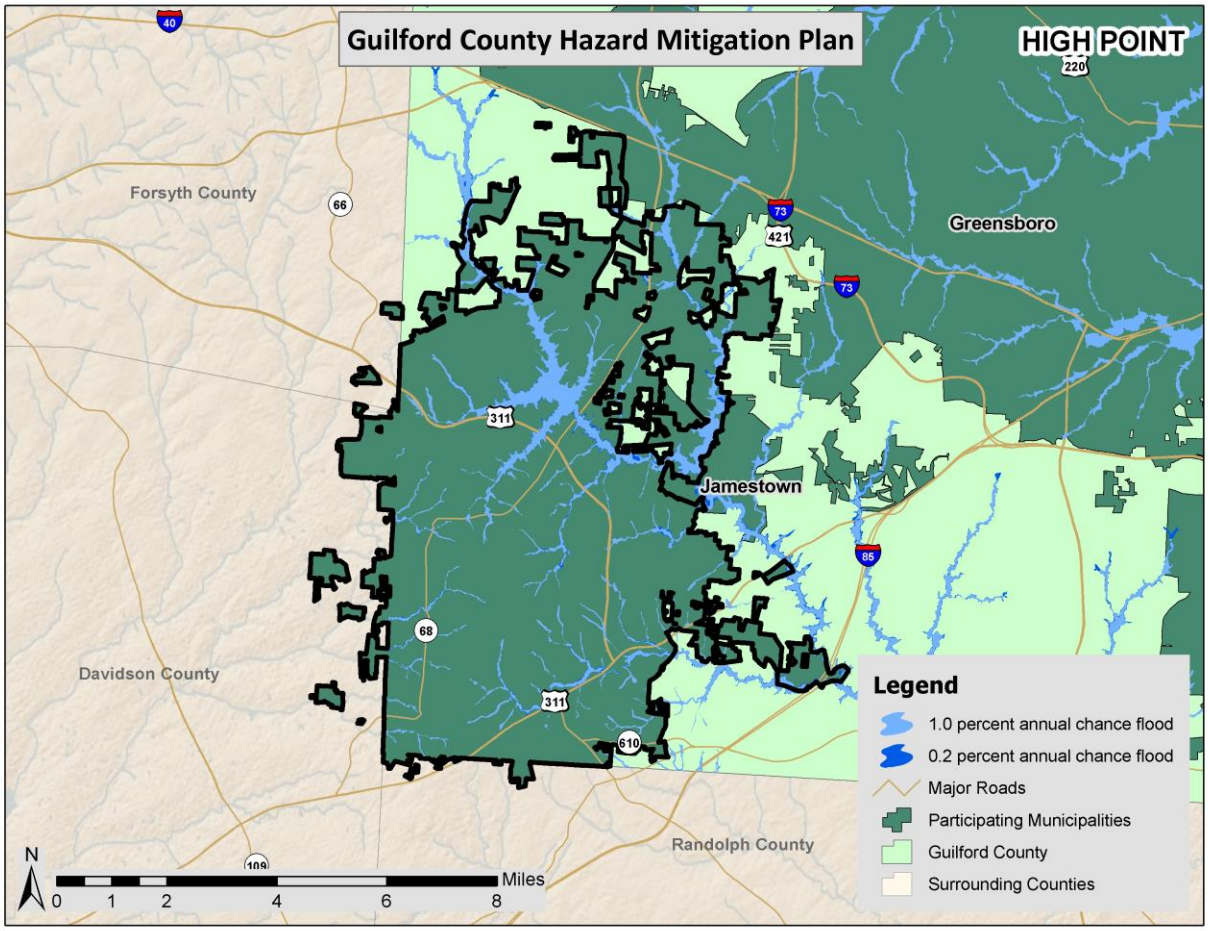
Source: Federal Emergency Management Agency

FIGURE 5.12: SPECIAL FLOOD HAZARD AREAS IN GREENSBORO



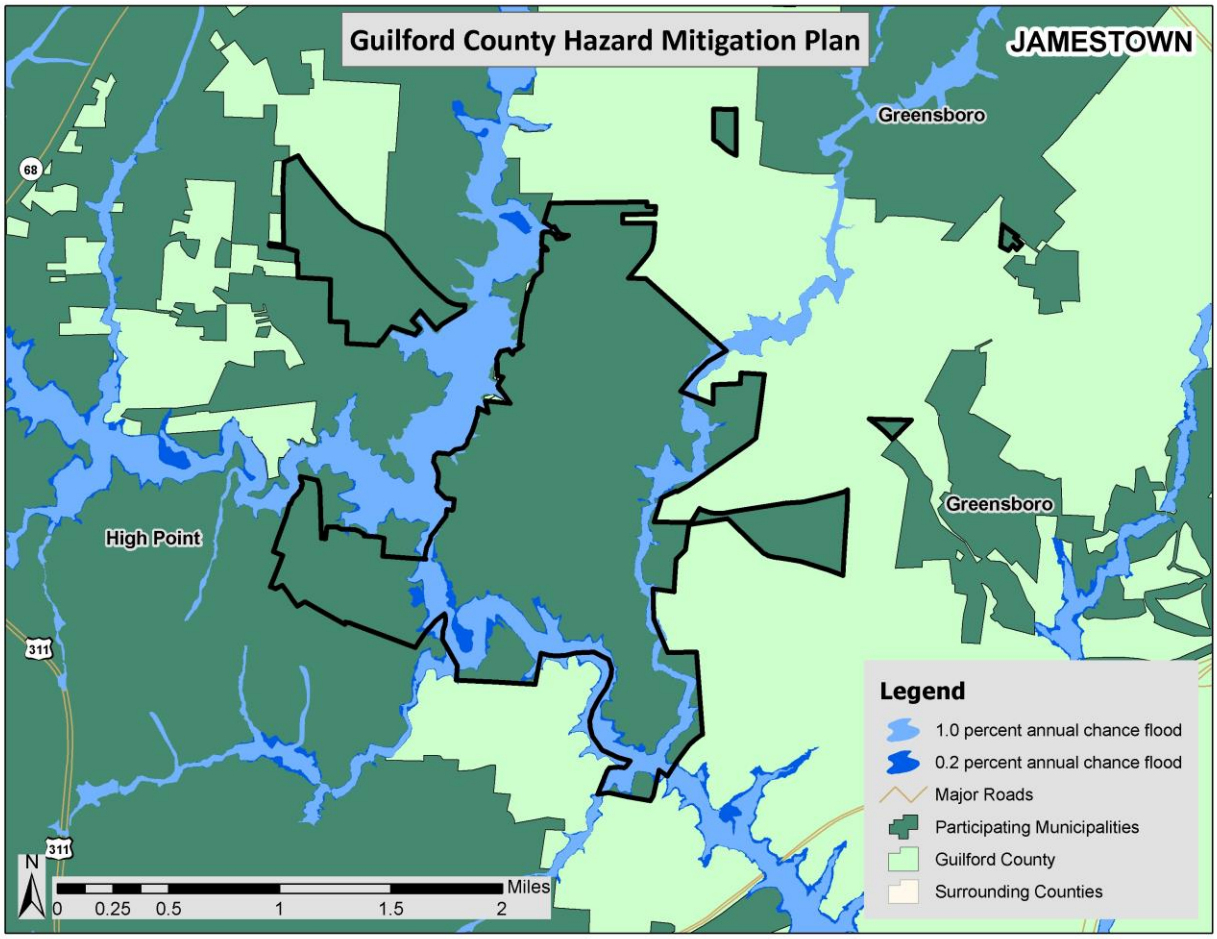
Source: Federal Emergency Management Agency

FIGURE 5.13: SPECIAL FLOOD HAZARD AREAS IN HIGH POINT



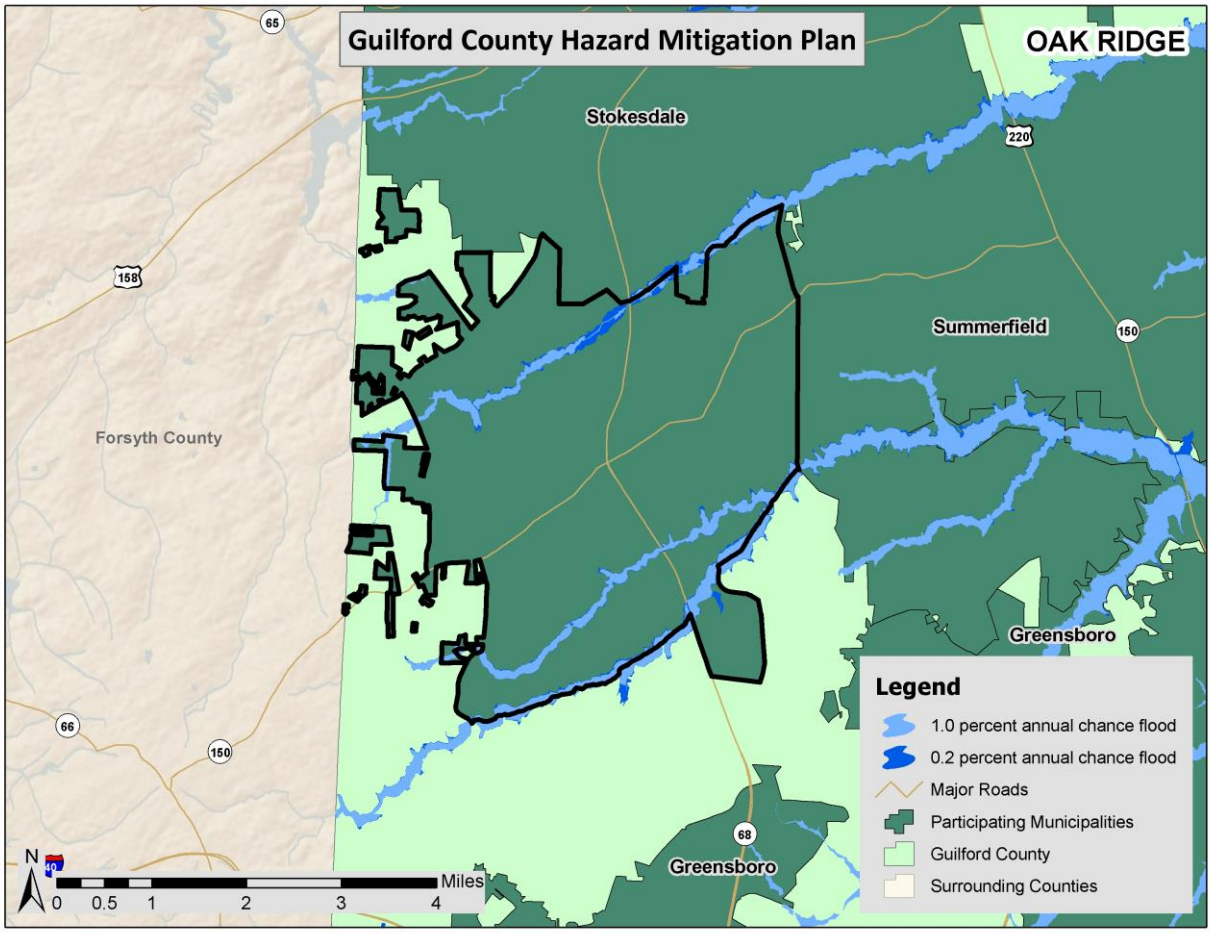
Source: Federal Emergency Management Agency

FIGURE 5.14: SPECIAL FLOOD HAZARD AREAS IN JAMESTOWN



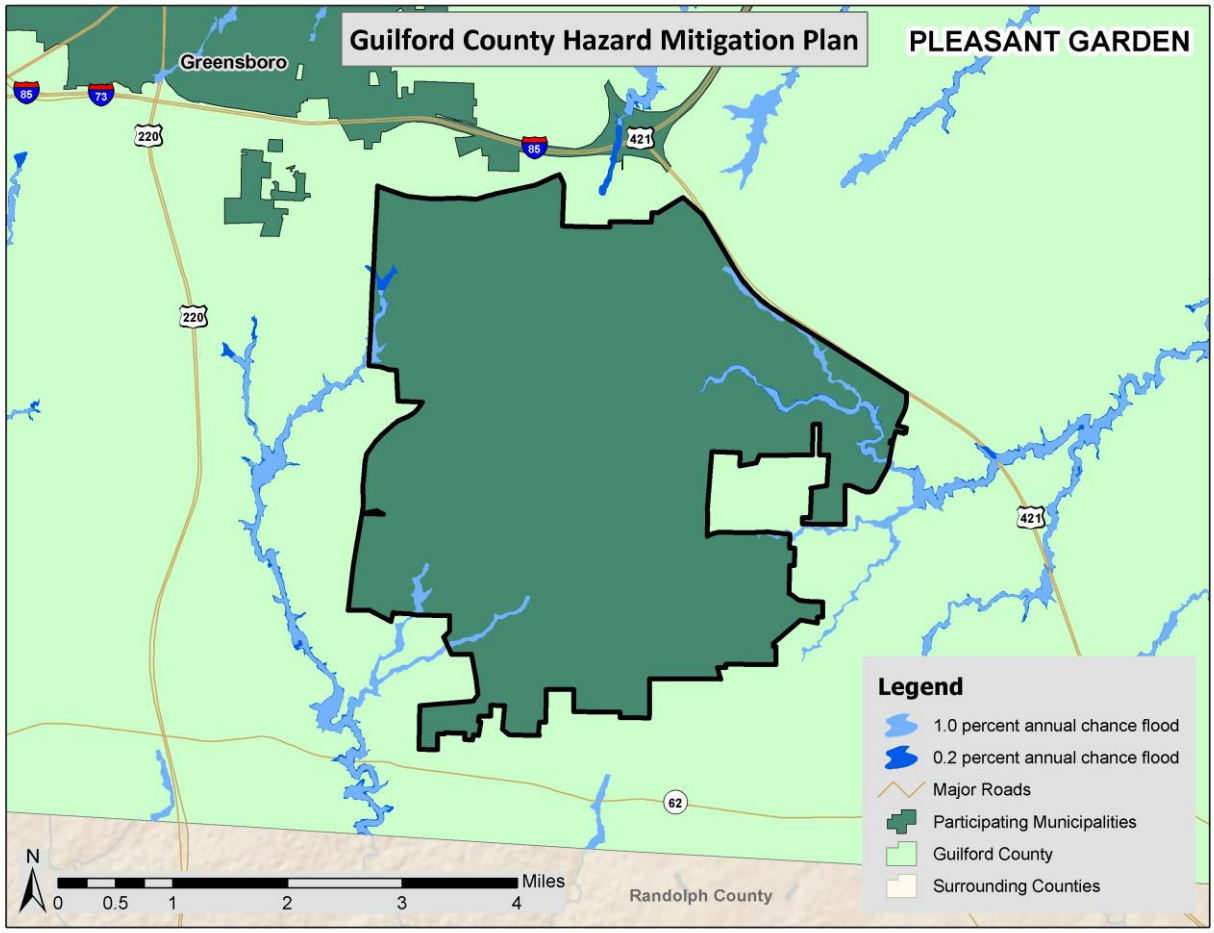
Source: Federal Emergency Management Agency

FIGURE 5.15: SPECIAL FLOOD HAZARD AREAS IN OAK RIDGE



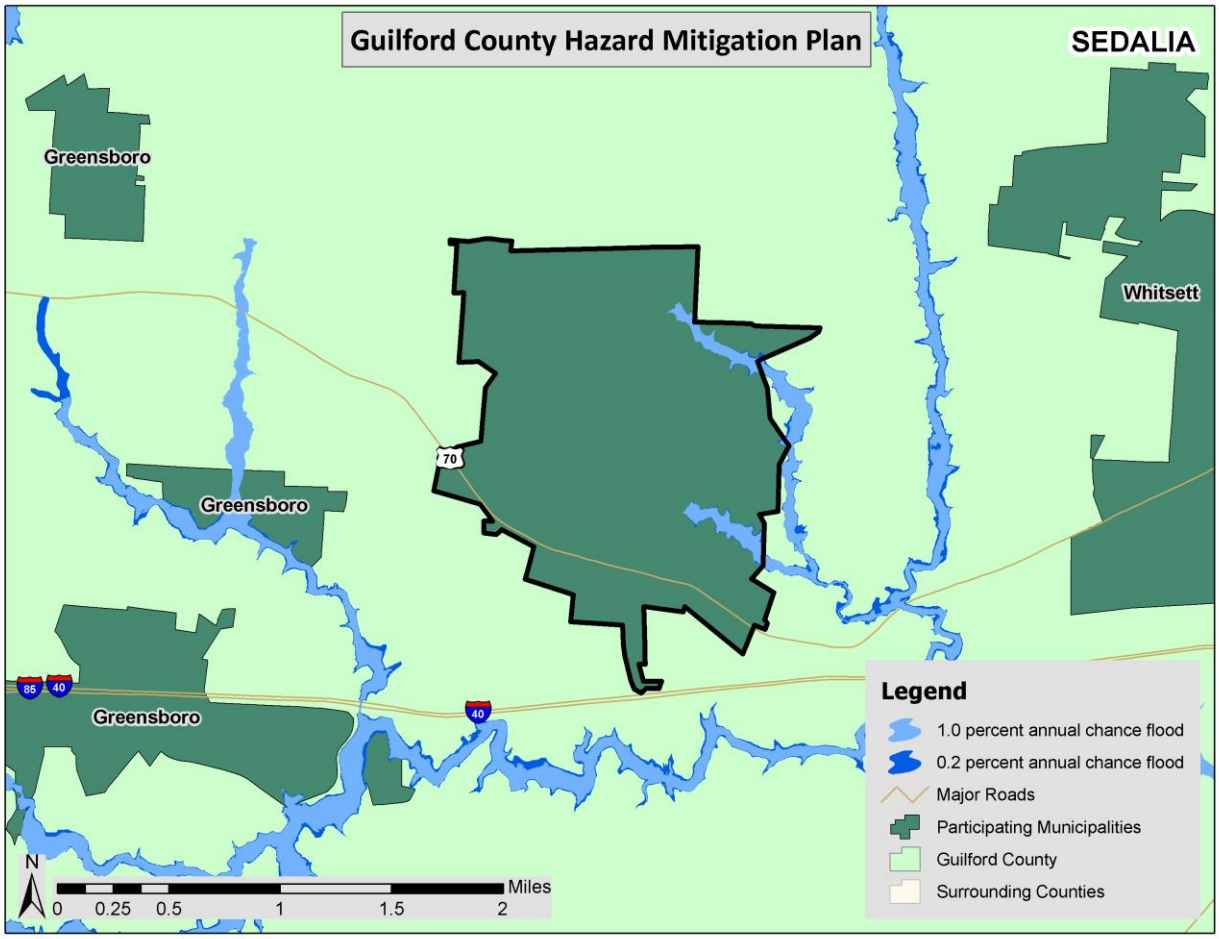
Source: Federal Emergency Management Agency

FIGURE 5.16: SPECIAL FLOOD HAZARD AREAS IN PLEASANT GARDEN



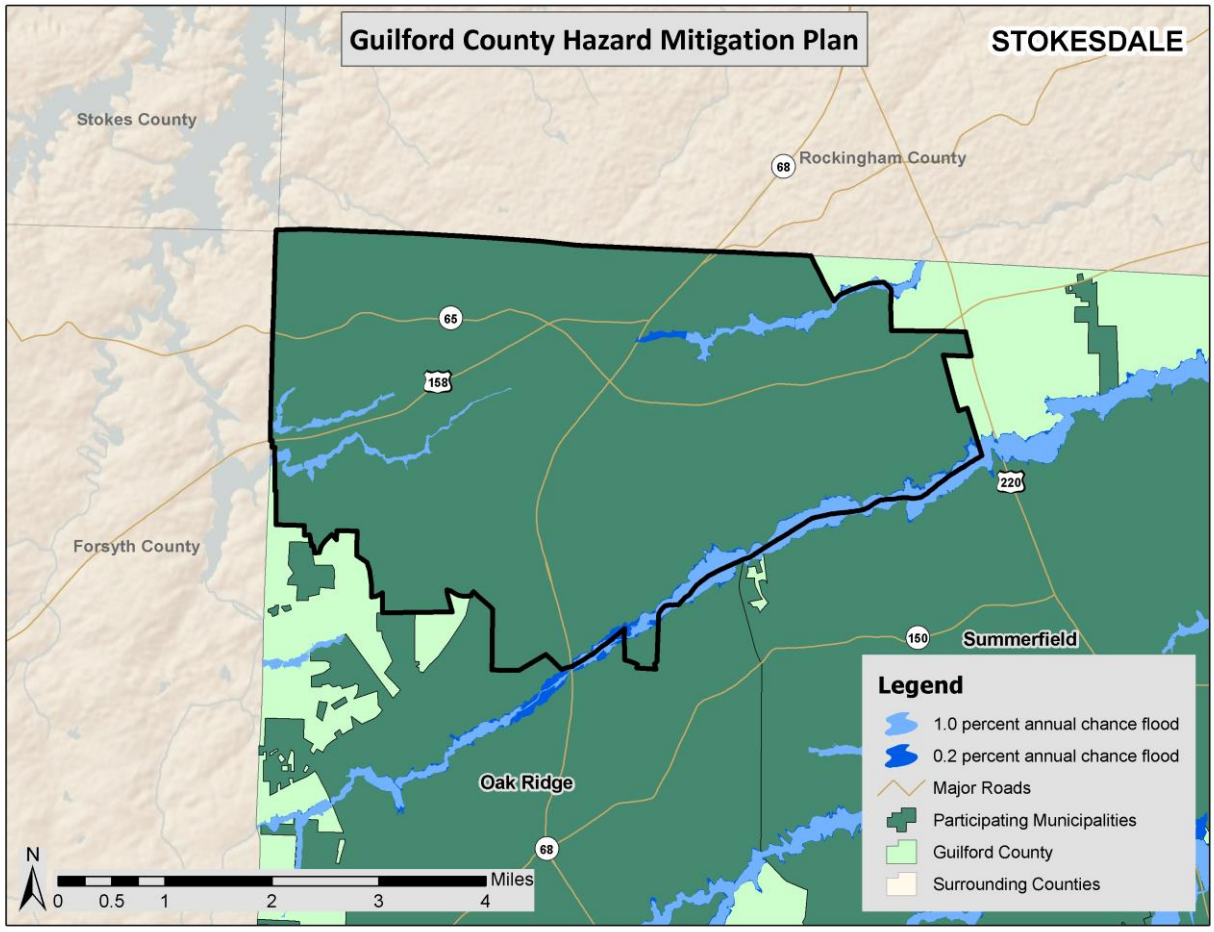
Source: Federal Emergency Management Agency

FIGURE 5.17: SPECIAL FLOOD HAZARD AREAS IN SEDALIA



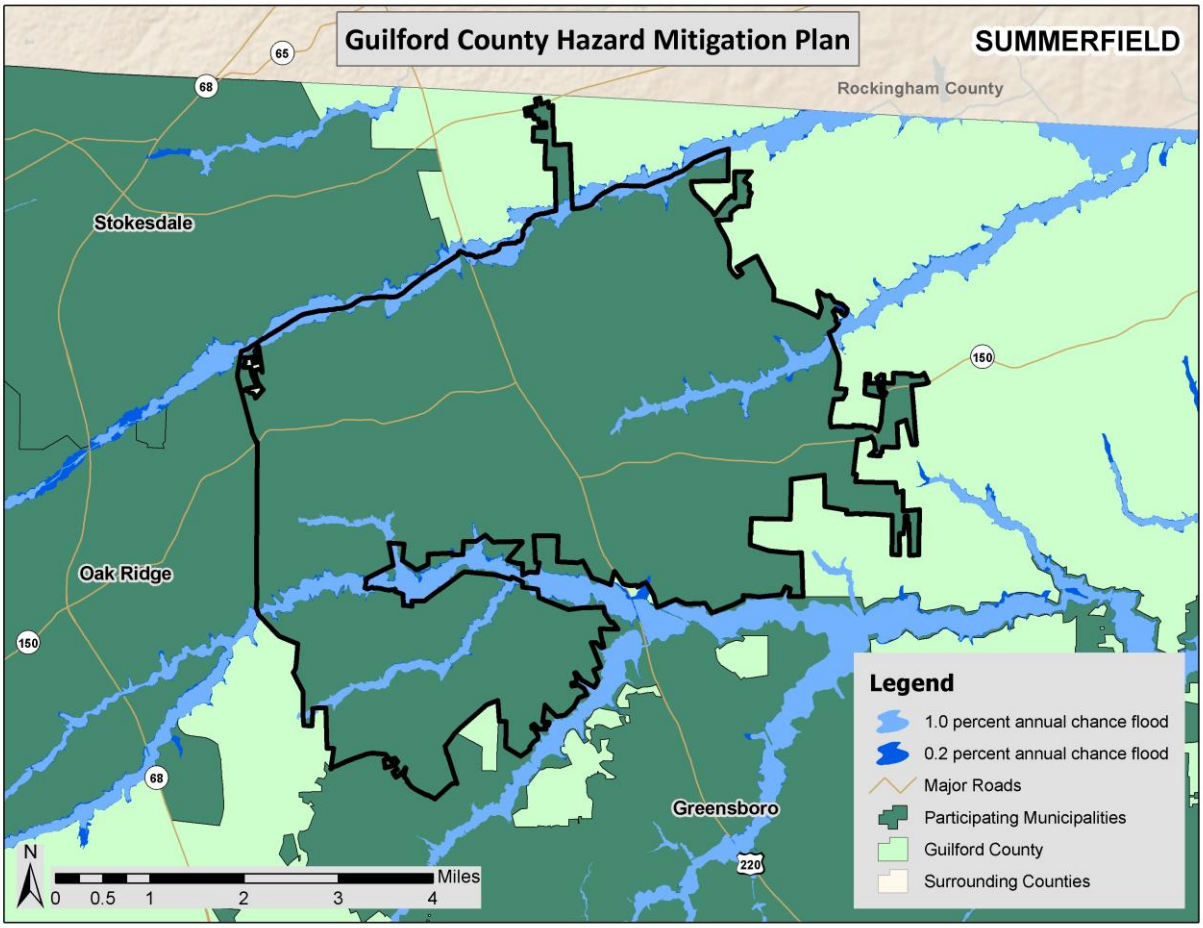
Source: Federal Emergency Management Agency

FIGURE 5.18: SPECIAL FLOOD HAZARD AREAS IN STOKESDALE



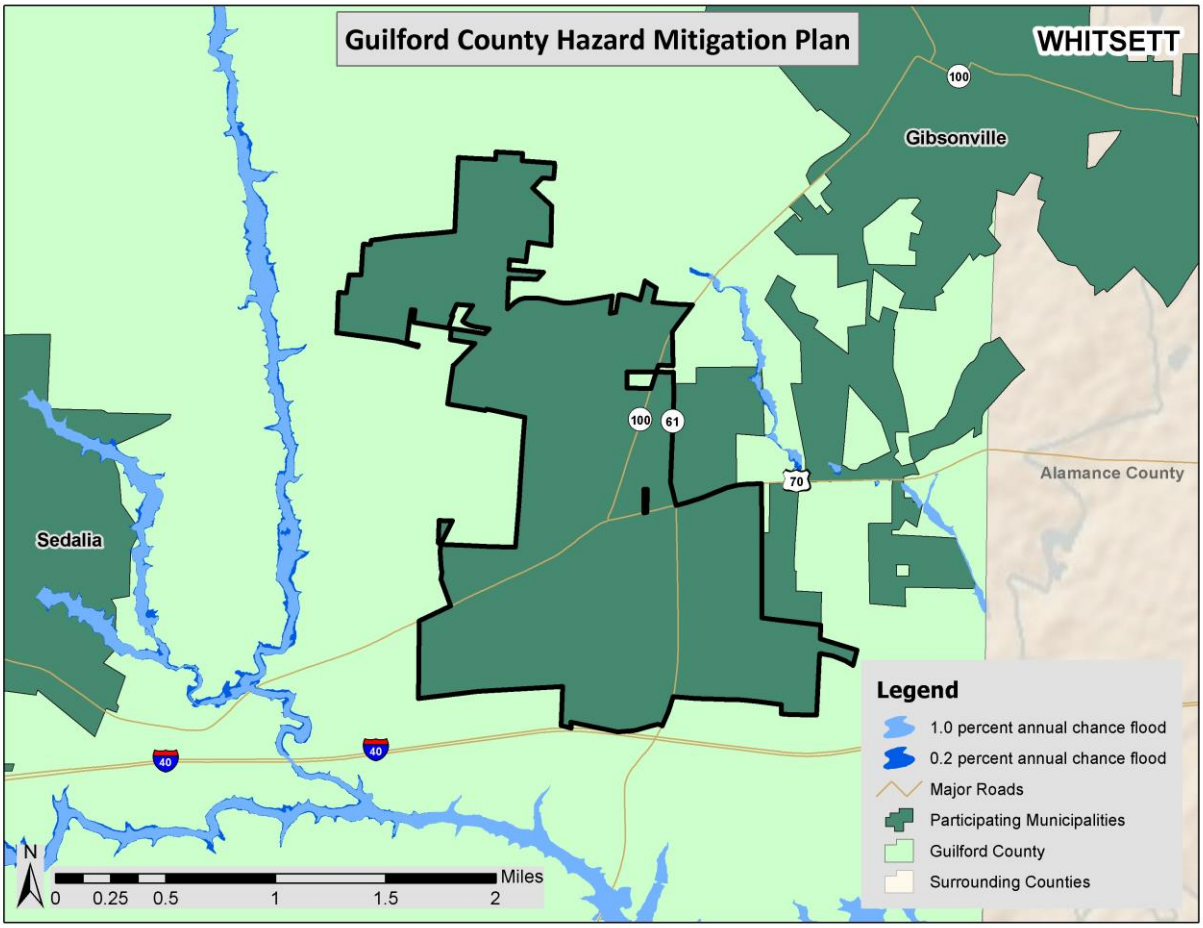
Source: Federal Emergency Management Agency

FIGURE 5.19: SPECIAL FLOOD HAZARD AREAS IN SUMMERFIELD



Source: Federal Emergency Management Agency

FIGURE 5.20: SPECIAL FLOOD HAZARD AREAS IN WHITSETT



Source: Federal Emergency Management Agency

5.9.3 Historical Occurrences

Information from the National Climatic Data Center was used to ascertain historical flood events. The National Climatic Data Center reported a total of 73 events throughout Guilford County since 1996.[13] A summary of these events is presented in **Table 5.20**. These events accounted for over $2.6 million (2014 dollars) in property damage throughout the county and 1 death.[14] Specific information on flood events for each jurisdiction, including date, type of flooding, and deaths and injuries, can be found in **Table 5.21**.

TABLE 5.20: SUMMARY OF FLOOD OCCURRENCES IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	0	0/0	$0

[13] These flood events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1996 through August 2014. It is likely that additional occurrences have occurred and have gone unreported in Guilford County.
[14] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Greensboro	24	1/0	$2,228,931
High Point	9	0/0	$30,266
Jamestown	1	0/0	$0
Oak Ridge	1	0/0	$0
Pleasant Garden	1	0/0	$0
Sedalia	0	0/0	$0
Stokesdale	0	0/0	$0
Summerfield	5	0/0	$0
Whitsett	0	0/0	$0
Unincorporated Area	32	0/0	$373,261
GUILFORD COUNTY TOTAL	**73**	**1/0**	**$2,632,458**

Source: National Climatic Data Center

TABLE 5.21: HISTORICAL FLOOD OCCURRENCES IN GUILFORD COUNTY

	Date	Type	Deaths / Injuries	Property Damage*
Gibsonville				
None Reported	--	--	--	--
Greensboro				
GREENSBORO	7/25/1996	Flash Flood	0/0	$0
GREENSBORO	6/19/2000	Flash Flood	0/0	$0
GREENSBORO	8/27/2000	Flash Flood	0/0	$0
GREENSBORO	8/28/2000	Flash Flood	0/0	$0
GREENSBORO	9/1/2000	Flash Flood	0/0	$0
GREENSBORO	7/4/2001	Flash Flood	0/0	$0
GREENSBORO	8/17/2003	Flash Flood	0/0	$15,485
GREENSBORO	8/31/2003	Flash Flood	0/0	$0
GREENSBORO	9/23/2003	Flash Flood	0/0	$0
GREENSBORO	7/17/2004	Flash Flood	0/0	$0
GREENSBORO	9/8/2004	Flash Flood	0/0	$0
GREENSBORO	9/27/2004	Flash Flood	0/0	$0
GREENSBORO	12/10/2004	Flash Flood	0/0	$0
GREENSBORO	6/14/2006	Flash Flood	0/0	$0
GREENSBORO	8/30/2006	Flash Flood	0/0	$0
GREENSBORO	4/15/2007	Flash Flood	0/0	$0
GREENSBORO	6/27/2007	Flash Flood	0/0	$0
GREENSBORO	6/27/2007	Flash Flood	0/0	$0
GREENSBORO	6/27/2007	Flash Flood	0/0	$0
GREENSBORO	6/3/2009	Flash Flood	1/0	$2,213,446
GREENSBORO	11/12/2009	Flash Flood	0/0	$0
GREENSBORO	1/25/2010	Flash Flood	0/0	$0
GREENSBORO	7/13/2010	Flash Flood	0/0	$0
GREENSBORO	8/11/2010	Flash Flood	0/0	$0

	Date	Type	Deaths / Injuries	Property Damage*
High Point				
HIGH PT	7/25/1996	Flash Flood	0/0	$0
HIGH POINT	9/3/1996	Flash Flood	0/0	$30,266
HIGH PT	4/17/1998	Flood	0/0	$0
HIGH PT	9/18/2002	Flash Flood	0/0	$0
HIGH PT	6/23/2006	Flash Flood	0/0	$0
HIGH PT	6/23/2006	Flash Flood	0/0	$0
HIGH PT	6/27/2006	Flash Flood	0/0	$0
HIGH PT	8/30/2006	Flash Flood	0/0	$0
HIGH PT	9/30/2010	Flash Flood	0/0	$0
Jamestown				
JAMESTOWN	9/30/2010	Flash Flood	0/0	$0
Oak Ridge				
OAK RIDGE	9/14/2000	Flash Flood	0/0	$0
OAK RIDGE ARPT	8/17/2013	Flash Flood	0/0	$0
Pleasant Garden				
PLEASANT GARDEN	9/3/2012	Flash Flood	0/0	$0
Sedalia				
None Reported	--	--	--	--
Stokesdale				
None Reported	--	--	--	--
Summerfield				
SUMMERFIELD	7/13/2003	Flash Flood	0/0	$0
SUMMERFIELD	7/30/2007	Flash Flood	0/0	$0
SUMMERFIELD	7/30/2007	Flash Flood	0/0	$0
SUMMERFIELD	7/30/2007	Flash Flood	0/0	$0
SUMMERFIELD	1/25/2010	Flash Flood	0/0	$0
Whitsett				
None Reported	--	--	--	--
Unincorporated Area				
SE PTN	4/28/1997	Flash Flood	0/0	$0
WEST PORTION	2/22/2003	Flash Flood	0/0	$0
GUILFORD (ZONE)	3/20/2003	Flood	0/0	$0
GUILFORD (ZONE)	4/10/2003	Flood	0/0	$0
CLIMAX	8/4/2003	Flash Flood	0/0	$0
GUILFORD	6/23/2006	Flash Flood	0/0	$0
TERRA COTTA	6/22/2008	Flash Flood	0/0	$0
(GSO)GREENSBORO RGNL	8/27/2008	Flash Flood	0/0	$33,084
GREENSBORO MAY ARPT	8/27/2008	Flash Flood	0/0	$165,418
HAMILTON LAKES	11/11/2009	Flash Flood	0/0	$0
RANKIN	1/25/2010	Flash Flood	0/0	$0
HAMILTON LAKES	6/16/2010	Flash Flood	0/0	$0
TERRA COTTA	7/27/2010	Flash Flood	0/0	$0
FOUR MILE	9/30/2010	Flash Flood	0/0	$0

	Date	Type	Deaths / Injuries	Property Damage*
DEEP RIVER	9/30/2010	Flash Flood	0/0	$0
BESSEMER	6/11/2011	Flash Flood	0/0	$0
GUILFORD CO.	6/11/2011	Flash Flood	0/0	$0
GREENSBORO MAY ARPT	6/28/2011	Flash Flood	0/0	$0
GUILFORD CO.	6/28/2011	Flash Flood	0/0	$0
BESSEMER	7/8/2011	Flash Flood	0/0	$0
BESSEMER	9/6/2011	Flash Flood	0/0	$0
TERRA COTTA	9/23/2011	Flash Flood	0/0	$0
BATTLE GROUND	6/22/2012	Flash Flood	0/0	$0
HAMILTON LAKES	7/9/2012	Flash Flood	0/0	$103,414
TERRA COTTA	8/19/2012	Flash Flood	0/0	$0
RANKIN	8/22/2012	Flash Flood	0/0	$0
PINECROFT	9/3/2012	Flash Flood	0/0	$0
HAMILTON LAKES	6/10/2013	Flash Flood	0/0	$0
BROADVIEW	6/25/2013	Flash Flood	0/0	$0
GUILFORD	7/10/2013	Flash Flood	0/0	$50,961
BROADVIEW	7/21/2013	Flash Flood	0/0	$20,384

*Property damage is reported in 2014 dollars; All damage may not have been reported.
Source: National Climatic Data Center

5.9.4 Historical Summary of Insured Flood Losses

According to FEMA flood insurance policy records as of November 2014, there have been 372 flood losses reported in Guilford County through the National Flood Insurance Program (NFIP) since 1978, totaling over $4.9 million in claims payments. A summary of these figures for each jurisdiction is provided in **Table 5.22**. It should be emphasized that these numbers include only those losses to structures that were insured through the NFIP policies, and for losses in which claims were sought and received. It is likely that many additional instances of flood loss in Guilford County were either uninsured, denied claims payment, or not reported.

TABLE 5.22: SUMMARY OF INSURED FLOOD LOSSES IN GUILFORD COUNTY

Location	Number of Policies	Flood Losses	Claims Payments
Gibsonville	26	0	$471,439
Greensboro	620	268	$4,161,371
High Point	280	61	$288,904
Jamestown	10	0	$0
Oak Ridge	3	1	$17,950
Pleasant Garden	2	0	$0
Sedalia	2	0	$0
Stokesdale	1	0	$0
Summerfield	14	0	$0
Whitsett	1	0	$0

Location	Number of Policies	Flood Losses	Claims Payments
Unincorporated Area	136	42	$471,439
GUILFORD COUNTY TOTAL	**1,095**	**372**	**$4,939,664**

Source: Federal Emergency Management Agency, National Flood Insurance Program

5.9.5 Repetitive and Severe Repetitive Loss Properties

FEMA defines a severe repetitive loss property as any insurable building for which: 1) four or more claims of more than $5,000, with the cumulative amount of such claims exceeding $20,000, were paid by the NFIP or 2) at least two claims exceeding the market value of the structure were paid by the NFIP, since 1978. A severe repetitive loss property may or may not be currently insured by the NFIP. Currently there are over 8,000 severe repetitive loss properties nationwide.

As of January 2014, there are no non-mitigated repetitive loss properties and 9 non-mitigated severe repetitive loss properties located in Guilford County, which accounted for 55 losses and over $2.0 million in claims payments under the NFIP. The average claim amount for these properties is $37,096. Three of the properties are single-family residential buildings, and the remaining six are other residential. Without mitigation these properties will likely continue to experience flood loses. **Table 5.23** presents detailed information on severe repetitive loss properties and NFIP claims for Guilford County.

TABLE 5.23: SUMMARY OF SEVERE REPETITIVE LOSS PROPERTIES IN GUILFORD COUNTY

Location	Number of Properties	Types of Properties	Number of Losses	Building Payments	Content Payments	Total Payments	Average Payment
Gibsonville	0	--	0	$0	$0	$0	$0
Greensboro	9	3 single-family residential; 6 other residential	55	$2,036,995	$3,310	$2,040,304	$37,096
High Point	0	--	0	$0	$0	$0	$0
Jamestown	0	--	0	$0	$0	$0	$0
Oak Ridge	0	--	0	$0	$0	$0	$0
Pleasant Garden	0	--	0	$0	$0	$0	$0
Sedalia	0	--	0	$0	$0	$0	$0
Stokesdale	0	--	0	$0	$0	$0	$0
Summerfield	0	--	0	$0	$0	$0	$0
Whitsett	0	--	0	$0	$0	$0	$0
Unincorporated Area	0	--	0	$0	$0	$0	$0
GUILFORD COUNTY TOTAL	**9**		**55**	**$2,036,995**	**$3,310**	**$2,040,304**	**$37,096**

Source: National Flood Insurance Program

5.9.6 Probability of Future Occurrences

Flood events will remain a threat in Guilford County, and the probability of future occurrences will remain highly likely (100 percent annual probability). The probability of future flood events based on

magnitude and according to best available data is illustrated in the figure above, which indicates those areas susceptible to the 1-percent annual chance flood (100-year floodplain) and the 0.2-percent annual chance flood (500-year floodplain). Additionally, according to the *Piedmont Together Climate Adaptation Report*, the increased likelihood of extreme participation events due to climate change will result in greater risks of flash flooding and impacts from stormwater runoff in the county.

It can be inferred from the floodplain location maps, previous occurrences, and severe repetitive loss properties that risk varies throughout Guilford County. For example, Greensboro has more floodplain and thus a higher risk of flood than the other municipalities. Mitigation actions may be warranted, particularly for severe repetitive loss properties.

5.9.7 Consequence Analysis

People (The Public and Public Confidence)

During flood events, people are often stranded and have to be rescued by first responders. Often lives are lost or people are injured. Public confidence is often impacted by flood events, especially when impacted people do not have flood insurance and are not covered by their home insurance policy. This can create public relations issues for the government.

Responders

Responders are often affected by flooding because floods can trap people in their homes or in other locations, forcing responders to put their lives at risk to return members of the public to safety. Often responders in flood situations face blocked roads and have difficulty safely protecting citizens.

Continuity of Operations

Flooding can impact continuity of operations by knocking out power sources and preventing emergency management personnel from being able to do their jobs properly. Floods typically have some impact on continuity of operations as they can cause severe disruption to normal operations and have done so in the past in Guilford County.

Built Environment (Property, Facilities, and Infrastructure)

Many buildings and structures could be impacted by a flood event. For a detailed analysis of flood prone properties, see *Section 6: Hazard Vulnerability.*

Critical Infrastructure and Key Resources

Critical infrastructure and key resources (CIKR) within Guilford County include assets, systems, and networks that are vital to the continued operation of government services. The incapacitation or destruction of these resources would have a debilitating effect on the county's security, economy, and/or public health.

Economy

There are a variety of economic impacts that could result from a large-scale flood event. The most major impact on soil that is covered by flood waters is the rapid depletion of oxygen, which is essential for plant growth and development. Secondly, flooding may modify nutrients within the soil either by leaching or changing their availability to the plant. Impact from submersion will vary with duration and temperature. The full extent of injury to seedlings would be determined by the current stage of

development at the time of flooding, duration of the flood event, air and soil temperatures, and the presence of axillary buds.

Most research indicates that wheat can withstand water-logged soils for up to 24 hours without severe damage, but barley would not last as long under these conditions. When a small-grain crop such as wheat or barley survives flooding, recovery may be very slow and yield will be much less than normal. Corn is very sensitive to prolonged saturation prior to the fifth- or sixth-leaf stage; however, after the sixth-leaf stage, corn can survive approximately 2–4 days of flooded conditions; once the silting stage is reached, shallow flooding would not cause a noticeable amount of damage.

Environment

The fluctuation of water levels in a wetland, especially flood waters, supports the biological diversity of low-lying areas by releasing nutrients into the soil and germinating wetland flora. Flooding also offers some control of invasive water weeds.

5.10 HAIL

5.10.1 Background

Hailstorms are a potentially damaging outgrowth of severe thunderstorms (thunderstorms are discussed separately in Section 5.8). Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until they develop to a sufficient weight and fall as precipitation. Hail typically takes the form of spheres or irregularly-shaped masses greater than 0.75 inches in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size. **Table 5.24** shows the TORRO Hailstorm Intensity Scale which is a way of measuring hail severity.

TABLE 5.24: TORRO HAILSTORM INTENSITY SCALE

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	mm to inch conversion (inches)	Typical Damage Impacts
H0	Hard Hail	5	0-20	0 - 0.2	No damage
H1	Potentially Damaging	5-**15**	>20	0.2 - 0.6	Slight general damage to plants, crops
H2	Significant	10-**20**	>100	0.4 - 0.8	Significant damage to fruit, crops, vegetation
H3	Severe	20-**30**	>300	0.8 - 1.2	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-**40**	>500	1.0 - 1.6	Widespread glass damage, vehicle bodywork damage

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	mm to inch conversion (inches)	Typical Damage Impacts
H5	Destructive	30-**50**	>800	1.2 - 2.0	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-**60**		1.6 - 2.4	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-**75**		2.0 - 3.0	Severe roof damage, risk of serious injuries
H8	Destructive	60-**90**		1.6 - 3.5	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-**100**		3.0 - 3.9	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100			Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: http://www.torro.org.uk/site/hscale.php

5.10.2 Location and Spatial Extent

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. It is assumed that Guilford County is uniformly exposed to severe thunderstorms; therefore, all areas of the county are equally exposed to hail which may be produced by such storms.

5.10.3 Historical Occurrences

According to the National Climatic Data Center, 164 recorded hailstorm events have affected Guilford County since 1967.[15] **Table 5.25** is a summary of the hail events in Guilford County. **Table 5.26** provides detailed information about each event that occurred in the county. In all, hail occurrences resulted in almost $2,000 (2014 dollars) in property damages.[16] Hail ranged in diameter from 0.75 inches to 2.75 inches. It should be noted that hail is notorious for causing substantial damage to cars, roofs, and other areas of the built environment that may not be reported to the National Climatic Data Center. It is likely that damages are greater than the reported value.

TABLE 5.25: SUMMARY OF HAIL OCCURRENCES IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	4	0/0	$0
Greensboro	42	0/0	$0

[15] These hail events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1956 through August 2014. It is likely that additional hail events have affected Guilford County. In addition to NCDC, the North Carolina Department of Insurance office was contacted for information. As additional local data becomes available, this hazard profile will be amended.

[16] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
High Point	16	0/0	$0
Jamestown	1	0/0	$0
Oak Ridge	3	0/0	$0
Pleasant Garden	4	0/0	$0
Sedalia	1	0/0	$0
Stokesdale	7	0/0	$0
Summerfield	5	0/0	$0
Whitsett	1	0/0	$0
Unincorporated Area	80	0/0	$1,871
GUILFORD COUNTY TOTAL	**164**	**0/0**	**$1,871**

Source: National Climatic Data Center

TABLE 5.26: HISTORICAL HAIL OCCURRENCES IN GUILFORD COUNTY

	Date	Magnitude	Deaths / Injuries	Property Damage*
Gibsonville				
GIBSONVILLE	4/3/1998	0.75 in.	0/0	$0
GIBSONVILLE	5/23/2004	0.88 in.	0/0	$0
GIBSONVILLE	5/14/2006	0.88 in.	0/0	$0
GIBSONVILLE	5/14/2006	0.88 in.	0/0	$0
Greensboro				
GREENSBORO	9/13/1996	0.75 in.	0/0	$0
GREENSBORO	3/5/1997	0.75 in.	0/0	$0
GREENSBORO	8/25/1997	0.75 in.	0/0	$0
GREENSBORO	5/20/1998	1.75 in.	0/0	$0
GREENSBORO	5/26/1998	0.75 in.	0/0	$0
GREENSBORO	6/15/1998	0.75 in.	0/0	$0
GREENSBORO	5/25/2001	1.00 in.	0/0	$0
GREENSBORO	5/25/2001	1.00 in.	0/0	$0
GREENSBORO	7/4/2002	0.88 in.	0/0	$0
GREENSBORO	7/4/2002	0.75 in.	0/0	$0
GREENSBORO	4/26/2003	1.25 in.	0/0	$0
GREENSBORO	5/31/2003	1.00 in.	0/0	$0
GREENSBORO	8/5/2003	0.75 in.	0/0	$0
GREENSBORO	8/22/2003	0.88 in.	0/0	$0
GREENSBORO	5/9/2004	0.75 in.	0/0	$0
GREENSBORO	3/23/2005	1.75 in.	0/0	$0
GREENSBORO	4/3/2006	0.75 in.	0/0	$0
GREENSBORO	5/14/2006	0.88 in.	0/0	$0
GREENSBORO	5/14/2006	0.88 in.	0/0	$0
GREENSBORO	5/14/2006	0.88 in.	0/0	$0
GREENSBORO	5/14/2006	1.00 in.	0/0	$0
GREENSBORO	5/14/2006	0.88 in.	0/0	$0
GREENSBORO	5/14/2006	1.00 in.	0/0	$0
GREENSBORO	5/14/2006	1.75 in.	0/0	$0

	Date	Magnitude	Deaths / Injuries	Property Damage*
GREENSBORO	5/14/2006	1.75 in.	0/0	$0
GREENSBORO	5/15/2006	0.75 in.	0/0	$0
GREENSBORO	5/26/2006	1.00 in.	0/0	$0
GREENSBORO	6/11/2006	0.75 in.	0/0	$0
GREENSBORO	6/11/2006	1.50 in.	0/0	$0
GREENSBORO	6/11/2006	0.75 in.	0/0	$0
GREENSBORO	6/23/2006	0.88 in.	0/0	$0
GREENSBORO	6/23/2006	1.00 in.	0/0	$0
GREENSBORO	6/23/2006	1.00 in.	0/0	$0
GREENSBORO	6/23/2006	0.75 in.	0/0	$0
GREENSBORO	8/30/2006	0.75 in.	0/0	$0
GREENSBORO	9/28/2006	0.88 in.	0/0	$0
GREENSBORO	4/15/2007	0.88 in.	0/0	$0
GREENSBORO	6/27/2007	0.75 in.	0/0	$0
GREENSBORO	6/27/2007	0.75 in.	0/0	$0
GREENSBORO	5/31/2008	1.00 in.	0/0	$0
GREENSBORO	8/19/2009	0.75 in.	0/0	$0
GREENSBORO	6/1/2012	1.75 in.	0/0	$0
High Point				
High Point	8/27/1994	0.75 in.	0/0	$0
HIGH POINT	7/18/1996	0.75 in.	0/0	$0
HIGH PT	4/17/1998	0.88 in.	0/0	$0
HIGH PT	5/7/1998	0.88 in.	0/0	$0
HIGH PT	6/3/2000	1.75 in.	0/0	$0
HIGH PT	7/2/2002	0.88 in.	0/0	$0
HIGH PT	4/30/2003	0.75 in.	0/0	$0
HIGH PT	5/2/2003	0.75 in.	0/0	$0
HIGH PT	7/4/2004	0.75 in.	0/0	$0
HIGH PT	7/17/2004	1.00 in.	0/0	$0
HIGH PT	5/14/2006	1.00 in.	0/0	$0
HIGH PT	6/8/2006	0.75 in.	0/0	$0
HIGH PT	6/23/2006	0.88 in.	0/0	$0
HIGH PT	8/30/2006	1.00 in.	0/0	$0
HIGH PT	8/30/2006	0.75 in.	0/0	$0
HIGH PT	4/20/2008	1.00 in.	0/0	$0
Jamestown				
JAMESTOWN	4/26/2003	0.88 in.	0/0	$0
Oak Ridge				
OAK RIDGE	5/12/2001	0.88 in.	0/0	$0
OAK RIDGE	3/23/2005	1.00 in.	0/0	$0
OAK RIDGE ARPT	7/20/2009	1.75 in.	0/0	$0
Pleasant Garden				
PLEASANT GARDEN	7/1/2002	1.50 in.	0/0	$0
PLEASANT GARDEN	8/7/2006	0.75 in.	0/0	$0
PLEASANT GARDEN	5/9/2009	0.88 in.	0/0	$0
PLEASANT GARDEN	4/19/2013	1.00 in.	0/0	$0

	Date	Magnitude	Deaths / Injuries	Property Damage*
Sedalia				
SEDALIA	9/20/2005	0.75 in.	0/0	$0
Stokesdale				
STOKESDALE	7/24/1997	1.00 in.	0/0	$0
STOKESDALE	7/3/2002	1.75 in.	0/0	$0
STOKESDALE	7/19/2003	0.88 in.	0/0	$0
STOKESDALE	6/11/2006	0.75 in.	0/0	$0
STOKESDALE	6/11/2006	0.75 in.	0/0	$0
STOKESDALE	7/4/2006	1.00 in.	0/0	$0
STOKESDALE	9/28/2006	0.75 in.	0/0	$0
Summerfield				
SUMMERFIELD	8/18/2000	2.50 in.	0/0	$0
SUMMERFIELD	7/13/2003	0.88 in.	0/0	$0
SUMMERFIELD	10/21/2005	0.75 in.	0/0	$0
SUMMERFIELD	9/28/2006	0.75 in.	0/0	$0
SUMMERFIELD	5/31/2008	0.75 in.	0/0	$0
Whitsett				
WHISTETT	6/22/2008	0.75 in.	0/0	$0
Unincorporated Area				
GUILFORD CO.	8/7/1967	0.75 in.	0/0	$0
GUILFORD CO.	6/22/1978	1.00 in.	0/0	$0
GUILFORD CO.	8/21/1979	1.00 in.	0/0	$0
GUILFORD CO.	4/27/1982	1.00 in.	0/0	$0
GUILFORD CO.	5/29/1982	1.75 in.	0/0	$0
GUILFORD CO.	4/2/1983	2.75 in.	0/0	$0
GUILFORD CO.	4/14/1984	1.75 in.	0/0	$0
GUILFORD CO.	5/6/1984	1.75 in.	0/0	$0
GUILFORD CO.	5/15/1985	0.75 in.	0/0	$0
GUILFORD CO.	5/22/1985	2.50 in.	0/0	$0
GUILFORD CO.	6/3/1985	1.00 in.	0/0	$0
GUILFORD CO.	6/5/1985	1.25 in.	0/0	$0
GUILFORD CO.	6/5/1985	1.00 in.	0/0	$0
GUILFORD CO.	4/12/1987	1.75 in.	0/0	$0
GUILFORD CO.	6/1/1987	1.75 in.	0/0	$0
GUILFORD CO.	5/16/1988	0.75 in.	0/0	$0
GUILFORD CO.	5/17/1988	0.75 in.	0/0	$0
GUILFORD CO.	5/17/1988	0.75 in.	0/0	$0
GUILFORD CO.	5/17/1988	0.75 in.	0/0	$0
GUILFORD CO.	5/17/1988	1.00 in.	0/0	$0
GUILFORD CO.	6/21/1988	0.75 in.	0/0	$0
GUILFORD CO.	7/10/1988	1.75 in.	0/0	$0
GUILFORD CO.	4/27/1989	0.75 in.	0/0	$0
GUILFORD CO.	6/2/1989	1.00 in.	0/0	$0
GUILFORD CO.	5/1/1990	1.00 in.	0/0	$0
GUILFORD CO.	5/1/1990	1.00 in.	0/0	$0
GUILFORD CO.	5/27/1990	1.00 in.	0/0	$0

	Date	Magnitude	Deaths / Injuries	Property Damage*
GUILFORD CO.	5/27/1990	1.75 in.	0/0	$0
GUILFORD CO.	7/1/1990	1.75 in.	0/0	$0
GUILFORD CO.	4/30/1992	0.75 in.	0/0	$0
GUILFORD CO.	6/26/1992	0.75 in.	0/0	$0
Julian	10/27/1995	1.50 in.	0/0	$0
JULIAN	5/29/1996	1.75 in.	0/0	$0
JULIAN,CLIMAX	10/18/1996	0.75 in.	0/0	$0
MONTICELLO	5/1/1998	0.75 in.	0/0	$0
GUILFORD	5/20/1998	1.00 in.	0/0	$0
MC LEANSVILLE	6/23/2006	1.75 in.	0/0	$0
CLIMAX	3/4/2008	0.75 in.	0/0	$0
GREENSBORO MAY ARPT	3/4/2008	0.75 in.	0/0	$0
COLFAX	3/4/2008	0.75 in.	0/0	$0
BROWNS SUMMIT	5/8/2008	0.75 in.	0/0	$0
BATTLE GROUND	5/8/2008	1.75 in.	0/0	$0
BROWNS SUMMIT	5/9/2008	0.75 in.	0/0	$0
SHERWOOD VLG	5/20/2008	0.88 in.	0/0	$0
BATTLE GROUND	5/31/2008	0.75 in.	0/0	$0
BATTLE GROUND	5/31/2008	0.88 in.	0/0	$0
GUILFORD	5/31/2008	1.00 in.	0/0	$0
BATTLE GROUND	5/31/2008	0.88 in.	0/0	$0
PINECROFT	5/31/2008	1.00 in.	0/0	$0
BATTLE GROUND	5/31/2008	1.25 in.	0/0	$0
BATTLE GROUND	5/31/2008	1.00 in.	0/0	$0
GUILFORD	6/22/2008	0.75 in.	0/0	$0
BATTLE GROUND	6/22/2008	0.75 in.	0/0	$0
HAMILTON LAKES	6/22/2008	0.88 in.	0/0	$0
HAMILTON LAKES	6/22/2008	0.88 in.	0/0	$0
BATTLE GROUND	6/3/2009	1.00 in.	0/0	$0
BROADVIEW	6/3/2009	0.75 in.	0/0	$0
BESSEMER	6/3/2009	1.00 in.	0/0	$0
CLIMAX	6/9/2009	1.00 in.	0/0	$0
HILLSDALE	7/20/2009	0.75 in.	0/0	$0
BROWNS SUMMIT	3/28/2010	1.00 in.	0/0	$1,361
DEEP RIVER	5/15/2010	1.00 in.	0/0	$0
DEEP RIVER	5/15/2010	1.00 in.	0/0	$0
VANDALIA	5/15/2010	1.00 in.	0/0	$0
GREENSBORO ARPT	4/27/2011	0.75 in.	0/0	$0
HAMILTON LAKES	4/27/2011	0.75 in.	0/0	$0
GREENSBORO ARPT	4/27/2011	0.88 in.	0/0	$0
BROWNS SUMMIT	6/9/2011	1.50 in.	0/0	$0
FOUR MILE	9/27/2011	1.00 in.	0/0	$0
GREENSBORO ARPT	3/24/2012	1.00 in.	0/0	$0
GROOMTOWN	3/24/2012	1.00 in.	0/0	$0
CLIMAX	3/24/2012	1.00 in.	0/0	$0
PINECROFT	6/1/2012	1.00 in.	0/0	$0

	Date	Magnitude	Deaths / Injuries	Property Damage*
POMONA	6/25/2013	1.75 in.	0/0	$510
GROOMTOWN	6/10/2014	1.25 in.	0/0	$0
KOONTZVILLE	6/16/2014	1.25 in.	0/0	$0
BRIGHTWOOD	6/16/2014	1.25 in.	0/0	$0
BRIGHTWOOD	6/16/2014	1.75 in.	0/0	$0
BRIGHTWOOD	6/16/2014	1.50 in.	0/0	$0
BROADVIEW	6/16/2014	1.00 in.	0/0	$0

*Property damage is reported in 2014 dollars; All damage may not have been reported.
Source: National Climatic Data Center

5.10.4 Probability of Future Occurrences

Based on historical occurrence information, it is assumed that the probability of future hail occurrences is highly likely (100 percent annual probability). Since hail is an atmospheric hazard (coinciding with thunderstorms), it is assumed that the entire county has equal exposure to this hazard. It can be expected that future hail events will continue to cause minor damage to property and vehicles throughout the county.

5.10.5 Consequence Analysis

People (The Public and Public Confidence)
Hail can have a negative impact on the public as it can often cause injury if people are struck by hail stones. Often the impoverished are detrimentally impacted if they cannot find shelter, but hail can impact anyone. There would be little negative impact on public confidence.

Responders
Hail can also affect responders who are often more susceptible to hail events due to the nature of their work which often forces police and emergency medical providers to be exposed to the elements. In these cases, responders could be negatively impacted by hail.

Continuity of Operations
Hail would likely have some impacts on continuity of operations as the warning time for these events is usually shorter and hail stones could potentially knock out power supplies or other critical resources which would affect operations.

Built Environment (Property, Facilities, and Infrastructure)
Hail can often have a significant effect on the built environment, depending on the size of the hail stones. Often these can damage roofs or other parts of homes and businesses as they are essentially rocks that are being propelled at high speeds. Hail can affect most any type of facility or infrastructure as well, causing damage to the structure.

Economy
A hailstorm could negatively impact the economy to some degree if the damage from the storm is large enough. Often hail causes a great deal of damage to personal property such as cars and homes, and these impacts would hurt the overall economy due to recovery efforts.

Environment

Hail often has a serious effect on crops and has been known to cause millions of dollars' worth of damage to farmers. It can also negatively impact livestock, as well as any flora or fauna that is not properly sheltered.

5.11 HURRICANE / OTHER TROPICAL DISTURBANCE

5.11.1 Background

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. The majority of 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.

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale (**Table 5.27**), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

TABLE 5.27: SAFFIR-SIMPSON SCALE

Category	Maximum Sustained Wind Speed (MPH)	Minimum Surface Pressure (Millibars)
1	74–95	Greater than 980
2	96–110	979–965
3	111–129	964–945
4	130–156	944–920
5	157 +	Less than 920

Source: National Hurricane Center (2012)

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 5.28** 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 5.28: 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

5.11.2 Location and Spatial Extent

Hurricanes and tropical storms threaten the entire Atlantic and Gulf seaboard of the United States. While coastal areas are most directly exposed to the brunt of landfalling storms, their impact is often felt hundreds of miles inland and they can affect Guilford County. All areas in Guilford County are equally susceptible to hurricane and tropical storms.

5.11.3 Historical Occurrences

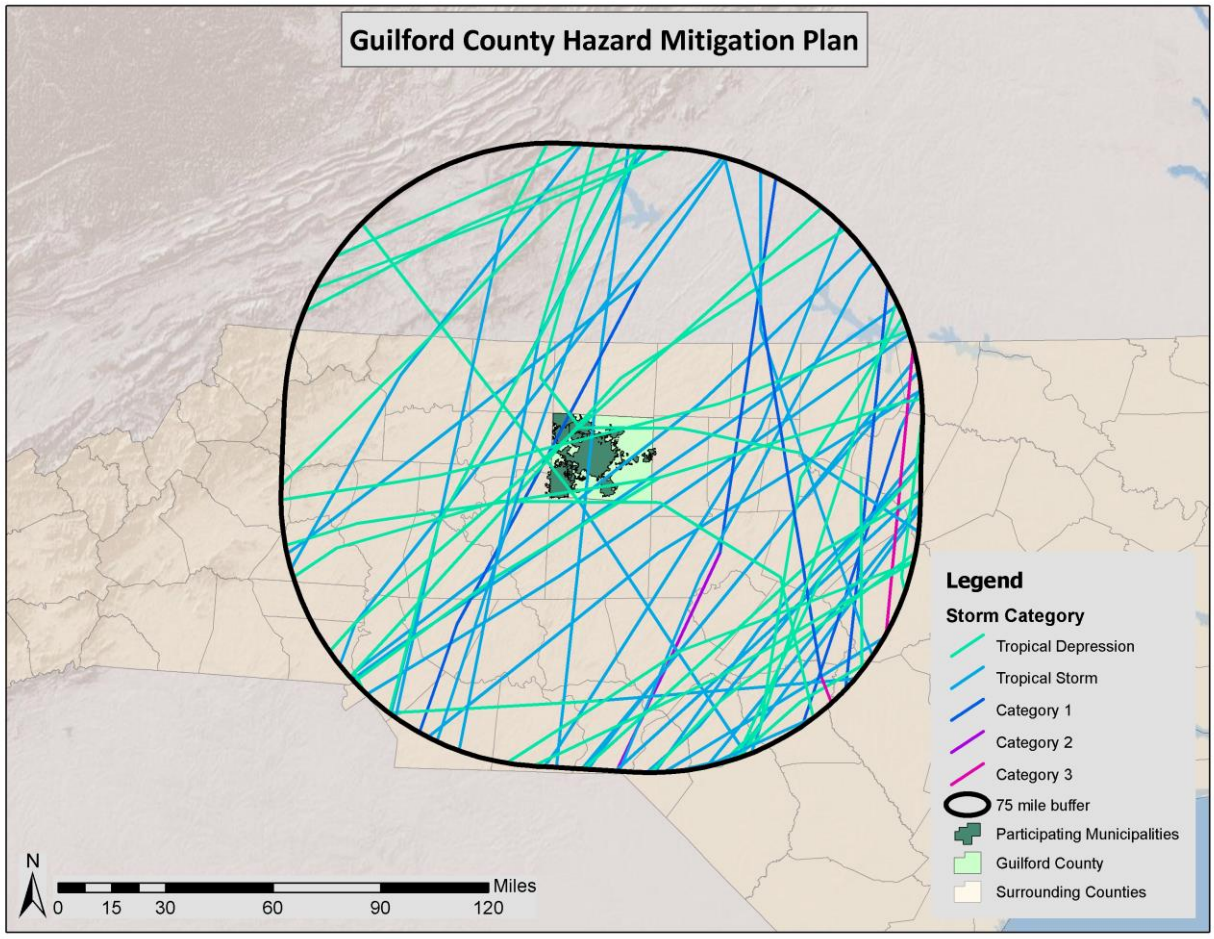
According to the National Hurricane Center's historical storm track records, 59 hurricane/tropical storm tracks have passed within 75 miles of Guilford County since 1854.[17] This includes 6 hurricanes, 31 tropical storms, and 22 tropical depressions.

Of the recorded storm events, 12 have traversed directly through Guilford County as shown in **Figure 5.21**. **Table 5.29** provides the date of occurrence, name (if applicable), maximum wind speed (as

[17] These storm track statistics do not include extra-tropical storms. Though these related hazard events are less severe in intensity, they may cause significant local impact in terms of rainfall and high winds.

recorded within 75 miles of Guilford County), and Category of the storm based on the Saffir-Simpson Scale for each event.

FIGURE 5.21: HISTORICAL HURRICANE STORM TRACKS WITHIN 75 MILES OF GUILFORD COUNTY



Source: National Oceanic and Atmospheric Administration; National Hurricane Center

TABLE 5.29: HISTORICAL STORM TRACKS WITHIN 75 MILES OF GUILFORD COUNTY (1850–2014)

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
9/9/1854	UNNAMED	50	Tropical Storm
9/17/1859	UNNAMED	40	Tropical Storm
6/23/1867	UNNAMED	40	Tropical Storm
10/4/1877	UNNAMED	40	Tropical Storm
9/12/1878	UNNAMED	60	Tropical Storm
9/11/1882	UNNAMED	40	Tropical Storm
10/12/1885	UNNAMED	40	Tropical Storm
6/22/1886	UNNAMED	40	Tropical Storm
7/1/1886	UNNAMED	45	Tropical Storm
9/10/1888	UNNAMED	35	Tropical Storm

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
9/24/1889	UNNAMED	45	Tropical Storm
8/28/1893	UNNAMED	75	Category 1
10/13/1893	UNNAMED	80	Category 1
9/29/1896	UNNAMED	85	Category 2
10/31/1899	UNNAMED	75	Category 1
6/16/1902	UNNAMED	35	Tropical Storm
9/14/1904	UNNAMED	60	Tropical Storm
10/11/1905	UNNAMED	25	Tropical Depression
9/23/1907	UNNAMED	35	Tropical Storm
8/31/1911	UNNAMED	25	Tropical Depression
6/14/1912	UNNAMED	35	Tropical Storm
9/3/1913	UNNAMED	40	Tropical Storm
8/3/1915	UNNAMED	35	Tropical Storm
9/23/1920	UNNAMED	35	Tropical Storm
10/3/1927	UNNAMED	35	Tropical Storm
8/11/1928	UNNAMED	30	Tropical Storm
10/2/1929	UNNAMED	50	Tropical Storm
9/6/1935	UNNAMED	45	Tropical Storm
10/20/1944	UNNAMED	50	Tropical Storm
9/18/1945	UNNAMED	50	Tropical Storm
10/9/1946	UNNAMED	30	Tropical Depression
9/24/1947	UNNAMED	30	Tropical Depression
8/28/1949	UNNAMED	40	Tropical Storm
8/31/1952	ABLE	45	Tropical Storm
10/15/1954	HAZEL	110	Category 3
8/17/1955	DIANE	60	Tropical Storm
7/10/1959	CINDY	30	Tropical Depression
8/31/1964	CLEO	25	Tropical Depression
6/9/1968	ABBY	25	Tropical Depression
5/26/1970	ALMA	25	Tropical Depression
10/1/1971	GINGER	30	Tropical Depression
9/15/1976	SUBTROP: UNNAMED	30	Tropical Depression
9/5/1979	DAVID	45	Tropical Storm
7/25/1985	BOB	45	Tropical Storm
8/18/1985	DANNY	25	Tropical Depression
9/8/1987	UNNAMED	0	Tropical Depression
8/29/1988	CHRIS	25	Tropical Depression
9/22/1989	HUGO*	85	Category 2
7/21/1994	UNNAMED	20	Tropical Depression
9/6/1996	FRAN	100	Category 3
7/24/1997	DANNY	20	Tropical Depression
9/5/1999	DENNIS	35	Tropical Storm
9/16/1999	FLOYD*	90	Category 2
9/19/2000	GORDON	25	Tropical Depression
9/23/2000	HELENE	25	Tropical Depression
7/2/2003	BILL	20	Tropical Depression

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
8/30/2004	GASTON	30	Tropical Depression
9/17/2004	IVAN	20	Tropical Depression
9/28/2004	JEANNE	20	Tropical Depression
7/7/2005	CINDY	20	Tropical Depression
6/14/2006	ALBERTO	35	Tropical Storm

*Although the track of these storms traversed just outside of the 75 mile buffer area, they were included in the hazard history since a federal disaster area was declared for Guilford County as a result of the storm's impact.
Source: National Hurricane Center

The National Climatic Data Center reported four events associated with a hurricane or tropical storm in Guilford County since 1996. Additionally, Federal records indicate that four disaster declarations were made in 1989 (Hurricane Hugo), 1996 (Hurricane Fran), 1999 (Hurricane Floyd), and 2004 (Hurricane Ivan) for the county.[18]

Flooding is often the greatest hazard of concern with hurricane and tropical storm events in Guilford County. Most events do not carry winds that are above that of the thunderstorms and straight line winds received by the county. Some anecdotal information is available for the major storms that have impacted that area as found below:

Hurricane Hugo – September 22-24, 1989
Hurricane Hugo was one of the largest storms on record in the Atlantic Basin that produced high winds and dumped heavy rains over much of North Carolina and South Carolina. Hugo reached a peak level of Category 5 on the Saffir-Simpson scale and made landfall near Isle of Palms in South Carolina as a Category 4, eventually passing over Charlotte and much of the surrounding area as a Category 1 storm. Although the storm caused its greatest damage in South Carolina, over 1,000 structures were destroyed or severely damaged in North Carolina, causing over $1 billion dollars in damages. Wind gusts reached over 40 mph and numerous trees were downed throughout much of south and western North Carolina.

Hurricane Fran – September 5-6, 1996
After being hit just a few weeks earlier by Hurricane Bertha, North Carolina was impacted by the one of the most devastating storms to ever make landfall along the Atlantic Coast. Fran dropped more than 10 inches of rain in many areas and had sustained winds of around 115 miles per hour as it hit the coast and began its path along the I-40 corridor central North Carolina. In the end, over 3 billion dollars in damages were reported in the state. Damages to infrastructure and agriculture added to the overall toll and more than 1.7 million people in the state were left without power.

Hurricane Floyd – September 16, 1999
Hurricane Floyd, combined with the weather conditions before and immediately after this hurricane, resulted in the most severe flooding and devastation in North Carolina history. In North Carolina, the storm resulted in 35 fatalities, over $3 billion in damages, 7,000 destroyed homes, 56,000 damaged homes, 1,500 people rescued from flooded areas, and more than 500,000 customers without electricity. Additionally, the flooding caused an estimated $813 million in agricultural losses affecting 32,000 farmers. There was also significant loss of livestock including 2,860,827 poultry, 28,000 swine, and 619 cattle.

[18] A complete listing of historical disaster declarations can be found in Section 4: *Hazard Identification*.

Hurricane Ivan – September 16-17, 2004
Just a week and a half following Tropical Storm Frances, the remnants of Hurricane Ivan hit western North Carolina when many streams and rivers were already well above flood stage. The widespread flooding forced many roads to be closed and landslides were common across the mountain region. Wind gusts reached between 40 and 60 mph across the higher elevations of the Appalachian Mountains resulting in numerous downed trees. More than $13.8 million of federal aid was dispersed across North Carolina following Ivan.

5.11.4 Probability of Future Occurrences

Given the inland location of the county, it is more likely to be affected by remnants of hurricane and tropical storm systems (as opposed to a major hurricane) which may result in flooding or high winds. The probability of being impacted is less than coastal areas, but still remains a real threat to Guilford County due to induced events like flooding and erosion. Based on historical evidence, the probability level of future occurrence is likely (between 10 and 100 percent annual probability). Given the regional nature of the hazard, all areas in the county are equally exposed to this hazard. However, when the county is impacted, the damage could be catastrophic, threatening lives and property throughout the planning area. Additionally, according to the *Piedmont Together Climate Adaptation Report*, the increased likelihood of hurricanes due to climate change will result in greater wind damage and increased flooding in the county.

5.11.5 Consequence Analysis

People (The Public and Public Confidence)
A number of people are expected to be displaced from their homes and will require accommodations in temporary public shelters due to a hurricane. This hazard could potentially have a negative effect on public confidence due to the possibility of a high magnitude event and the difficulties that might arise for governments in terms of response and recovery.

Responders
The impacts on responders from this type of storm could potentially be very high as responders may be physically injured or killed during a storm event by flooding or high winds. In addition, their homes and personal effects could also be impacted which would limit their response capability.

In terms of their actual response capacity, downed trees in the wake of a hurricane often block roads and make ingress and egress difficult, thereby causing issues with response time. This is also often true of the resulting floodwaters. Moreover, due to the large scale spatial impact of hurricanes and the number of citizens affected by the storm, response time will be reduced because of the number of incidents that require emergency responders.

Continuity of Operations
Continuity of operations in a hurricane event can be severely affected if power is lost or if critical facilities or infrastructure are damaged during an event. Although Guilford County has a plan in place to maintain continuity of operations in the event of a storm, a hurricane with a high magnitude would likely disrupt operations to some degree due to the impacts it would have on personnel.

Built Environment (Property, Facilities, and Infrastructure)

Many buildings and structures could be impacted by a hurricane or tropical storm event. For a detailed analysis of dollar damage to properties, see *Section 6: Hazard Vulnerability.*

Economy

In general, the economy would be severely impacted by a hurricane or tropical storm event. Due to the massive scale of these events and multiple types of impacts from flooding and high winds, commerce would definitively slow down as efforts to rebuild are undertaken.

Debris Generation

HAZUS-MH estimates the amount of debris that will be generated by the hurricane scenario. The model breaks the debris into three general categories: brick/wood, reinforced concrete/steel, and trees. This distinction is made because of the different types of material-handling equipment required to handle the debris. The model estimates that a total of 104,304 tons of debris will be generated. Of the total amount, brick/wood comprises 3.88 percent of the total, reinforced concrete/steel comprises 0.00 percent of the total, and tree debris comprises 96.12 percent of the total.

Environment

Flooding and wind damage are the main impacts that would be felt by a hurricane in Guilford County. Please refer to the Flood Hazard Profile for a discussion on flood-related impacts and the Tornado Hazard Profile for a discussion on relevant wind-related impacts.

5.12 THUNDERSTORM (WIND AND LIGHTNING)

5.12.1 Background

Thunderstorms can produce a variety of accompanying hazards including wind (discussed here), hail, and lightning (discussed here).[19] Although thunderstorms generally affect a small area, they are very dangerous and may cause substantial property damage.

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

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as "severe." A severe thunderstorm occurs when the storm produces at least one of these three elements: 1) hail at least one inch in diameter, 2) a tornado, or 3) winds of at least 58 miles per hour.

[19]The hail hazard is discussed as separate a hazard in this section.

Wind

Thunderstorm events have the capability of producing straight-line winds that can cause severe destruction to communities and threaten the safety of a population. Such wind events, sometimes separate from a thunderstorm event, are common throughout Guilford County. Therefore, high winds are also reported in this section.

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

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

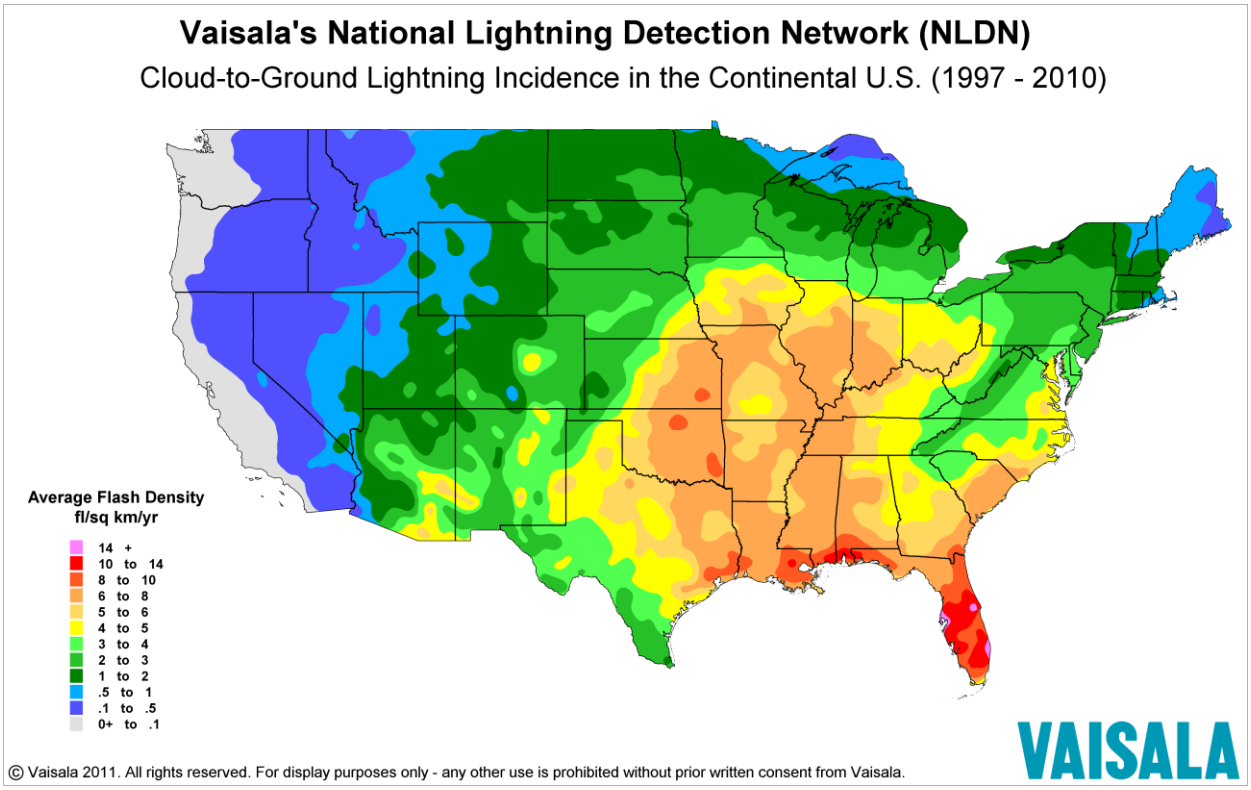
Lightning

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes the thunder which often accompanies lightning strikes. While most often affiliated with severe thunderstorms, lightning may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

Lightning strikes occur in very small, localized areas. For example, they may strike a building, electrical transformer, or even a person. According to FEMA, lightning injures an average of 300 people and kills 80 people each year in the United States. Direct lightning strikes also have the ability to cause significant damage to buildings, critical facilities, and infrastructure largely by igniting a fire. Lightning is also responsible for igniting wildfires that can result in widespread damages to property.

Figure 5.22 shows a lightning flash density map for the years 1997-2010 based upon data provided by Vaisala's U.S. National Lightning Detection Network (NLDN®).

FIGURE 5.22: LIGHTNING FLASH DENSITY IN THE UNITED STATES



Source: Vaisala United States National Lightning Detection Network

5.12.2 Location and Spatial Extent

Wind

A wind event is an atmospheric hazard, and thus has no geographic boundaries. It is typically a widespread event that can occur in all regions of the United States. However, thunderstorms are most common in the central and southern states because atmospheric conditions in those regions are favorable for generating these powerful storms. Also, Guilford County typically experiences several straight-line wind events each year. These wind events can and have caused significant damage. It is assumed that Guilford County has uniform exposure to a thunderstorm/wind event and the spatial extent of an impact could be large.

Lightning

Lightning occurs randomly, therefore it is impossible to predict where and with what frequency it will strike. It is assumed that all of Guilford County is uniformly exposed to lightning.

5.12.3 Historical Occurrences

Wind

According to NCDC, there have been 254 reported thunderstorm wind and high wind events since 1956 in Guilford County.[20] These events caused almost $2.0 million (2014 dollars) in damages.[21] There were also reports of two fatalities and two injuries. **Table 5.30** summarizes this information. **Table 5.31** provides detailed thunderstorm wind and high wind event reports, including date, magnitude, and associated damages for each event.

TABLE 5.30: SUMMARY OF THUNDERSTORM / HIGH WIND OCCURRENCES IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	8	0/0	$0
Greensboro	36	0/1	$391,415
High Point	11	0/0	$280,487
Jamestown	4	0/0	$0
Oak Ridge	11	0/0	$2,038
Pleasant Garden	8	0/0	$5,444
Sedalia	3	0/0	$0
Stokesdale	5	0/0	$0
Summerfield	8	0/0	$10,889
Whitsett	2	0/0	$0
Unincorporated Area	158	2/1	$1,307,527
GUILFORD COUNTY TOTAL	**254**	**2/2**	**$1,997,800**

Source: National Climatic Data Center

TABLE 5.31: HISTORICAL THUNDERSTORM / HIGH WIND OCCURRENCES IN GUILFORD COUNTY

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
Gibsonville					
Gibsonville	8/26/1993	Thunderstorm Wind	0 kts.	0/0	$0
GIBSONVILLE	5/20/2000	Thunderstorm Wind	60 kts. E	0/0	$0
GIBSONVILLE	8/18/2000	Thunderstorm Wind	50 kts. E	0/0	$0
GIBSONVILLE	7/20/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GIBSONVILLE	6/11/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GIBSONVILLE	6/27/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GBSNVLL MC LEAN ARPT	8/8/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
GIBSONVILLE	9/2/2012	Thunderstorm Wind	50 kts. EG	0/0	$0

[20] These thunderstorm events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1955 through August 2014 and these high wind events are only inclusive of those reported by NCDC from 1996 through August 2014. It is likely that additional thunderstorm and high wind events have occurred in Guilford County. As additional local data becomes available, this hazard profile will be amended.

[21] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
Greensboro					
Greensboro	8/12/1993	Thunderstorm Wind	0 kts.	0/0	$0
Greensboro	8/17/1993	Thunderstorm Wind	65 kts.	0/0	$0
Greensboro	8/26/1993	Thunderstorm Wind	0 kts.	0/0	$0
GREENSBORO	4/20/1996	Thunderstorm Wind	0 kts.	0/0	$0
GREENSBORO	5/11/1996	Thunderstorm Wind	60 kts.	0/0	$302,655
GREENSBORO	5/24/1996	Thunderstorm Wind	0 kts.	0/0	$0
GREENSBORO	3/5/1997	Thunderstorm Wind	50 kts.	0/0	$73,967
GREENSBORO	7/28/1997	Thunderstorm Wind	50 kts.	0/0	$14,793
GREENSBORO	6/16/1998	Thunderstorm Wind	50 kts.	0/0	$0
GREENSBORO	6/30/1998	Thunderstorm Wind	50 kts.	0/1	$0
GREENSBORO	7/7/1999	Thunderstorm Wind	50 kts.	0/0	$0
GREENSBORO	5/25/2000	Thunderstorm Wind	70 kts. E	0/0	$0
GREENSBORO	8/10/2000	Thunderstorm Wind	50 kts. E	0/0	$0
GREENSBORO	6/1/2002	Thunderstorm Wind	50 kts. E	0/0	$0
GREENSBORO	6/27/2003	Thunderstorm Wind	52 kts. MG	0/0	$0
GREENSBORO	6/27/2003	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	4/3/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	4/17/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/11/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/11/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/11/2006	Thunderstorm Wind	52 kts. EG	0/0	$0
GREENSBORO	6/11/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/11/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	8/3/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	8/30/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	9/28/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	11/16/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	4/15/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/4/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/4/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/4/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/5/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	8/21/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/3/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	6/22/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO	7/21/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
High Point					
HIGH PT	5/20/2000	Thunderstorm Wind	60 kts. E	0/0	$0
HIGH PT	5/25/2000	Thunderstorm Wind	60 kts. E	0/0	$0
HIGH PT	3/8/2005	Thunderstorm Wind	54 kts. MG	0/0	$0
HIGH PT	4/17/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
HIGH PT	4/17/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
HIGH PT	7/19/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
HIGH PT	7/13/2009	Thunderstorm Wind	50 kts. EG	0/0	$16,601
HIGH PT	4/5/2011	Thunderstorm Wind	50 kts. EG	0/0	$263,886

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
HIGH PT	6/1/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
HIGH PT	6/19/2014	Thunderstorm Wind	50 kts. EG	0/0	$0
HIGH PT	6/19/2014	Thunderstorm Wind	50 kts. EG	0/0	$0
Oak Ridge					
OAK RIDGE	6/15/2000	Thunderstorm Wind	50 kts. E	0/0	$0
OAK RIDGE	7/4/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE ARPT	6/27/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE	5/26/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE	5/27/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE ARPT	9/8/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE ARPT	4/19/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE ARPT	8/10/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
OAK RIDGE	8/10/2013	Thunderstorm Wind	50 kts. EG	0/0	$1,019
OAK RIDGE	8/10/2013	Thunderstorm Wind	50 kts. EG	0/0	$1,019
OAK RIDGE	6/19/2014	Thunderstorm Wind	50 kts. EG	0/0	$0
Pleasant Garden					
PLEASANT GARDEN	3/11/2000	Thunderstorm Wind	50 kts. E	0/0	$0
PLEASANT GARDEN	5/22/2001	Thunderstorm Wind	50 kts. E	0/0	$0
PLEASANT GARDEN	8/7/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
PLEASANT GARDEN	7/8/2008	Thunderstorm Wind	50 kts. EG	0/0	$0
PLEASANT GARDEN	5/9/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
PLEASANT GARDEN	6/23/2010	Thunderstorm Wind	50 kts. EG	0/0	$5,444
PLEASANT GARDEN	7/20/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
PLEASANT GARDEN	4/28/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
Sedalia					
SEDALIA	7/13/2003	Thunderstorm Wind	50 kts. EG	0/0	$0
SEDALIA	3/8/2005	Thunderstorm Wind	50 kts. EG	0/0	$0
SEDALIA	7/4/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
Stokesdale					
STOKESDALE	9/14/2000	Thunderstorm Wind	50 kts. E	0/0	$0
STOKESDALE	8/12/2004	Thunderstorm Wind	50 kts. EG	0/0	$0
STOKESDALE	6/19/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
STOKESDALE	6/27/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
STOKESDALE	8/21/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
Summerfield					
SUMMERFIELD	7/28/1997	Thunderstorm Wind	50 kts.	0/0	$0
SUMMERFIELD	6/15/2000	Thunderstorm Wind	50 kts. E	0/0	$0
SUMMERFIELD	5/13/2002	Thunderstorm Wind	50 kts. E	0/0	$0
SUMMERFIELD	7/28/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
SUMMERFIELD	8/30/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
SUMMERFIELD	6/24/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
SUMMERFIELD	6/24/2010	Thunderstorm Wind	50 kts. EG	0/0	$10,889
SUMMERFIELD	7/24/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
Whitsett					
WHITSETT	8/14/2011	Thunderstorm Wind	50 kts. EG	0/0	$0

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
WHITSETT	7/21/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
Unincorporated Area					
GUILFORD CO.	8/2/1956	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/17/1957	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/25/1960	Thunderstorm Wind	60 kts.	0/0	$0
GUILFORD CO.	8/9/1962	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	3/19/1963	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD CO.	7/3/1964	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/13/1964	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/27/1965	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/4/1965	Thunderstorm Wind	55 kts.	0/0	$0
GUILFORD CO.	5/1/1966	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/29/1967	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/4/1967	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/24/1969	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/4/1970	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/29/1971	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	3/24/1975	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	2/18/1976	Thunderstorm Wind	54 kts.	0/0	$0
GUILFORD CO.	7/15/1976	Thunderstorm Wind	84 kts.	0/0	$0
GUILFORD CO.	8/14/1976	Thunderstorm Wind	60 kts.	0/0	$0
GUILFORD CO.	8/14/1976	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/4/1979	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/21/1979	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/1/1980	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD CO.	8/15/1980	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/6/1981	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/28/1981	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/29/1982	Thunderstorm Wind	52 kts.	0/0	$0
GUILFORD CO.	3/6/1983	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/10/1984	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD CO.	7/26/1984	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/26/1984	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/3/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/5/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/5/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/4/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/4/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/10/1985	Thunderstorm Wind	55 kts.	0/0	$0
GUILFORD CO.	10/15/1985	Thunderstorm Wind	52 kts.	0/0	$0
GUILFORD CO.	10/15/1985	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/28/1986	Thunderstorm Wind	52 kts.	0/0	$0
GUILFORD CO.	7/29/1986	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/29/1986	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/15/1987	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/1/1987	Thunderstorm Wind	0 kts.	0/0	$0

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
GUILFORD CO.	9/10/1987	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/10/1988	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/17/1988	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/23/1988	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD CO.	6/26/1988	Thunderstorm Wind	0 kts.	1/0	$0
GUILFORD CO.	7/10/1988	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/10/1988	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/26/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/5/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/5/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/6/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/6/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/6/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/23/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	6/16/1989	Thunderstorm Wind	0 kts.	1/0	$0
GUILFORD CO.	6/16/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/12/1989	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	2/10/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	5/1/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/1/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/11/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/29/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	10/18/1990	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/9/1991	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/29/1991	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	7/3/1991	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD CO.	7/3/1991	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	3/10/1992	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	3/10/1992	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	4/24/1992	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/11/1992	Thunderstorm Wind	0 kts.	0/0	$0
GUILFORD CO.	8/11/1992	Thunderstorm Wind	57 kts.	0/0	$0
GUILFORD CO.	11/22/1992	Thunderstorm Wind	0 kts.	0/0	$0
Brownes Summit	6/8/1995	Thunderstorm Wind	0 kts.	0/0	$0
Julian	10/27/1995	Thunderstorm Wind	0 kts.	0/0	$0
COUNTYWIDE	1/19/1996	Thunderstorm Wind	0 kts.	0/0	$0
CLIMAX	7/16/1997	Thunderstorm Wind	50 kts.	0/0	$0
GUILFORD (ZONE)	2/16/1998	High Wind	45 kts.	0/0	$0
GREENSBORO ARPT	5/25/2000	Thunderstorm Wind	71 kts. M	0/0	$0
GREENSBORO ARPT	9/14/2000	Thunderstorm Wind	52 kts. M	0/0	$0
COLFAX	8/17/2003	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	3/7/2004	High Wind	50 kts. EG	0/0	$0
MONTICELLO	7/13/2005	Thunderstorm Wind	50 kts. EG	0/0	$0
CLIMAX	5/18/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
MC LEANSVILLE	7/19/2006	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	4/16/2007	High Wind	54 kts. MG	0/0	$0

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
MC LEANSVILLE	6/27/2007	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	2/10/2008	Strong Wind	43 kts. EG	0/0	$5,514
GUILFORD	3/4/2008	Thunderstorm Wind	52 kts. MG	0/0	$0
DEEP RIVER	3/4/2008	Thunderstorm Wind	51 kts. MG	0/0	$0
HAMILTON LAKES	3/4/2008	Thunderstorm Wind	50 kts. EG	0/0	$0
(GSO)GREENSBORO RGNL	5/8/2008	Thunderstorm Wind	54 kts. MG	0/0	$0
MONTICELLO	5/8/2008	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO MAY ARPT	6/23/2008	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	1/7/2009	Strong Wind	39 kts. MG	0/0	$1,107
COLFAX	5/6/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
RUDD	6/3/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
HAMILTON LAKES	6/3/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
DEEP RIVER	6/3/2009	Thunderstorm Wind	58 kts. EG	0/0	$0
GUILQUARRY	6/10/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
CLIMAX	8/5/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
BRIGHTWOOD	8/20/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
BROWNS SUMMIT	9/28/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
BROWNS SUMMIT	9/28/2009	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	11/11/2009	Strong Wind	35 kts. EG	0/0	$1,107
GUILFORD (ZONE)	12/9/2009	Strong Wind	40 kts. EG	0/0	$1,107
GUILFORD (ZONE)	2/10/2010	High Wind	50 kts. EG	0/0	$1,089
COLFAX	4/8/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
POMONA	6/14/2010	Thunderstorm Wind	50 kts. EG	0/0	$1,089
PINECROFT	6/14/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
SCALESVILLE	6/15/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO MAY ARPT	6/15/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
HAMILTON LAKES	6/16/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD	7/13/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
DEEP RIVER	7/16/2010	Thunderstorm Wind	50 kts. EG	0/0	$5,444
HILL TOP	8/5/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO ARPT	8/11/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
COLFAX	11/16/2010	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	2/25/2011	Strong Wind	44 kts. MG	0/0	$1,055,544
HILLSDALE	4/28/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
BESSEMER	4/28/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
MONTICELLO	4/28/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	4/28/2011	Strong Wind	49 kts. EG	0/0	$1,056
GREENSBORO MAY ARPT	5/26/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
MC LEANSVILLE	6/11/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
HILLSDALE	6/18/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO MAY ARPT	6/18/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
BESSEMER	6/22/2011	Thunderstorm Wind	50 kts. EG	0/0	$0

	Date	Type	Magnitude†	Deaths / Injuries	Property Damage*
GUILFORD CO.	6/28/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
COLFAX	7/24/2011	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILQUARRY	2/22/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO MAY ARPT	2/22/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
BATTLE GROUND	2/24/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
GREENSBORO ARHRBR AR	3/24/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
TERRA COTTA	6/1/2012	Thunderstorm Wind	50 kts. EG	0/0	$15,512
BATTLE GROUND	6/22/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
CLIMAX	7/20/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
BATTLE GROUND	9/2/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
PINECROFT	9/2/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
HILLSDALE	10/18/2012	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD (ZONE)	1/30/2013	Strong Wind	40 kts. EG	0/0	$2,038
DEEP RIVER	1/30/2013	Thunderstorm Wind	50 kts. EG	0/0	$510
GROOMTOWN	4/19/2013	Thunderstorm Wind	50 kts. EG	0/0	$510
GUILFORD	6/10/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILQUARRY	6/13/2013	Thunderstorm Wind	50 kts. EG	0/1	$203,843
BATTLE GROUND	6/25/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
SEDGEFIELD	6/28/2013	Thunderstorm Wind	50 kts. EG	0/0	$2,038
SEDGEFIELD	8/10/2013	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILFORD CO.	9/1/2013	Thunderstorm Wind	50 kts. EG	0/0	$1,019
HAMILTON LAKES	2/21/2014	Thunderstorm Wind	50 kts. EG	0/0	$3,000
(GSO)GREENSBORO RGNL	3/12/2014	Thunderstorm Wind	53 kts. MG	0/0	$5,000
HAMILTON LAKES	6/10/2014	Thunderstorm Wind	50 kts. EG	0/0	$1,000
BRIGHTWOOD	6/16/2014	Thunderstorm Wind	50 kts. EG	0/0	$0
GUILQUARRY	6/19/2014	Thunderstorm Wind	50 kts. EG	0/0	$0

*Property damage is reported in 2014 dollars; All damage may not have been reported.
†E = estimated; EG = estimated gust; ES = estimated sustained ;MG = measured gust ;MS = measured sustained
Source: National Climatic Data Center

Lightning

According to the National Climatic Data Center, there have been a total of nine recorded lightning events in Guilford County since 1997, as listed in summary **Table 5.32**.[22] These events resulted in almost $2.5 million (2014 dollars) in damages.[23] Detailed information on historical lightning events can be found in **Table 5.33**.

[22] These lightning events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1997 through August 2014. It is certain that additional lightning events have occurred in Guilford County. The State Fire Marshall's office was also contacted for additional information but none could be provided. As additional local data becomes available, this hazard profile will be amended.
[23] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

It is certain that more than nine events have impacted the county. Many of the reported events are those that caused damage, and it should be expected that damages are likely much higher for this hazard than what is reported.

TABLE 5.32: SUMMARY OF LIGHTNING OCCURRENCES IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	0	0/0	$0
Greensboro	1	0/0	$290,357
High Point	1	0/0	$9,239
Jamestown	0	0/0	$0
Oak Ridge	2	0/0	$6,599
Pleasant Garden	0	0/0	$0
Sedalia	0	0/0	$0
Stokesdale	0	0/0	$0
Summerfield	0	0/0	$0
Whitsett	0	0/0	$0
Unincorporated Area	5	0/0	$2,154,891
GUILFORD COUNTY TOTAL	**9**	**0/0**	**$2,461,086**

Source: National Climatic Data Center

TABLE 5.33: HISTORICAL OCCURRENCES IN GUILFORD COUNTY

	Date	Deaths / Injuries	Property Damage*	Details
Gibsonville				
None Reported	--	--	--	--
Greensboro				
GREENSBORO	3/26/2002	0/0	$290,357	Lightning started a fire that destroyed the third floor of a home.
High Point				
HIGH PT	7/1/2002	0/0	$9,239	A lightning strike caused minor damage to a public library.
Jamestown				
None Reported	--	--	--	--
Oak Ridge				
OAK RIDGE	7/28/1997	0/0	$0	LIGHTNING HIT A HOME IN OAK RIDGE. NO DAMAGE DETAILS WERE AVAILABLE.
OAK RIDGE	6/26/2002	0/0	$6,599	At least four house fires were started by lightning strikes in the Oak Ridge area.
Pleasant Garden				
None Reported	--	--	--	--
Sedalia				
None Reported	--	--	--	--

	Date	Deaths / Injuries	Property Damage*	Details
Stokesdale				
None Reported	--	--	--	--
Summerfield				
None Reported	--	--	--	--
Whitsett				
None Reported	--	--	--	--
Unincorporated Area				
SEDGEFIELD	5/1/2002	0/0	$395,942	A lightning strike started a fire that severely damaged a historic home.
HAMILTON LAKES	6/12/2010	0/0	$1,633,294	Lightning struck a large fuel tank at the Colonial Pipeline gasoline tank farm resulting in a large fire destroying the tank and resulting in the closure of Interstate 40 for four hours. The tank contained 840,000 gallons of gasoline at the time of the fire.
(GSO)GREENSBORO RGNL	6/16/2010	0/0	$108,886	Lightning struck the runway at the Piedmont Triad International Airport creating a hole two feet wide and 18 inches deep in the runway.
DEEP RIVER	8/11/2010	0/0	$16,333	A home on Windstream Court in High Point sustained roof damage due to a lightning strike. The damages were estimated.
BESSEMER	8/11/2010	0/0	$436	A lightning strike damaged an outbuilding at 3865 Arbor Drive in Greensboro. The damage was estimated at $300 and the content loss was $100.

*Property Damage is reported in 2014 dollars; all damage may not have been reported.
Source: National Climatic Data Center

5.12.4 Probability of Future Occurrences

Wind

Given the high number of previous events, it is certain that wind events, including straight-line wind and thunderstorm wind, will occur in the future. This results in a probability level of highly likely (100 percent annual probability) for future wind events for the entire county. Additionally, according to the *Piedmont Together Climate Adaptation Report*, storm wind speeds are estimated to increase at a proportional rate of 1-8 percent based upon rising global ocean temperatures.

Lightning

Although there was not a high number of historical lightning events reported throughout Guilford County via NCDC data, it is considered a regular occurrence, especially accompanied by thunderstorms. In fact, lightning events will assuredly happen on an annual basis, though not all events will cause damage. According to Vaisala's U.S. National Lightning Detection Network (NLDN®), Guilford County is located in an area of the country that experienced an average of 3 to 4 lightning flashes per square kilometer per year between 1997 and 2010. Therefore, the probability of future events is highly likely (100 percent annual probability). It can be expected that future lightning events will continue to threaten life and cause minor property damages throughout the county.

5.12.5 Consequence Analysis

People (The Public and Public Confidence)

Wind

Thunderstorms are generally associated with several other hazards such as high wind and flooding, the latter of which is caused by torrential rain. As such, the public could be impacted in a number of ways by a thunderstorm event. High wind can cause trees to fall and potentially result in injuries or death and rising floodwaters can lead to drowning or other serious injury. Although often not as severe as hurricanes or tornadoes, the impacts on the public from thunderstorms can be significant. However, the public confidence is usually not affected to a large degree as a result of thunderstorms.

Lightning

Although relatively rare when compared to other hazards, the impacts of lightning on people can be severe, resulting in death or severe injury if a person is struck. Fatalities and injuries from lightning events most often occur when a person is exposed and in outdoor conditions during a thunderstorm. Exposure to water and open areas also increases the likelihood that a person will be struck. Lightning generally has a low probability of impacting public confidence.

Responders

Wind

Responders are not generally affected to any great degree by thunderstorm events, although it should be noted that they could be impacted in many of the same ways as the public. Otherwise, responders could be affected by road blockages caused by downed trees or floodwaters, which would ultimately reduce their response time.

Lightning

Although responders are generally aware of the effects of lightning and take precautions to avoid being impacted by a lightning strike, it is possible that they could be struck. Moreover, taking the necessary precautions to avoid a lightning strike can often reduce response times as staying inside and away from lightning is the best way to avoid injury from the hazard.

Continuity of Operations

Wind

In general, continuity of operations during a thunderstorm event can be maintained. Thunderstorm events often affect power in much the same way as tornadoes and hurricanes, which ultimately may

impact operations. However, thunderstorm events are typically not large enough and their impacts are not wide enough to disrupt continuity of operations in Guilford County.

Lightning
Most critical facilities and infrastructure are protected against lightning via surge protectors and lightning rods. However, if lightning were to shut down large parts of the power grid due to blowing a transformer, operations would be detrimentally impacted. In general, however, continuity of operations during a lightning event would not be affected.

Built Environment (Property, Facilities, and Infrastructure)

Wind
Thunderstorms often have their greatest impact on the built environment as they can cause damage to homes via strong winds or flooding and will often impact facilities and infrastructure in the same way. Power losses often occur due to damage to power lines and roads can flood and cause damage as well. In fact, thunderstorms are often considered one of the greater hazards of concern even though any given event will cause relatively little damage, because damaging events occur so frequently.

Lightning
Lightning generally does not have a major impact on property, facilities, or infrastructure. However, it has been known to affect power and energy sources through strikes which can shut down power for hours and sometimes days. Lightning is also responsible for igniting fires that can result in widespread damage to property.

Economy

Wind
Economic impacts from thunderstorm events can often be far reaching as the damage from these events are often widespread, affecting both homes and businesses. This damage can result in business and economic disruption through the recovery process.

Lightning
Since lightning events generally pass through the area quickly and cause relatively little property damage when compared to other hazards, effects on the economy will likely be minimal. Nevertheless, if power-related infrastructure is damaged, this could cause some economic strain to replace and get the system back to full capacity.

Environment

Wind
Thunderstorms can impact crops via high wind and flooding and can also impact the natural environment through these elements. Flooding can kill plants and animals as well as contaminate drinking water supplies for human populations. High wind can harm forests by bringing down trees and cause fires from downed power lines that impact the environment.

Lightning
The environmental effects of lightning are relatively minimal, although lightning has been known to cause wildfires which can lead to widespread damage. For more details on these impacts, please see this section of the wildfire hazard.

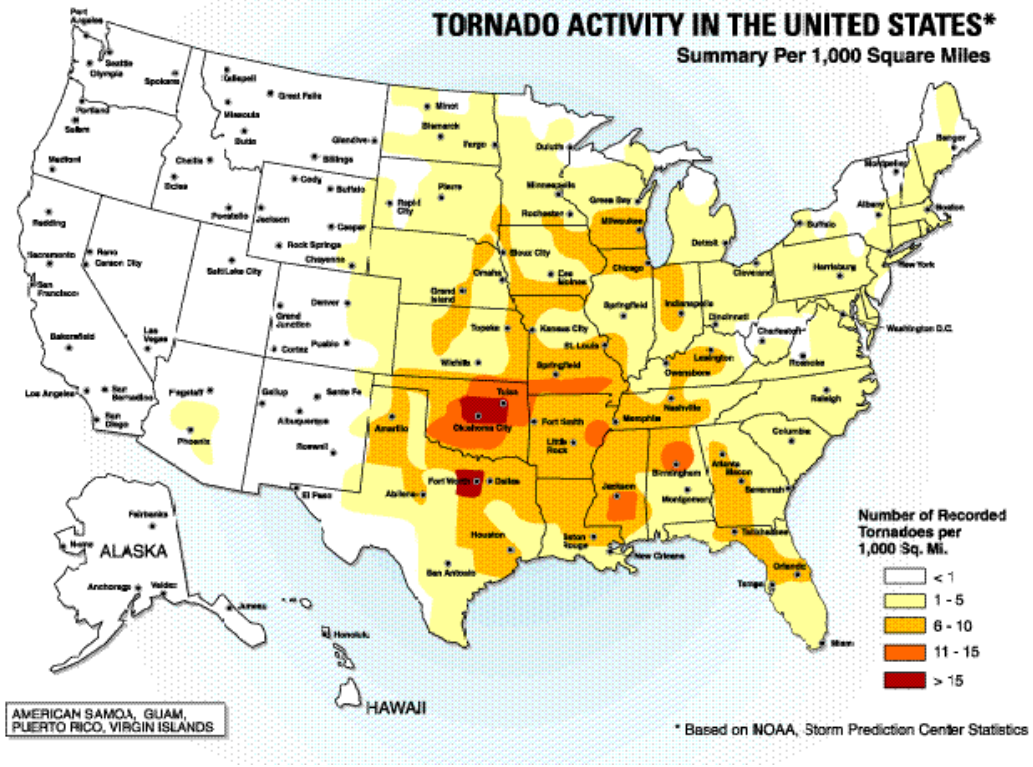
5.13 TORNADO

5.13.1 Background

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 miles per hour to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries.[24] According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas, and Florida respectively. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), Florida experiences the greatest number of tornadoes per square mile of all U.S. states (SPC, 2002). **Figure 5.23** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles.

FIGURE 5.23: TORNADO ACTIVITY IN THE UNITED STATES



Source: Federal Emergency Management Agency

[24] NOAA, 2009.

Tornadoes are more likely to occur during the months of March through May and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings (particularly mobile homes). Tornadic magnitude is reported according to the Fujita and Enhanced Fujita Scales. Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (**Table 5.34**). Tornado magnitudes that were determined in 2005 and later were determined using the Enhanced Fujita Scale (**Table 5.35**).

TABLE 5.34: THE FUJITA SCALE (EFFECTIVE PRIOR TO 2005)

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

Source: National Weather Service

TABLE 5.35: THE ENHANCED FUJITA SCALE (EFFECTIVE 2005 AND LATER)

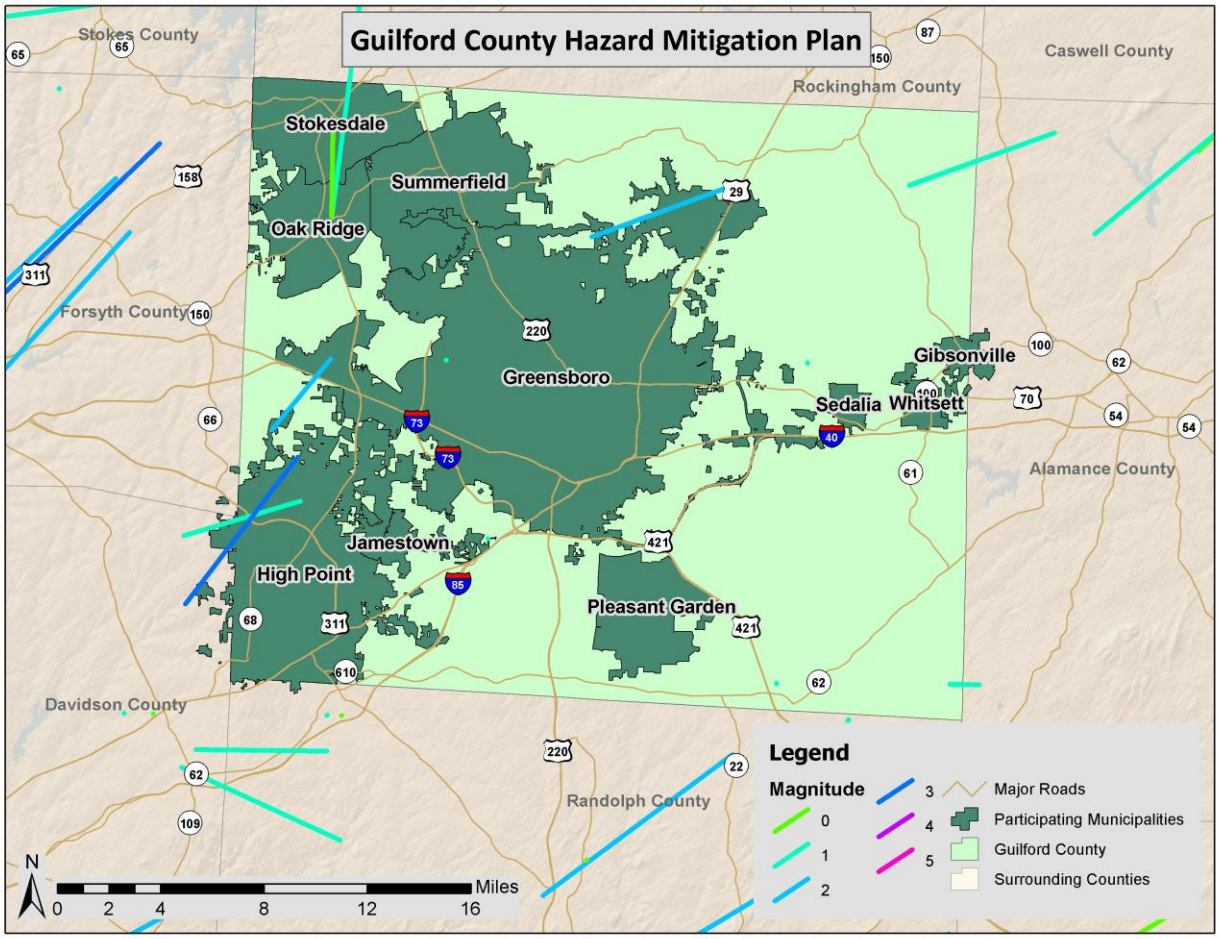
EF-SCALE NUMBER	INTENSITY PHRASE	3 SECOND GUST (MPH)	TYPE OF DAMAGE DONE
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs;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

Source: National Weather Service

5.13.2 Location and Spatial Extent

Tornadoes occur throughout the state of North Carolina, and thus in Guilford County. Tornadoes typically impact a relatively small area, but damage may be extensive. Event locations are completely random and it is not possible to predict specific areas that are more susceptible to tornado strikes over time. Therefore, it is assumed that Guilford County is uniformly exposed to this hazard. With that in mind, **Figure 5.24** shows tornado track data for many of the major tornado events that have impacted the county. While no definitive pattern emerges from this data, some areas that have been impacted in the past may be potentially more susceptible in the future.

FIGURE 5.24: HISTORICAL TORNADO TRACKS IN GUILFORD COUNTY



Source: National Weather Service Storm Prediction Center

5.13.3 Historical Occurrences

Tornadoes were responsible for one disaster declaration in Guilford County in 1989.[25] According to the National Climatic Data Center, there have been a total of 13 recorded tornado events in Guilford County since 1954 (**Table 5.36**), resulting in $19.9 million (2014 dollars) in property damages.[26] [27] In addition, one death and five injuries were reported (**Table 5.37)**. The magnitude of these tornadoes ranges from EF0 to EF3 in intensity, although an EF4 or EF5 event is possible. It is important to note that only tornadoes that have been reported are factored into this risk assessment. It is likely that a high number of occurrences have gone unreported over the past 64 years.

[25] A complete listing of historical disaster declarations can be found in Section 4: *Hazard Profiles*.
[26] These tornado events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1950 through August 2014. It is likely that additional tornadoes have occurred in Guilford County. As additional local data becomes available, this hazard profile will be amended.
[27] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

TABLE 5.36: SUMMARY OF TORNADO OCCURRENCES IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	0	0/0	$0
Greensboro	0	0/0	$0
High Point	1	0/0	$10,888,625
Jamestown	0	0/0	$0
Oak Ridge	1	0/0	$0
Pleasant Garden	0	0/0	$0
Sedalia	0	0/0	$0
Stokesdale	1	0/0	$0
Summerfield	0	0/0	$0
Whitsett	0	0/0	$0
Unincorporated Area	10	1/5	$8,974,132
GUILFORD COUNTY TOTAL	**13**	**1/5**	**$19,862,757**

Source: National Climatic Data Center

TABLE 5.37: HISTORICAL TORNADO OCCURRENCES IN GUILFORD COUNTY

	Date	Magnitude	Deaths/ Injuries	Property Damage*	Details
Gibsonville					
None Reported	--	--	--	--	--
Greensboro					
None Reported	--	--	--	--	--
High Point					
HIGH PT	3/28/2010	EF3	0/0	$10,888,625	The tornado initially touched down as an EF1 with winds around 100 mph near Old Plank Road in southwest Guilford County. It was in this area where the Apple Tree Academy sustained significant damage and two vehicles including a small bus were rolled 50 yards across the street. From this point the tornado continued northeast across Highway 311. The next area to experience damage was just north of Highway 311 and south of Old Mill Road along Langdale, Imperial and Impala Drives. Tornado damage in this area continued to indicate EF1 winds with numerous trees down along with a number of home with roof and siding damage. The tornado intensified to an EF2 as it crossed Old Mill Road towards Johnson Street. The EF2 tornado severely damaged numerous homes along Brandon Drive. In one instance, an entire bedroom was blown off a single story home. Three

	Date	Magnitude	Deaths/ Injuries	Property Damage*	Details
					individuals who were taking shelter in a bedroom closet were carried 50 feet and were buried under the debris. One individual experienced several broken bones but overall injuries were not serious. The remainder of the house was shifted off the foundation approximately 8 inches. EF2 tornado damage continued north of Old Mill Road to Skeet Club Road along either side of Johnson Road with winds around 130 mph for most of its duration but briefly reached EF3 intensity with winds of 138 mph near Hampton Park Drive at 1278 Silverstone Court where the upper level of a two story home was blown off. Fifty to sixty homes along Hampton Park Drive, Scarlet Drive, Ruskin Drive and Johnson Road were severely damaged. The tornado crossed Johnson Road as an EF2 crossing Elmwood Avenue, Oakforest Drive and Maplewood Avenue. Nearly every home in this highly urbanized area experienced minor to moderate damage. The upper floor of a two story home on Elmwood Avenue was blown off. The tornado weakened to an EF1 as it crossed Maplewood Avenue and Wellingham Lane, where numerous homes experienced roof and siding damage. The tornado finally lifted off the ground north of Kendale Road. In total 603 single family homes were damaged with 21 homes being completely destroyed. Thirty-one multifamily homes were damaged with 16 reported destroyed. Finally, eleven businesses sustained damage, with 3 businesses completely destroyed.
Jamestown					
None Reported	--	--	--	--	--
Oak Ridge					
OAK RIDGE	7/7/2005	F0	0/0	$0	A tornado blew down trees from Oak Ridge to Stokesdale.
Pleasant Garden					
None Reported	--	--	--	--	--
Sedalia					
None Reported	--	--	--	--	--

	Date	Magnitude	Deaths/ Injuries	Property Damage*	Details
Stokesdale					
STOKESDALE	9/17/2004	F1	0/0	$0	A tornado touched down near the intersection of Harrell Road and Lee's Glen Road. Three garages lost their roofs and numerous trees were snapped or uprooted. The tornado then tracked north across Meadows Drive and Haw Meadows Drive where falling trees caused significant damage to at least three well-built homes, one of which was a total loss. The tornado continued north to Prince Edward road where about 70 percent of the trees in a heavily wooded area were snapped or downed. Along Kelly Court, a garage was destroyed. At South Point Drive, the roof was blown off a house resulting in major structural damage. Other houses lost shingles, siding and porches. The tornado then continued across the county line into Rockingham County. In Guilford County, three houses suffered total losses, nine homes sustained major damage, and 52 sustained minor damage.
Summerfield					
None Reported	--	--	--	--	--
Whitsett					
None Reported	--	--	--	--	--
Unincorporated Area					
GUILFORD CO.	6/16/1954	F2	0/1	$22,066	
GUILFORD CO.	4/5/1957	F1	0/1	$2,112,393	
GUILFORD CO.	9/29/1959	F1	0/0	$203,980	
GUILFORD CO.	6/12/1962	F1	0/0	$19,655	Small tornado near McLeansville. Funnel moved northeastward, remaining just above ground level and making a noise like a diesel locomotive. Trees broken off above ground, roofs damaged. No evidence of high winds outisde immediate path of storm.
GUILFORD CO.	4/17/1967	F1	0/0	$177,719	Storm moved southwest-northeast across field near Whitsett. Porch ripped off a home, several outbuildings demolished. Apple orchard severely damaged. Hail and heavy rain with storm. Meteorologist visisted scene, reported damage apparently caused by tornado moving on a skipping path.

	Date	Magnitude	Deaths/ Injuries	Property Damage*	Details
GUILFORD CO.	5/14/1967	F1	0/0	$1,777,193	
GUILFORD CO.	10/8/1976	F1	0/0	$104,320	A tornado skipped along near Vickery Chapel Road off Highway I-85 near Greensboro. A trailer truck was damaged, trees, and some homes. Damage about $15,000.
GREENSBORO ARPT	5/7/1998	F1	0/0	$145,664	A tornado touched down approximately 1 mile southeast of the Piedmont-Triad International Airport near Greensboro. The first damage occurred just south of West Friendly Avenue. The tornado moved to the southeast and lifted at Jamestown Road approximately 1.5 miles from its initial touchdown. Damage was rated at F1 initially and F0 at the point it rose back into the thunderstorm. This tornado was produced by the same parent storm that produced the Clemmons tornado less than an hour before this one.
CLIMAX	5/7/1998	F1	0/0	$0	A tornado touched down in extreme southeast Guilford county and tracked to the southeast for approximately 2.5 miles . It moved into extreme northeast Randolph county before lifting about 2 miles north of Liberty. The tornado produced F1 damage. The exact path stretched from Lake Juno Road to Liberty Grove Road.
DEEP RIVER	5/8/2008	EF2	1/3	$4,411,142	The tornado, originally an EF-0, initially touched down just north of Squire Davis Park near the intersection of Sandy Ridge Road and Johnson Street. From there the tornado tracked northeast and intensified to EF-1 intensity as it approached the Farmers Market and Interstate 40. The tornado overturned several cars and tractor trailers as it crossed Interstate 40. A roof was blown off of an office building just north of the interstate as the tornado continued to intensify. As the tornado moved further northeast into an industrial complex, it further strengthened to EF-2 with winds estimated around 130 mph based on damage to warehouses. Numerous warehouses along Little Santee Road, Capital Drive, and West Market Street sustained significant damage. Numerous vehicles and

	Date	Magnitude	Deaths/ Injuries	Property Damage*	Details
					tractor trailers were also overturned in the industrial complex. At its widest point, the tornado was just over 200 yards wide. The tornado quickly lifted off of the ground after crossing West Market Street near the post office. The tornado was on the ground for about four miles. One fatality occurred along West Market Street next to the Lamination Service Building located at 8717 West Market Street. The fatality occurred as a 51 year old man slept in the rig of his tractor trailer. Three other injuries were reported, two of which occurred in automobiles and another in the I.H. Caffey Warehouse Distribution Center.

*Property damage is reported in 2014 dollars; All damage may not have been reported.
Source: National Climatic Data Center

5.13.4 Probability of Future Occurrences

According to historical information, tornado events are not an annual occurrence for the county. However, given the county's location in the southeastern United States and history of tornadoes, an occurrence is possible every few years. While the majority of the reported tornado events are small in terms of size, intensity, and duration, they do pose a significant threat should Guilford County experience a direct tornado strike. The probability of future tornado occurrences affecting Guilford County is likely (10 to 100 percent annual probability).

5.13.5 Consequence Analysis

People (The Public and Public Confidence)

The entire Guilford County population is vulnerable to the impacts of a tornado regardless of the measured magnitude. Because it cannot be predicted where a tornado will touch down, it cannot be said which areas of the population within the county are most vulnerable. However, injuries as well as deaths resulting from tornadoes are the most significant impacts. Tornadoes often have a high likelihood of affecting public confidence due to their destructive and highly visible impacts.

Responders

Responders could be critically affected by tornado events as the onset is often very rapid and unpredictable, thereby putting response personnel potentially in harm's way. Due to the unpredictability of such events, response may also be hindered as responders may be unable to access those that have been affected if storm conditions persist and they are unable to safely enter affected areas.

Continuity of Operations

Continuity of operations could be greatly impacted by a tornado as personnel may be harmed and critical resources damaged or destroyed during a tornado. In many ways, since the impacts of a tornado are unpredictable, it is also difficult to predict and plan for the appropriate ways to ensure a continuity of operations. Although Guilford County is well prepared for such an event, disruption of operations will likely take place to some degree.

Built Environment (Property, Facilities, and Infrastructure)

Building Inventory

Guilford County has been impacted by tornadoes ranging in intensity from F0 through F3 based on the Fujita and Enhanced-Fujita scales. Because it cannot be predicted where a tornado may touch down, all buildings and facilities within the county are considered exposed to the hazard and at risk for being impacted.

Wind

Building materials play a role in how well a structure can withstand tornado force winds. **Table 5.38** shows the percentage of buildings by type within Guilford County according to Hazus-MH data. Buildings that use structural steel, reinforced concrete, or load-bearing masonry have the best chance of withstanding a tornado event in the county. Homes constructed of wood or manufactured material are most at risk. Non-engineered structures in the county are far more vulnerable than engineered buildings to damage from tornado winds.

TABLE 5.38 GUILFORD COUNTY BUILDINGS BY MATERIAL TYPE

Building Material	Total Number of Buildings	Percentage of Total
Manufactured Concrete	1,989	1.2%
Manufactured	6,883	4.0%
Masonry	3,374	2.0%
Steel	8,513	4.9%
Wood	132,858	76.9%
Other	550	<.01%
Total	172,774	

Critical Facilities and Key Resources

All critical facilities and key resources are equally vulnerable to the impacts of a tornado. The magnitude of the tornado will determine the extent of damage and impacts that are felt throughout the county. These impacts can include structural failure, debris damage, and loss of facility functionality.

Critical Infrastructure

The county's infrastructure system is equally vulnerable to the impacts of a tornado. This includes critical infrastructure such as roads, railroads, bridges, utilities (power and gas), and pipelines. Any number of these infrastructure systems could be damaged in the event of a tornado. Impacts could include structural damage, impassable or blocked roadways, failed utility lines, railway failure, and impassable bridges.

Key Resources
The county's key resources are equally vulnerable to the impacts of a tornado. Any number of key resources could be damaged or lost in the event of a tornado. Impacts could include structural damage, and loss of power and utilities.

Economy
A tornado can impact any area of Guilford County at any time and brings with it significant property and crop damage costs. After past events, there has been a substantial halt to many economic activities and losses to businesses have often been high.

Environment
Downed trees, power lines, and other forms of vegetation and building material can block roadways, cover residential areas, and cause property and building damage. Coordinated countywide cleanup efforts after a tornado can include removal of debris. Multi-material facilities may be available for debris drop-off for residents. Debris cleanup may be part of individual insurance policies.

5.14 WINTER STORM

5.14.1 Background

A winter storm can range from a 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. 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 damages, such as roof collapses on older buildings. All winter storm events have the potential to present dangerous conditions to the affected area.

Snow Storms
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 as an accumulation of 4 of 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
Ice storms, which are much more common in Guilford County than snow 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 of the winter storm elements – snow, sleet, ice, etcetera – have the potential to cause significant hazard to a community. Even small accumulations can down power lines and tree limbs and create hazardous driving conditions. Furthermore, communication and power may be disrupted for days.

5.14.2 Location and Spatial Extent

Nearly the entire continental United States is susceptible to winter storm 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. Guilford County is accustomed to severe winter weather conditions and often receives winter weather during the winter months. Given the atmospheric nature of the hazard, the entire county has uniform exposure to a winter storm.

5.14.3 Historical Occurrences

Winter weather has resulted in six disaster declarations in Guilford County. This includes the Blizzard of 1996, one subsequent 1996 winter storm, a severe winter storm in 2000, ice storms in 2002 and 2003, and a severe winter storm in 2014.[28] The National Climatic Data Center does not report winter storm events at the municipal level, however, there have been a total of 54 recorded winter storm events and in Guilford County since 1996 (**Table 5.39**).[29] These events resulted in almost $8.2 million (2014 dollars) in damages.[30] Detailed information on the recorded winter storm events can be found in **Table 5.40**.

TABLE 5.39: SUMMARY OF WINTER STORM EVENTS IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Guilford County	54	0/0	$8,177,346

Source: National Climatic Data Center

TABLE 5.40: HISTORICAL WINTER STORM EVENTS IN GUILFORD COUNTY

	Date	Type of Storm	Deaths / Injuries	Property Damage*
Guilford County				
GUILFORD (ZONE)	1/6/1996	Heavy Snow	0/0	$0
GUILFORD (ZONE)	1/11/1996	Ice Storm	0/0	$0
GUILFORD (ZONE)	2/2/1996	Ice Storm	0/0	$0
GUILFORD (ZONE)	2/16/1996	Heavy Snow	0/0	$0
GUILFORD (ZONE)	1/8/1997	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/13/1997	Winter Storm	0/0	$0

[28] A complete listing of historical disaster declarations can be found in Section 4: *Hazard Profiles*.
[29] These ice and winter storm events are only inclusive of those reported by the National Climatic Data Center (NCDC) from 1996 through August 2014. It is likely that additional winter storm conditions have affected Guilford County.
[30] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

	Date	Type of Storm	Deaths / Injuries	Property Damage*
GUILFORD (ZONE)	12/29/1997	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/23/1998	Ice Storm	0/0	$0
GUILFORD (ZONE)	1/2/1999	Ice Storm	0/0	$0
GUILFORD (ZONE)	1/18/2000	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/20/2000	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/22/2000	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/24/2000	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/28/2000	Winter Storm	0/0	$0
GUILFORD (ZONE)	11/19/2000	Heavy Snow	0/0	$0
GUILFORD (ZONE)	2/12/2001	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/3/2002	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/6/2002	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/4/2002	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/16/2003	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/27/2003	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/13/2003	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/26/2004	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/15/2004	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/26/2004	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/30/2005	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/15/2005	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/18/2007	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/21/2007	Winter Weather	0/0	$0
GUILFORD (ZONE)	12/7/2007	Winter Weather	0/0	$22,903
GUILFORD (ZONE)	1/17/2008	Winter Weather	0/0	$0
GUILFORD (ZONE)	2/13/2008	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/22/2009	Winter Weather	0/0	$0
GUILFORD (ZONE)	2/3/2009	Winter Weather	0/0	$0
GUILFORD (ZONE)	3/1/2009	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/18/2009	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/30/2009	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/29/2010	Winter Storm	0/0	$0
GUILFORD (ZONE)	2/5/2010	Winter Storm	0/0	$54,443
GUILFORD (ZONE)	2/12/2010	Winter Weather	0/0	$0
GUILFORD (ZONE)	3/2/2010	Winter Storm	0/0	$0
GUILFORD (ZONE)	12/4/2010	Winter Weather	0/0	$0
GUILFORD (ZONE)	12/16/2010	Winter Weather	0/0	$0
GUILFORD (ZONE)	12/25/2010	Winter Storm	0/0	$0
GUILFORD (ZONE)	1/10/2011	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/17/2013	Winter Storm	0/0	$0
GUILFORD (ZONE)	11/26/2013	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/21/2014	Winter Weather	0/0	$0
GUILFORD (ZONE)	1/28/2014	Winter Weather	0/0	$0
GUILFORD (ZONE)	2/12/2014	Winter Storm	0/0	$0
GUILFORD (ZONE)	3/3/2014	Winter Weather	0/0	$0
GUILFORD (ZONE)	3/6/2014	Winter Storm	0/0	$0

	Date	Type of Storm	Deaths / Injuries	Property Damage*
GUILFORD (ZONE)	3/6/2014	Ice Storm	0/0	$8,100,000
GUILFORD (ZONE)	3/17/2014	Winter Weather	0/0	$0

*Property damage is reported in 2014 dollars; All damage may not have been reported.
Source: National Climatic Data Center

There have been several severe winter weather events in Guiflord County. The text below describes two of the major events (one snow and one ice event) and associated impacts on the county. Similar impacts can be expected with most severe winter weather.

1996 Winter Storm – January 6-8, 1996
This storm left two feet of snow in some areas and several thousand citizens without power for up to nine days. Although shelters were opened, some roads were impassible for many days. This event caused considerable disruption to business, industry, schools, and government services.

2002 Ice Storm – December 4-5, 2002
An ice storm produced up to an inch of freezing rain in central North Carolina impacting 40 counties. A total of 24 people were killed, and as many as 1.8 million people were left without electricity. Additionally, property damage was estimated at almost $100 million. New records were also set for traffic accidents and school closing durations. The scale of destruction was comparable to that of hurricanes that have impacted the state, such as Hurricane Fran in 1996. The storm cost the state $97.2 million in response and recovery.

Winter storms throughout the planning area have several negative externalities including hypothermia, cost of snow and debris cleanup, business and government service interruption, traffic accidents, and power outages. Furthermore, citizens may resort to using inappropriate heating devices that could to fire or an accumulation of toxic fumes.

5.14.4 Probability of Future Occurrences

Winter storm events will remain a regular occurrence in Guilford County due to its location in the western half of the state. According to historical information, Guilford County generally experiences several winter storm events each year. Therefore, the annual probability is highly likely (100 percent). Additionally, according to the *Piedmont Together Climate Adaptation Report*, the increased likelihood of ice storms due to climate change will result in a higher number of automobile accidents (injuries, fatalities, and traffic jams) as well as more power outages in the county.

5.14.5 Consequence Analysis

People (The Public and Public Confidence)
Winter storms most often impact people indirectly. Winter storms can create dangerous driving conditions by limiting visibility for drivers or creating slick conditions that make maneuverability difficult. Loss of power can create very cold conditions for residents, making it difficult to stay warm. Residents may try to heat their home using alternative means, which runs the risk of carbon monoxide poisoning caused by improperly ventilated heating sources. In addition, dangerously cold temperatures increase

the risk of wind chill, frostbite, and hypothermia. Winter storms generally do not have a large impact on public confidence, but it could be impacted if road clearing or response operations are slow.

Responders

Responders in winter storm and freeze events face a variety of hazards themselves including slick or icy roads that could cause harm to responders if they are attempting to quickly respond to an emergency as is often the case. Crashed emergency vehicles and injuries to responders are always a possibility, but their chances increase during a winter storm event. Winter storms can also make it difficult to access more rural areas if roads are snowed over and vehicles cannot pass through.

Continuity of Operations

Generally, continuity of operations can be maintained during a winter storm event in Guilford County. However, winter storms do have the potential to affect power transmission and can make it difficult for emergency management employees to arrive to work. As a result, there will likely be some disruption of operations during a winter storm event.

Built Environment (Property, Facilities, and Infrastructure)

Schools

Winter storms have the potential to impact public and private school schedules through closings and delays. Poor driving conditions, lack of power and heat, and mechanical problems with school buses and equipment due to cold weather conditions are potential concerns.

School closures and delays can lead to logistical problems for teachers and school administrators, especially in the event of end-of-term exams and standardized testing schedules. It can also result in logistical problems for making up school days.

Critical Infrastructure and Key Resources

Winter storms have the potential to create hazardous driving conditions leading to accidents on roadways. The North Carolina Climate Office reports that 70 percent of winter-weather–related injuries are a result of accidents on the road.[31] The North Carolina Highway Patrol call volume can double during a winter storm compared to a typical 24-hour period. This creates significant problems for emergency workers. Accidents can cause highways to become “large parking lots” as well as cause motorists to strand their vehicles, making it difficult for emergency workers to reach those who need assistance. In general, major and local roadways become severely impacted when temperatures drop, making pre-treatment solutions ineffective. Transportation impacts can be minimized during early- and late-season events when paved surfaces are able to warm sufficiently to prevent winter precipitation accumulation. Winter storms can also result in delays and cancellations of flights at airports in Guilford County due to slick conditions on runways. There is also the potential of a loss of power that can close the airport.

Utilities

One of the primary identified impacts of winter storms on Guilford County is the disruption of utilities. Utilities that are at risk of being affected include telephone, internet, cable, and water. Newspaper reports typically cite trees falling on electrical wires—as well as trees that have already been damaged from previous incidents that fall during a winter storm—or the stress caused by ice accumulation as main causes for power outages.

[31] State Climate Office of North Carolina. *Winter weather—impacts*. Retrieved May 7, 2012, from http://www.nc-climate.ncsu.edu/climate/winter_wx/Impacts.php

Economy

In the event of a winter storm, there is a high potential of business and office closures, modified business and office hours, and cancellation or postponement of sporting and other planned events in the county. This can be contributed to poor road conditions (including icy and slick conditions) that result in fewer people using the roads to get to their destination or a loss of power and heat that result in a loss of operations at specific facilities. Businesses that seek the most benefit from a winter storm event are those associated with cleanup, recovery operations, or rebuilding.

Environment

Winter storms have an impact on the environment through the clearing of roadways. Snow on the roads can pick up contaminants from chemicals and oil products in traffic as well as the salt mixture that is used to de-ice the roads. These contaminants can be carried to nearby waterways, which, contaminates water sources and is absorbed by groundwater.

In addition, vegetation can be damaged by these storm types. Vegetation destruction reduces available habitats, and threatens wildlife.

Biological Hazards

5.15 BIOTERRORISM

5.15.1 Background

While there are many biological agents to be concerned with as they exist in nature, there are some that can also be used as a weapon. It is very difficult to spread many of these diseases to large populations of people. There have been few instances of bioterrorism to this point. While it is likely that another bioterrorism event will be attempted, it is unlikely that a large population will be exposed or that it will affect Guilford County and its citizens. However, consideration and planning must still address the possibility, no matter how slight.

Examples of agents identified by the Center for Disease Control and Prevention (CDC) that have been or have the potential to be used in bioterrorism form include anthrax, botulism, brucellosis, plague, smallpox, tularemia, and viral hemorrhagic fevers.

Anthrax, a serious disease caused by Bacillus anthracis, a bacterium that forms spores, was used as a biological weapon in the United States in 2001 when it was deliberately spread through the postal system. Botulism, a muscle-paralyzing disease caused by a toxin made by a bacterium called Clostridium botulinum, could potentially be released into food sources, causing foodborne illnesses. Brucellosis is a rare infectious disease caused by the bacteria Brucella; used a biological weapon, the bacteria could also be introduced into a food source for human consumption.

Plague, a disease caused by Yersinia pestis, a bacterium found in rodents and their fleas in many areas around the world, could be used in an aerosol attack through its pneumonic form. Because of the delay in exposure and becoming sick, those infected with the disease could travel around the

globe transmitting the disease to others before knowing they were sick. This could have dire consequences in controlling the outbreak of the disease in large populations.

Smallpox is a serious, contagious infectious disease caused by the variola virus; no treatment exists and the only prevention is vaccination. According to the CDC, the disease is now eradicated after a successful worldwide vaccination program; however, there is still concern that the variola virus could still be used as an agent of bioterrorism through the development of the disease in a laboratory setting.

Tularemia is a highly infectious disease caused by the bacterium Francisella tularensis, which is found in animals. Used as a biological weapon, the bacteria would likely be made airborne for exposure by inhalation. Because the bacterium is widely found in nature, the disease could be grown in large quantity in a laboratory; however, an effective aerosol weapon has yet to be manufactured to release it in a bioterrorism event.

Finally, viral hemorrhagic fevers (VHFs) refer to illnesses caused by specific viruses that cause severe multisystem syndromes. Many of these have been considered for bioterrorism. The Marburg and Ebola viruses are well-known examples of VHFs.

5.15.2 Location and Spatial Extent

Due to the nature of a bioterrorism event, it would be difficult to predict a precise location where this type of event would occur. Moreover, a large-scale event may have impacts that spread throughout the county. Therefore, all areas in Guilford County are considered equally susceptible to bioterrorism.

5.15.3 Historical Occurrences

No incidents have ever been recorded as affecting those within the bounds of Guilford County.

5.15.4 Probability of Future Occurrence

Although no incidents have been recorded in Guilford County, future occurrences are considered possible.

5.15.5 Consequence Analysis

People (The Public and Public Confidence)

The general public can be exposed to emerging diseases through different means based on the particular threat and its potential transmission routes. Vaccinations, when available, are the best means of preventing transmission and infection. Public Health information messages will be disseminated via the media in order to provide preventive measures to limit or avoid exposure.

A bioterrorism event may or may not elicit a large-scale response from government and nongovernmental organizations, dependent on the scope of the attack. For major incidents, public notification and information will be important to prevent further exposure and ensure the public that efforts are underway to handle the situation. Communicating with the media will not only assist in this

dispersal of information, but also ensure that appropriate information is getting out. These efforts can help bring about positive outcomes and positive public perception.

Responders

During a disease outbreak, responders can expect an increase in workload and should practice a higher level of precaution toward exposure than they would normally. Plans exist for first response and health care to address the needs of such situations. Communication between these agencies regarding plans and procedures maximize the efficiency and effectiveness of the combined efforts.

Continuity of Operations

Continuity of operations may be impacted if those in governmental or other key roles are impacted by the bioterrorism event and cannot perform their normal duties. Although plans are in place to ensure continuity of operations, a large-scale event or one that has significant impacts on operational-level staff could affect continuity of operations.

Built Environment (Property, Facilities, and Infrastructure)

Critical Facilities and Personnel

Hospitals – The primary impacts for hospitals during bioterrorism events are an increase in patients due to infected and exposed individuals and the spread of the biological substance within the facility.
Emergency Services – Workload may be increased for emergency services as individuals infected and exposed to the biological substance may require transport to a hospital facility.
Emergency Shelters – There are no expected impacts.

Transportation Systems

Interstates – There are no expected impacts.
Airports – Airports can be targeted for the transmission of biological material to airline travelers and workers, though it is highly unlikely at the airports in Guilford County.
Rail Lines – There are no expected impacts.

Critical Utilities

High Voltage Distribution Lines – There are no expected impacts.
Power Lines – There are no expected impacts.
Natural Gas – There are no expected impacts.

Communication Systems and Networks

Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities

Dam Failures – There are no expected impacts.
I-40 Fuel Farm – There are no expected impacts.

Economy

Local-National Economies – The economic impact of a bioterrorism event is dependent on where it took place, the severity of the incident, and if the threat of another event seems likely. Tourism could be significantly impacted in some areas, affecting commerce and large public gatherings.

Large Employers – There are no expected impacts.
Financial Centers – There are no expected impacts.

Special Consideration Areas
City Centers – There are no expected impacts.
Large Event Arenas – There are no expected impacts.
Historical and Cultural Landmarks – There are no expected impacts.

Environment
The environmental impact is dependent on the particular biological substance being transmittable to animal or plant life, or if it can be distributed through the water supply. Also, the delivery method of the agent's release could cause physical harm to the environment as well.

5.16 PUBLIC HEALTH EMERGING DISEASE

5.16.1 Background

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

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

There have been two significant viral outbreaks from emerging diseases in recent years of both national and international importance. The West Nile Virus is a virus that typically is passed to humans or animals by mosquitoes. Severe Acute Respiratory Syndrome (SARS) is a respiratory syndrome that is transmitted by airborne droplets. While both of these conditions caused a great deal of public health concern when they were first identified, SARS has virtually all but disappeared, while West Nile Virus occurs with low frequency and causes serious disease in only a very small percentage of cases.

Other communicable diseases pose a greater threat to the residents of Guilford County. Some of the infectious diseases of greatest concern include influenza, particularly in a pandemic form, as well as norovirus, and multiple antibiotic-resistant tuberculosis. Even in one of its normal year-to-year variants, influenza (commonly referred to as "flu") can result in serious illness and even death in young children, the elderly and immune-compromised persons. But there is always the potential risk of the emergence of influenza in one of the pandemic H1N1 forms, such as in the "Spanish Flu" outbreak of 1918-19, which killed over 50 million people worldwide. Every year, Guilford County sees hundreds of cases of influenza, leading to hundreds of hours of lost productivity in businesses due to sick employees. Of note, a vaccine for influenza is produced every year and, according to the CDC, is highly effective in preventing the disease.

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

Tuberculosis (TB) is a bacterial infection that originates from airborne exposure. Currently there are only a couple of dozen new tuberculosis cases in Guilford County each year. However, multiple drug-resistant strains, and even new extreme drug-resistant strains, are showing up with increasing frequency. Since Guilford County has a large and varied immigrant and refugee population of persons coming from countries with drug-resistant strains, TB is a disease that could become a cause of greater concern in coming years.

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

5.16.2 Location and Spatial Extent

Due to the nature of a public health/emerging disease event, it would be difficult to predict a precise location where this type of event would occur. Moreover, a large-scale event may have impacts that spread throughout the county. Therefore, all areas in Guilford County are considered equally susceptible to public health/emerging diseases.

5.16.3 Historical Occurrences

In 2003, the SARS outbreak that began in Southeast Asia began showing up in the United States. There was a single confirmed case of SARS in North Carolina in 2003, with 8 suspected cases, as described by Guilford County Department of Public Health.

An outbreak of the West Nile Virus began showing up in the United States in 1999, with Guilford County reporting its first infected bird in 2000. One individual with ties to Guilford County was confirmed as

being infected with West Nile Virus in South Carolina in 2002. No other cases have been reported in Guilford County.

As stated previously, influenza, norovirus, and tuberculosis are regularly occurring health issues in Guilford County. With the exception of tuberculosis, these conditions are not legally reportable to county or state public health agencies, so data on disease incidence is not readily available. However, these diseases are monitored through local epidemiological surveillance systems in hospitals and health departments, and any potential outbreaks are investigated promptly.

During events involving outbreaks, as stated in NCGS § 130A – 145, the State Health Director and a local health director are empowered to exercise quarantine and isolation authority. Quarantine and isolation authority shall be exercised only when and so long as the public health is endangered, all other reasonable means for correcting the problem have been exhausted, and no less restrictive alternative exists.

5.16.4 Probability of Future Occurrence

Due to some recent incidents that have been recorded in Guilford County, future occurrences are considered possible.

5.16.5 Consequence Analysis

People (The Public and Public Confidence)

The general public can be exposed to emerging diseases through different means based on the particular threat and its potential transmission routes. Vaccinations, when available, are the best means of preventing transmission and infection. Public Health information messages will be disseminated via the media in order to provide preventive measures to limit or avoid exposure.

The public confidence in government and nongovernmental organizations response may be impacted by public health outbreaks. The level of confidence the public possesses is based upon societal expectations, media influence, and past experience following other outbreaks. An effective response to the outbreak can help to guide public confidence toward a favorable level. Collaboration with media outlets can also assist in keeping the public informed and helping to protect them from exposure.

Responders

During a disease outbreak, responders can expect an increase in workload and should practice a higher level of precaution toward exposure than they would normally. Plans exist for first response and health care to address the needs of such situations. Communication between these agencies regarding plans and procedures maximize the efficiency and effectiveness of the combined efforts.

Continuity of Operations

Continuity of operations may be impacted if those in governmental or other key roles are impacted by the disease or public health threat and cannot perform their normal duties. Although plans are in place to ensure continuity of operations, a large-scale event or one that has significant impacts on operational-level staff could affect continuity of operations.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – There are no expected impacts.
Commercial – There are no expected impacts.
Industrial – There are no expected impacts.
Hazardous Materials Facilities – There are no expected impacts.

Critical Facilities and Personnel

Hospitals – The primary impacts for hospitals during disease outbreaks are an increase in patients and the spread of disease within the hospitals.
Emergency Services – Workload may be increased for emergency services as individuals infected with disease may require transport to a hospital facility.

Emergency Shelters – There are no expected impacts.

Transportation Systems

Interstates – There are no expected impacts.
Airports – There are no expected impacts.
Rail Lines – There are no expected impacts.

Critical Utilities

High Voltage Distribution Lines – There are no expected impacts.
Power Lines – There are no expected impacts.
Natural Gas – There are no expected impacts.

Communication Systems and Networks

Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities

Dam Failures – There are no expected impacts.
I-40 Fuel Farm – There are no expected impacts.

Economy

Local-National Economies – One of the more significant economic impacts that could be seen in Guilford County involves the livestock industry. Diseases like Bovine Spongiform Encephalitis (BSE) and Foot and Mouth disease can affect large populations of animals like cattle and severely devastate the livestock industry. There are numerous agricultural businesses in Guilford County, many of them having livestock as a main source of income. Absenteeism could also have a significant economic impact.
Large Employers – If employees are affected, there may be some loss in productivity.
Financial Centers – If employees are affected, there may be some loss in productivity.

Special Consideration Areas
City Centers – There are no expected impacts.
Large Event Arenas – There are no expected impacts.
Historical and Cultural Landmarks – There are no expected impacts.

Environment

The environmental impact is dependent on the particular biological substance being transmittable to animal or plant life, or if it can be distributed through the water supply.

Technological Hazards

5.17 BUILDING / STRUCTURE COLLAPSE

5.17.1 Background

A building or structure collapse, also called a structural failure, can be defined as any significant compromise of a standing, built enclosure, including its roof, walls, floors (in multi-story structures), or other large areas. Any material used to build structures has a strength limit that once passed can lead to a structural failure.

Building/structure collapses have a variety of causes, typically occurring as a secondary impact following the incidence of another hazard. The most common occurrences of structure collapse are external in nature, including explosions (both accidental and purposeful) and vehicles striking the structure and destroying key supports. Buildings that are under construction are more likely to experience a structure collapse from the effects of another hazard.

5.17.2 Location and Spatial Extent

A building or structure collapse is an uncommon occurrence anywhere, especially as structural engineering has continued to progress throughout time. Most of the structure collapses that occur are at construction sites but occasionally can be due to outside forces. Some areas near fault lines or other hazards are more prone to collapse, as not all residences and businesses are built to withstand the hazard(s) that are associated with fault lines.

5.17.3 Historical Occurrences

Collapses in general are especially uncommon in Guilford County. Several calls per year include vehicles striking structures, where a rescue of those within the vehicle or structure is necessary. Most of these collapses do not cause significant impact to the county as a whole, but there is potential for greater impact if the incidence were at a location of interest such as one of the hospitals, the Greensboro Coliseum, a large employer during business hours, or a mall.

5.17.4 Probability of Future Occurrence

There have been few past incidents of structure collapse in Guilford County, though future occurrences are considered possible.

5.17.5 Consequence Analysis

People (The Public and Public Confidence)

The collapse of an occupied building is a highly dangerous situation to occupants and passersby. Falling debris and debris that is carried out by the pressure of the collapse can injure those outside the building. Those persons who are inside the structure are most likely to be injured. Generally, these occupants will have more severe injuries, which can include death. Following a collapse anyone inside the structure is likely to be trapped and could suffer further injury while awaiting rescue and removal from the structure.

During and after a building collapse, the public will be influenced by the perceived effectiveness of the response to the collapse. This perception could be impacted by eyewitness accounts, victims, and in particular the reporting of the event by the media. Expectations may or may not be met, affecting public confidence in the ability of government and other involved entities to make decisions and act in emergency situations.

Responders

First responders will be impacted by a building collapse, as they are required to respond to such incidents. The possibility exists for secondary collapses to occur during rescue operations. If such secondary instances occur, rescuers could be injured and the condition of those trapped may worsen. Highly-trained teams such as Urban Search and Rescue teams exist for these situations and should be activated early and utilized fully to minimize the impact. Until these teams arrive, rescuers must be cognizant of the dangers associated with secondary collapses and proceed with caution.

Continuity of Operations

Generally, continuity of operations can be relatively easily maintained during a structure collapse in Guilford County. Since the effects will be very localized and are not likely to directly impact availability of personnel, there is a low risk of impact on continuity of operations.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – In cases of structure collapse, homes may become inhabitable or require significant repair and displace residents.

Commercial – Building collapses in business settings could lead to disruptions to normal operations or closures and work stoppages.
Industrial – Building collapses in industrial settings could lead to disruptions to normal operations or closures and work stoppages.
Hazardous Materials Facilities – Structural issues at hazardous materials site could not only bring about the operational issues noted in commercial and industrial settings, but could also cause hazardous material releases or spills.

Critical Facilities and Personnel
Hospitals – Structural issues at a hospital could significantly impact hospital operations. Some departments may close completely and force patients to be sent to other facilities. In some areas, biohazards or other hazardous materials may be released or spilled.
Emergency Services – Structural failures in emergency services facilities could lead to the use of alternative operating areas or the need for mutual aid assistance. In some buildings, critical systems may be housed and could experience disruptions.
Emergency Shelters – Shelters may be activated if there are numerous displaced persons from large businesses or residential areas that experience collapses (for example, due to an earthquake).

Transportation Systems
Interstates – There are no expected impacts.
Airports – While airport facilities are generally well-constructed, damages to any structures on airport property can cause hindrances in airport operations.
Rail Lines – Railroad stations could experience structural collapses, which could significantly impact rail operations. Also, debris from structures in close proximity to the rail network could impact operations as well.

Critical Utilities
High Voltage Distribution Lines – There can be impacts if the building that collapses is directly tied to the functioning or management of power. If the building collapses on equipment or structures that are part of the power distribution network, it could also have significant impact on the delivery of services.
Power Lines – There can be impacts if the building that collapses is directly tied to the functioning or management of power. If the building collapses on equipment or structures that are part of the power distribution network, it could also have a significant impact on the delivery of services.
Natural Gas – There can be some impacts if the building that collapses is directly tied to the functioning or management of power. If the building collapses on natural gas lines or other parts of the distribution network, it could also have significant impact on the delivery of the product.

Communication Systems and Networks
Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts, though a downed tower could provide some sporadic service issues.
Internet Capabilities – Impacts are unlikely, though some sporadic service issues could arise. A structural issue at a facility housing a particular internet service provider's systems and equipment could affect its customers.

High Loss Potential Facilities
Dam Failures – There are no expected impacts, though structural damage to pump or gate houses could cause flow issues in the worst of scenarios, which are highly unlikely.

I-40 Fuel Farm – Critical systems or processes could be affected if they are housed in an affected building or structure, which may cause some level of operational disruption. Sparks from a structural incident may ignite fires or bring about explosions.

Economy

Local-National Economies – The economic impact of a building collapse is ultimately dependent on what structures collapse and the extent of the damage. If the collapse occurs in a business district and forces other businesses to be closed for cleanup or inspected for possible damage, this further impacts the local economy. Of greatest economic concern are large employers that have a significant stake in the local economy such as any of the hospitals, schools, or colleges.

Large Employers – Structural collapses in any of the hospitals, schools, colleges, or other large businesses can be costly, both to the facility itself as well as the community.

Financial Centers – A structural collapse at a financial institution could be especially problematic to the local economy, depending on what equipment and systems are impacted.

Special Consideration Areas

City Centers – Building collapses in city centers could lead to disruptions in everyday commerce or bring about closures and work stoppages.

Large Event Arenas – A collapse of an arena can have a significant impact on the local economy, as significant revenue is generated by large events.

Historical and Cultural Landmarks – A structure collapse involving a landmark can cause irreparable harm to its historical or cultural value.

Environment

The environmental impact of a building collapse would most likely be minimal. Run off from the collapsed building could contaminate nearby wildlife and/or water supplies if it is not controlled.

5.18 COMMUNICATIONS SYSTEM DISRUPTION / FAILURE

5.18.1 Background

The widespread failure or disruption of communications systems is uncommon. In most cases, there are backup systems in place to keep communication lines flowing. Extreme situations or the presence of several significant hazards would be necessary for an incident that would affect multiple communications systems. Communications infrastructure is designed to withstand high winds and other weather elements; however, failure is always a possibility and must be planned for regardless of the unlikelihood. In Guilford County, one issue that can cause or exacerbate a communications system disruption is that numerous facilities in the county are constructed in a way that radio coverage is greatly diminished within the building. This kind of disruption can occur without a precipitating event and result in similar impacts to communication among response personnel.

Disruptions are more likely to occur than actual failures. Overloaded systems due to other hazards or disaster circumstances may cause temporary connectivity issues, especially in cell phone networks. The public and some government and business operations have become more reliant on cell phones for communicating. During large-scale events or emergencies when cell phone traffic is high, it can cause overload situations and disruptions could result.

5.18.2 Location and Spatial Extent

Since a communications disruption/failure would generally have impacts throughout the county's entire network, the location for this hazard is considered countywide.

5.18.3 Historical Occurrences

In Wilmington, North Carolina, Hurricane Floyd caused a temporary outage of the county's 800 megahertz (MHz) radio system. Guilford County had a similar instance in the spring of 2011 when the 800 MHz radio system entered into Failsoft mode. This significantly impacted radio transmissions as multiple sets of talk groups were consolidated into single channels, a result of the system losing "trunking" capability. Occasional impediments in radio transmissions can be expected in these situations. Many digital talk groups in Greensboro had disruptions, especially those associated with law enforcement. Decision makers may ultimately decide to switch operational communications over to a backup system until the primary system's issues are corrected.

During and immediately after Hurricane Katrina, the city of New Orleans, Louisiana and adjacent areas experienced significant communications issues as flooding impacted multiple systems. Cell phone towers and their generators, landline infrastructure, and other communications equipment and structures were temporarily out of service. Much of this scenario was due to the strength of the storm and the area's topographical characteristics. A similar incident is unlikely to occur in Guilford County due to its geographic location and topography.

5.18.4 Probability of Future Occurrence

Since there have been some previous occurrences of communication disruption/failure and future occurrences are probable, the probability is considered to be likely.

5.18.5 Consequence Analysis

People (The Public and Public Confidence)

The public has become increasingly reliant on cell phone communications. Many households have decided to forgo landline services completely in exchange for cell phones. In large-scale emergencies, many calls will be made to dispatch centers, loved ones, etc. that may cause overloading of the cell phone networks. These disruptions can cause issues that range from slight nuisances to the end user to preventing an emergency from being reported. Extended disruptions or complete outages can significantly impact communications and in extreme cases, put some in danger during emergencies as responders will be delayed or may not receive notification at all.

Public confidence may be impacted based upon societal expectations, media influence, and past experience with issues or failures in communication systems. Public confidence can be gained when the public's expectations of response and recovery services are met or exceeded. Public confidence may be impacted by media interpretation and reporting of the event, whether positively or negatively. Lastly, the public's experience with prior incidents of like type and scope will affect confidence because the public may compare services rendered from one communications interruption or failure to another.

Responders

Impact may center more on operational information passing rather than performing physical tasks such as rescue, patient care, and firefighting. Communication is vital to efficient and effective service, and disruptions or breakdowns could impact the service provided. Backup forms of communication must be identified and maintained in order to provide a means for critical communications while primary systems are repaired and restored. Once the primary systems are operational, an appropriate transition away from the backup system should be implemented to lessen the transition's impact on ongoing operations.

Continuity of Operations

A communications disruption/failure would potentially have extensive impacts on continuity of operations because of the loss of ability for responders and other emergency personnel to communicate effectively. This could cause a great deal of stress to operations and create some level of disorder in terms of continuity.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – Issues within communications systems can cause limitations on person to person contact and prevent or hinder emergency communications.

Commercial – Disruptions or failures in communications systems may cause hindrances in business interactions and processes. Also, the affected businesses may be unable to report emergencies in a timely fashion.

Industrial – Disruptions or failures in communications systems may cause hindrances in business interactions and processes. Also, the affected businesses may be unable to report emergencies in a timely fashion.

Hazardous Materials Facilities – A communications failure during incidents at one or more hazardous materials facilities could be problematic. Notification to the appropriate personnel to manage the incident could be delayed, allowing the incident to potentially worsen as the release continues or spreads. Also, the inoperability of communication systems could prevent the proper evacuation of workers and visitors, or hinder intra-facility communication during the event.

Critical Facilities and Personnel

Hospitals – Hospitals can be affected by communications systems failures. Typically, there are backup systems in place. Most facilities utilize radios that allow for continued communication within the facility. There may be more significant impacts when trying to communicate outside of the facility.

Emergency Services – Emergency services may experience some delayed response times if emergencies cannot be called in through conventional means such as telephone or cell phone. Also, if the dispatch system itself is down, dispatchers may have to use alternative means to dispatch calls and pass on call-related information to response units.

Emergency Shelters – In the event that emergency shelters are opened and primary communications systems have failed, these shelters can be staffed with amateur radio operators who can facilitate continued operational communications until the primary systems can be restored. However, these operators can only contact other facilities or areas that have other amateur radio operators and the necessary radio equipment is available.

Transportation Systems

Interstates – Communications failures may have some impact on interstate travel if incidents or other road condition issues cannot be reported and dealt with in a timely manner.
Airports – Airports can be impacted by communications issues, especially if the communication failure is internal. Such communications failures could impact air travel locally, regionally, and potentially at a national level, especially if the failures are widespread. External communications failures may delay the reporting of general air traffic incidents and in turn delay the dispatch of appropriate personnel.
Rail Lines – Rail lines could be impacted by communications issues, especially if the communication failure is within the rail system's own infrastructure. The internal disruptions could promote compounding incidents and/or delay the notification of such incidents. External communications failures may delay the reporting of railroad system problems or concerns and in turn delay the dispatch of appropriate personnel.

Critical Utilities
High Voltage Distribution Lines – During communications interruptions or failures, issues with high voltage lines may not be reported or dispatched to appropriate personnel in a timely manner, delaying restoration efforts.
Power Lines – During communications interruptions or failures, power line issues may not be reported or dispatched to appropriate personnel in a timely manner, delaying restoration efforts.
Natural Gas – During communications interruptions or failures, natural gas incidents may not be reported or dispatched to appropriate personnel in a timely manner, increasing the likelihood of a greater impact.

Communication Systems and Networks
Telephone Systems – Telephone line issues may not be reported or dispatched to appropriate personnel in a timely manner.
Cell Phone Towers – Cellular telephone towers are connected to the landline telephone system. Failure of the landline system will cause impacts in the cell phone network.
Internet Capabilities – Internet connections may be the type of communication interrupted, depending on the incident. If telephone line-based systems are the issue, some internet connectivity may be impacted.

High Loss Potential Facilities
Dam Failures – Dam failures or other problems associated with a dam may not be reported or dispatched to appropriate personnel in a timely manner.
I-40 Fuel Farm – Incidents at the fuel farm may not be reported or dispatched to appropriate personnel in a timely manner.

Economy
Local-National Economies – Significant economic impact is unlikely unless communications systems are down for extended periods of time. Days or weeks of outages will affect businesses and commerce significantly and may require numerous resources to fix, replace, or temporarily take the place of the current system in place.
Large Employers – Large employers can be significantly impacted depending on the communications system involved and the length of the incident. Backup systems may limit or eliminate any impact.
Financial Centers – Financial centers can be significantly impacted depending on the communications system involved and the length of the incident. Backup systems may limit or eliminate any impact.

Special Consideration Areas
City Centers – City centers could be impacted by communications system failures if public safety events occur and response is delayed due to notification issues.
Large Event Arenas – Large events may be delayed or cancelled if communications systems fail.
Historical and Cultural Landmarks – Communications issues may have some impact on these facilities, primarily affecting response to incidents that occur within them.

Environment
There are no expected impacts.

5.19 ENERGY / POWER / UTILITY FAILURE

5.19.1 Background

A failure in the power distribution network can happen for varying reasons. Some possible examples include the physical failure of power lines due to hazards as discussed in the Critical Utilities sections throughout this document, as well as problems within the network itself including faults at a power station, shorts or overloading in a circuit(s), or physical damages at a substation.

There are three different types of power outages - transient faults, brownouts, and blackouts. A transient fault is a brief outage caused by a fault in a power line. The issue is corrected when the power flow clears the faulty part of the circuit, and power is returned. A brownout occurs when voltage falls to an inadequate level. A blackout occurs when there is a complete loss in the power supply. Blackouts are generally longer lasting outages than the previous two examples and may involve significant repairs. These outages can range from minutes to weeks or more depending on the significance of the failure in the network.

5.19.2 Location and Spatial Extent

Due to the unpredictable nature of where exactly a power or utility outage will occur, the entire county is considered to be equally susceptible to this hazard. However it should be noted that in more urbanized areas, the effects of an outage at a single location or facility would likely impact larger numbers of people.

5.19.3 Historical Occurrences

Most of the lengthy power outages that have occurred in Guilford County have been due to winter storms with ice accumulation, as the area occasionally experiences this type of weather during the winter months. This accumulation can make travel dangerous and also cause branches, trees, and power lines to break or fall, causing power disruptions or outages in the affected area. Power outages can vary depending on the amount of precipitation, its location, and its form.

On February 25, 2010, one such ice accumulation event occurred, as ¼ of an inch of icing followed a 3 inch snowfall. The weight of the icepack and snow during this storm caused the downing of trees and power lines, resulting in over 12,000 homes without power. More recently, in 2014 a major ice storm impacted the county and many areas of the state knocking down power lines and causing power outages for several days in some cases.

Guilford County experienced record power outages during an ice storm on December 4, 2002. Almost a million people in central North Carolina lost power due to ½ an inch to an inch of ice accumulation causing power line failures and downed trees. Some areas lost power for a week or more in this event.
Power outages do not occur only during weather-related events. In 2003, the Northeast Blackout showed how vulnerable large networks are to widespread outage. An estimated 55 million people were without power after a critical failure in the system, as many power plants in Ontario, Canada and the Northeast went offline. A single cause could not be attributed to this incident, but several issues led to a cascading failure. Overload protection was unable to keep a small problem in the system from affecting other parts of the system, which led to the power outage affecting a larger area.

5.19.4 Probability of Future Occurrence

Based on the high number of outages that have occurred in past years, the probability of a power or utility failure is considered likely.

5.19.5 Consequence Analysis

People (The Public and Public Confidence)
Some issues that need to be considered during a power outage include transportation tie-ups and accidents, medical emergencies, and communications disruptions. The transportation problems would likely be related to traffic lights and signals not working or from decreased visibility during the night. Medical emergencies could stem from homes not having power to operate heating and air conditioning systems, particularly during conditions of extreme temperatures. Also medical equipment that relies on power could shut off, no longer providing a patient with treatment he or she requires. The communications issues could prevent the public from being able to call emergency services. Business disruptions could also impact services that the public wants or needs. Lastly, well pumps would not function without power unless on backup generator power.

Public perception during any incident involving public utility systems depends on the impacts that are presented and how government and nongovernmental entities act. Extended, widespread outages could have the potential for pressure from the public. The media's reporting of the incident and the response could significantly influence public expectations and perception. Passing information to the public about ongoing efforts and when service restoration can be expected could assist in maximizing the confidence and satisfaction of the public.

Responders
As mentioned in the General Public section, there may be issues relating to transportation, medical equipment, extreme weather temperatures, and communications issues in the event of a power outage. Any of these issues could impact the call volume for emergency responders. If communications disruptions are present, it could affect notification processes and increase response times. Until power is restored, some critical facilities may need generators to provide backup power. Law enforcement may become strained if additional personnel are needed to deal with unusual circumstances such as unrest, looting, or traffic control if signals are not operating appropriately.

Continuity of Operations

Generally, continuity of operations can be maintained during a power or utility outage event in Guilford County. However, when power transmission lines go down, it can make it difficult for emergency management employees to arrive to work. As a result, there will likely be some disruption of operations during an outage.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – Many residential structures do not have backup generators in place. If power fails, the residents of these homes may not be able to refrigerate their food, regulate medical equipment properly (such as oxygen), etc. until power is restored.

Commercial – Unless backup power is available, many business processes may be hindered or stopped by power disruptions.

Industrial – Unless backup power is available, many business processes may be hindered or stopped by power disruptions.

Hazardous Materials – In the event of power outage, hazardous materials facilities typically have backup systems to continue critical operations and to maintain the hazardous materials on site. However, uncontrolled processes and spills are more likely to occur if backup systems do not operate correctly during these outages. There could be tremendous economic impact to businesses or the community as a whole with extended outages; many of these facilities require a significant amount of energy to operate at normal capacity.

Critical Facilities and Personnel

Hospitals – Hospitals are required to have generators that provide power during outages. Other facilities can take in patients if needed when a particular facility or multiple facilities are unable to provide care due to a power outage.

Emergency Services – Like hospitals, there are emergency services facilities equipped with generators to keep power supplied for continued operations during a power outage. Mutual aid agreements are put in place to handle situations where there is not an adequate supply of operational resources.

Emergency Shelters – Emergency shelters may be activated if power outages are widespread and prolonged. Some shelters may be located in affected areas and alternative locations may need to be considered.

Transportation Systems

Interstates – Energy/power outages are unlikely to impact interstates significantly.

Airports – Airport facilities are required to have backup power to keep key operations going during power outages. Other airports have experienced grounded flights and suspended operations as a result of a power outage until power was able to be restored. Extended outages may cause more significant impacts on flight patterns.

Rail Lines – Rail lines can be impacted by power outages if backup power sources fail. Signals at railroad crossings may not work appropriately and in more severe cases, networks may be stopped until power is restored to prevent incidents.

Critical Utilities

High Voltage Distribution Lines – High Voltage Distribution lines are directly tied to power outages.

Power Lines – Power lines are directly tied to power outages.

Natural Gas – The distribution of natural gas may be affected by power outages; however, the delivery of natural gas to customers is not usually dependent on external power sources.

Communication Systems and Networks
Telephone Systems – Telephone systems may or may not be impacted by energy/power outage. Typically, weather hazards could cause many of the outages to power, which could affect landline phones at the same time.

Cell Phone Towers – Cellular telephone towers generally have backup power to function during power outages. However, depending on the presence of other hazards or lengthy outages, cell phone reception may be impacted.
Internet Capabilities – Internet connections that originate from or are linked to energy sources in affected areas will likely see effects from a power outage.

High Loss Potential Facilities
Dam Failures – Dams are not significantly impacted by power outage. Many of the processes could be bypassed and done manually if there was no power. Other processes, such as the pulling of water from lakes, would have backup generators in place to continue normal operations.
I-40 Fuel Farm – In the event of a power outage, the businesses at the fuel farm have backup systems to continue critical operations. Uncontrolled processes and spills are more likely to occur if these backup systems do not operate correctly. There would be significant economic impact involved with an outage, as a significant amount of energy is needed to operate at normal capacity whether there are backup systems in place or not.

Economy
Local-National Economies – Extended outages could shut down businesses and have significant financial impacts depending on the area of the outage, the period of time the outage occurs, and the nature of the business(es) that are affected.
Large Employers – The impact that a power outage would have on large employers depends on if the outage occurred during business hours. The impacts are also dependent on how long the outage lasts and if backup power is in place. Backup systems may not cover all of the business's operations, only the critical functions, so there may still be some impact even with a backup system.
Financial Centers – The impact that a power outage would have on the financial centers depend on if the outage occurs during business hours. The impacts are also dependent on how long the outage lasts.

Special Consideration Areas
City Centers – The impact that a power outage will have on a city center depends on if the outage occurs during business hours. The impacts are also dependent on how long and how widespread the power or energy issues are in the business district.
Large Event Arenas – Power outages could have a significant impact on facilities like the Greensboro Coliseum if an event(s) is taking place.
Historical and Cultural and Landmarks – Power outages may impact the operation of landmarks since many of these facilities rely on electricity. Extended outages could provoke closings.

Environment
There are no expected impacts.

5.20 HAZARDOUS MATERIALS INCIDENT

5.20.1 Background

Hazardous materials can be found in many forms and quantities that can potentially cause death; serious injury; long-lasting health effects; and damage to buildings, homes, and other property in varying degrees. Such materials are routinely used and stored in many homes and businesses and are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This subsection on the hazardous material hazard is intended to provide a general overview of the hazard, and the threshold for identifying fixed and mobile sources of hazardous materials is limited to general information on rail, highway, and FEMA-identified fixed HAZMAT sites determined to be of greatest significance as appropriate for the purposes of this plan.

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways, and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents, and 266 are due to other causes.[32] In essence, HAZMAT incidents consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife as well.

HAZMAT incidents can also occur as a result of or in tandem with natural hazard events, such as floods, hurricanes, tornadoes, and earthquakes, which in addition to causing incidents can also hinder response efforts. In the case of Hurricane Floyd in September 1999, communities along the Eastern United States were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills, and a variety of other environmental pollutants that caused widespread toxological concern.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

5.20.2 Location and Spatial Extent

As a result of the 1986 Emergency Planning and Community Right to Know Act (EPCRA), the Environmental Protection Agency (EPA) provides public information on hazardous materials. One facet of this program is to collect information from industrial facilities on the releases and transfers of certain toxic agents. This information is then reported in the Toxic Release Inventory (TRI). TRI sites indicate where such activity is occurring. Guilford County has 187 TRI sites. A second facet of the program is to

[32] FEMA, 1997.

collect information on significant quantities of hazardous chemicals maintained at fixed facilities. These facilities are known as Tier II facilities. There are 419 Tier II Facilities in the county. Additionally, facilities that use extremely hazardous substances are required to develop a Risk Management Plan (RMP) that must be revised and resubmitted to the EPA ever five years. There are 13 RMP facilities in Guilford County.

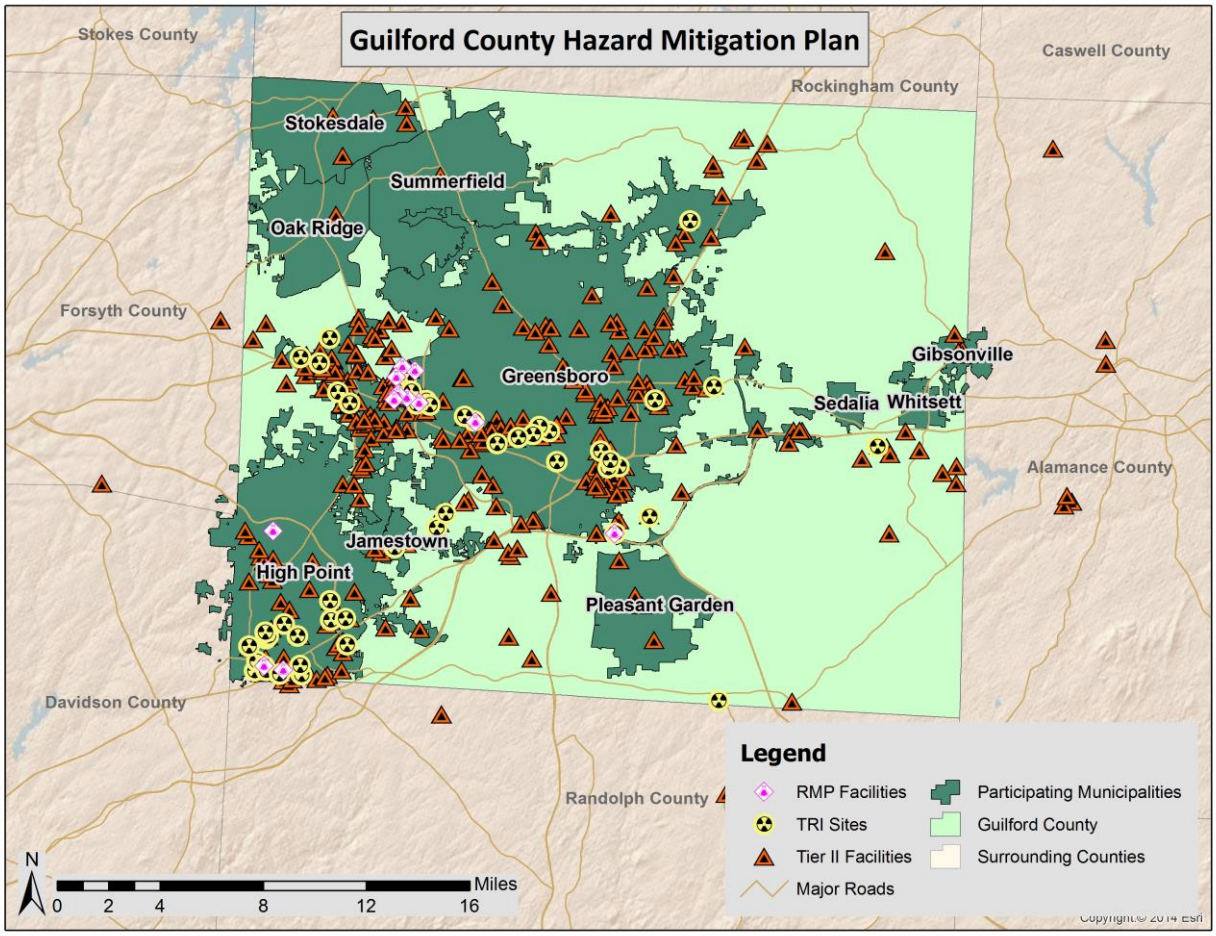
All of these fixed hazardous materials sites are summarized in **Table 5.41** and shown in **Figure 5.25.**

TABLE 5.41: SUMMARY OF FIXED HAZARDOUS MATERIALS SITES IN GUILFORD COUNTY

Location	TRI Facilities	Tier II Facilities	RMP Facilities
Gibsonville	0	4	0
Greensboro	86	221	9
High Point	82	68	4
Jamestown	11	3	0
Oak Ridge	0	1	0
Pleasant Garden	0	5	0
Sedalia	0	0	0
Stokesdale	0	5	0
Summerfield	0	1	0
Whitsett	0	0	0
Unincorporated Area	8	111	0
GUILFORD COUNTY TOTAL	**187**	**419**	**13**

Source: Environmental Protection Agency

FIGURE 5.25: FIXED HAZARDOUS MATERIALS SITES IN GUILFORD COUNTY



Source: Environmental Protection Agency

In addition to "fixed" hazardous materials locations, hazardous materials may also impact the county via roadways and rail. Many roads in the county are subject to hazardous materials transport and all roads that permit hazardous material transport are considered potentially at risk to an incident.

5.20.3 Historical Occurrences

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) lists historical occurrences throughout the nation. A "serious incident" is 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 gallons 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.

However, prior to 2002, a hazardous materials "serious incident" was defined as follows:

- a fatality or major injury due to a hazardous material,
- closure of a major transportation artery or facility or evacuation of six or more person due to the presence of hazardous material, or
- a vehicle accident or derailment resulting in the release of a hazardous material.

There have been a total of 2,220 recorded HAZMAT incidents in Guilford County since 1971 (**Table 5.42**). These events resulted in nearly $76,000 (2014 dollars) of property damage as well as 1 death and 28 injuries.[33] **Table 5.43** presents detailed information on historical HAZMAT incidents in Guilford County as reported by the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA). However, due to the high number of reported incidents, detailed information is only provided for those incidents that are classified as serious incidents.

TABLE 5.42: SUMMARY OF HAZMAT INCIDENTS IN GUILFORD COUNTY

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2014)
Gibsonville	2	0/0	$895
Greensboro	2,088	1/25	$42,327
High Point	107	0/3	$0
Jamestown	8	0/0	$4,022
Oak Ridge	0	0/0	$0
Pleasant Garden	0	0/0	$0
Sedalia	1	0/0	$0
Stokesdale	2	0/0	$13,198
Summerfield	0	0/0	$0
Whitsett	3	0/0	$0
Unincorporated Area	10	0/0	$15,512
GUILFORD COUNTY TOTAL	**2,220**	**1/28**	**$75,954**

Source: Untied States Department of Transportation Pipeline and Hazardous Materials Safety Administration

TABLE 5.43: SERIOUS HAZMAT INCIDENTS IN GUILFORD COUNTY

Report Number	Date	City	Mode	Serious Incident?	Fatalities / Injuries	Damages ($)*	Quantity Released
Gibsonville							
None Reported	--	--	--	--	--	--	--
Greensboro							
I-1976030738	3/1/1976	GREENSBORO	Highway	Yes	0/0	$0	300 LGA
I-1977070198	6/28/1977	GREENSBORO	Highway	Yes	0/0	$0	300 LGA
I-1979041231	4/14/1979	GREENSBORO	Highway	Yes	0/0	$0	300 LGA
I-1979061010	5/1/1979	GREENSBORO	Highway	Yes	0/0	$0	385 LGA

[33] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2014, the October 2014 monthly index was used.

Report Number	Date	City	Mode	Serious Incident?	Fatalities / Injuries	Damages ($)*	Quantity Released
I-1979120614	11/8/1979	GREENSBORO	Highway	Yes	0/0	$0	805 LGA
I-1980090308	8/18/1980	GREENSBORO	Highway	Yes	0/0	$0	563 LGA
I-1980100440	9/20/1980	GREENSBORO	Highway	Yes	0/0	$0	5,869 LGA
I-1980101010	9/25/1980	GREENSBORO	Highway	Yes	0/0	$0	930 SLB
I-1982030735	2/20/1981	GREENSBORO	Highway	Yes	0/0	$0	750 LGA
I-1982100088	9/22/1982	GREENSBORO	Highway	Yes	0/0	$0	0
I-1982100088	9/22/1982	GREENSBORO	Highway	Yes	0/0	$0	13,000 SLB
I-1987110100	10/30/1987	GREENSBORO	Highway	Yes	1/4	$0	8,000 LGA
I-1990080042	7/26/1990	GREENSBORO	Highway	Yes	0/0	$0	600 LGA
I-1991090582	9/8/1991	GREENSBORO	Highway	Yes	0/0	$0	129 LGA
I-1991110412	9/26/1991	GREENSBORO	Highway	Yes	0/0	$0	55 LGA
I-1992090751	8/20/1992	GREENSBORO	Highway	Yes	0/0	$0	700 LGA
I-1993090117	8/24/1993	GREENSBORO	Highway	Yes	0/0	$0	5,000 LGA
I-1995071369	7/5/1995	GREENSBORO	Highway	Yes	0/0	$0	0.264172 LGA
I-1997100017	9/4/1997	GREENSBORO	Highway	Yes	0/0	$36,983	1,300 LGA
I-1997100623	9/5/1997	GREENSBORO	Highway	Yes	0/0	$0	200 LGA
I-1999101169	9/30/1999	GREENSBORO	Highway	Yes	0/1	$0	9,000 LGA
I-2000040521	3/30/2000	GREENSBORO	Rail	Yes	0/3	$0	5,300 LGA
I-2001060345	11/13/2000	GREENSBORO	Highway	Yes	0/0	$0	4,500 LGA
I-2003050215	8/28/2002	GREENSBORO	Highway	Yes	0/0	$0	5,500 LGA
I-2003090170	1/30/2003	GREENSBORO	Highway	Yes	0/0	$0	260 LGA
I-2003100511	9/25/2003	GREENSBORO	Highway	Yes	0/0	$0	324.14 LGA
I-2003120134	10/2/2003	GREENSBORO	Highway	Yes	0/0	$0	175 LGA
E-2009020080	12/23/2008	GREENSBORO	Highway	Yes	0/0	$0	500 LGA
E-2009110327	10/27/2009	GREENSBORO	Highway	Yes	0/0	$0	387.5 LGA
I-2011010037	12/10/2010	GREENSBORO	Highway	Yes	0/0	$0	300 LGA
I-2012040248	11/29/2011	GREENSBORO	Highway	Yes	0/0	$0	200 LGA
I-2012040248	11/29/2011	GREENSBORO	Highway	Yes	0/0	$0	1,000 LGA
High Point							
I-1977010157	12/31/1976	HIGH POINT	Highway	Yes	0/0	$0	5,200 LGA
I-1985060263	5/29/1985	HIGH POINT	Highway	Yes	0/0	$0	150 LGA
I-2011010135	11/10/2010	HIGH POINT	Highway	Yes	0/0	$0	181 LGA
Jamestown							
I-1989040054	3/15/1989	JAMESTOWN	Rail	Yes	0/0	$0	2,600 LGA
I-2001050986	3/19/2001	JAMESTOWN	Highway	Yes	0/0	$4,022	300 LGA
E-2013030384	3/27/2013	JAMESTOWN	Highway	Yes	0/0	$0	100 LGA
Oak Ridge							
None Reported	--	--	--	--	--	--	--
Pleasant Garden							
None Reported	--	--	--	--	--	--	--
Sedalia							
None Reported	--	--	--	--	--	--	--
Stokesdale							
I-1978020301	1/31/1978	STOKESDALE	Highway	Yes	0/0	$0	6,000 LGA
I-2002120039	11/12/2002	STOKESDALE	Highway	Yes	0/0	$13,198	4,000 LGA

Report Number	Date	City	Mode	Serious Incident?	Fatalities / Injuries	Damages ($)*	Quantity Released
Summerfield							
None Reported	--	--	--	--	--	--	--
Whitsett							
None Reported	--	--	--	--	--	--	--
Unincorporated Area							
None Reported	--	--	--	--	--	--	--

*Property damage is reported in 2014 dollars.
Source: Untied States Department of Transportation Pipeline and Hazardous Materials Safety Administration

5.20.4 Probability of Future Occurrence

Given the location of numerous TRI, Tier II, and RMP facilities in Guilford County as well as prior roadway, railway, air, and other incidents it is highly likely that a hazardous material incident may occur in the county (100 percent annual probability). However, county and municipal officials are mindful of this possibility and take precautions to prevent such an event from occurring. Additionally, there are detailed plans in place to respond to an occurrence.

5.20.5 Consequence Analysis

People (The Public and Public Confidence)

The accidental or intentional release of a hazardous material could have both immediate and long lasting effects on the health of the public. Any release needs to be quickly identified and the proper response guidelines followed to reduce the possible impact on the public. Evacuation is always a consideration when dealing with harmful substances. The public should be aware that hazards exist from the presence of hazardous materials, and should take preparedness actions at home and in the workplace to act should a release of materials occur.

The confidence of the public in government and nongovernmental organizations and their response capabilities and efforts may be influenced during disaster events. Some of the influences are based upon societal expectations, media influence, and past experiences, in this case with hazardous materials incidents. Public confidence can be gained when the public's expectations of response and recovery services are met or exceeded. Media interpretation and reporting of the event, whether positive or negative, can influence public perception significantly.

Responders

First responders must be vigilant when hazardous materials are suspected to be involved. The proper protective apparel must be worn and protocols must be followed to ensure that contaminated individuals and objects go through appropriate decontamination procedures prior to being moved away from the incident, regardless of the situation. Contamination of other responders or citizens must be avoided. The appropriate personnel, such as Hazardous Materials teams, must be notified to ensure that the proper measures are taken to prevent further harm and other related impacts.

Continuity of Operations

During a hazardous materials incident, normal operations could likely be maintained with some additional stress on daily operations. In the event of a larger scale hazardous materials spill, there could

be some loss of continuity of operations as a result of strain on personnel and equipment, but typically this will not be the case.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – Residential structures have numerous hazardous materials sitting around that are generally contained, but can become hazards when spilled, used incorrectly, mixed with other chemicals, or come in contact with fire. Cleaning products, fertilizers, and pesticides are common examples of household supplies that are considered hazardous materials. Fires, explosions, leaks, or releases into the air or water supply are the incidents most likely to occur from residential buildings.

Commercial – Commercial buildings may have hazardous materials contained within them that could present a hazard. These materials are regulated and reported to appropriate entities. Proper containers and labeling can prevent inappropriate use, but accidents can still cause workers to be exposed.

Industrial – Many industrial facilities have some types of hazardous materials onsite that could, if handled improperly, become a health and/or environmental risk.

Hazardous Materials Facilities – A hazardous materials event is most likely to take place where the material is created or stored. Hazardous materials facilities have their own highly-trained personnel for handling and cleaning up the particular substances stored onsite. The facility's plans are highly specific to the materials stored there, thus providing for effective responses to incidents that involve these materials. Some facilities contain hazardous materials that can spread or leak quickly, or are held in extremely dangerous concentrations. There can still be significant effects on workers and others in close proximity despite having good planning in place.

Critical Facilities and Personnel

Hospitals – Hospitals utilize and store some hazardous materials on site. Biological materials and radioactive wastes are the primary concerns in a hospital setting. Plans are in place to manage these concerns in both routine and emergency situations. An external hazardous materials event that occurs near the hospital or directly impacts a hospital could create service disruptions such as patient care. Decisions about sheltering-in-place or evacuation could be complex, and may require outside resources if evacuations are deemed necessary in a situation.

Emergency Services – Some emergency services facilities store hazardous materials onsite, including cleaning agents and fuel. These must be appropriately contained and labeled. Emergency personnel and headquarters could also be targeted and exposed to hazardous materials intentionally.

Emergency Shelters – Emergency shelters may be opened if homes have been exposed to hazardous materials and evacuations occur. Hazardous materials could also impact emergency shelters themselves. If this occurs, inhabitants would be moved to alternative facilities.

Transportation Systems

Interstates – Hazardous materials can have an impact on interstate transportation if a release occurs on or in the vicinity of the roadway. Significant traffic disruptions may occur, slowing commerce or forcing alternative routing and further congestion of other areas.

Airports – Airports facilities may have to cease operations if hazardous materials are released nearby or discovered onsite.

Rail Lines – Rail lines are one of the more prominent places that hazardous materials are transported. A hazardous materials event on the rail system can impact rail traffic and the overall system. Cleanup efforts wherever the event occurred could be costly and go on for extended periods, shutting down that part of the rail system for that time.

Critical Utilities

High Voltage Distribution Lines – It is possible for high voltage lines to be impacted by hazardous materials if fire or other physical hazards to the network are involved. Long-term outages may occur if there are downed or corrupted lines or if technicians are unable to repair issues due to the presence of hazardous materials.

Power Lines – It is possible for power lines to be impacted by hazardous materials if fire or other physical hazards to the network are involved. Long-term outages may occur if there are many downed or corrupted lines or technicians are unable to repair issues due to the presence of hazardous materials.

Natural Gas – Natural gas distribution lines can be problematic with some hazardous materials if contact is made with the natural gas supply. Most of the natural gas infrastructure is located underground, making exposure highly unlikely. Natural gas itself can be the hazardous material involved in the incident. A utility or other work crew may strike a line or cause some kind of leak. Also, degradation of the line can cause a release. Explosions and fires would be significant concerns for the immediate vicinity.

Communication Systems and Networks

Telephone Systems – It is possible for telephone lines to be impacted by hazardous materials if fire or other physical hazards to the network are involved. Long-term outages may occur if there are many downed or corrupted lines or technicians are unable to repair issues due to the presence of hazardous materials.

Cell Phone Towers – It is unlikely but possible for cell phone towers to be impacted by hazardous materials if fire or other physical hazards are involved which hinder their operability. Long-term outages may occur if technicians are unable to repair the tower or handle other issues due to the presence of hazardous materials.

Internet Capabilities – Internet connections are not likely to be impacted by hazardous materials unless cable-based connections are impacted. Wireless sites that are hit directly may cause local or regional connectivity problems.

High Loss Potential Facilities

Dam Failures – Dams are unlikely to be impacted by hazardous materials. The most likely incident would be a transportation incident near a dam that may cause some contamination issues.

I-40 Fuel Farm – With respect to hazardous materials, the fuel farm is primarily a fire concern, as seen in the event that occurred there in 2010. Gasoline, diesel, and crude oil all have low reactivity to other materials and do not pose significant concern.

Economy

Local-National Economies – The economic impact of a hazardous materials related incident can be significant locally. Affected commerce is the greatest concern, as spills and releases can force businesses such as shopping centers, markets, and financial centers to be shut down for indeterminate periods of time. Contaminated water can be especially problematic as it can cause extensive shutdowns and put many people in danger. The overall costs depend on the chemical(s) involved, how much is released, the processes and time used to manage the spill or release, who or what is contaminated, whether a fire takes place, etc. Cleanup is a less significant cost and is typically handled by the party responsible for the spill or release.

Large Employers – Large employers can be significantly impacted by hazardous materials, especially during business hours. Cleanup processes may be costly after the incident depending on the product involved and the severity of the exposure, spill, or release.

Financial Centers – Hazardous materials incidents could have a significant impact on financial centers, especially during business hours. Cleanup processes may be costly after the incident depending on the product involved and the severity of the exposure, spill, or release.

Special Consideration Areas
City Centers – Hazardous materials incidents would likely have a significant impact on city centers, especially during business hours when there are many people present. Cleanup processes could be very costly after the incident depending on the product involved and the severity of the exposure, spill, or release.
Large Event Arenas – A hazardous materials incident could occur at any large gathering if it was the target of a terrorism event. Also, a large event arena could be forced to deal with a hazardous materials incident if it is located in close proximity to them. Greensboro Coliseum in particular, is located near a manufacturing and storage facility. Arenas may also be situated along transportation routes where vehicles transporting such materials could become involved in an accident.
Historical and Cultural Landmarks – Hazardous materials are unlikely to impact parks or its visitors unless it was specifically targeted or affected by a person, vehicle, or other carrier, or if the substance's leak or release were to spread from an incident into the park(s).

Environment
The environmental impact is highly dependent on the location and the severity of the event. Some of the materials involved in these incidents can be cleaned up or do not have lasting impacts on the areas affected. Others may cause crops and other vegetation to be destroyed, sometimes beyond the ability to grow back and animal populations may become displaced. Some areas may be deemed uninhabitable or not fit for development. Water sources may also be impacted by hazardous materials releases or spills, which can affect fish, animal, and plant populations as well as humans that come in contact with contaminated water.

5.21 NUCLEAR POWER PLANT EMERGENCY

5.21.1 Background

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

By some estimates, over 50 percent of nuclear accidents that have ever occurred were in the United States.[34] However, it is also important to note that generally, nuclear accidents are a rare occurrence. Many incidents are extremely well known due to their large-scale impact and serious effects on people and the environment.

One of the most notorious accidents in the United States was the Three Mile Island accident which occurred in 1979 and released small amounts of radioactive gases and iodine into the environment.

[34] Benjamin K. Sovacool. A Critical Evaluation of Nuclear Power and Renewable Electricity in Asia *Journal of Contemporary Asia*, Vol. 40, No. 3, August 2010, pp. 393–400.

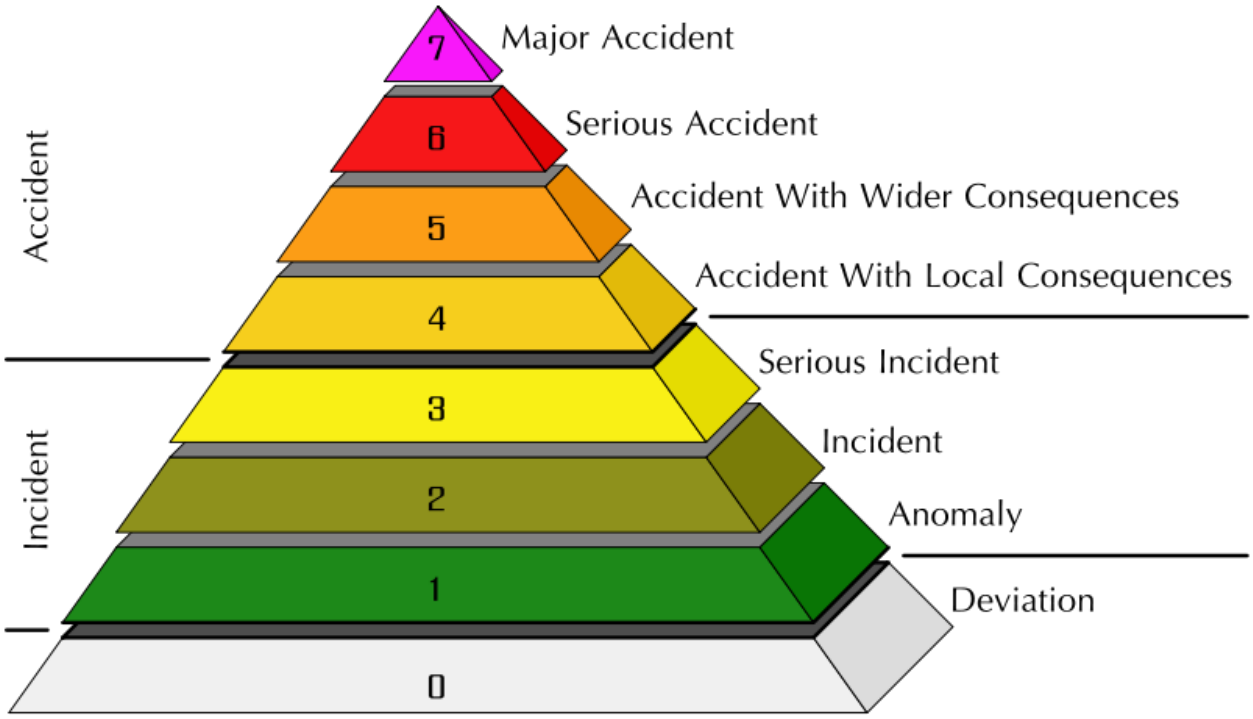
Although no deaths have been directly attributed to the accident, it invoked a strong public reaction and demonstrated the potential dangers associated with nuclear power generation.

Shearon Harris Nuclear Power Plant, which is the plant located closest to Guilford County, is a 2,948 megawatt power plant that began commercial operation in 1987. It has pressurized water reactors and operates with a very high level of security.

5.21.2 Location and Spatial Extent

The southeastern portion of the county is at risk to a nuclear incident. Areas in this part of the county are susceptible due to their relative proximity to the Shearon Harris Power Plant. The International Atomic Energy Association has developed a scale called the International Nuclear and Radiological Event Scale (INES) which provides a quantitative means of assessing the extent of a nuclear event. This scale, like the MMI used for earthquakes, is logarithmic which means that each increasing level on the scale represents an event 10 times more severe than the previous level (**Figure 5.26**).

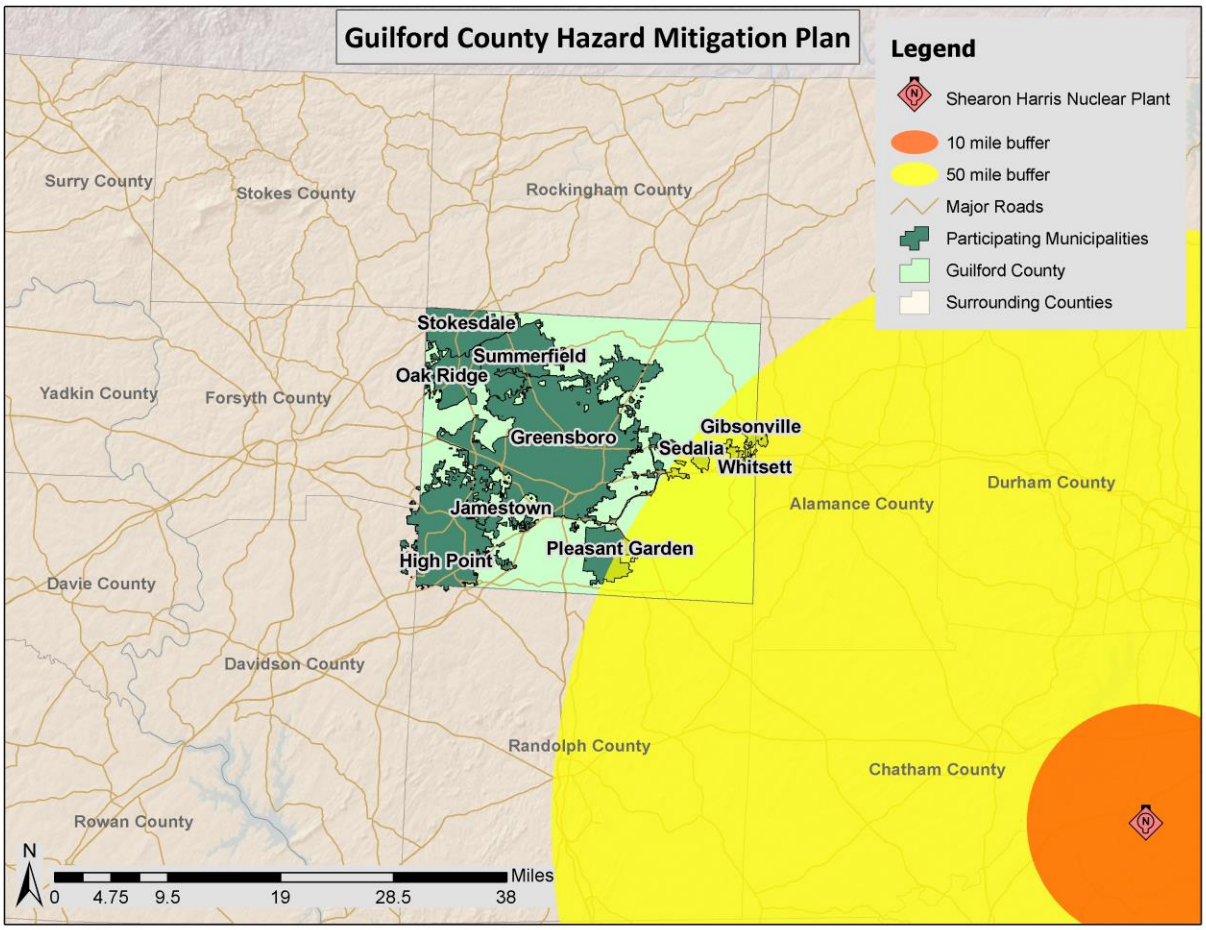
FIGURE 5.26: INTERNATIONAL NUCLEAR EVENT SCALE



Source: International Atomic Energy Agency

The Nuclear Regulatory Commission defines two emergency planning zones around nuclear plants. Areas located within 10 miles of the station are considered to be within the zone of highest risk to a nuclear incident and this radius is the designated evacuation radius recommended by the Nuclear Regulatory Commission. Within the 10-mile zone, the primary concern is exposure to and inhalation of radioactive contamination. The most concerning effects in the secondary 50-mile zone are related to ingestion of food and liquids that may have been contaminated. None of the county is located within the 10-mile radius of the power plant; however, a portion of the county is located within this 50-mile radius which is still considered to be at risk from a nuclear incident (**Figure 5.27**).

FIGURE 5.27: NUCLEAR POWER PLANT INCIDENT HAZARD ZONES IN GUILFORD COUNTY



Source: International Atomic Energy Agency

5.21.3 Historical Occurrences

Although there have been no major nuclear events at the Shearon Harris Nuclear Power Plant, there is some possibility that one could occur as there have been incidents in the past in the United States at other facilities and at facilities around the world.

5.21.4 Probability of Future Occurrences

A nuclear event is a very rare occurrence in the United States due to the intense regulation of the industry. There have been incidents in the past, but it is considered unlikely (less than 1 percent annual probability).

5.21.5 Consequence Analysis

People (The Public and Public Confidence)

The public is most impacted from ingesting the material(s) through home grown crops, milk produced from livestock which have fed on contaminated grasses, and consuming contaminated surface water. Ingestion of radiological materials may result in internal contamination if ionizing radiation is released in the body. This can cause serious health risks, especially if critical organs are affected. Some organs such as the thyroid take in certain isotopes. It is extremely difficult to purge the material from the body.

The public will be extremely concerned about their health and safety during and after a nuclear incident. Confidence will be dependent upon the availability of information and perceived quality of response by government and nongovernment service providers.

Responders

First responders are vulnerable to the same impacts as the general public but also may be at greater risk due to their need to function outdoors, operating in contaminated environments. These responders will likely need to operate in personal protective equipment and limit their outdoor exposure. Proper decontamination is likely to be necessary to reduce the spread of contamination.

Continuity of Operations

In the wake of a nuclear accident, continuity of operations in Guilford County would likely be maintained relatively well since the county is only impacted in some areas by the 50 mile buffer area. Generally operations could proceed from their normal location, with personnel and equipment remaining more or less unharmed.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – There are no expected impacts.
Commercial – Some businesses within the IPZ, mainly agricultural, may be affected by an incident at the Shearon Harris facility.
Industrial – There are no expected impacts.
Hazardous Materials Facilities – There are no expected impacts.

Critical Facilities and Personnel

Hospitals – Hospitals are likely to experience an increase in patients. Hospitals are likely to also require more advanced support in obtaining water and food for continuing operations. Prior to entry into the hospitals, decontamination processes for patients, visitors, vendors, and employees may be necessary.
Emergency Services – Emergency services agencies may experience increased call volumes.
Emergency Shelters – Emergency shelters may be opened for this event for those persons not having access to protective structures.

Transportation Systems

Interstates – Checkpoints and decontamination stations may be set up along routes that leave the IPZ resulting in increased travel times.
Airports – There are no expected impacts.
Rail Lines – There are no expected impacts.

Critical Utilities
High Voltage Distribution Lines – There are no expected impacts.
Power Lines – There are no expected impacts.
Natural Gas – There are no expected impacts.

Communication Systems and Networks
Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts.
Internet Capabilities – There are no expected impacts

High Loss Potential Facilities
Dam Failures – There are no expected impacts.
I-40 Fuel Farm – There are no expected impacts.

Economy
Local-National Economies – Economies within the IPZ and the area surrounding it are likely to see decreased discretionary spending. Travel and tourism may be limited for an extended period of time. Interstate commerce may be impacted as decontamination stations may need to be established and some drivers may elect to attempt to circumnavigate the affected area extending travel times and increasing the time to market for products.
Large Employers – Large employers may see increased absenteeism and requests to work from home. Some employees may self-evacuate resulting in a loss of productivity.
Financial Centers – In person financial transactions are likely to be more limited, electronic transactions may increase due to the public electing not to go outside.

Special Consideration Areas
City Centers – Travel within the IPZ may be limited to prevent spread of contaminants. Buildings within the IPZ, including those in the city of Gibsonville, may require decontamination stations for those that wish to enter the buildings.
Large Event Arenas – There are no expected impacts. Some events may be cancelled or rescheduled even if these arenas are deemed safe.
Historical and Cultural Landmarks – While no structural damage to the landmarks is likely, visitation and attendance may decrease temporarily within the IPZ, affecting some tourism and local commerce.

Environment
Contaminants may impact the land and water for many years. Wildlife may experience increased likelihood of cancer and other health problems.

5.22 PIPELINE FAILURE

5.22.1 Background

Pipelines in the United States are used to transport and distribute a number of products from their extraction point to sites where those materials are utilized throughout the country. Pipelines 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. Transportation of these products via

pipeline is abundant in the United States due to the cost-effectiveness of the process which allows quick movement with relatively minimal cost.

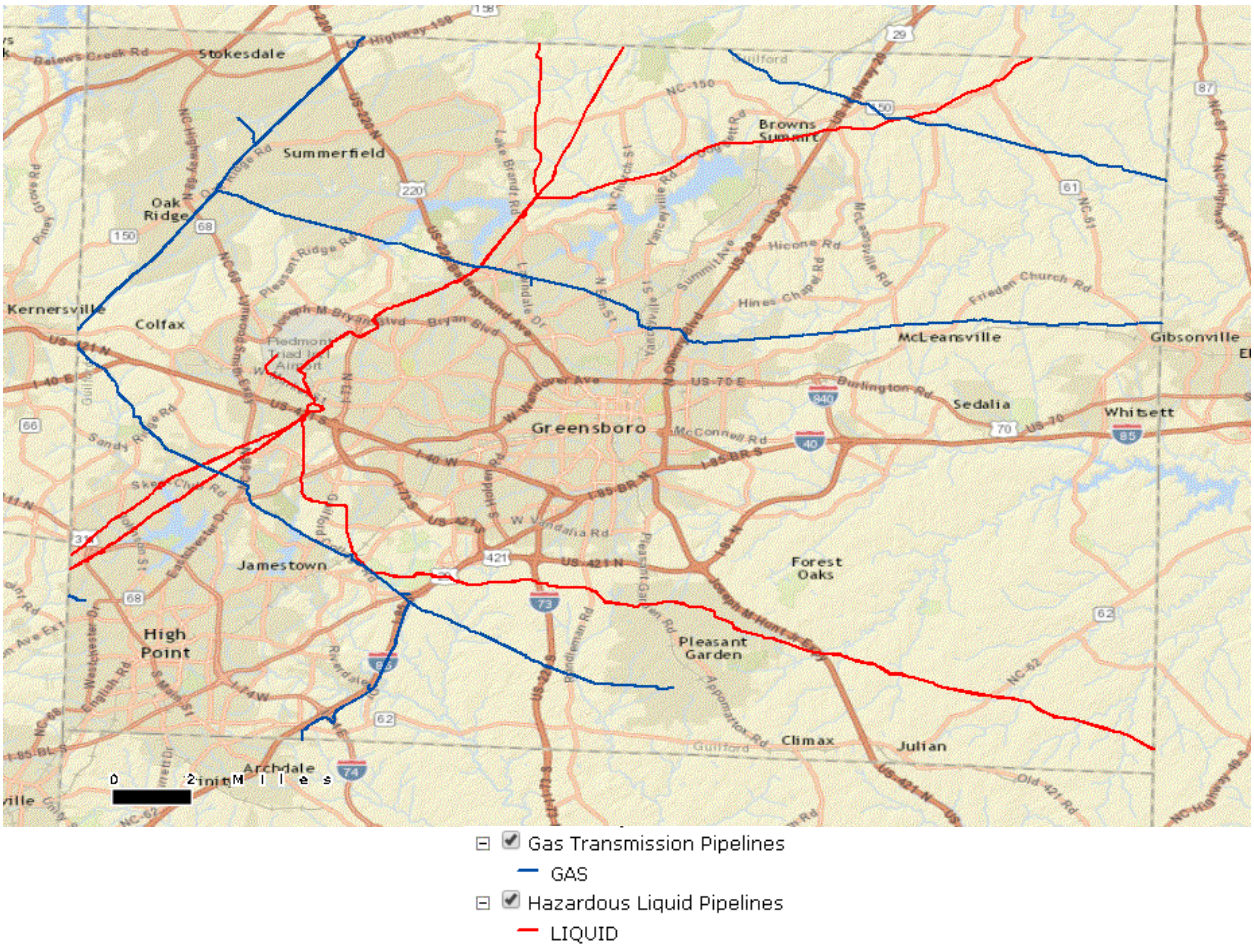
Generally pipelines are safe and effective, transporting materials where they are needed without incident. However, many pipelines in the United States were installed over 60 years ago and were made with materials such as cast and wrought iron or bare steel which degrade over time. This presents a definitive danger to people and property as a leak or spill of hazardous products from a degraded pipeline could prove disastrous, causing costly damage to property and injury or death.

As a result, there has been a recent movement to replace many of these older pipelines with newer materials such as plastics that can reduce the risk of a pipeline failure and a hazard incident. In 2011, the Pipeline Safety, Regulatory Certainty, and Job Creation Act was passed and called for the US Department of Transportation to conduct a state by state survey of pipelines and accelerate repairs of aging infrastructure. The following website provides a state by state update of the progress of this initiative: http://primis.phmsa.dot.gov/comm/states.htm?nocache=4496.

5.22.2 Location and Spatial Extent

Pipelines exist throughout the state of North Carolina and in Guilford County. Across the state, there are over 192,000 miles of hazardous liquid line, 17,591 miles of gas transmission gathering lines, and 1,263,987 miles of gas distribution main lines. In Guilford County, there are 1,248 miles of gas lines and 822 miles of hazardous liquid lines. For more specific description of the location of pipelines in Guilford County, see **Figure 5.28** below.

FIGURE 5.28: PIPELINES IN GUILFORD COUNTY



5.22.3 Historical Occurrences

There have been some reported incidents of pipeline disruptions/failures within Guilford County, dating back to the 1970s. In 1978 there were two spills that occurred on a line connected to the Greensboro tank farm. As a result of these spills, 14,700 gallons and 8,400 gallons of gas were spilled, respectively. In 1987, a 17,000 gallon spill occurred near Lake Brandt on the Plantation Pipeline that was caused by digging in the area. As a result, there was leakage into the nearby neighborhood of Guilford Green, although fortunately the fuel did not reach the lake itself.

Additionally, the events of Hurricane Katrina in September 2005 led to significant disruptions in the distribution networks of both liquid petroleum products and natural gas throughout the Southeast, including Guilford County. The impacts were significant as motorists lined up at gas stations trying to acquire fuel while it was available. Some stations could not keep up with the demand and ran out of

fuel.[35] Natural gas customers experienced significant price hikes as a result of the pipeline disruptions and other network damages caused by the hurricane.[36]

5.22.4 Probability of Future Occurrence

Since there have been some reported incidents of major pipeline disruptions or failures within Guilford County, future occurrences are possible.

5.22.5 Consequence Analysis

People (The Public and Public Confidence)

The main concerns for the public with natural gas include fire ignition, explosions, and service loss. Any part of the distribution network that contains product may experience some form of failure as discussed in the "Background" section. The release of natural gas has the potential to spark fires or cause explosions due to the material's characteristics. This is especially hazardous in residential or other populated areas.

Responders

First responders would be primarily tasked with evacuating people within potentially hazardous environments, treating and transporting patients, containing any releases, and preventing and/or extinguishing fires or explosions.

Continuity of Operations

Continuity of operations can typically be maintained during a pipeline event in Guilford County. However, a large-scale pipeline explosion or failure would certainly put a strain on operations, requiring a great deal of attention from responders. This could certainly disrupt continuity of operations to some degree.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – The primary concerns with residential buildings during a pipeline failure include gas inhalation, fires, explosions, and loss of heating. Natural gas leaks could lead to asphyxia in some cases. The natural gas that is used in home heating has the compound mercaptan, which has a distinctly strong odor that can detect a leak before the environment becomes hazardous to health. The fire and explosion risks are present due to the presence of methane in natural gas, which is highly flammable and can be explosive in certain conditions. Gasoline is also flammable, but is not an explosive risk. Lastly, some homes may lose their primary heat source when natural gas service is disrupted.37

Commercial – Pipeline failure could cause the hazards of gas inhalation, fire, and loss of heating. Employees and patrons of businesses are subject to the same hazards as residents in their homes as discussed in "Residential." Some businesses in Guilford County have natural gas heating systems or rely

[35] Jad Mouawad, 2005. "Katrina's Shock to the System," *New York Times*. http://www.nytimes.com/2005/09/04/business/04oil.html?pagewanted=all

[36] Desmond Lachman, 2005. "Katrina Has Had an Impact on Natural Gas and Electricity Production as well as Crude Oil Supplies," *Financial Times*. http://www.aei.org/article/energy-and-the-environment/conventional-energy/katrina-has-had-an-impact-on-natural-gas-and-electricity-production-as-well-as-crude-oil-supplies/

[37] National Institute of Health, 2011, *What You Need to Know About Natural Gas Detectors*. http://www.nidcd.nih.gov/health/smelltaste/pages/gasdtctr.aspx

on natural gas for some of their food preparation processes. A pipeline failure would interrupt these processes, thus having a negative impact on business.
Industrial – The industrial businesses of Guilford County have some of the same concerns as the commercial businesses. Employees are subject to the same hazards discussed in "Residential" and "Commercial." Industrial facilities may be heated through natural gas systems as well.
Hazardous Materials Facilities – If a facility is located near a natural gas release, the potential exists for interactions between the hazardous materials stored on the site and the natural gas. Also, any fires present or explosions caused by a release of fuels or natural gas could cause containment failures for the hazardous materials on the site(s).

Critical Facilities and Personnel
Hospitals – A pipeline failure may cause some additional strain on hospitals if there are patients due to the incident.
Emergency Services – Emergency responders will be responsible for handling any impacts created by a pipeline incident, including hazardous materials response, patient care, and fire suppression. The potential for an explosion also exists, requiring evacuations led by first responders. Fuel shortages can significantly impact emergency operations.
Emergency Shelters – There are no expected impacts, unless the incident occurs during cold weather and some residents lose the ability to heat their homes due to natural gas supply issues. An emergency shelter(s) may be activated in this case.

Transportation Systems
Interstates – If there is a pipeline break near an interstate, responders may have to shut traffic down until the release is contained. Lanes of travel may be blocked by vehicles that run out of fuel during shortages.
Airports – If fuel shortages result from pipeline failure, it can significantly impact operations.
Rail Lines – If there is a pipeline break near railroad tracks, responders may have to shut that line down until the release is contained.

Critical Utilities
High Voltage Distribution Lines – There are no expected impacts.
Power Lines – There are no expected impacts.
Natural Gas – A pipeline failure would significantly impact the availability of natural gas countywide.

Communications Systems and Networks
Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities
Dam Failures – There are no expected impacts.
I-40 Fuel Farm – The I-40 Fuel Farm could be significantly impacted if fuels are no longer flowing into the facility for storage and/or further distribution.

Economy
Local-National Economies – Of greatest concern with the pipelines in Guilford County is the distribution and availability of fuels. A shortage in gasoline and/or diesel could have drastic impacts on the local economy and potentially the national economy depending on the breadth or duration of the shortage.

Much of the impact would be from lost commerce, as the travel of cargo, workers, and visitors could be limited or completely stopped depending on the severity of the supply issues. The primary financial effects of a significant natural gas incident in the pipeline would be on the natural gas industry and businesses that rely on natural gas for heating. The costs of lost service and repairs could be severe in the case of a pipeline failure for the natural gas providers. Business closures could have a significant impact on the local economy. Some restaurants may rely on natural gas for some of their food preparation as well.
Large Employers – Business closures may be possible for those businesses that rely on gasoline or diesel for operations or natural gas for heating or food preparation.
Financial Centers – There are no expected impacts.

Special Consideration Areas
City Centers – The impacts of a pipeline failure on a city center may include business closures. The closures may be due to an inability to receive or transport goods or services during fuel shortages, or the loss of heating systems and food preparation processes that rely on natural gas during natural gas incidents.
Large Event Arenas – There are no expected impacts.
Historical and Cultural Landmarks – Fuel shortages may impact the number of visitors to these landmarks.

Environment
Impacts would be confined to the immediate area of the pipeline failure, including exposures to vegetation and wildlife.

5.23 RESOURCE SHORTAGE (WATER / FUEL)

5.23.1 Background

Society relies on many resources to conduct routine activities. Without the most critical resources in ample supply, the public's way of life can be severely hampered. Water, electricity, and fuel are among the most critical resources and occasionally may be subject to supply issues. Electrical disruptions and outages were addressed in the Energy/Power/Utility Failure section. This section will address water and fuel shortages.

While most of the Earth's surface is covered by water (70%), a mere 3% of that water is freshwater. More than 68% of this freshwater is found in glaciers and ice caps, while only .3% is found in rivers, lakes, etc. Fresh, potable water is in very limited supply, estimated to be only .08% of the Earth's water.[38] In the case of a water shortage, rationing or elimination of nonessential activities or events could become viable options to limit unnecessary consumption of water during times of concern.

Fuel, or petroleum, is also a limited resource that is used globally for many different purposes. Petroleum alone makes up about 40% of the total energy consumption in the United States.[39] When there are shortages of this valuable commodity, the activities and commerce of impacted areas could be significantly slowed. Decisions must be made to sustain critical operations, such as first response

[38] United States Geological Survey, *Earth's Water Distribution,* http://ga.water.usgs.gov/edu/waterdistribution.html
[39] The National Academy of Sciences, *What You Need to Know About Energy – Supply and Demand*, http://www.nap.edu/reports/energy/supply.html

capabilities. Rationing or the elimination of nonessential activities or events could become viable options to limit unnecessary consumption of fuel during times of concern.

5.23.2 Location and Spatial Extent

Since a water or fuel shortage would impact the entire county when it occurs, the location of this hazard is considered to be countywide.

5.23.3 Historical Occurrences

In July of 2002, there was a major water shortage throughout North Carolina. This shortage was exacerbated by exceptional drought conditions over an extended period of time. The majority of the years between 1998 and 2002 were marked as under some level of drought. The shortage led to a significant water emergency for Guilford County, in particular in the City of Greensboro. At its worst point, the city had only a 67 day water supply and emergency conservation measures were put in place.

In September of 2008, the impacts of Hurricanes Gustav and Ike caused shortages of fuel in Guilford County and many other parts of the Southeast. Oil refineries in the Gulf of Mexico and the pipelines that deliver the product to various distribution points experienced significant disruptions or damages. Three years prior in August of 2005, Hurricane Katrina caused major shortages of fuel after it damaged or shut down many of the refineries and pipelines in the same region. In both shortages, there were long lines of vehicles at gas stations as the public attempted to fill up gas tanks before the supply ran out. Some stations were completely out of diesel and regular unleaded gasoline.

The fuel situation in the area was also critical during the OPEC fuel crisis in 1973 and 1974. Some gas stations in Greensboro implemented limits on refueling, including one station recorded as asking customers to purchase a maximum of 10 gallons. This illustrates how the geopolitical climate with respect to oil in the Middle East and other major oil reserves can have a significant impact on the price and supply of fuel.

5.23.4 Probability of Future Occurrence

Fuel and water shortages have occurred a number of times in Guilford County over the past several decades. Water shortages were more common in recent years but fuel shortages have certain impacted the county as well. As a result, the probability of future occurrences is likely.

5.23.5 Consequence Analysis

People (The Public and Public Confidence)

During events such as drought that cause water shortages or emergencies, the public is given limitations on using water for non-essential purposes such as watering lawns or washing vehicles. Water shortages beyond this are possible but unlikely. Greater restrictions could be implemented and enforced in extreme water emergencies. Due to these impacts to the public, first response agencies may require additional resources to deal with heightened public safety or medical emergency concerns.

Fuel shortages are not as critical to life safety but could impact decisions made about travel and routine life activities. When concerns about fuel supply are voiced, the public often resorts to panic buying, and

lines become long at gas stations. Before the shortage even takes place, gas stations may be overtaxed, as fuel is dispensed faster than it can be replenished. In extreme shortages, limitations could be placed on consumers and in some cases businesses, jurisdictions, and other groups. Rationing at gas stations may be implemented and non-essential business or governmental activities may be put on hold or eliminated completely.

Water and other resource shortages can influence the public and the outlook on how the government and any related nongovernmental organizations respond to the shortage. If rationing and restrictions are put in place, it will impact the public and its confidence in the entities responsible for dealing with these occurrences. Collaboration with the media could have some influence on what is reported and could lessen or prevent any negative perception.

Responders

Water shortages are more likely to present life safety issues than fuel shortages. In the event of a water shortage, more health-related emergencies such as dehydration can be expected, particularly if mechanisms are not in place to effectively obtain water from other areas. The concern is heightened during warm weather conditions, especially with extreme temperatures. Water shortages may also hamper firefighting.

Continuity of Operations

The nature of a resource shortage generally means that there is some recognition that the shortage will occur in advance of major issues. The county generally has plans in place to ensure that continuity of operations can be maintained during a resource shortage. Still, a long-term resource shortage could have a definitive impact on operations.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – In the midst of a water shortage, the prime concerns for a residence would deal with hydration, preparation of food, and personal hygiene. In a fuel shortage, generators that run on fuel may not be operational. In both water and fuel shortage scenarios, there may be limitations put on property maintenance.

Commercial – Water intensive processes may be disrupted during water shortages. Accommodations such as restrooms for employees may not be operational. During fuel supply concerns, generators may not be able to be used and property maintenance may be limited. Also, business operations that require transportation could be impacted significantly.

Industrial – Water intensive processes may be disrupted during water shortages. Accommodations such as restrooms for employees may not be operational. During fuel supply concerns, generators may not be able to be used and property maintenance may be limited. Also, business operations that require transportation could be impacted significantly.

Hazardous Materials Facilities – Water intensive processes may be disrupted during water shortages. Accommodations such as restrooms for employees may not be operational. Decontamination procedures in the event of a spill or release that require water may need to be altered or otherwise considered. During fuel supply concerns, generators may not be able to be used and property maintenance may be limited. Also, business operations that require transportation could be impacted significantly.

Critical Facilities and Personnel

Hospitals – During water or fuel shortages, there could be significant impacts on hospital facilities and operations. Water intensive processes within the facility may be disrupted. Some medical procedures may need to be postponed or altered. In the event of a fuel shortage, interfacility transportation of patients may be impacted and backup generators may not be operational if needed.
Emergency Services – The major concern for emergency services during water shortages deals with firefighting. At the emergency services facilities, accommodations such as restrooms or showers and gear washing machines may not have the water needed for use. Fuel shortage events would spur concerns about emergency vehicles' consumption of fuel, as well as equipment and generators that run off of fuel.
Emergency Shelters – If emergency shelters are open and a water shortage occurs, the facilities may have difficulties accommodating basic needs like restrooms and personal hygiene. There should be little impact on shelters during fuel shortages, unless the facility has a backup generator that runs on fuel.

Transportation Systems
Interstates – There are no expected impacts on the interstate system during a water shortage. Vehicular traffic on interstates could see significant impacts during a fuel shortage. Many travelers' vehicles may breakdown due to running out of fuel, which could block roadways for others. Maintenance and response mechanisms could be limited or unavailable depending on whether fuel is available as well.
Airports – During water or fuel shortages, there could be significant impacts on airport operations. Maintenance measures or accommodations on the airplanes that require water may not be able to be carried out. Accommodations such as restrooms for patrons and employees at the airport may not be operational, which could force the facility to shut down operations until the crisis is resolved. A fuel crisis can be equally as problematic, as without fuel the airplanes cannot fly and again operations could be shut down.
Rail Lines – Maintenance measures or accommodations on the trains that require water may not be able to be carried out during a water shortage. Rail systems could be severely impacted by fuel shortages as many locomotives utilize diesel fuel for power.

Critical Utilities
High Voltage Distribution Lines – There are no expected impacts, though if there are issues with the infrastructure associated with the power distribution network during a fuel crisis, service may be delayed until fuel distribution is restored.
Power Lines – There are no expected impacts, though if there are issues with the infrastructure associated with the power distribution network during a fuel crisis, service may be delayed until fuel distribution is restored.
Natural Gas – If there are issues within the pipeline network during a fuel crisis, service may be delayed until fuel distribution is restored.

Communications Systems and Networks
Telephone Systems – There are no expected impacts, though if there are issues with the infrastructure during a fuel crisis, service/repairs may be delayed until fuel distribution is restored.
Cell Phone Towers – There are no expected impacts, though if there are issues with the infrastructure during a fuel crisis, service/repairs may be delayed until fuel distribution is restored.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities
Dam Failures – There are no expected impacts.

I-40 Fuel Farm – The primary concern at the Fuel Farm during water supply emergencies is fire protection on site. Some water-intensive processes or basic accommodations for employees may be affected as well. The Fuel Farm's operations could be significantly impacted by the shortage of fuel. Productivity and profit would be of concern, but security issues may be an additional concern. There may be attempts of theft at the site when the fuel supply becomes critically low.

Economy

Local-National Economies – Shortages dealing with critical resources such as water and fuel can have detrimental impacts on the economy. Governmental entities, businesses and the public may be forced to make significant and drastic decisions in order to deal with the complexities of shortages. Water supply disruptions could impact tourism and commerce if water is needed in key processes. Businesses such as hotels and restaurants may have to consider having water hauled in or closing. The hauling and delivery of goods and supplies can be severely impacted by fuel shortages, causing significant disruptions in economic activity. The overall impact is dependent on the severity and the duration of the shortage. It is also dependent on the availability of the resource from other sources and the ability to effectively get these resources to the intended end user.

Large Employers – As stated previously, large businesses may have to consider having water hauled in or closing, whether for basic accommodations, water-intensive processes, or both. Businesses that depend on transportation for goods and services may experience significant setbacks during fuel crises. Workers may not be able to commute to work, bringing about productivity concerns and significant costs.

Financial Centers – In water shortage emergencies, financial centers may not have basic accommodations fulfilled, which could significantly alter operations or force a complete closing. During fuel crises, employees may not be able to commute to work, also altering operations significantly.

Special Consideration Areas

City Centers – City centers may be affected during a water supply crisis. Water-dependent businesses such as restaurants may consider closing, which would affect commerce. Basic accommodations for visitors and workers may be limited or unavailable. Backup generators may be limited or unavailable during fuel crises. Also, reductions of or limitations on nonessential travel may reduce commerce or productivity in the affected city center.

Large Event Arenas – During a water shortage, accommodations such as restrooms, hydration, and food preparation for patrons and employees may not be operational. Fuel shortage could provide some impact on attendance of events depending on the ability of employees to commute.

Historical and Cultural Landmarks – Accommodations such as restrooms for patrons and employees may not be operational during a crisis dealing with the water supply. With fuel crises, tourism may decline, impacting the revenue generated by the landmarks and the local economy.

Environment

In the case of a severe water shortage, vegetation and crops, livestock, and aquatic wildlife may experience some impact. Livestock may not be given adequate water and could experience illness or death. Typical or alternative sources of water may be tapped for more water, affecting ecosystems as water levels drop. There are no expected impacts to the environment during a fuel shortage.

5.24 TRANSPORTATION INCIDENT

5.24.1 Background

While transportation accidents occur on a daily basis, large-scale incidents involving commerce or mass transit are uncommon but can have significant impacts on the community. This section will focus on these large-scale incidents, which will include incidents involving airplanes on and off airport properties in Guilford County and incidents involving trains. The area has experienced several incidents involving either airplanes or trains, but occurrence is relatively infrequent and significant impacts are rare. The most common impacts involve how the incident will impact daily life, such as travel and commerce.
In Guilford County, the most prominent site for air travel is Piedmont Triad International Airport (PTIA) located in Greensboro. There are smaller airports within the county such as Southeast Greensboro Airport which have much smaller operations that are of very low significance to national air travel. Incidents have and will occur both on and off of airport properties, as will be discussed in the "Historical Data" section.

Guilford County is also a major thoroughfare for rail commerce and travel. A major rail line passes through the downtown areas of both Greensboro and High Point. Norfolk Southern and Amtrak are the two major carriers of cargo and passengers.

5.24.2 Location and Spatial Extent

Transportation incidents are most likely to occur along major transportation corridors such as highways, interstates, or railways. However, transportation incidents can occur throughout the county, especially given the number of planes that take flight in and out of regional and local airports.

5.24.3 Historical Occurrences

There have been numerous incidents in Guilford County involving airplanes. Some of these incidents have occurred at PTIA while others were outside of any airport's boundaries. The following incidents are just a sample of some of the incidents that have occurred within the county. Much of this information is from response records in the Guilford Metro 9-1-1 system archive.

In October of 2011, a small private plane crashed into a home in a subdivision in Colfax. There was no one inside the home at the time, but the occupants of the airplane did not survive. In January of 2004, a plane went off of the runway during its takeoff attempt. There were no significant injuries or deaths. In November of 2002, a small plane struck trees while in flight and crashed near Route 421 near Southeast Greensboro Airport. The pilot was the only occupant and the only injury/fatality in the incident. In August of 2000, a DC-9 airplane made an emergency landing at PTIA due to smoke in the cockpit. Of the 63 crew and passengers, no one was injured during the landing or the fire that resulted, which damaged the plane substantially.[40] In 1989, the left main gear in the landing gear system of a 737 airplane was not functioning correctly. The plane made an emergency landing at PTIA with 107 occupants. Like the incident in 2000, there were no injuries or deaths. Finally, on February 11, 2015, there was a plane crash at 150 Air Harbor Road. This was a single engine aircraft and there was one fatality.

There have also been several incidents within Guilford County that involved trains. In May of 2010, a derailment occurred in downtown Greensboro. No one was injured in the incident, where six of the

[40] Aviation Safety Network, 2000, ASN Aircraft accident McDonnell Douglas DC-9-32 N838AT Greensboro, NC. http://aviation-safety.net/database/record.php?id=20000808-0

train's cars derailed.[41] In December of 2005, 11 cars derailed in Greensboro. Again, no one was injured.[42] Trains also have collided with other travelers. In October of 1987, a 57 car train struck a gasoline tanker in Greensboro. In 1979, another train struck a gasoline tanker in Greensboro. Both of these incidents occurred near the Interstate 40 Fuel Farm, where fuel is continuously being distributed to and from the facility.

5.24.4 Probability of Future Occurrence

Transportation incidents are a highly likely event given that automobile accidents occur nearly every single day to some degree. However, these smaller-scale transportation incidents would have a relatively low impact overall on the community. That said, transportation incidents are fairly common and the probability of a major future occurrence is likely.

5.24.5 Consequence Analysis

People (The Public and Public Confidence)

In the event of a transportation incident such a plane crash or train derailment, there is a possibility of injury or death. The first concern in any incident is toward life safety, and emergency services will respond to not only assist patients, but to monitor for fire or hazardous materials that could impact others. A train derailment could impact the rail system, as other trains scheduled to pass through the area of the incident may be stopped or redirected. A plane crash on the site of an airport could drastically alter operations, also causing stoppages or redirection. An offsite plane crash may not impact other flights, but could impact businesses, homes, and other parts of everyday life depending on where the incident takes place.

Public confidence in the response to a transportation incident is dependent on the expectations of the public and past experience with such incidents. Partnering with the media to ensure proper notification of the incident and dissemination of incident-related public safety information can provide for positive outcomes.

Responders

During any transportation-related incident, first responders will be responsible for public safety and returning the area of the scene back to normal as best as possible. Some of the concerns that may be present during and after an incident include the injured, fatalities, and the protection of others from hazards that result from the incident. Hazardous materials (fuel or cargo), entrapped passengers, fires, and explosions are some examples of these hazards, both for airplanes and trains. Response agencies are trained to identify, monitor, and react to any of these possibilities to provide an effective public safety response.

Continuity of Operations

Since these types of events occur on a relatively regular basis and their impact is generally fairly localized, there would probably be little disruption to continuity of operations from a transportation incident.

[41] News and Record, May 25, 2010. *Roads Reopen in Greensboro Following Train Derailment.* http://www.news-record.com/content/2010/05/25/article/roads_closed_in_greensboro_following_train_derailment
[42] WXII 12 News, 2005, *Officials Investigate Train Derailment*. http://www.wxii12.com/news/5673497/detail.html

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – A plane striking a home is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact homes in close proximity to rail lines.
Commercial – A plane crashing into a business in Guilford County is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact businesses in close proximity to rail lines.
Industrial – A plane crashing into a business in Guilford County is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact businesses in close proximity to rail lines.
Hazardous Materials Facilities – A plane crashing into a business in Guilford County is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact businesses in close proximity to rail lines. The exposure of one hazardous material to another could cause significant reactions, possibly resulting in a fire, explosion, or other hazardous outcome. Some of the storage facilities within the county with outside containers could be at risk to being struck by a plane or train.

Critical Facilities and Personnel

Hospitals – A plane striking one of the hospitals is highly unlikely. The hospitals of Guilford County are not located in close proximity to rail lines and thus could not be directly affected by a derailment. However, either type of transportation incident could increase the volume of patients in the facility.
Emergency Services – A plane is unlikely to directly strike one of the emergency services facilities. A plane crash would likely tie up a significant amount of resources, straining the ability to respond to other incidents. Facilities such as fire stations may be located in close proximity to rail lines, and a derailment and/or resulting hazardous materials incident could directly affect the facility.
Emergency Shelters – Evacuees of impacted areas and survivors of the transportation incident itself may be sheltered temporarily in emergency shelters.

Transportation Systems

Interstates –There are no expected impacts, as a plane crash or a train derailment affecting an interstate is highly unlikely.
Airports – Airports will be directly affected by incidents involving airplanes, especially on site. Short term or potentially long term closures are possible depending on the magnitude of the incident. While Piedmont Triad International Airport is not one of the major national travel hubs, any disruptions to its operations will have some impact on air travel and commerce. Incidents in the rail system should not have any significant impact on the airports of Guilford County.
Rail Lines – The rail system should not be impacted significantly by airplane-related incidents unless the incident occurs on or in close proximity to a station or rail line. Rail lines are directly affected by incidents in the rail system. The incident(s) may delay or cause rerouting of trains, which impacts the entire system. Commerce and travel will be affected, especially if the major routes are disrupted for significant periods of time.

Critical Utilities

High Voltage Distribution Lines – There are no expected impacts, unless a plane or train strikes a power line or pole.
Power Lines – There are no expected impacts, unless a plane or train strikes a power line or pole.
Natural Gas – There are no expected impacts.

Communications Systems and Networks
Telephone Systems – There are no expected impacts, unless a plane or train strikes a telephone line or pole.
Cell Phone Towers – Impacts are highly unlikely, as a struck cell phone tower would only cause some sporadic issues. Other nearby towers can compensate for the loss, but some areas could still experience connectivity issues.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities
Dam Failures – There are no expected impacts.
I-40 Fuel Farm – The likelihood of a plane striking any of the structures of the facility is low. On the Fuel Farm site, there are rail lines within and along its confines. In the case of a derailment, operations may be hindered or shut down, especially if spills or releases of hazardous materials are involved.

Economy

Local-National Economies – The economic impact of a plane crash or a train derailment would be relatively minor. Plane crashes may discourage some from traveling while a train derailment may have a temporary impact on commerce. However, operations are expected to return to normal in a short period of time following the incident.
Large Employers – A plane crashing into a business in Guilford County is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact businesses in close proximity to rail lines.
Financial Centers – A plane crashing into a financial center in Guilford County is highly unlikely. A train derailment and/or hazardous materials release from a container within the train could impact businesses in close proximity to rail lines.

Special Consideration Areas
City Centers – The likelihood of a plane striking any of the buildings or other parts of a city center is very low. There are some rail lines that pass through the downtown Greensboro area, which makes it possible for impacts from a derailment incident. This could cause impacts such casualties, evacuations, or hindrances on commerce.
Large Event Arenas – The Greensboro Coliseum has a low likelihood of being struck by a plane. However, a rail line runs very close by and impacts are possible. These impacts could vary from access issues to the arena to a complete closure due to hazardous materials or other significant safety concerns.
Historical and Cultural Landmarks – There are no expected impacts.

Environment

The impacts of a transportation incident vary on the types of materials contained. Fuels are hazardous to plant and wildlife populations, and may also be harmful if spilled into a water source. Other contained chemicals and materials can be hazardous to these populations as well, depending on the characteristics of the substance(s).

Man-Made / Intentional Hazards

5.25 CIVIL DISTURBANCE

5.25.1 Background

Public unrest has been evident in society from the earliest recordings of civilization. Most of these disturbances have been related to political or social issues. Insurrection has framed much of history, dictating the governance and progression of society. In recent years, most of the publicized disturbances have been protests and riots. Rioting does not occur very often in the United States; however, marches and protests are common and could subsequently lead to riots.

5.25.2 Location and Spatial Extent

Civil disturbance or unrest can occur in any location in the county but is more likely to take place in or near prominent locations such as government buildings or significant landmarks.

5.25.3 Historical Occurrences

In Guilford County, there have not been any major civil disturbances in recent years. While there are occasional marches and protests that take place in its bounds, they have not had significant threat of violence associated with them.

On November 3, 1979, an event since named the Greensboro Massacre saw members of the Ku Klux Klan and American Nazis clash with members of the Communist Party marching for African-American industrial workers. The event climaxed with Klansmen opening gunfire on marchers, five of whom died.[43]

A disturbance near North Carolina Agricultural and Technical State University in Greensboro led to the shooting death of a college student on May 22, 1969. African American student protestors clashed with city police and members of the National Guard for three days (May 21-23), leading to several civilian and nine officer injuries in addition to the fatality. Dozens of students were arrested for disturbing the peace on public school property.[44]

Downtown Greensboro is well-publicized for its part in the non-violent, sit-in protests during the civil rights movement. In 1960, a group of four freshmen from North Carolina Agricultural and Technical College were denied service for being African Americans at a lunch counter in the business F.W. Woolworth. In response, they sat at the counter for several days, with others later joining in on the protest. A large boycott of the business followed, resulting in substantial losses for the company before it relented and enacted changes in policy chain-wide.[45]

[43] University of North Carolina at Greensboro Libraries: Civil Rights Greensboro, *The Greensboro Massacre*, http://library.uncg.edu/dp/crg/topicalessays/greensmassacre.aspx
[44] University of North Carolina at Greensboro Libraries: Civil Rights Greensboro, *Dudley High School/NC A&T University Disturbances, May 1969*, http://library.uncg.edu/dp/crg/topicalessays/dudleyatprotest.aspx
[45] Library of Congress, *Greensboro Lunch Counter Sit-In*, http://www.loc.gov/exhibits/odyssey/educate/lunch.html

5.25.4 Probability of Future Occurrence

Despite some history of civil disturbance in Guilford County historically, there have been few recent events, so the probability of future occurrences is possible.

5.25.5 Consequence Analysis

People (The Public and Public Confidence)

The United States and Guilford County are relatively stable politically and socially. However, there are United States citizens who hold extremist opinions and ideals. There is always the likelihood of some incident sparking some form of violence or disobedience. Most incidences of civil disturbance or insurrection have specific targets, unlike terrorism where maximum effect (including casualties) is desired. Therefore, collateral damage is not as likely but still possible.

The public confidence in government and nongovernmental organizations response is paramount during these incidents. There will be high emotions already present within the community; an effective, organized, and professional response is crucial to instill confidence in community members. Working with the media is also an important component, as the messages disseminated can influence public perception. The incident response, the media, and also societal expectations will all factor into the positive or negative outcome in the minds of the public.

Responders

During riots, first responders are put into a situation of extreme danger during riots. Responders, especially those employed by local, state, or federal governments, may actually be targeted in such events. Law enforcement personnel trained and equipped to deal with such situations would be utilized to provide for public safety efforts. Other operations may be put on hold in areas of unrest until the situation improves.

Continuity of Operations

Continuity of operations could be disrupted by a civil disturbance, especially if the aim of the unrest is aimed at government buildings or officials. Plans to maintain continuity of operations are in place, but operations would likely be disrupted to some degree civil disturbance.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – If disturbances occur in residential areas, residents may be unable to access their homes and neighborhoods without putting their safety in jeopardy. Destruction of property is also possible in such a scenario.

Commercial – In commercial settings, civil unrest can lead to the destruction of property or theft of goods and equipment. Workers may not be able to access the workplace or may not be able to work at all if the business is shut down during the disturbance.

Industrial – Industrial facilities are vulnerable to the destruction of property, to the theft of goods or equipment, or sabotage of the equipment and systems housed in the facility(ies). Workers may not be able to access the workplace or may not be able to work at all if the business is shut down during the disturbance.

Hazardous Materials Facilities – Hazardous materials facilities are vulnerable to the destruction of property, to the theft of goods or equipment, or sabotage of the equipment and systems housed in the facility(ies). Workers may not be able to access the workplace or may not be able to work at all if the

business is shut down during the disturbance. The hazardous materials themselves may be released by the perpetrator(s) or stolen for later use.

Critical Facilities and Personnel
Hospitals – During incidences of civil disturbance, the hospitals may expect higher volume of patients. While hospitals are unlikely to be targeted during civil unrest, there could be some impacts if the violence is nearby. These impacts include the possibility of limited access to the hospital for workers, patients, and emergency/patient transportation crews. Incidents of violence in emergency departments and other sections of hospital are also more likely to occur.
Emergency Services – A civil unrest event will likely increase call volume in the jurisdiction, increase the potential for the targeting of responders, or cause access issues relating to emergency scenes and the transportation of patients to hospitals.
Emergency Shelters – There are no expected impacts.

Transportation Systems
Interstates – There may be increased traffic on interstates if residents and visitors leave the area during times of unrest. There are no other expected impacts.
Airports – During violent civil incidents, travel from the affected area may increase and travel to the area may decrease. The violence is unlikely to carry over onto airport property.
Rail Lines – During violent civil incidents, travel from the affected area may increase and travel to the area may decrease. The violence is unlikely to carry over onto railroads or the stations between.

Critical Utilities
High Voltage Distribution Lines – There are no expected impacts.
Power Lines – There are no expected impacts.
Natural Gas – There are no expected impacts.

Communications Systems and Networks
Telephone Systems – There are no expected impacts.
Cell Phone Towers – There are no expected impacts.
Internet Capabilities – There are no expected impacts.

High Loss Potential Facilities
Dam Failures – There are no expected impacts.
I-40 Fuel Farm – While unlikely, the fuel farm and its containers may be targeted.

Economy

Local-National Economies – The economic impact of civil disturbances is dependent on the extent of media coverage of the event and people's feelings of safety in the area(s) affected. Tourism can be negatively affected, causing potential visitors to go somewhere else or not travel at all. Businesses or homeowners may choose to move out and real estate values could potentially fall as well. These effects are dependent on the severity, the scope, and the nature of the disturbance(s).
Large Employers – Civil disturbances can lead to work stoppages, which results in loss of productivity.
Financial Centers – Targeting of or impacts on financial institutions could lead to significant economic hardship through the impairment of financial transactions.

Special Consideration Areas
City Centers – City centers could be the nexus of insurrection activity. This activity could limit access to businesses or services in the area, impairing commerce.
Large Event Arenas – There are no expected impacts.
Historical and Cultural Landmarks – Landmarks of cultural value may be targeted.

Environment
Impacts are unlikely, unless other hazards are caused by violent acts.

5.26 CYBERTERRORISM

5.26.1 Background

Cyberterrorism is a deliberate attack on an individual or group using the internet. In the past few decades, society has become dependent on computers and internet connections for much of daily life. This dependence has opened up the avenue for crime to be committed from afar, often from a different country. Some common examples of cyberterrorism include a hacker accessing bank accounts by hacking into a bank's website, infecting a computer system with a virus, Trojan horse, or worm to inflict damage to the information in the system, or disseminating incorrect or otherwise flawed information, also called "misinformation." Also, denial-of-service attacks could occur against prominent websites, which prevent legitimate users from accessing information or services.

5.26.2 Location and Spatial Extent

Cyber attacks could occur anywhere within the county.

5.26.3 Historical Occurrences

In Guilford County, large-scale cyberterrorism attempts or attacks have not been reported.

5.26.4 Probability of Future Occurrence

Although there have been no previous cyber threats in the county of significant impact, it is possible that the county could be impacted in the future.

5.26.5 Consequence Analysis

People (The Public and Public Confidence)
The aim of a cyberterrorist is typically to corrupt or exploit protected information. Depending on the target of the ploy, a significant number of people can be victims of identity theft, fraud, or other forms of technology-based crime. Anyone with an account, membership, or other relationship with an entity that requires the storage of information is vulnerable. An individual/user must rely on the entity of affiliation to create and maintain safeguards against the intrusion of computerized systems. However, even the strongest of safeguards can be corrupted or evaded. Continual monitoring of attempted or successful attempts at cyberterrorism is warranted to lessen the potential impacts.

The public confidence in government and nongovernmental organizations response may be impacted by a disaster based upon societal expectations and media influence with respect to cyberterrorism. Public confidence can be gained when the public's expectations of response and recovery services are met or exceeded. Public confidence may be impacted by media interpretation and reporting of the event, whether positively or negatively.

Responders

Cyberterrorists may try to intrude on safety equipment, apparatus, or systems. This may increase call volume or hinder emergency operations.

Continuity of Operations

In the event of a cyber-attack, continuity of operations could be impacted if many of the services (such as internet or other IT programs) that are required to maintain daily operations are shut down by the attack. This could cause considerable detriment to normal operations in the county.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – There are no expected impacts.
Commercial – Some commercial technologies may be targeted and exploited by cyberterrorists.
Industrial – Some industrial technologies may be targeted and exploited by cyberterrorists.
Hazardous Materials Facilities – Cyberterrorists may target and exploit or manipulate processes which in turn cause the release of hazardous materials.

Critical Facilities and Personnel

Hospitals – Cyberterrorists may target life sustaining equipment or systems, or cause other technological disruptions.
Emergency Services – Cyberterrorists may target and sabotage information networks,
Emergency Shelters – Emergency shelters are unlikely to be targets of cyberterrrorism.

Transportation Systems

Interstates – There are no expected impacts.
Airports – Numerous systems utilized by airports can be compromised by cyberterrorists.
Rail Lines – Numerous systems utilized by rail lines can be compromised by cyberterrorists.

Critical Utilities

High Voltage Distribution Lines – Cyberterrorists could target and sabotage power distribution systems.
Power Lines – Cyberterrorists could target and sabotage power distribution systems.
Natural Gas – Natural gas distribution technologies could be targeted by cyberterrorism.

Communications Systems and Networks

Telephone Systems – The telephone system could be compromised by cyberterrorists, either by disrupting the ability to use it or exploiting the information that can be obtained from those using it.
Cell Phone Towers – Operations could be disrupted by cyberterrorists exploiting systems and equipment.
Internet Capabilities – Cyberterrorists can compromise the systems that provide internet accessibility.

High Loss Potential Facilities

Dam Failures – There are no expected impacts.
I-40 Fuel Farm – The systems used in operations at the Fuel Farm could be compromised by cyberterrorists.

Economy

Local-National Economies – Freezing, redirecting, or stealing financial assets can have various impacts on a victim, a group, or possibly society as a whole. Banking and credit institutions are commonly affected or targeted by fraudulent activities. Large-scale intrusions can have significant impacts on the local, or potentially the national, economy.
Large Employers – Large employers are more likely to be targeted by cyberterrorists than individuals or small businesses. The larger businesses generally have greater assets to exploit and store more personal information on private individuals or employees.
Financial Centers – As stated previously, banking and credit institutions are commonly affected or targeted by fraudulent activities. Large-scale intrusions can have significant economic impact.

Special Consideration Areas
City Centers – There are no expected impacts.
Large Event Arenas – There are no expected impacts.
Historical and Cultural Landmarks – There are no expected impacts.

Environment

There are no expected impacts.

5.27 TERRORISM

5.27.1 Background

Terrorism is defined in the United States by 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."[46] Academic literature identifies some overarching political goals that terrorism seeks to achieve, including spreading anxiety and alarm among immediate victims, families, and the general public; eliminating opponents and destroying symbolic targets; and generating direct damage on society, such as affecting business confidence. In the following sections, some general background information about terrorism is presented prior to the county's hazard identification and risk assessment findings.

There are two general types of terrorist groups: network and hierarchical. The type of organization a group adopts largely depends on how long the group has existed. More recently developed groups tend to organize or adapt to the possibilities of the network model. Older, more established groups lean toward the hierarchical structure and are often more associated with violence of a political nature.[47] Terrorist acts can be committed by large, formally organized groups with terrorist cells in different parts of the world, or they can originate from smaller groups or individuals from a small city or domestic "homegrown" location. In the United States, terrorists that are "homegrown" do not belong to a

[46] U.S. Code of Federal Regulations. 23 C.F.R. Section 0.85
[47] Terrorism Research. *Terrorist groups*. Retrieved December 27, 2011, from http://www.terrorism-research.com/groups/

defined group, may operate very effectively "under the radar," and may pose the biggest threat initially at the local level.[48]

5.27.2 Location and Spatial Extent

A terror threat could potentially occur at any location in the county. However, the very definition of a terrorist event indicates that it is most likely to be targeted at a critical or symbolic resource/location/event. Ensuring and protecting the continuity of critical infrastructure and key resources (CIKR) of the United States is essential to the Nation's security, public health and safety, economic vitality, and way of life. CIKR includes physical and/or virtual systems or assets that, if damaged, would have a detrimental impact on national security, including large-scale human casualties, property destruction, economic disruption, and significant damage to morale and public confidence. **Table 5.44** lists the U.S. Department of Homeland Security's (DHS) identified main critical infrastructure sectors.

TABLE 5.44: U.S. DEPARTMENT OF HOMELAND SECURITY CRITICAL INFRASTRUCTURE SECTORS

- Agriculture and Food
- Banking and Finance
- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Government Facilities
- Healthcare and Public Health
- Information Technology
- National Monuments and Icons
- Nuclear Reactors, Materials, and Waste
- Postal and Shipping
- Transportation Systems
- Water

Although all critical facilities (see Section 6: *Vulnerability Assessment*) are at a heightened level of risk in Guilford County, there are several facilities and events in the county that have been identified as the likely primary targets. Guilford County Emergency Management maintains a list of facilities and events at elevated risk of terror threat.

5.27.3 Historical Occurrences

Although there have been no major terror events in Guilford County, there is some possibility that one could occur in the future as there have been incidents in the United States in the past and there are several facilities/events that could be potential targets.

5.27.4 Probability of Future Occurrences

Guilford County has had no recorded terrorist events. Due to no recorded incidents against the county, the probability of future occurrences of a terrorist attack is unlikely (less than 1 percent annual probability).

[48] *Ibid.*

5.27.5 Consequence Analysis

People (The Public and Public Confidence)

As seen after the attacks on September 11, 2001 in New York City and Washington, D.C., there can be significant impacts far away from the site of the incident. Fear and worry about additional attacks or for loved ones in areas affected are just a couple examples of impacts that could occur. Other impacts include discrimination or changed interactions between people of differing nationalities depending on the nature and intent of the attack(s) and who perpetrated the attack(s).

During and after a terrorism event, the public will be expecting services to be provided despite the uncertainty of any existing hazards or further impacts. The partnership and involvement of the media is crucial not just for public guidance information, but also for keeping the public informed of the efforts underway or of any obstacles or concerns hindering response efforts. Effective planning and partnerships developed prior to the incident will provide for smoother operations, even during times of chaos like a major terrorism incident. Agencies and organizations working together in an efficient and effective way will provide for the best chance of positive public perception in these government and nongovernmental organizations.

Responders

The danger to human life in a terrorist event is dependent on the form of attack utilized, as well as its location, severity, and scope. In any terror incident, responders must conduct a scene size up to determine hazards to themselves and then others. Decisions must be made about how to handle victims and those in close proximity that may have been victimized or exposed. If hazardous materials are present, it could change the strategy completely. Fear and panic will be significant in the case of a terrorist act, whether it occurs in Guilford County or elsewhere in the state or nation.

Dependent on the location, the scope, and the nature of the event(s), the impacts can vary greatly and could be felt nationwide, as seen with the September 11, 2001 attacks. Response efforts could last hours, days, or potentially longer. The length of time for recovery efforts could vary as well. Collaboration at all levels can provide for the most stable, effective, and efficient effort in returning to normal activities and operations. Identification of further threats and open communication lines can prevent further harm or detriment to response and recovery operations.

Continuity of Operations

A terrorist event would likely have a high impact on continuity of operations, especially due to the disorder that would result and the unpredictability of this kind of event. Emergency personnel may be directly affected or targeted, which would cause definitive harm to maintaining continuity of operations.

Built Environment (Property, Facilities, and Infrastructure)

Building Stock

Residential – Single-family dwellings are not likely to be targets for terrorism. However, any areas that have specifically targeted populations could be vulnerable to an attack. These populations may relate to a person or group's ethnicity, religion, and socioeconomic status. Dwellings in close proximity to a target may experience indirect impacts as well. Depending on the method of attack, impacts could include stray bullets or debris from explosions. These could affect people, pets, electrical systems, or water systems, to name a few; other hazards to homes include structural collapse or fires. Lastly, the presence

of chemical agents can create health hazards through dangerous reactions with water sources or building materials.
Commercial – Commercial structures may be vulnerable to terrorist attacks, especially those that house companies of international or national significance. However, those within Guilford County are unlikely to be priority targets.
Industrial – Industrial sites are exposed to the same hazards as residential and commercial structures. However, depending on the type of industry it can have a different level of impact. Many industrial sites contain hazardous materials as well as dangerous machines or products that would pose a significant hazard to the public in a terrorism event.
Hazardous Materials Facilities – Terrorism is a significant concern with any kind of hazardous material, whether the materials exist on the targeted site or if hazardous materials were introduced as the instrument of the attack. Hazardous materials and facilities require significant planning for evacuation, containment, and cleanup, and require significant resources for response operations to spills or other releases.

Critical Facilities
Hospitals – The primary concern with a terrorism event is the influx of patients requiring care. Terrorism is unlikely to pose a specific hazard to a hospital unless the structure itself is the target or is in close proximity to a target. Many patients could be injured or their medical condition worsened by the impacts of the terrorism event.
Emergency Services – Emergency services buildings are not considered high probability targets for location terrorists to strike. In other countries, ambulance services and 9-1-1 centers have been targets; however, that pattern has not been seen here in the United States. Alternate locations should be set up so that emergency operations can continue if an emergency services facility was affected or targeted by a terrorism event. If one or more towers tied to the 9-1-1 center's communication systems were disrupted, it could have a detrimental impact to the center's communications to responders, leading to detrimental impacts on response operations as well.

Emergency Shelters – Shelters may need to be activated in a terrorism event to house and care for displaced individuals. These shelters are unlikely to be the target of an attack. However, planning for the evacuation and migration of shelter occupants in any emergency situation can alleviate issues if a shelter is directly affected by a terrorist event.

Transportation Systems
Interstates – Bridges found throughout the interstate system can be targeted by terrorism. Not only would the actual structural failure affect those on, under, or near the bridge, but also the loss of its functionality would significantly hinder travel and commerce.
Airports – Past experiences with terrorists using airplanes for terrorist activity suggest a need for planning and collaboration with all parties of interest including local, state, and federal agencies. Due to its location on the eastern seaboard near large cities like Charlotte, Raleigh, Washington, D.C., and Atlanta, Piedmont Triad International Airport is a noteworthy waypoint and a lower traffic airport, offering an alternative location for planes with emergencies to land without drastically disrupting national or regional air travel.
Rail Lines – The most likely means of disrupting rail lines would be the derailing of a train, primarily by sabotage of the rail or the switching control system. Using explosives would be the simplest means because hacking into systems to cause collisions and other undesired actions to moving rail cars would be more complex operations. In addition to disrupting rail traffic, a derailing can impact other means of travel such as a nearby road or airport. The rail cars involved in an incident could contain hazardous

materials, valuable goods, or passengers. Any of these would have some form of significant impact, including monetary and social costs, as well as injury, illness, or death. The response and cleanup could be lengthy as well, tying up resources and adding more costs to the overall incident.

Critical Utilities

High Voltage Distribution Lines – Damage to these structures or lines could disrupt power distribution for a large area, affecting emergency response and other facets of government and business. The economic impacts may also be significant as extended outages can be especially costly and inconvenient.

Power Lines – While there is a low likelihood of power lines being directly targeted by terrorism, they are vulnerable to being affected indirectly from other targeted buildings or objects. Power lines are prominent in most parts of Guilford County and are not the sturdiest forms of infrastructure. Similar to high voltage lines, extended power outages can be costly and inconvenient, disrupting normal operations and routine lives.

Natural Gas – Natural gas lines are a concern as a target for terrorists. A major pipeline runs through Guilford County, but natural gas itself must be exposed to oxygen before it could cause an explosion. Most natural gas explosions are small and rarely deadly. The real concern is in shutting off natural gas to end consumers. Sabotage of a pipeline could disconnect a significant number of homes and businesses for considerable periods of time.

Communication Systems and Networks

Telephone Systems – Due to their location (generally along power distribution lines) these networks face the same hazards as power lines themselves. Targeting of phone lines would temporarily disrupt communications and slow the notification of the terrorist event and its impacts, making it a desirable option for coordinated or multifaceted attacks. These lines can be shut down or damaged with relative ease. The lines themselves can be cut, ripped down, or destroyed. Any disruption in service can be costly to the affected community(ies).

Cell Phone Towers – Like telephone systems above, cell phone towers would be an effective target for disrupting communications. In order to significantly impact cell phone communications, numerous towers would need to be targeted as cell phones will simply pick up the next closest tower in the event of one being affected.

Internet Capabilities – Cyberterrorism is a major concern as society continues to depend on the internet more and more. This topic will be covered in the next hazard section.

High Loss Potential Facilities

Dam Failures – A terrorist attack on a dam would be a low likelihood but high impact event. The targeting of a dam could significantly impact transportation and commerce, as well as destroy residential, commercial, and industrial structures.

I-40 Fuel Farm – While unlikely, there is the possibility of terrorists targeting the large fuel farm located in Guilford County. The aftermath of such an event would require a large-scale response due to the hazardous nature of the materials stored at the facility. Damage to the storage tanks, pumping stations, pipeline or other facilities would pose a significant risk to the public and the environment. The economic and resource loss could also be extensive and could

Economy

Local-National Economies – The economic impact of a terrorist attack can vary from minimal to severe. If the incident occurs in Guilford County, it could hinder the local economy but may not have an impact at the national level.

Tourism and some commerce could decline significantly if people, events, or businesses are hesitant to come to the area following an incident. An incident in a major city or a financial hub could affect the entire country. The events of September 11, 2001 had an immediate impact on the local and national economies. However, this event and other large scale attacks like it could drastically alter economies for generations.

Large Employers – There are several large businesses that are at risk for terrorism, mainly because of their international profiles. Companies like UPS and FedEx, which also deal in international commerce and movement of goods, are prime examples of potential targets for terrorism. Schools like the University of North Carolina at Greensboro, North Carolina Agricultural and Technical State University, and other large schools within Guilford County could be targeted and cause significant impacts, especially if shut down for a period of time.

Financial Centers – Damage to these facilities could have long-lasting impacts on the community. The loss of equipment and systems within these structures could have detrimental impacts on financial transactions.

Special Consideration Areas

City Centers – Terrorism would most likely occur in city centers during large public gatherings or during business hours to cause the most harm and promote the most fear. Political gatherings would be high priority targets as well.

Large Event Arenas – Arenas can be targeted by terrorism, particularly during events that may have some form of political, cultural, or historical value, or simply any event with a large number of people in attendance.

Historical and Cultural Landmarks – Like the other special consideration areas described above, a politically significant event or other large gathering could make a landmark more attractive to terrorists, however, there is a low likelihood of Guilford County's landmarks being targeted by acts of terrorism.

Environment

Impacts on the environment depend on the type of attack utilized by terrorists. A biological, chemical, or other hazardous material can have impacts on human, animal, and plant populations alike. The impacts can vary depending on the particular hazard(s) at play.

Conclusions

5.28 CONCLUSIONS ON HAZARD RISK

The hazard profiles presented in this section were developed using best available data and result in what may be considered principally a qualitative assessment as recommended by FEMA in its "How-to" guidance document titled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA Publication 386-2). It relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgment regarding observed and/or anticipated hazard impacts. It also carefully considers the findings in other relevant plans, studies, and technical reports.

5.28.1 Hazard Extent

Table 5.45 describes the extent of each natural hazard identified for Guilford County. The extent of a hazard is defined as its severity or magnitude, as it relates to the planning area.

TABLE 5.45:EXTENT OF GUILFORD COUNTY HAZARDS

Natural Hazards	
Drought	Drought extent is defined by PDSI classifications which include Extremely Moist, Very Moist, Mid-Range, Moderate Drought, Severe Drought, and Extreme Drought classifications (pages 5:6-5:7). According to the PDSI classifications, the most severe drought condition is Extreme. Guilford County has received this ranking 2 times over the 14-year reporting period.
Earthquake	Earthquake extent can be measured by the Richter Scale (Table 5.5) and the Modified Mercalli Intensity (MMI) scale (Table 5.6) and the distance of the epicenter from Guilford County. According to data provided by the National Geophysical Data Center, the greatest MMI to impact the county was IV (moderate) with a correlating Richter Scale measurement of approximately 4.3 (last reported on November 20, 1969). The epicenter of this earthquake was located 183.0 km away.
Extreme Cold	The extent of extreme cold can be defined by the minimum temperature reached. The lowest temperature recorded in Guilford County is -8 degrees Fahrenheit (reported on January 21, 1985).
Extreme Heat	The extent of extreme heat can be defined by the maximum temperature reached. The highest temperature recorded in Guilford County is 106 degrees Fahrenheit (reported on July 20, 1926).
Fire	Wildfire data was provided by the North Carolina Division of Forest Resources and is reported annually by county from 2004-2013. Analyzing the data indicates the following wildfire hazard extent for the county. • The greatest number of fires to occur in any year was 61 in 2011. • The greatest number of acres to burn in a single year occurred in 2007 when 112.0 acres were burned. Although this data lists the extent that has occurred, larger and more frequent wildfires are possible throughout the county.

Flooding

Flood extent can be measured by the amount of land and property in the floodplain as well as flood height and velocity. The amount of land in the floodplain accounts for 7.0 percent of the total land area in Guilford County.

Flood depth and velocity are recorded via United States Geological Survey stream gages throughout the county. While a gage does not exist for each participating jurisdiction, there is one at or near many areas. The greatest peak discharge recorded for the county was reported on July 21, 1919. Water reached a discharge of 11,600 cubic feet per second. The greatest gage height in the county was recorded on October 15, 1954 at 24.20 feet. Additional peak discharge readings and gage heights are in the table below.

Location/Jurisdiction	Date	Peak Discharge (cfs)	Gage Height (ft)
Guilford County			
Reedy Fork near Gibsonville	9/25/1947	11,600	20.77
South Buffalo Creek near Greensboro	7/15/1949	10,000	11.54
West Fork Deep River near High Point	9/24/1947	8,450	19.92
Reedy Fork near Oak Ridge	10/10/1959	3,950	10.94
Haw River near Summerfield	10/15/1954	1,310	24.20
Rock Creek near Whitsett	10/15/1954	5,860	24.02

Hail

Hail extent can be defined by the size of the hail stone. The largest hail stone reported in Guilford County was 2.75 inches (reported on April 2, 1983). It should be noted that future events may exceed this.

Hurricane and Tropical Storm

Hurricane extent is defined by the Saffir-Simpson Scale which classifies hurricanes into Category 1 through Category 5 (Table 5.26). The greatest classification of hurricanes to traverse directly through Guilford County was an unnamed storm in 1893 which reached a maximum wind speed of 65 knots in the county. Although the county is much more likely to be impacted by the remnants of a hurricane or tropical storm, it is possible that a storm can impact the county directly.

Thunderstorm – Wind

Thunderstorm extent is defined by the number of thunder events and wind speeds reported. The strongest recorded wind event in Guilford County was reported on July 15, 1976 at 84 knots (approximately 97 mph). It should be noted that future events may exceed these historical occurrences.

Thunderstorm – Lightning

According to the Vaisala flash density map (Figure 5.22), Guilford County is located in an area that experiences 3 to 4lightning flashes per square kilometer per year. It should be noted that future lightning occurrences may exceed these figures.

Tornado

Tornado hazard extent is measured by tornado occurrences in the US provided by FEMA (Figure 5.23) as well as the Fujita/Enhanced Fujita Scale (Tables 5.33 and 5.34). The greatest magnitude reported in Guilford County was an EF3 (reported on March 28, 2010). It should be noted that an EF5 tornado is possible.

Winter Storm

The extent of winter storms can be measured by the amount of snowfall received (in inches). The greatest 24-hour snowfall reported in the county was 20.0 inches on March 2, 1927. Due to unpredictable variations in snowfall throughout the county, extent totals will vary for each participating jurisdiction and reliable data on snowfall totals is not abundantly available.

Biological Hazards	
Bioterrorism	A bioterrorism event would have significant consequences on the general public and could potentially cause major strain to hospitals and medical care providers. In some more severe scenarios, quarantines may be required as public health officials attempt to restrict the spread of infectious disease. The extent for this could be widespread, impacting thousands of people.
Public Health / Emerging Disease Threat	A public health/emerging disease threat could have a large –scale effect throughout the county and may cause illness in many people. Possible impacts from a disease threat depend largely on the impacted population, but might include anything from absenteeism and loss of productivity in the workplace to death or serious illness to humans or livestock. A serious disease threat could affect many thousands of people.
Technological Hazards	
Building / Structure Collapse	A building or structure collapse would most likely occur to a building that is under construction. The impacts would be relatively localized, but could be very serious, causing death or injury to anyone in or around the structure. Depending on the size of the structure, possibly hundreds of people could be affected even though in this type of event, generally only a single structure would collapse and the area of impact would be relatively small.
Communications Systems Disruption / Failure	For a communications systems disruption or failure, the greatest extent that is possible is a complete shutdown of all communications equipment. However, this is unlikely to occur as it is more likely that a loss of one form of communication (radio, cell phone) will be shut down, causing emergency personnel to seek out other forms of communication and delaying/disrupting response time.
Energy / Power/ Utility Failure	There are many impacts that would occur as a result of an energy/power/utility failure. Among other impacts, traffic lights could be down, residents might lose heat or air conditioning, medical equipment may be non-operational, and well pumps could be shut down limiting access to clean water. These failures could potentially be widespread, leaving tens of thousands of homes and businesses without power or utilities.
Hazardous Materials Incident	According to USDOT PHMSA, the largest hazardous materials incident reported in the county was 9,000 LGA released on the highway on September 30, 1999 and 13,000 SLB released on the highway on September 22, 1982. It should be noted that larger events are possible.
Nuclear Power Plant Emergency	Although there is no history of a nuclear accident at the Shearon Harris Power Plant, other events across the globe and in the United States in particular indicate that an event is possible. Since several national and international events were Level 7 events on the INES, the potential for a Level 7 event at Shearon Harris is possible.
Pipeline Failure	A pipeline failure could be caused in several different ways. If an explosion or fire were the cause of the incident, the impacts might include fatalities or injuries as well as loss of a fuel source and damage to personal property. However, the impacts could also be less fatal in which case the more immediate effects might be down time for services and significant price hikes for consumers.
Resource Shortage (Water / Fuel)	A resource failure would likely have widespread impacts that cause a strain on the local economy and on everyone in the county. In the past, the county has experienced events wherein there was less than 70 days of water supply available which is very low. Similarly, the county has experienced rationing of fuel supplies. Both of these types of events could occur again and the extent could be similar or somewhat worse.

Transportation Incident	A transportation incident might cause death or injury to those involved in the accident as well as to bystanders near the site of the incident. The main effects of a transportation incident might be fire or explosions and a shutdown of transportation corridors. Although these events are relatively common and emergency officials deal with them fairly often, the impacts to individuals might be severe with disruption to daily life at a minimum.
Man-Made / Intentional Hazards	
Civil Disturbance	Often one of the greatest impacts from civil disturbances is collateral damage to people and property. During civil disturbances, property can be destroyed or stolen and citizens can be injured due to violence that erupts. First responders may also be targeted and many times are more likely to be injured as a result of civil unrest that the average citizen.
Cyberterrorism	While there is seldom physical damage inflicted from a cyberterrorism event, the effects of such an event are often damaging in other ways. For example, theft, denial of service attacks, and dissemination of misinformation can all result from a cyberterror event. Moreover, these events are often aimed at shutting down IT systems which can result in loss of productivity and damage to IT infrastructure.
Terrorism	There is no history of terror threats in Guilford County; however; it is possible that one of these events could occur. If this were to take place, the magnitude of the event could range on the scale of critical damage with many fatalities and injuries to the population.

5.28.2 Priority Risk Index

In order to draw some meaningful planning conclusions on hazard risk for Guilford County, the results of the hazard profiling process were used to generate countywide hazard classifications according to a "Priority Risk Index" (PRI). The purpose of the PRI is to categorize and prioritize all potential hazards for Guilford County as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided in the next section, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for the jurisdictions in Guilford County to consider as part of their proposed mitigation strategy.

The prioritization and categorization of identified hazards for Guilford County is based principally on the PRI, a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI is used to assist the Guilford County Hazard Mitigation Planning Team in gaining consensus on the determination of those hazards that pose the most significant threat to the county based on a variety of factors. The PRI is not scientifically based, but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Guilford County based on standardized criteria.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor[49], as summarized in **Table 5.46**. To calculate the PRI value for a given hazard, the

[49] The Hazard Mitigation Planning Team, based upon any unique concerns or factors for the planning area, may adjust the PRI weighting scheme during future plan updates.

assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

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

According to the weighting scheme and point system applied, the highest possible value for any hazard is 4.0. When the scheme is applied for Guilford County, the highest PRI value is 3.1 (winter storm). Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the Hazard Mitigation Planning Team.

TABLE 5.46: PRIORITY RISK INDEX FOR GUILFORD COUNTY

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	Less than 6 hours	Self explanatory	4	
Duration	Less than 6 hours	Self explanatory	1	10%
	Less than 24 hours	Self explanatory	2	
	Less than one week	Self explanatory	3	
	More than one week	Self explanatory	4	

5.28.3 Priority Risk Index Results

Table 5.47 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Hazard Mitigation Planning Team. The results were then used in calculating PRI values and making final determinations for the risk assessment.

TABLE 5.47: SUMMARY OF PRI RESULTS FOR GUILFORD COUNTY

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Natural Hazards						
Drought	Likely	Minor	Large	More than 24 hours	More than 1 week	**2.5**
Earthquake	Possible	Minor	Moderate	Less than 6 hours	Less than 6 hours	**2.0**
Extreme Cold	Possible	Minor	Large	More than 24 hours	Less than 1 week	**2.1**
Extreme Heat	Likely	Minor	Large	More than 24 hours	Less than 1 week	**2.4**
Fire	Likely	Minor	Small	Less than 6 hours	Less than 1 week	**2.3**
Flooding	Highly Likely	Limited	Small	6 to 12 hours	Less than 1 week	**2.8**
Hail	Highly Likely	Minor	Moderate	6 to 12 hours	Less than 6 hours	**2.5**
Hurricane / Other Tropical Disturbance	Likely	Limited	Large	More than 24 hours	Less than 24 hours	**2.6**
Thunderstorm – Wind	Highly Likely	Limited	Moderate	6 to 12 hours	Less than 6 hours	**2.8**
Thunderstorm – Lightning	Highly Likely	Limited	Negligible	6 to 12 hours	Less than 6 hours	**2.4**
Tornado	Likely	Critical	Small	Less than 6 hours	Less than 6 hours	**2.7**
Winter Storm	Highly Likely	Critical	Moderate	More than 24 hours	Less than 1 week	**3.1**
Biological Hazards						
Bioterrorism	Possible	Critical	Negligible	Less than 6 hours	Less than 1 week	**2.4**
Public Health / Emerging Disease Threat	Possible	Critical	Negligible	Less than 6 hours	Less than 1 week	**2.4**
Technological Hazards						
Building / Structure Collapse	Possible	Limited	Negligible	Less than 6 hours	Less than 6 hours	**1.9**
Communications Systems Disruptions / Failures	Likely	Minor	Large	Less than 6 hours	Less than 1 week	**2.7**
Energy / Power / Utility Failure	Likely	Limited	Moderate	Less than 6 hours	Less than 1 week	**2.8**
Hazardous Materials Incident	Highly Likely	Limited	Small	Less than 6 hours	Less than 24 hours	**2.8**
Nuclear Power Plant Emergency	Unlikely	Limited	Moderate	6 to 12 hours	Less than 1 week	**2.1**
Pipeline Failure	Possible	Limited	Small	Less than 6 hours	Less than 1 week	**2.3**
Resource Shortage (Water / Fuel)	Likely	Limited	Large	More than 24 hours	More than 1 week	**2.8**
Transportation Incident	Likely	Critical	Negligible	Less than 6 hours	Less than 24 hours	**2.6**

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Man-Made / Intentional Hazards						
Civil Disturbance	Possible	Limited	Moderate	12 to 24 hours	More than 1 week	**2.4**
Cyberterrorism	Possible	Limited	Negligible	Less than 6 hours	Less than 24 hours	**2.0**
Terrorism	Unlikely	Critical	Small	Less than 6 hours	Less than 24 hours	**2.2**

5.29 FINAL DETERMINATIONS

The conclusions drawn from the hazard profiling process for Guilford County, including the PRI results and input from the Hazard Mitigation Planning Team, resulted in the classification of risk for each identified hazard according to three categories: High Risk, Moderate Risk, and Low Risk (**Table 5.48**). For purposes of these classifications, risk is expressed in relative terms according to the estimated impact that a hazard will have on human life and property throughout all of Guilford County. A more quantitative analysis to estimate potential dollar losses for each hazard has been performed separately, and is described in Section 6: *Vulnerability Assessment*. It should be noted that although some hazards are classified below as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and their assigned classification will continue to be evaluated during future plan updates.

TABLE 5.48: CONCLUSIONS ON HAZARD RISK FOR GUILFORD COUNTY

HIGH RISK	Winter Storm Thunderstorm – Wind Flooding Energy / Power / Utility Failure Hazardous Materials Incident Resource Shortage (Water / Fuel) Tornado Communications Systems Disruption / Failure Hurricane / Other Tropical Disturbance Transportation Incident
MODERATE RISK	Drought Hail Civil Disturbance Extreme Heat Thunderstorm – Lightning Bioterrorism Public Health / Emerging Disease Threat Fire Pipeline Failure
LOW RISK	Terrorism Extreme Cold Nuclear Power Plant Emergency Earthquake Cyberterrorism Building / Structure Collapse

SECTION 6
VULNERABILITY ASSESSMENT

This section identifies and quantifies the vulnerability of the jurisdictions within Guilford County to the significant hazards identified in the previous sections (*Hazard Identification and Profiles*). It consists of the following subsections:

- 6.1 Overview
- 6.2 Methodology
- 6.3 Explanation of Data Sources
- 6.4 Asset Inventory
- 6.5 Vulnerability Assessment Results
- 6.6 Conclusions on Hazard Vulnerability

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44 CFR Requirement
44 CFR Part 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. The description shall include an overall summary of each hazard and its impact on the community. 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 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; (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.

6.1 OVERVIEW

This section builds upon the information provided in Section 4: *Hazard Identification and* Section 5*: Hazard Profiles* by identifying and characterizing an inventory of assets in Guilford County. In addition, the potential impact and expected amount of damages caused to these assets by each identified hazard event is assessed. The primary objective of the vulnerability assessment is to quantify exposure and the potential loss estimates for each hazard. In doing so, Guilford County and the participating jurisdictions may better understand their unique risks to identified hazards and be better prepared to evaluate and prioritize specific hazard mitigation actions.

This section begins with an explanation of the methodology applied to complete the vulnerability assessment, followed by a summary description of the asset inventory as compiled for jurisdictions in Guilford County. The remainder of this section focuses on the results of the assessment conducted.

6.2 METHODOLOGY

This vulnerability assessment was conducted using three distinct methodologies: (1) A stochastic risk assessment; (2) a geographic information system (GIS)-based analysis; and (3) a risk modeling software analysis. Each approach provides estimates for the potential impact of hazards by using a common,

systematic framework for evaluation, including historical occurrence information provided in the *Hazard Identification* and *Hazard Profiles* sections. A brief description of the three different approaches is provided on the following pages.

6.2.1 Stochastic Risk Assessment

The stochastic risk assessment methodology was applied to analyze hazards of concern that were outside the scope of hazard risk models and the GIS-based risk assessment. This involves the consideration of annualized loss estimates and impacts of current and future buildings and populations. Annualized loss is the estimated long-term weighted average value of losses to property in any single year in a specified geographic area (i.e., municipal jurisdiction or county). This methodology is applied primarily to hazards that do not have geographically-definable boundaries and are therefore excluded from spatial analysis through GIS. A stochastic risk methodology was used for the following hazards:

- Bioterrorism
- Building/Structure Collapse
- Civil Disturbance
- Cyberterrorism
- Drought
- Energy/Power/Utility Failure
- Extreme Cold
- Extreme Heat
- Hail
- Public Health/Emerging Disease Threat
- Pipeline Failure
- Resource Shortage (Water/Fuel)
- Terrorism
- Thunderstorm- Lightning
- Thunderstorm- Wind
- Tornado
- Transportation Incident
- Winter Storm

All of the natural hazards listed above are considered atmospheric and have the potential to affect all current and future buildings and all populations. Likewise, because man-made and technological hazards are often unpredictable and do not have a defined area in which they are more likely to occur, all current and future buildings and populations are considered at risk. **Table 6.1** provides information about all improved property in Guilford County that is vulnerable to these hazards. For all hazards, annualized loss estimates were determined using the best available data on historical losses from sources including NOAA's National Climatic Data Center records, county and municipal hazard mitigation plans, and local knowledge. Annualized loss estimates were generated by totaling the amount of property damage over the period of time for which records were available, and calculating the average

annual loss. Given the standard weighting analysis, losses can be readily compared across hazards providing an objective approach for evaluating mitigation alternatives.

For a number of the biological, technological and man-made hazards, no data with historical property damages was available. Therefore a detailed vulnerability assessment could not be completed for these hazards at this time.

The results for these hazards are found at the end of this section in **Table 6.16**.

6.2.2 GIS-Based Analysis

Other hazards have specified geographic boundaries that permit additional analysis using Geographic Information Systems (GIS). These hazards include:

- Fire
- Flood
- Hazardous Material Incident
- Nuclear Power Plant Emergency
- Wildfire

The objective of the GIS-based analysis was to determine the estimated vulnerability of critical facilities and populations for the identified hazards in Guilford County using best available geospatial data. Digital data was collected from local, regional, state, and national sources for hazards and buildings. This included local tax assessor records for individual parcels and buildings and geo-referenced point locations for identified assets (critical facilities and infrastructure, special populations, etc.) when available. ESRI® ArcGIS™ 10.2 was used to assess hazard vulnerability utilizing digital hazard data, as well as local building data. Using these data layers, hazard vulnerability can be quantified by estimating the assessed building value for parcels and/or buildings determined to be located in identified hazard areas. The results of the analysis provided an estimate of the number of parcels, buildings, and critical facilities, as well as the estimated value of those buildings determined to be potentially at risk to the hazards with delineable geographic hazard boundaries.

6.2.3 Risk Modeling Software Analysis

A risk modeling software was used for the following hazards:

- Earthquake
- Hurricane/Other Tropical Disturbance

There are several models that exist to model hazards. Hazus-MH was used in this vulnerability assessment to address the aforementioned hazards.

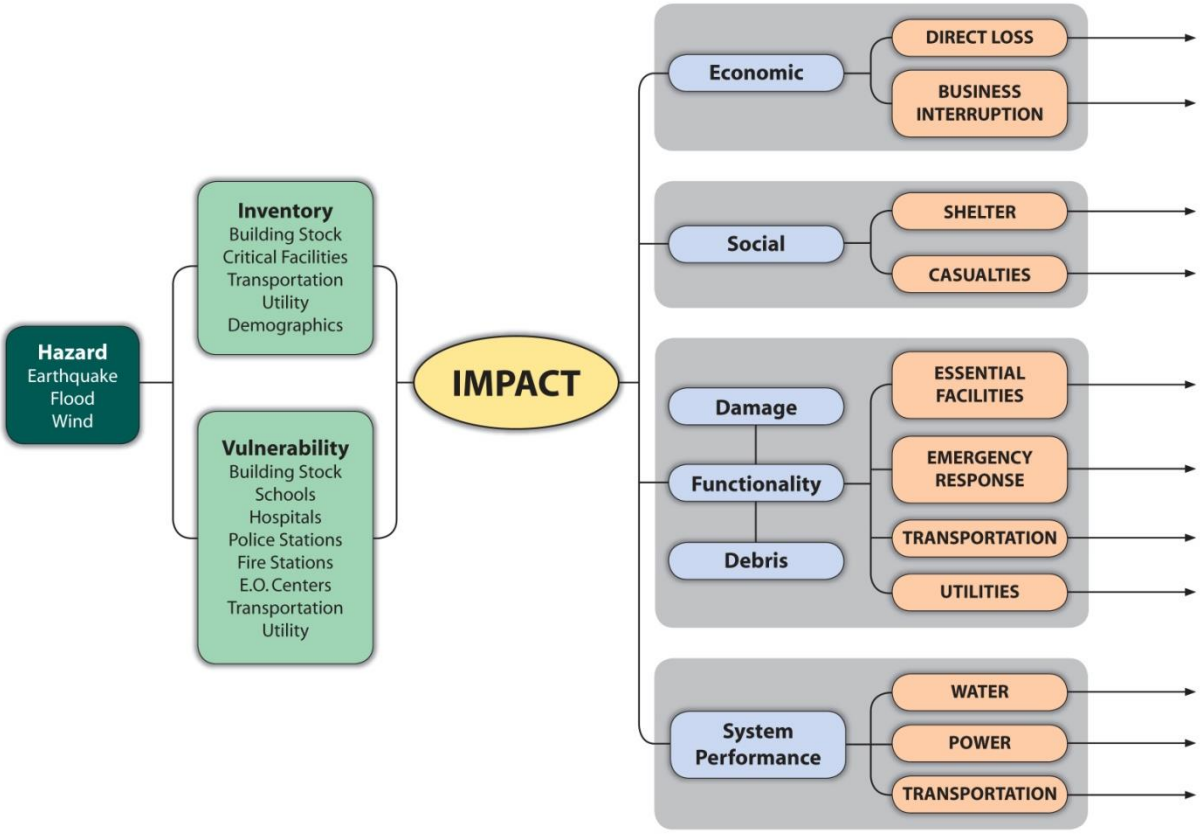
Hazus-MH

Hazus-MH ("Hazus") is a standardized loss estimation software program developed by FEMA. It is built upon an integrated GIS platform to conduct analysis at a regional level (i.e., not on a structure-by-structure basis). The Hazus risk assessment methodology is parametric, in that distinct hazard and inventory parameters (e.g., wind speed and building types) can be modeled using the software to determine the impact (i.e., damages and losses) on the built environment.

The Guilford County Risk Assessment utilized Hazus-MH to produce hazard damage loss estimations for hazards for the planning area. At the time this analysis was completed, Hazus-MH 2.1 was used to estimate potential damages from hurricane winds earthquake hazards using Hazus-MH methodology. Although the program can also model losses for flood and storm surge, it was not used in this Risk Assessment.

Figure 6.1 illustrates the conceptual model of the Hazus-MH methodology.

FIGURE 6.1: CONCEPTUAL MODEL OF HAZUS-MH METHODOLOGY



Hazus-MH is capable of providing a variety of loss estimation results. In order to be consistent with other hazard assessments, annualized losses are presented when possible. Some additional results based on location-specific scenarios may also be presented to provide a complete picture of hazard vulnerability.

Loss estimates provided in this vulnerability assessment are based on best available data and methodologies. The results are an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, non-specific locations, demographics, or economic parameters).

All conclusions are presented in "Conclusions on Hazard Vulnerability" at the end of this section.

6.3 EXPLANATION OF DATA SOURCES

Earthquake

Hazus-MH 2.1 (as described above) was used to assess earthquake vulnerability. A level 1, probabilistic scenario to estimate annualized loss was utilized. In this scenario, several return periods (events of varying intensities) are run to determine annualized loss. Default Hazus earthquake damage functions and methodology were used to determine the probability of damage. Results are calculated at the 2000 U.S. Census tract level in Hazus and presented at the county level.

Flood

FEMA Digital Flood Insurance Rate Maps (DFIRMs) were used to determine flood vulnerability. DFIRM data can be used in ArcGIS for mapping purposes and they identify several features including floodplain boundaries and base flood elevations. Identified areas on the DFIRM represent some features of Flood Insurance Rate Maps including the 100-year flood areas (1.0-percent annual chance flood), and the 500-year flood areas (0.2-percent annual chance flood). For the vulnerability assessment, local parcel data and critical facilities were overlaid on the 100-year floodplain areas and 500-year floodplain areas. It should be noted that such an analysis does not account for building elevation.

Hurricane and Tropical Storm Wind

Hazus-MH 2.1 (as described above) was used to assess wind vulnerability. For the hurricane wind analysis, a probabilistic scenario was created to estimate the annualized loss damage and probable peak wind speeds in Guilford County. Default Hazus wind speed data, damage functions, and methodology were used in to determine the probability of damage for 50-, 100-, 500-, and 1,000-year frequency events (also known as return periods) in the scenario. Results are calculated in Hazus at the 2000 U.S. Census tract level and presented at the county and municipal level.

Hazardous Materials Incident

For the fixed hazardous materials incident analysis, RMP, TRI, and Tier II data was used. The Toxic Release Inventory is a publicly available database from the federal Environmental Protection Agency (EPA) that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; RCRA Subtitle C treatment, storage, and disposal (TSD) facilities; and solvent recovery services;
- Has 10 or more full-time employee equivalents; and
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, bioaccumulative, and toxic (PBT) chemicals are subject to different thresholds of 10 pounds, 100 pounds, or 0.1 grams depending on the chemical.

A second facet of the EPCRA program is to collect information on significant quantities of hazardous chemicals maintained at fixed facilities. These facilities are known as Tier II facilities. Additionally, facilities that use extremely hazardous substances are required to develop a Risk Management Plan (RMP) that must be revised and resubmitted to the EPA ever five years.

For the mobile hazardous materials incident analysis, transportation data including major highways and railroads were obtained from the North Carolina Department of Transportation. This data is ArcGIS compatible, lending itself to buffer analysis to determine risk.

Nuclear Accident

The data used to determine vulnerability to a nuclear accident in Guilford County is based on the location of the Shearon Harris Nuclear Power Station and buffer radii recommended by the Nuclear Regulatory Commission for emergency management planning in the event of a nuclear accident.

Wildfire

The data used to determine vulnerability to wildfire in Guilford County is based on GIS data called the Southern Wildfire Risk Assessment (SWRA). This data is available on the Southern Wildfire Risk Assessment website and can be downloaded and imported into ArcGIS. A specific layer, known as "Wildland Urban Interface Risk Index" (WUIRI) was used to determine vulnerability of people and property. The WUIRI is presented on a scale of 0 to -9. It combines data on housing density with the data on the impact and likelihood of a wildfire occurring in a specific area. The primary purpose of the data is to highlight areas of concern that may be conducive to mitigation actions. Due to the assumptions made, it is not a true probability. However, it does provide a comparison of risk throughout the region.

6.4 ASSET INVENTORY

An inventory of geo-referenced assets within Guilford County and its jurisdictions was compiled in order to identify and characterize those properties potentially at risk to the identified hazards[1]. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. Under this assessment, two categories of physical assets were created and then further assessed through GIS analysis. These are presented below in Section 6.4.1.

[1] While potentially not all-inclusive for the jurisdictions in Guilford County, "georeferenced" assets include those assets for which specific location data is readily available for connecting the asset to a specific geographic location for purposes of GIS analysis.

6.4.1 Physical and Improved Assets

The two categories of physical assets consist of:

1. Improved Property: Includes all improved properties in Guilford County according to local parcel data provided by the county. The information has been expressed in terms of the number of parcels and total assessed value of improvements (buildings) that may be exposed to the identified hazards. In addition, building footprint data was available for all jurisdictions and it was used to improve the overall assessment by providing an accurate assessment of how many buildings are located in hazard areas. However, it should be noted that building footprint data from all jurisdictions except has not been updated since 2009, so it likely underestimates building counts.

2. Critical Facilities: Critical facilities vary by jurisdiction and the critical facilities provided by each jurisdiction are used in this section. It should be noted that this listing is not all-inclusive for assets located in the county, and it is anticipated that it may be expanded or adjusted during future plan updates as more geo-referenced data becomes available for use in GIS analysis.

The following tables provide a detailed listing of the geo-referenced assets that have been identified for inclusion in the vulnerability assessment Guilford County.

Table 6.1 lists the number of parcels, total value of parcels, total number of parcels with improvements, and the total assessed value of improvements for participating areas of Guilford County (study area of vulnerability assessment).[2]

TABLE 6.1: IMPROVED PROPERTY IN GUILFORD COUNTY

Location	Number of Parcels	Total Assessed Value of Parcels	Number of Buildings	Total Assessed Value of Buildings
Gibsonville	1,649	$178,241,594	1,433	$154,341,094
Greensboro	97,767	$19,666,049,287	93,597	$16,019,848,887
High Point	41,212	$6,407,012,606	37,919	$5,439,737,655
Jamestown	1,559	$300,290,620	1,436	$258,958,430
Oak Ridge	2,950	$760,562,395	2,397	$586,084,400
Pleasant Garden	2,245	$282,641,387	1,726	$228,683,600
Sedalia	505	$36,558,578	282	$25,209,700
Stokesdale	2,547	$460,965,801	2,022	$338,828,600
Summerfield	4,444	$1,167,195,614	3,694	$898,565,400
Whitsett	391	$37,913,736	266	$27,821,830
Unincorporated Area	52,724	$8,498,262,423	39,934	$6,594,245,877
GUILFORD COUNTY TOTAL	**207,993**	**$37,795,694,041**	**184,706**	**$30,572,325,473**

Source: Guilford County GIS Department

[2] Total assessed values for improvements is based on tax assessor records as joined to digital parcel data. This data does not include dollar figures for tax-exempt improvements such as publicly-owned buildings and facilities. It should also be noted that, due to record keeping, some duplication is possible thus potentially resulting in an inflated value exposure for an area.

Table 6.2 lists the fire stations, law and justice, EMS stations, hospitals, schools, and other critical facilities located in Guilford County. These facilities were identified as primary critical facilities in that they are necessary to maintain government functions and protect the life, health, safety, and welfare of citizens. These facilities were geospatially mapped and used as the basis for further geographic analysis of the hazards that could potentially affect critical facilities. All critical facility information was provided by local governments and the Guilford County GIS department.

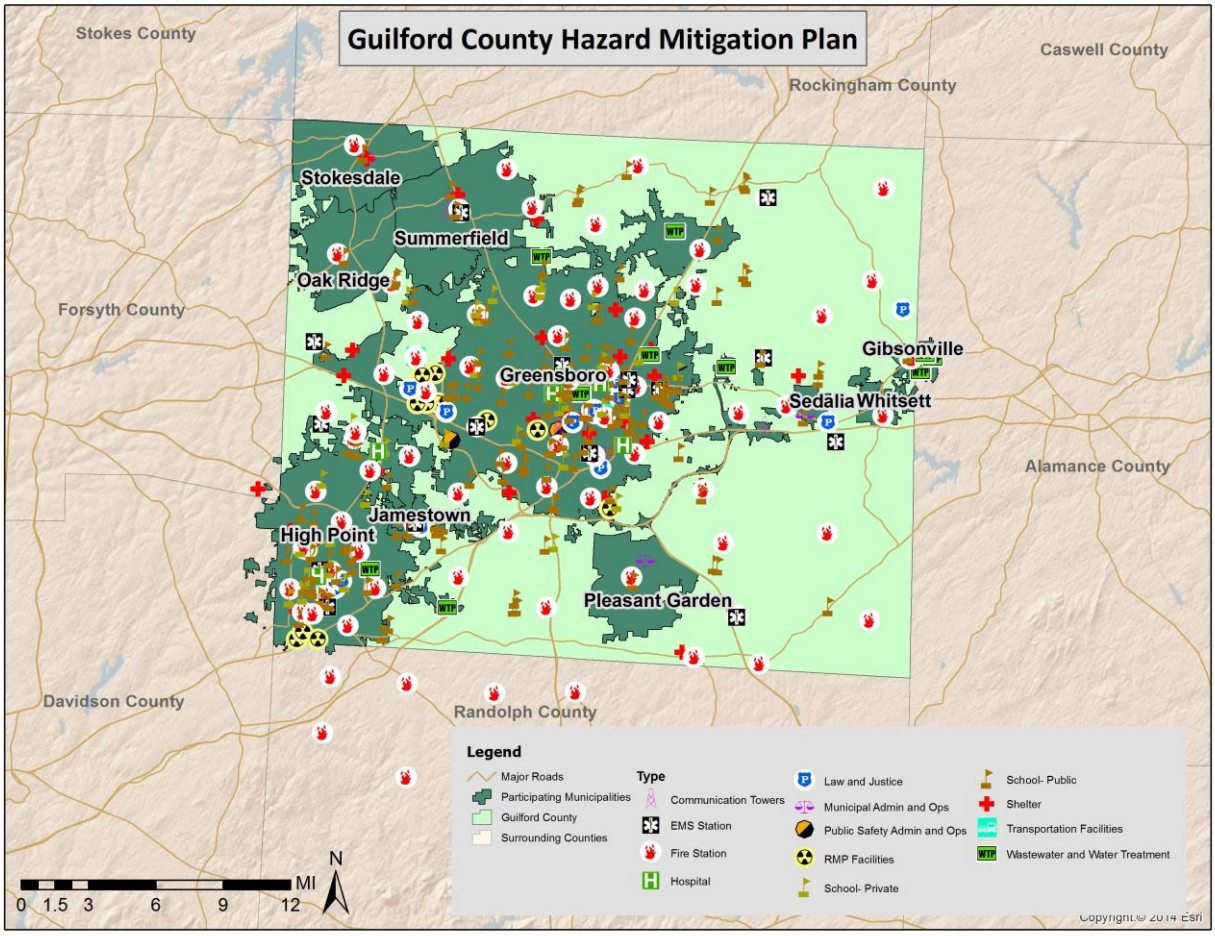
In addition, **Figure 6.2** shows the locations of the primary critical facilities in Guilford County. **Table 6.16**, near the end of this section, shows a complete list of the critical facilities by name, as well as the hazards that affect each facility. As noted previously, this list is not all-inclusive and only includes information provided by local governments.

TABLE 6.2: CRITICAL FACILITY INVENTORY IN GUILFORD COUNTY

Location	Fire Stations	Law and Justice	EMS Stations	Hospitals	Schools	Other
Gibsonville	1	1	0	0	1	4
Greensboro	24	13	6	5	84	46
High Point	15	3	3	2	35	15
Jamestown	1	1	1	0	6	1
Oak Ridge	1	0	0	0	1	1
Pleasant Garden	1	0	0	0	1	1
Sedalia	0	0	0	0	1	2
Stokesdale	1	0	0	0	1	3
Summerfield	3	1	1	0	1	4
Whitsett	1	0	0	0	0	1
Unincorporated Area	31	3	5	0	31	12
GUILFORD COUNTY TOTAL	**79**	**22**	**16**	**7**	**162**	**90**

Source: Local Governments

FIGURE 6.2: CRITICAL FACILITY LOCATIONS IN GUILFORD COUNTY



Source: Local Governments

6.4.2 Social Vulnerability

In addition to identifying those assets potentially at risk to identified hazards, it is important to identify and assess those particular segments of the resident population in Guilford County that are potentially at risk to these hazards.

Table 6.3 lists the population by jurisdiction according to U.S. Census 2010 population estimates. The total population in Guilford County according to Census data is 488,406 persons. Additional population estimates are presented in Section 3: *Community Profile*.

TABLE 6.3: TOTAL POPULATION IN GUILFORD COUNTY

Location	Total 2010 Population
Gibsonville*	6,410
Greensboro	269,666
High Point*	104,371
Jamestown	3,382

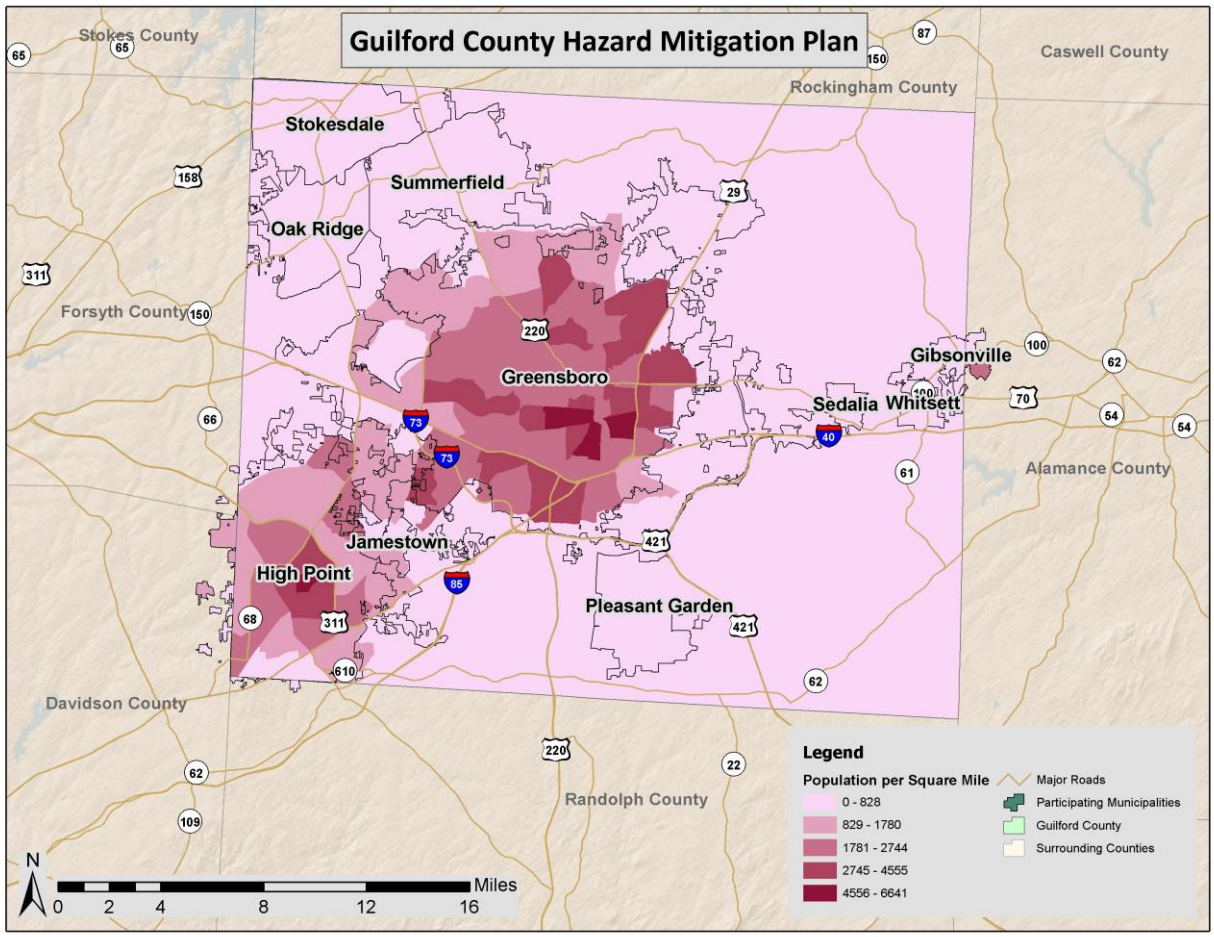
Location	Total 2010 Population
Oak Ridge	6,185
Pleasant Garden	4,489
Sedalia	623
Stokesdale	5,047
Summerfield	10,232
Whitsett	590
Unincorporated Area	85,888
GUILFORD COUNTY TOTAL	**488,406**

*The population counts of Gibsonville and High Point include population residing in neighboring counties. Note: these populations are not included in the Guilford County total.

Source: United States Census 2010

In addition, **Figure 6.3** illustrates the population density by census tract as it was reported by the U.S. Census Bureau in 2010.

FIGURE 6.3: POPULATION DENSITY IN GUILFORD COUNTY



Source: U.S. Census Bureau, 2010

6.4.3 Development Trends and Changes in Vulnerability

Since the previous hazard mitigation plan was approved in 2011, Guilford County has experienced limited growth and development. **Table 6.4** shows the number of building units constructed since 2010 according to the U.S. Census American Community Survey.

TABLE 6.4: BUILDING COUNTS FOR GUILFORD COUNTY

Jurisdiction	Total Housing Units (2013)	Units Built 2010 or later	% Building Stock Built Post-2010
Gibsonville*	2,688	38	1.4%
Greensboro	125,852	582	0.5%
High Point*	46,246	372	0.8%
Jamestown	1,385	0	0.0%
Oak Ridge	2,295	12	0.5%
Pleasant Garden	1,632	0	0.0%
Sedalia	303	0	0.0%
Stokesdale	1,878	0	0.0%
Summerfield	4,035	0	0.0%
Whitsett	330	2	0.6%
GUILFORD COUNTY TOTAL	**219,307**	**1,320**	**0.6%**

*The housing unit counts for Gibsonville and High Point include units located in neighboring counties. Note: these housing units are not included in the Guilford County total.
Source: United States Census Bureau

Table 6.5 shows population growth estimates for the county and municipalities from 2010 to 2013 based on the U.S. Census Annual Estimates of Resident Population.

TABLE 6.5: POPULATION GROWTH FOR GUILFORD COUNTY

Jurisdiction	Population Estimates (as of July 1)				% Change 2010-2013
	2010	2011	2012	2013	
Gibsonville*	6,434	6,518	6,583	6,640	3.2%
Greensboro	269,628	272,637	276,566	279,639	3.7%
High Point*	104,608	105,839	106,678	107,741	3.0%
Jamestown	3,393	3,502	3,568	3,617	6.6%
Oak Ridge	6,291	6,365	6,431	6,519	3.6%
Pleasant Garden	4,498	4,534	4,567	4,616	2.6%
Sedalia	624	631	637	646	3.5%
Stokesdale	5,059	5,110	5,156	5,221	3.2%
Summerfield	10,260	10,374	10,476	10,614	3.5%
Whitsett	591	597	603	610	3.2%
GUILFORD COUNTY TOTAL	**489,657**	**495,165**	**501,018**	**506,610**	**3.5%**

*The population counts for Gibsonville and High Point include populations residing in neighboring counties. Note: these populations are not included in the Guilford County total.
Note: July 1 population estimates were used in this table to allow comparison of annual population counts (April 1 Census estimates were used for all other population counts throughout the plan which is why the counts may differ).
Source: United States Census Bureau

Based on the data above, there has been a low rate of residential development in the county since 2010. However, Gibsonville experienced a slightly higher rate of development compared to the rest of the county, resulting in an increased number of structures that are vulnerable to the potential impacts of the identified hazards. Additionally, there has been some population growth across Guilford County; however, Jamestown experienced a higher rate of growth compared to the rest of the county. Since the population has increased across the county, there is now a greater number of people exposed to the identified hazards. Therefore, population growth has impacted the county's vulnerability since the previous local hazard mitigation plan was approved and there has been a slight increase in the overall vulnerability.

It is also important to note that as development increases in the future, greater populations and more structures and infrastructure will be exposed to potential hazards if development occurs in the floodplains, high landside susceptibility areas, high wildfire risk areas, primary and secondary hazardous materials buffers, or Shearon Harris Power Plant's 50-mile buffer.

6.5 VULNERABILITY ASSESSMENT RESULTS

As noted earlier, only hazards with a specific geographic boundary, modeling tool, or sufficient historical data allow for further analysis. Those results are presented here. All other hazards are assumed to impact the entire planning region (drought, extreme cold, extreme heat, hail, thunderstorm (lightning and high wind), tornado, winter storm, bioterrorism, public health/emerging disease, communications systems disruption/failure, and resource shortage,) or, due to lack of data, analysis would not lead to credible results (building/structure collapse, energy/power/utility failure, pipeline failure, transportation incident, civil disturbance, cyberterrorism and terrorism). The total county exposure, and thus risk, was presented in **Table 6.1**.

The annualized loss estimate for all hazards is presented at the end of this section in **Table 6.15.**

The hazards presented in this subsection include: hurricane and tropical storm winds, earthquake, flood, hazardous materials incident, nuclear accident, and wildfire.

6.5.1 Hurricane and Tropical Storm

Historical evidence indicates that Guilford County has some risk to the hurricane and tropical storm hazard. There have been four disaster declarations due to hurricanes (Hurricane Hugo, Hurricane Fran, Hurricane Floyd, and Hurricane Ivan) in the county. Several tracks have come near or traversed through Guilford County, as shown and discussed in Section 5: *Hazard Profiles*.

Hurricanes and tropical storms can cause damage through numerous additional hazards such as flooding, erosion, tornadoes, high winds, and precipitation, thus it is difficult to estimate total potential losses from these cumulative effects. The current Hazus-MH hurricane model only analyzes hurricane winds and is not capable of modeling and estimating cumulative losses from all hazards associated with hurricanes; therefore only hurricane winds are analyzed in this section. It can be assumed that all existing and future buildings and populations are at risk to the hurricane and tropical storm hazard. Hazus-MH 2.1 was used to determine annualized losses for the county as shown below in **Table 6.6.** In the comparative annualized loss analysis at the end of this section, only losses to buildings are reported

in order to best match annualized losses reported for other hazards. Hazus-MH reports losses at the U.S. Census tract level, so determining participating jurisdiction losses was not possible.

TABLE 6.6: ANNUALIZED LOSS ESTIMATIONS FOR HURRICANE WIND HAZARD

Location	Building Loss	Contents Loss	Inventory Loss	Total Annualized Loss
Guilford County	$2,278,000	$56,7000	$16,000	$2,861,000

Source: Hazus-MH 2.1

In addition, probable peak wind speeds were calculated in Hazus. These are shown below in **Table 6.7.**

TABLE 6.7: PROBABLE PEAK HURRICANE/TROPICAL STORM WIND SPEEDS (MPH)

Location	50-year event	100-year event	500-year event	1,000-year event
Gibsonville	64	73.8	92.9	99.4
Greensboro	64.7	74.4	93.4	99.7
High Point	63.9	73.2	93	99.4
Jamestown	63.8	73	92.8	99.3
Oak Ridge	62.3	71.6	91.4	97.7
Pleasant Garden	64.7	74.4	94	99.9
Sedalia	63.8	73.4	92.6	98.4
Stokesdale	62	71.4	90.7	96.9
Summerfield	62.7	71.9	91.6	98.3
Whitsett	64	73.8	92.9	99.4
Unincorporated Area	65.3	75.0	93.8	100.9
MAXIMUM WIND SPEED REPORTED	**65.3**	**75.0**	**93.8**	**100.9**

Source: Hazus-MH 2.1

Social Vulnerability

Given equal susceptibility across Guilford County, it is assumed that the total population is at risk to the hurricane and tropical storm hazard.

Critical Facilities

Given equal vulnerability across Guilford County, all critical facilities are considered to be at risk. Some buildings may perform better than others in the face of such an event due to construction and age, among other factors. Determining individual building response is beyond the scope of this plan. However, this plan will consider mitigation actions for vulnerable structures, including critical facilities, to reduce the impacts of the hurricane wind hazard. A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

In conclusion, a hurricane event has the potential to impact many existing and future buildings, critical facilities, and populations in Guilford County. Hurricane events can cause substantial damage in their wake including fatalities, extensive debris clean-up, and extended power outages.

6.5.2 Earthquake

For the earthquake hazard vulnerability assessment, a probabilistic scenario was created to estimate the annualized loss for the county. The results of the analysis reported at the U.S. Census tract level do not make it feasible to estimate losses at the jurisdiction level. Since the scenario is annualized, no building counts are provided. Losses reported included losses due to building damage (structural and non-structural), contents, and inventory. However, like the analysis for hurricanes, the comparative annualized loss figures at the end of this section only utilize building losses in order to provide consistency with other hazards. **Table 6.8** summarizes the findings.

TABLE 6.8: ANNUALIZED LOSS ESTIMATIONS FOR EARTHQUAKE HAZARD

Location	Structural Building Loss	Non-Structural Building Loss	Contents Loss	Inventory Loss	Total Annualized Loss
Guilford County	$121,000	$302,000	$93,000	$5,000	$521,000

Source: Hazus-MH 2.1

Social Vulnerability

It can be assumed that all existing and future populations are at risk to the earthquake hazard.

Critical Facilities

The Hazus probabilistic analysis indicated that no critical facilities would sustain measurable damage in an earthquake event. However, all critical facilities should be considered at-risk to minor damage, should an event occur. A list of individual critical facilities and their risk can be found in **Table 6.16**.

In conclusion, an earthquake has the potential to impact all existing and future buildings, facilities, and populations in Guilford County. Minor earthquakes may rattle dishes and cause minimal damage while stronger earthquakes will result in structural damage as indicated in the Hazus scenario above. Impacts of earthquakes include debris clean-up, service disruption and, in severe cases, fatalities due to building collapse. Specific vulnerabilities for assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates if data becomes available. Furthermore, mitigation actions to address earthquake vulnerability will be considered.

6.5.3 Flood

Historical evidence indicates that Guilford County is susceptible to flood events. A total of 73 flood events have been reported by the National Climatic Data Center, resulting in $2.6 million (2014 dollars) in property damage and 1 fatality. On an annualized level, these damages amounted to $147,467 for Guilford County.

In order to assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using Digital Flood Insurance Rate Map (DFIRM) data in combination with local tax assessor records for each of the Guilford County municipalities. The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the building values for only those improved properties that were confirmed to be located within an identified floodplain. **Table 6.9** presents the potential at-risk property. Both the number of parcels/buildings and the approximate value are presented.

TABLE 6.9: ESTIMATED EXPOSURE OF PARCELS/BUILDINGS TO THE FLOOD HAZARD

Location	1.0-percent ACF			0.2-percent ACF		
	Approx. Number of Parcels	Approx. Number Improved Buildings	Approx. Improved Value of Buildings[3]	Approx. Number of Parcels	Approx. Number Improved Buildings	Approx. Improved Value of Buildings[4]
Gibsonville	2	4	$682,100	2	0	$0
Greensboro	3,986	2,793	$1,931,137,009	594	135	$571,121,300
High Point	2,617	1,946	$674,641,430	1,015	184	$206,170,800
Jamestown	98	83	$20,264,430	143	30	$19,196,550
Oak Ridge	186	124	$29,147,100	244	26	$44,326,000
Pleasant Garden	63	43	$6,609,400	36	10	$3,041,200
Sedalia	27	19	$1,731,500	13	0	$0
Stokesdale	99	53	$18,034,500	68	13	$16,249,100
Summerfield	157	107	$34,043,900	126	5	$23,395,700
Whitsett	0	0	$0	0	0	$0
Unincorporated Area	3,627	1,783	$281,518,700	2,956	369	$445,130,980
GUILFORD COUNTY TOTAL	**10,862**	**6,955**	**$2,997,810,069**	**5,197**	**772**	**$1,328,631,630**

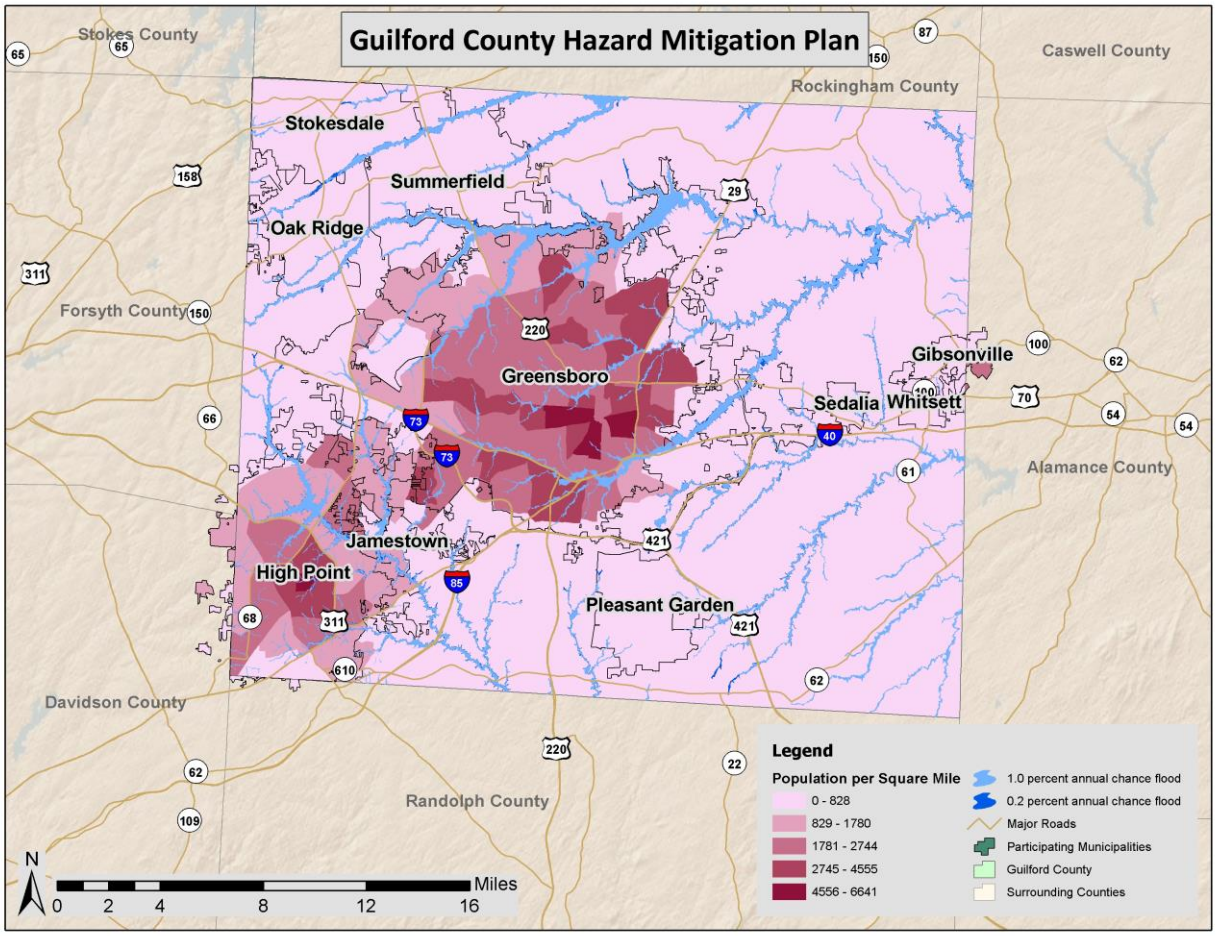
Source: Federal Emergency Management Agency DFIRM

Social Vulnerability

U.S. Census 2010 population at the tract level was used for analysis to determine where areas of high population concentration intersect with flood prone areas in the county. **Figure 6.4** is presented to gain a better understanding of the at-risk population.

[3] Improved value of buildings is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-percent annual chance floodplain, since building footprints were not associated with dollar value data.
[4] Improved value of buildings is estimated based on the building value associated with parcels that have been identified as being located in the 0.2-percent annual chance floodplain, since building footprints were not associated with dollar value data.

FIGURE 6.4 : POPULATION DENSITY NEAR FLOODPLAINS



Source: FEMA DFIRM, United States Census 2010

Critical Facilities

The critical facility analysis revealed that there are 7 critical facilities located in the either the 1.0-percent annual chance or 0.2 percent annual chance floodplain. Two of these facilities are water intake facilities which in some cases are necessarily located within the floodplain. The remaining five facilities are a shelter, a public safety coordination center, a sheriff's office, a fire station and a school (as previously noted, this analysis does not consider building elevation, which may negate risk.) A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

In conclusion, a flood has the potential to impact many existing and future buildings, facilities, and populations in Guilford County, though some areas are at a higher risk than others. All types of structures in a floodplain are at-risk, though elevated structures will have a reduced risk. As noted, the floodplains used in this analysis include the 100-year and 500-year FEMA regulated floodplain boundaries. It is certainly possible that more severe events could occur beyond these boundaries or urban (flash) flooding could impact additional structures. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates. Furthermore, areas subject to repetitive flooding should be analyzed for potential mitigation actions.

6.5.4 Hazardous Materials Incident

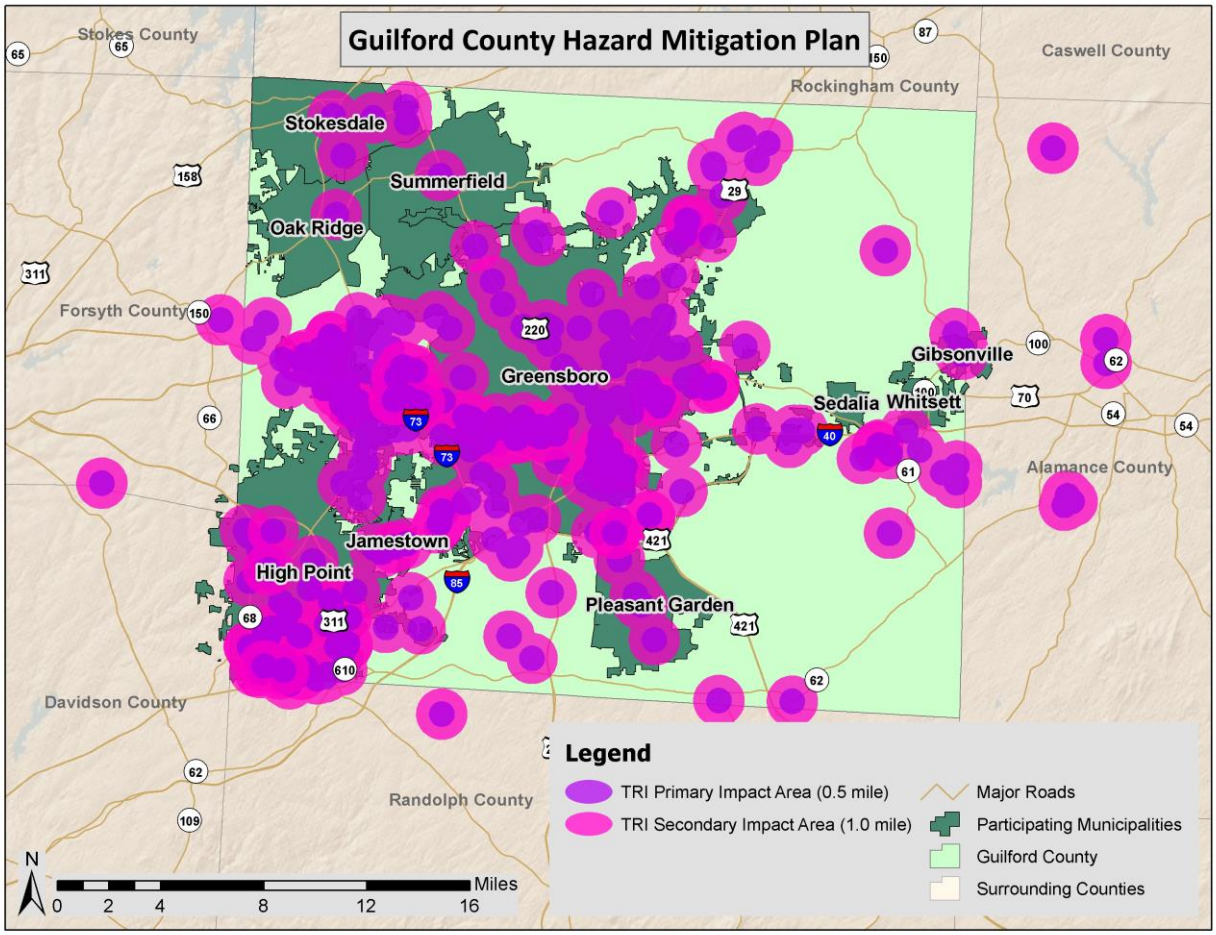
Historical evidence indicates that Guilford County is susceptible to hazardous materials events. A total of 2,220 HAZMAT incidents have been reported by the Pipeline and Hazardous Materials Safety Administration, resulting in $75,954 (2014 dollars) in property damage, 1 death, and 28 injuries. On an annualized level, these damages amount to $12,412 for Guilford County.

Most hazardous materials incidents that occur are contained and suppressed before destroying any property or threatening lives. However, they can have a significant negative impact. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. In a hazardous materials incident, solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions will directly affect how the hazard develops. Certain chemicals may travel through the air or water, affecting a much larger area than the point of the incidence itself. Non-compliance with fire and building codes, as well as failure to maintain existing fire and containment features, can substantially increase the damage from a hazardous materials release. The duration of a hazardous materials incident can range from hours to days. Warning time is minimal to none.

In order to conduct the vulnerability assessment for this hazard, GIS intersection analysis was used for fixed and mobile areas and building footprints/parcels.[5] In both scenarios, two sizes of buffers—0.5-mile and 1.0-mile—were used. These areas are assumed to respect the different levels of effect: immediate (primary) and secondary. Primary and secondary impact sites were selected based on guidance from the PHMSA Emergency Response Guidebook. For the fixed site analysis, geo-referenced RMP, TRI, and Tier 2 listed toxic sites in Guilford County, along with buffers, were used for analysis as shown in **Figure 6.5.** For the mobile analysis, the major roads (Interstate highway, U.S. highway, and State highway) and railroads, where hazardous materials are primarily transported that could adversely impact people and buildings, were used for the GIS buffer analysis. **Figure 6.6** shows the areas used for mobile toxic release buffer analysis. The results indicate the approximate number of parcels/buildings and improved value, as shown in **Table 6.10** (fixed sites), **Table 6.11** (mobile road sites) and **Table 6.12** (mobile railroad sites).[6]

[5] This type of analysis will likely yield inflated results (generally higher than what is actually reported after an actual event).
[6] Note that parcels included in the 1.0-mile analysis are also included in the 0.5-mile analysis.

FIGURE 6.5: FIXED FACILITY HAZARDOUS MATERIALS SITES WITH BUFFERS IN GUILFORD COUNTY



Source: Environmental Protection Agency

TABLE 6.10: EXPOSURE OF IMPROVED PROPERTY TO HAZARDOUS MATERIALS (FIXED SITES)

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[7]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[8]
Gibsonville	835	1,194	$68,559,094	1,171	1,676	$93,779,994
Greensboro	41,713	47,252	$8,070,942,653	80,216	90,514	$13,282,355,768
High Point	19,591	19,764	$2,983,677,355	32,631	33,549	$4,223,744,255
Jamestown	805	787	$127,909,130	1,390	1,474	$235,825,930
Oak Ridge	226	270	$46,521,000	725	885	$143,814,800
Pleasant Garden	548	761	$61,387,800	1,360	2,167	$129,269,800
Sedalia	0	0	$0	9	0	$0
Stokesdale	515	780	$61,042,300	1,450	2,180	$165,812,100

[7] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.
[8] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-mile buffer, since building footprints were not associated with dollar value data.

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[7]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[8]
Summerfield	281	399	$32,165,500	927	1,421	$149,106,800
Whitsett	22	40	$2,166,100	94	170	$8,681,930
Unincorporated Area	8,479	10,098	$1,883,308,252	20,011	26,866	$3,058,377,452
GUILFORD COUNTY TOTAL	**73,015**	**81,345**	**$13,337,679,184**	**139,984**	**160,902**	**$21,490,768,829**

FIGURE 6.6: MOBILE HAZMAT BUFFERS IN GUILFORD COUNTY

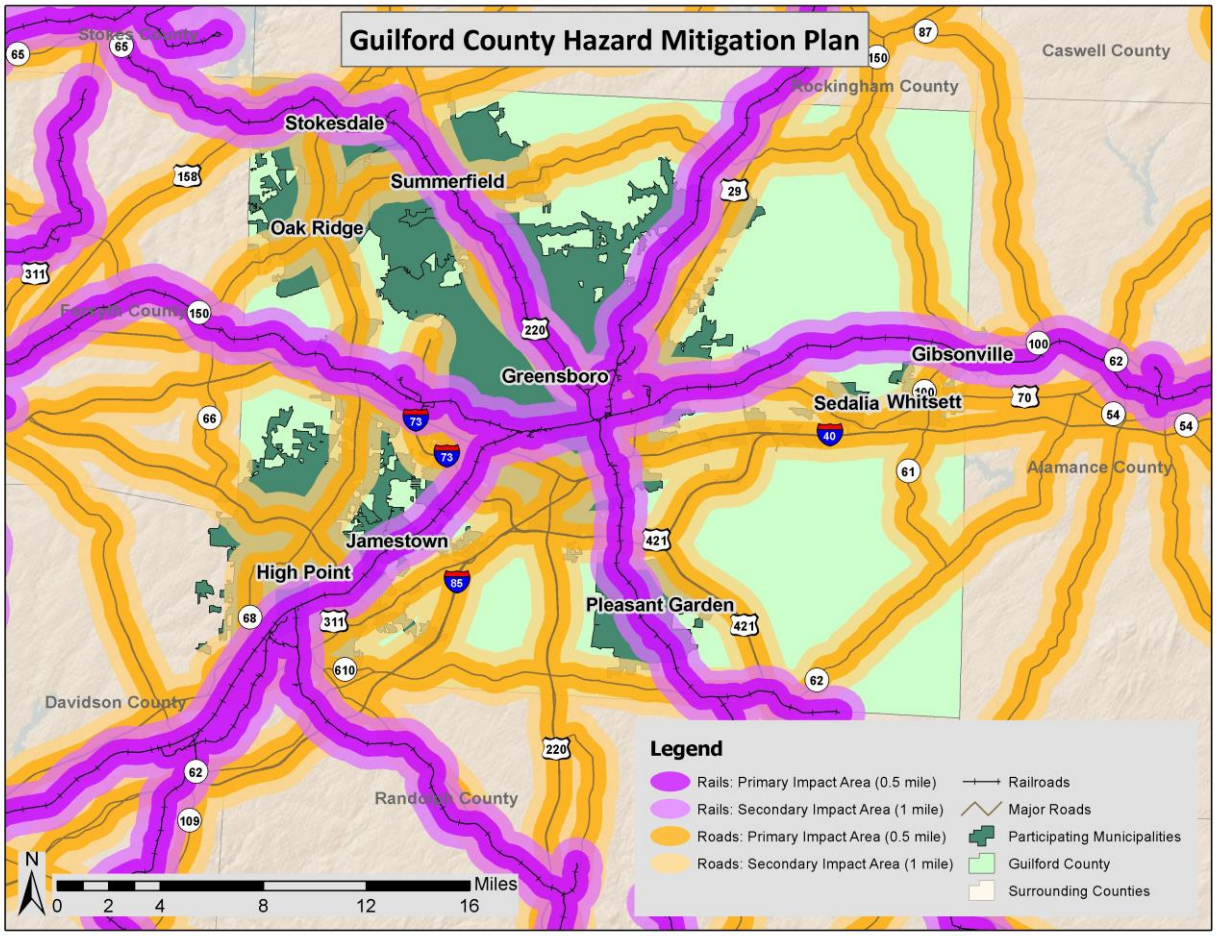


TABLE 6.11: EXPOSURE OF IMPROVED PROPERTY TO HAZARDOUS MATERIALS SPILL (MOBILE ANALYSIS - ROAD)

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[9]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[10]
Gibsonville	1,440	1,791	$139,233,894	1,649	2,058	$154,341,094
Greensboro	34,873	37,827	$5,917,674,176	60,957	69,588	$9,576,324,668
High Point	17,497	18,038	$2,341,160,630	32,611	33,534	$3,764,390,055
Jamestown	0	0	$0	77	118	$28,390,500
Oak Ridge	1,786	2,355	$358,854,300	2,432	3,279	$489,232,800
Pleasant Garden	265	435	$26,787,100	664	1,042	$82,249,200
Sedalia	235	244	$10,533,200	452	483	$22,431,000
Stokesdale	2,095	3,103	$271,629,600	2,532	3,863	$337,150,900
Summerfield	1,922	2,853	$377,349,900	3,090	4,466	$653,859,100
Whitsett	304	618	$22,504,230	353	757	$26,384,830
Unincorporated Area	20,005	27,772	$2,446,224,155	33,263	46,983	$4,406,069,937
GUILFORD COUNTY TOTAL	**80,422**	**95,036**	**$11,911,951,185**	**138,080**	**166,171**	**$19,540,824,084**

TABLE 6.12: EXPOSURE OF IMPROVED PROPERTY TO HAZARDOUS MATERIALS SPILL (MOBILE ANALYSIS - RAILROAD)

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[11]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[12]
Gibsonville	970	1,365	$79,304,494	1,174	1,684	$93,898,794
Greensboro	33,131	38,128	$6,110,292,735	59,095	66,880	$10,022,957,433
High Point	9,876	9,806	$1,408,813,855	16,599	17,643	$2,091,410,855
Jamestown	844	833	$144,971,430	1,441	1,509	$244,677,430
Oak Ridge	0	0	$0	0	0	$0
Pleasant Garden	848	1,395	$83,649,100	1,432	2,539	$133,740,900
Sedalia	0	0	$0	0	0	$0
Stokesdale	1,259	1,928	$128,876,900	1,697	2,756	$173,311,600
Summerfield	916	1,463	$162,883,200	1,976	2,758	$437,758,900
Whitsett	0	0	$0	12	19	$2,001,100
Unincorporated Area	4,294	6,385	$589,928,645	8,785	13,488	$1,246,814,867
GUILFORD COUNTY TOTAL	**52,138**	**61,303**	**$8,708,720,359**	**92,211**	**109,276**	**$14,446,571,879**

[9] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.
[10] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-mile buffer, since building footprints were not associated with dollar value data.
[11] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.
[12] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-mile buffer, since building footprints were not associated with dollar value data.

Social Vulnerability

Given high susceptibility across Guilford County, it is assumed that the total population is at risk to hazardous materials incidents. It should be noted that areas of population concentration may be at an elevated risk due to a greater burden to evacuate population quickly.

Critical Facilities

Fixed Site Analysis:

The critical facility analysis for fixed TRI sites revealed that there are 287 facilities located in a HAZMAT risk zone. The primary impact zone includes 195 facilities. The remaining facilities are in the secondary, 1.0-mile, zone. A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

Mobile Analysis:

The critical facility analysis for road and railroad transportation corridors revealed that there are 243 critical facilities located in the primary and secondary mobile HAZMAT buffer areas for roads and 226 critical facilities located in the railroad HAZMAT buffer areas. The 1.0-mile road buffer area (worst case scenario modeled) includes the following critical facilities: 4 communication towers, 12 EMS stations, 51 fire stations, 6 hospitals, 9 law and justice buildings, 9 municipal admin/ops buildings, 4 public safety admin/ops buildings, 13 RMP facilities, 20 private schools, 83 public schools, 24 shelters, and 8 wastewater/water treatment facilities. The railroad buffer areas include the following: 5 communication towers, 12 EMS stations, 36 fire stations, 6 hospitals, 19 law and justice buildings, 11 municipal admin/ops buildings, 5 public safety admin/ops buildings, 13 RMP facilities, 16 private schools, 73 public schools, 21 shelters, 2 transportation facilities, and 7 wastewater/water treatment facilities. It should be noted that many of the facilities located in the buffer areas for railroad are also located in the buffer areas for road and/or the fixed site analysis. A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

In conclusion, a hazardous material incident has the potential to impact many existing and future buildings, critical facilities, and populations in Guilford County. Those areas in a primary buffer are at the highest risk, though all areas carry some vulnerability due to variations in conditions that could alter the impact area such direction and speed of wind, volume of release, etc.

6.5.5 Nuclear Accident

The location of Shearon Harris Nuclear Power Plant southeast of Guilford County demonstrates that the county is at some risk to the effects of a nuclear accident. Although there have not been any major events at this plant in the past, there have been major events at other nuclear stations around the country. Additionally, smaller scale incidents at Shearon Harris Nuclear Power Plant have occurred.

In order to assess nuclear risk, a GIS-based analysis was used to estimate exposure during a nuclear event within each of the risk zones described in *Section 5: Hazard Profiles*. The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the total assessed building values for only those improved properties that were confirmed to be located within one of the risk zones. There are no properties in Guilford County located within the 10-mile risk zone, so **Table 6.13** only presents potential at-risk properties in the 50-mile buffer zone. Both the number of parcels/buildings and the approximate value are presented.

TABLE 6.13: ESTIMATED EXPOSURE OF PARCELS/BUILDINGS TO A NUCLEAR ACCIDENT

Location	50-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved Buildings	Approx. Improved Value of Buildings[13]
Gibsonville	1,649	2,058	$154,341,094
Greensboro	219	154	$29,445,200
High Point	0	0	$0
Jamestown	0	0	$0
Oak Ridge	0	0	$0
Pleasant Garden	453	791	$38,880,300
Sedalia	505	538	$25,209,700
Stokesdale	0	0	$0
Summerfield	0	0	$0
Whitsett	391	799	$27,821,830
Unincorporated Area	14,675	22,834	$1,713,121,335
GUILFORD COUNTY TOTAL	**17,892**	**27,174**	**$1,988,819,459**

Source: International Atomic Energy Agency

Social Vulnerability

Since areas in the southeast part of the county are within the 50-mile buffer area, this segment of the population is considered to be at highest risk to a nuclear accident. However, other populations in the county may also be at some risk.

Critical Facilities

The critical facility analysis revealed that there are a total of 33 critical facilities located in the 50-mile nuclear buffer area including 1 communication tower, 2 EMS stations, 9 fire stations, 3 law and justice buildings, 4 municipal admin/ops buildings, 8 public schools, 3 shelters, and 3 wastewater/water treatment facilities. A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

In conclusion, a nuclear accident has the potential to impact many existing and future buildings, facilities, and populations in the Guilford County, though areas in the southwest of the county are at a higher risk than others.

6.5.6 Fire

Historical evidence indicates that Guilford County is susceptible to wildfire events. An annual average of 33 wildfires were reported by the North Carolina Division of Forest Resources from 2005 to 2014.

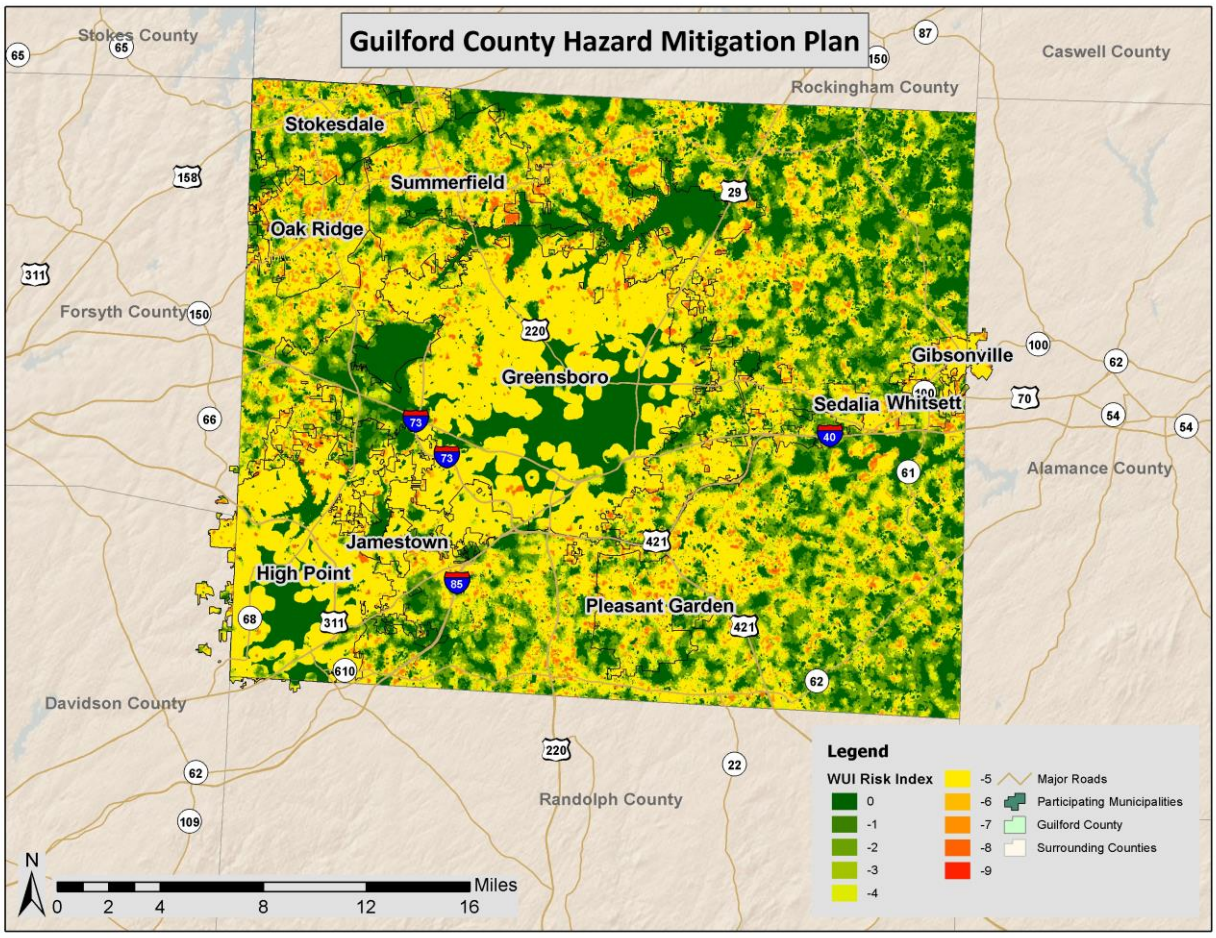
To estimate exposure to wildfire, the approximate number of parcels and their associated improved value was determined using GIS analysis. For the critical facility analysis, areas of risk were intersected

[13] Improved value of buildings is estimated based on the building value associated with parcels that have been identified as being located in the 50-mile buffer, since building footprints were not associated with dollar value data.

with critical facility locations. **Figure 6.7** shows the Wildland Urban Interface Risk Index (WUIRI) data, which is a data layer that shows a rating of the potential impact of a wildfire on people and their homes. The key input, Wildland Urban Interface (WUI), reflects housing density (houses per acre) consistent with Federal Register National standards. The location of people living in the WUI and rural areas is key information for defining potential wildfire impacts to people and homes. Initially provided as raster data, it was converted to a polygon to allow for analysis. The Wildland Urban Interface Risk Index data ranges from 0 to -9 with lower values being most severe (as noted previously, this is only a measure of relative risk). **Figure 6.8** shows the areas of analysis where any grid cell is less than -5. Areas with a value below -5 were chosen to be displayed as areas of risk because this showed the upper echelon of the scale and the areas at highest risk.

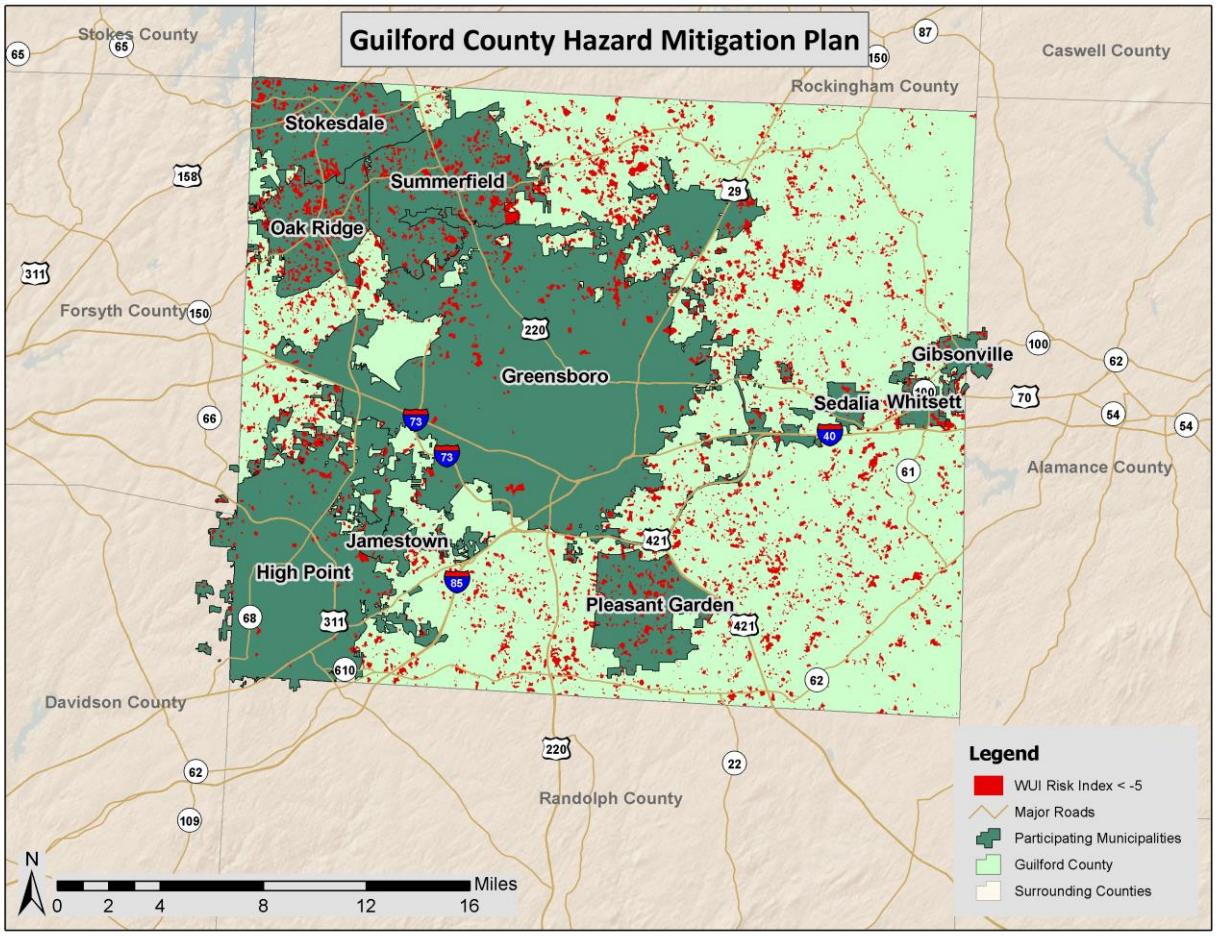
Table 6.14 shows the results of the analysis.

FIGURE 6.7: WUI RISK INDEX AREAS IN GUILFORD COUNTY



Source: Southern Wildfire Risk Assessment Data

FIGURE 6.8: WILDFIRE RISK AREAS IN GUILFORD COUNTY



Source: Southern Wildfire Risk Assessment Data

TABLE 6.14: EXPOSURE OF IMPROVED PROPERTY TO WILDFIRE RISK AREAS

	HIGH WILDFIRE RISK AREA		
Location	**Approx. Number of Parcels**	**Approx. Number of Buildings**	**Approx. Improved Value**
Gibsonville	277	141	$25,207,400
Greensboro	5,684	3,419	$1,218,785,309
High Point	2,076	1,253	$362,956,750
Jamestown	109	40	$19,726,800
Oak Ridge	1,552	1,173	$300,792,000
Pleasant Garden	835	647	$110,044,500
Sedalia	119	56	$8,247,900
Stokesdale	1,246	963	$166,217,600
Summerfield	2,090	1,577	$406,553,700
Whitsett	154	157	$14,771,130
Unincorporated Area	17,775	12,335	$2,551,274,842
GUILFORD COUNTY TOTAL	**31,917**	**21,761**	**$5,184,577,931**

Social Vulnerability

Although not all areas have equal vulnerability, there is some susceptibility across the entire county. It is assumed that the total population is at low risk to the wildfire hazard. Determining the exact number of people in wildfire risk areas is difficult with existing data and could be misleading.

Critical Facilities

The critical facility analysis revealed that there are 15 critical facilities located in the wildfire risk area (areas where the WUIRI is less than -5): 1 EMS station, 7 fire stations, 1 municipal admin/ops, 5 public schools, and 1 shelter. However, it should also be noted, that several factors could impact the spread of a wildfire putting all facilities at some risk. A list of specific critical facilities and their associated risk can be found in **Table 6.16** at the end of this section.

In conclusion, a wildfire event has the potential to impact some existing and future buildings, critical facilities, and populations in Guilford County.

6.6 CONCLUSIONS ON HAZARD VULNERABILITY

The results of this vulnerability assessment are useful in at least three ways:

- Improving our understanding of the risk associated with the hazards in Guilford County through better understanding of the complexities and dynamics of risk, how levels of risk can be measured and compared, and the myriad of factors that influence risk. An understanding of these relationships is critical in making balanced and informed decisions on managing the risk.
- Providing a baseline for policy development and comparison of mitigation alternatives. The data used for this analysis presents a current picture of risk in Guilford County. Updating this risk "snapshot" with future data will enable comparison of the changes in risk with time. Baselines of this type can support the objective analysis of policy and program options for risk reduction in the region.
- Comparing the risk among the hazards addressed. The ability to quantify the risk to all these hazards relative to one another helps in a balanced, multi-hazard approach to risk management at each level of governing authority. This ranking provides a systematic framework to compare and prioritize the very disparate hazards that are present in Guilford County. This final step in the risk assessment provides the necessary information for local officials to craft a mitigation strategy to focus resources on only those hazards that pose the most threat to Guilford County and its municipalities.

Exposure to hazards can be an indicator of vulnerability. Economic exposure can be identified through locally assessed values for improvements (buildings), and social exposure can be identified by estimating the population exposed to each hazard. This information is especially important for decision-makers to use in planning for evacuation or other public safety related needs.

The types of assets included in these analyses include all building types in the participating jurisdictions. Specific information about the types of assets that are vulnerable to the identified hazards is included in each hazard subsection (for example all building types are considered at risk to the winter storm hazard and commercial, residential, and government owned facilities are at risk to repetitive flooding, etc).

Table 6.15 presents a summary of annualized loss for each hazard in Guilford County. Due to the reporting of hazard damages primarily at the county level, it was difficult to determine an accurate annualized loss estimate for each municipality. Therefore, an annualized loss was determined using the damage reported from historical occurrences at the county level. These values should be used as an additional planning tool or measure risk for determining hazard mitigation strategies throughout the county.

TABLE 6.15: ANNUALIZED LOSS FOR GUILFORD COUNTY*

Event	Guilford County
Natural Hazards	
Drought	Negligible
Earthquake	$121,000
Extreme Cold	Negligible
Extreme Heat	Negligible
Fire	Negligible
Flooding	$147,647
Hail	$40
Hurricane/Tropical Disturbance	$2,278,000
Thunderstorm (Wind/Lightning)	$267,321
Tornado	$2,871,725
Winter Storm	$454,297
Biological Hazards	
Bioterrorism	Negligible
Public Health/Emerging Disease	Negligible
Technological Hazards	
Building/Structure Collapse	Negligible
Communications Systems Failure	Negligible
Energy/Power/Utility Failure	Negligible
HAZMAT Incident	$15,360
Nuclear Power Plant Emergency	Negligible
Pipeline Failure	Negligible
Resource Shortage (Fuel/Water)	Negligible
Transportation Incident	Negligible
Man-Made/Intentional Hazards	
Civil Disturbance	Negligible
Cyberterrorism	Negligible
Terrorism	Negligible

*In this table, the term "Negligible" is used to indicate that no property damage for the particular hazard was recorded. This could be the case either because there were no events that caused dollar damage or because documentation of that particular type of event is not well kept or readily available.

As noted previously, all existing and future buildings and populations (including critical facilities) are vulnerable to atmospheric hazards including drought, extreme cold, extreme heat, hail, hurricane and tropical disturbance, lightning, thunderstorm wind, tornado, and winter storm. All existing and future buildings are also vulnerable to many of the biological, technological, and man-made hazards including bioterrorism, public health/emerging disease, building/structure collapse, communications systems disruption/failure, energy/power/utility failure, pipeline failure, resource shortage, transportation incident, civil disturbance, cyberterrorism, and terrorism. Some buildings may be more vulnerable to these hazards based on locations, construction, and building type. **Table 6.16** shows the critical facilities vulnerable to additional hazards analyzed in this section. The table lists those assets that are determined to be exposed to each of the identified hazards (marked with an "**X**").

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TABLE 6.16: AT-RISK CRITICAL FACILITIES IN GUILFORD COUNTY

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
GIBSONVILLE																																
Gibsonville Fire Dept St. 6	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Gibsonville Police Department	Law and Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Gibsonville Public Works Facility	Municipal Admin and Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Gibsonville Town Hall	Municipal Admin and Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Gibsonville Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Scott Drive Sewage Pump Station	Wastewater and Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	
Sullivan Court Sewage Pump Station	Wastewater and Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	
GREENSBORO																																
Justice Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Mcleansville Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	
Meadowood Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
NC A&T University Viper Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Time Warner Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
EMS Base 1	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
EMS Base 3	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
EMS Base 4	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
EMS Base 6	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	
PTAR 10	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X	
Guilford County EMS Maintenance Shop	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Fire Station 57	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X					X	X	X	X	X	
Greensboro Fire Station 2	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Greensboro Fire Station 1	Fire Station	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Greensboro Fire Station 10	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Greensboro Fire Station 11	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Fire Station 14	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X	X	X	
Greensboro Fire Station 18	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X							X	X	X	X	X	
Greensboro Fire Station 20	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Fire Station 21	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Greensboro Fire Station 4	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Greensboro Fire Station 40	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Greensboro Fire Station 41	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X					X	X			X	X	X	X	X	
Greensboro Fire Station 43	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X							X	X	X	X	X	
Greensboro Fire Station 48	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Greensboro Fire Station 49	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Greensboro Fire Station 52	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Fire Station 56	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Greensboro Fire Station 61	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X					X	X	X	X	X	
Greensboro Fire Station 7	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Fire Station 8	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	
Greensboro Fire Station 19	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Greensboro Fire Station 17	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Greensboro Fire Station 59	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	
Pinecroft-Sedgefield Fire St. 23	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Cone Behavior Health	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Moses Cone Memorial Hospital	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X	
Wesley Long Community Hospital	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X		X			X	X	X	X	X	
Cone Women's Hospital	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Kindred Hospital	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
County Courts Building - Greensboro	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Greensboro Police Department - Administrative Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Greensboro Police Department - Central Division Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Greensboro Police Department - Eastern Division Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X			X	X	X	X	X	
Greensboro Police Department - Southern Division Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Police Department - Western Division Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Guilford County Sheriff's Office - Greensboro Detention Center	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X	X			X	X	X	X	X	
Guilford County Sheriff's Office - Law Enforcement Center	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X	X			X	X	X	X	X	
Guilford County Sheriff's Office - Main Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X	X			X	X	X	X	X	
Guilford County Sheriff's Office - Special Operations Office	Law And Justice	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Juvenile Detention Center	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X			X	X	X	X	X	
N.C. Agricultural & Technical State Univ. Police Dept.	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			X	X	X	X	X	
University Of North Carolina - Greensboro Police Dept.	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X	X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
BB&T Building (Guilford County Information Services)	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Greensboro City Services Center	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Guilford County Administration Building (Old Court House)	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Melvin Municipal Office Building (City Of Greensboro)	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
City Of Greensboro City Coordination Center	Public Safety Admin And Ops	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Guilford County Emergency Services And Emergency Operations Center	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Guilford-Metro 911 Communications	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
University Of North Carolina - Greensboro Emergency Coordination Center	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Brenntag Mid-South Inc.	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Ecoflo	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Greensboro 1 Terminal	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro 2 Terminal	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Greensboro Ii Terminal	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Harris Teeter Greensboro Frozen Foods Distribution	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Harris Teeter Greensboro Perishable Foods Dist.	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
Motiva Enterprises LLC, Greensboro Terminal	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Pactiv - Greensboro	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
B-Nai Shalom Synagogue	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Caldwell Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Canterbury School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Christ Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X				X				X	X	X	X	X	
Covenant Christian	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	
Greensboro Day School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X						X				X	X	X	X	X	
Greensboro Montessori	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Guilford Day School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	
Imani Institute	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Islamic Center Of GSO	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
Mell Burton School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X				X	X	X	X	X	
Napoleon B. Smith	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
New Garden Friends School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X								X	X	X	X	X	

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		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Next School, The	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Our Lady Of Grace	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X				X			X	X	X	X	X	
Pendle Hill Friends School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Ridgefield Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
St.Pius X School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Alderman Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	
Allen Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Archer Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Aycock Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Bessemer Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Bluford Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Brightwood Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
Brooks Global Studies School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Claxton Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X							X	X	X	X	X	
Colfax Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X	X	X	
Cone Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Doris Henderson Newcomers School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Dudley High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	

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Erwin Montessori School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Falkener Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X				X	X	X	X	X	
Foust Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	
Frazier Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	
Gateway Education Center School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Gillespie Park Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
General Greene Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Greensboro College Middle College	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
Grimsley High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Guilford Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X				X	X	X	X	X	
Guilford Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Hairston Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X				X	X	X	X	X	
Hampton Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X				X	X	X	X	X	
High School Ahead Academy	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Hunter Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Irving Park Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Jackson Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X				X	X	X	X	X	

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		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Jefferson Elementary	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Jesse Wharton Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Jones Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
Joyner Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X				X	X	X	X	X	
Kernodle Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Kiser Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	X	
Lindley Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X				X				X	X	X	X	X	
McIver Education Center School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Mendenhall Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X								X	X	X	X	X	
Morehead Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X								X	X	X	X	X	
Murphey Traditional Academy School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
Page High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X				X	X	X	X	X	
Pearce Elementary	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Peck Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X				X	X	X	X	X	
Peeler Open Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X						X	X	X	X	X	
Pilot Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X				X	X	X	X	X	
Rankin Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X				X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Reedy Fork Elementary	School- Public	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	
Sarah Walden Herbin-Dale J. Metz Education Center	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	X	
Scale Greensboro Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Sedgefield Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X				X	X	X	X	X	
Smith High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	X	
Sternberger Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
The Academy at Lincoln	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X				X	X	X	X	X	
The Academy at Smith	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X						X	X	X	X	X	
The Early College at Guilford	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
The Middle College at Bennett	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	X	
The Middle College at GTCC - Greensboro	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
The Middle College at N.C. A&T	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
The Middle College at UNCG	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
The STEM Early College at N.C. A&T	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
Twilight School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Washington Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Weaver Education Center School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Western High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Wiley Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	
Barber Park/George Simkins Sports Center	Shelter	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Brown Recreation Center	Shelter	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
College Park Baptist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Craft Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X						X			X	X	X	X	X	
Girl Scout Learning Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Glenwood Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	
Greensboro Sportsplex	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Guilford County Agricultural Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Leonard Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Lewis Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Lindley Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Peeler Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	
Presbyterian Church Of The Covenant	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
Smith Senior Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Teamsters Local 391 Union Hall	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Trotter Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Warnersville Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
Windsor Recreation Center	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	
Galyon Transportation Center	Transportation Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Greensboro Wastewater Treatment Plant- N. Buffalo Plant	Wastewater And Water Treatment	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X		X							X	X	X	X	X	
Greensboro Wastewater Treatment Plant- TZ Osborne	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X					X	X	X	X	X	
Greensboro Water Treatment Plant - Lake Townsend	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X					X	X	X	X	X	
Greensboro Water Treatment Plant - NL Mitchell	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Greensboro Water Treatment Plant - Reedy Fork	Wastewater And Water Treatment	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
HIGH POINT																																	
EMS Base 2	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
PTAR 7	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
PTAR 9	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
High Point Fire Training Building	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	X	
High Point Fire Station 1	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X				X	X	X	X	X	
High Point Fire Station 10	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	
High Point Fire Station 11	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X								X	X	X	X	X	
High Point Fire Station 2	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
High Point Fire Station 3	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X				X	X	X	X	X	
High Point Fire Station 4	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	
High Point Fire Station 5	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	X	
High Point Fire Station 6	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X				X	X	X	X	X	
High Point Fire Station 7	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X				X	X	X	X	X	
High Point Fire Station 8	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
High Point Fire Station 9	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	X	X	
High Point Fire Station 12	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
High Point Fire Station 13	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	
High Point Fire Station 126	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
High Point Regional	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	
Cone Health- MedCenter	Hospital	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
County Courts Building - High Point	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Guilford County Sheriff's Office - High Point Detention Center	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
High Point Police Department	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
High Point City Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
High Point City 9-1-1 Communications Center & City Coordination Center	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
High Point Fire Department Technical Services/Shop	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Future Foam, Inc	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Hunter Farms Dairy	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Kao Specialties Americas LLC	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Suiza Dairy Group, LLC Dba Dairy Fresh, LLC	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	X	X	
Baldwin's Chapel Sch.	School- Private	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X	X	X	
Hayworth Christian School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	
High Point Christian Acad.	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
High Point Friends School	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Immaculate Heart Of Mary	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X				X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Matrix Christian Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Paramount Christian Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Phoenix Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Piedmont School, The	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Wesleyan Education Center	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Allen Jay Elementary School	School- Public	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Allen Jay Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Andrews High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
Dean B. Pruette SCALE Academy	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Fairview Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Ferndale Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Florence Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
High Point Central High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Johnson St. Global Studies	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Kirkman Park Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Montlieu Avsenue Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Northwood Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Oak Hill Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Oak View Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
Parkview Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Penn-Griffin School for the Arts	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
Shadybrook Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Southwest Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Southwest High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Southwest Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X							X	X	X	X	X	
The Academy at Central	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
The Middle College at GTCC - High Point	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	
Triangle Lake Montessori Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	X	X	
Union Hill Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Welborn Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
Church Of God Of Prophecy	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Deep River Friends Meeting	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
First Presbyterian Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X				X			X	X	X	X	X	
Hartley Drive Family YMCA	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
Seventh Day Adventist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Amtrak Train Station	Transportation Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Eastside Wastewater Treatment Plant	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Frank L. Ward Water Treatment Plant	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
JAMESTOWN																																	
EMS Medic 3	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Pinecroft-Sedgefield Station 46	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Guilford County Sheriff's Office - District 3 Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Jamestown Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Christine Joyner Greene Education Center	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Haynes Inman Education Center	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Jamestown Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Jamestown Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Millis Road Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
Ragsdale High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL																MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
OAK RIDGE																																		
Oak Ridge Fire Dept Station 15	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Oak Ridge Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Oak Ridge Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
PLEASANT GARDEN																																		
Pleasant Garden Fire Station 3	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Pleasant Garden Town Hall	Municipal Admin And Ops	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X		X		X			X	X	X	X	X	
Pleasant Garden Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
SEDALIA																																		
Sedalia Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Sedalia Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
St. James United Methodist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
STOKESDALE																																		
Stokesdale Fire Dept Station 12	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X	
Stokesdale Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Stokesdale Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Stokesdale Town Hall	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Stokesdale United Methodist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
SUMMERFIELD																																	
Summerfield Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X	X			X	X	X	X	X	
EMS Medic 1	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Summerfield Fire Dept Station 29	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Summerfield Fire Dept Station 39	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Summerfield Fire Dept Station 9	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Guilford County Sheriff's Office - District 1 Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Summerfield Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Summerfield Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Center United Methodist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Summerfield United Methodist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
WHITSETT																																	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Whitsett Fire Dept Station 31	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	X	
Whitsett Town Hall	Municipal Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	X	
UNINCORPORATED AREA																																
High Point Jail Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	
North Tower	Communication Towers	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	
EMS Base 5	EMS Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X					X	X	X	X	X	
EMS Medic 2	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
EMS Medic 4	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X					X	X				X	X	X	X	
EMS Medic 5	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	
EMS Medic 6	EMS Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	
Alamance Fire Dept Station 44	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Alamance Fire Dept Station 54	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	
Climax Fire District Station 35	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Colfax Fire Dept Station 16	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X	X	X				X	X	X	X	
Fire District 13 Station 55	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	
Fire District 13 Station 58	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X								X	X	X	X	
Fire District 28 Station 28	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X						X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL														MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Greensboro Fire Station 53	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Julian Fire Dept Station 36	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Kimesville Fire Dept Station 45	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	X	
Mcleansville Fire Dept St. 27	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Mcleansville Fire Dept St. 37	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	X	
Mcleansville Fire Dept St. 47	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X					X	X			X	X	X	X	X	
Mount Hope Fire Dept Station 38	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	X	
Northeast Fire Dept Station 32	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
Northeast Fire Dept Station 33	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Northeast Fire Dept Station 34	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Oak Ridge Fire Dept Station 51	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
Pinecroft-Sedgefield Fire St. 22	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Pinecroft-Sedgefield Fire St. 24	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Pinecroft-Sedgefield Fire St. 25	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	
Southeast Fire District St 30	Fire Station	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	X	
Climax Fire Station 42	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	
Fire District 13 Station 13	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X			X	X			X	X	X	X	X	
Guil-Rand Fire Station 20	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X		X			X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Guil-Rand Fire Station 21	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Guil-Rand Fire Station 39	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	X	
Guil-Rand Fire Station 40	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X		X				X	X	X	X	X	
Guil-Rand Fire Station 41	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	
Level Cross Station 43	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X						X	X	X	X	X	
PTIA Fire Station 100	Fire Station	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Guilford County Sheriff's - Prison Farm	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	X	
Guilford County Sheriff's Office - District 2 Office	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X					X	X	X	X	X	X	
Piedmont Triad International Airport Police Department	Law And Justice	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	
Guilford County Animal Shelter	Public Safety Admin And Ops	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	
Olympic Products, LLC	RMP Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Greensboro Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X						X	X	X	X	X	
Shining Light Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X						X	X	X	X	X	
Triad Christian Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X						X	X	X	X	X	
Tri-City Jr. Academy	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X							X	X	X	X	X	
Vandalia Christian	School- Private	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X				X	X	X	X	X	
Alamance Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X				X		X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Brown Summit Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X		X			X	X	X	X	X	
Eastern Guilford High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X								X	X	X	X	X	X	
Eastern Guilford Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X						X		X	X	X	X	X	X	
George C. Simkins Jr. Elementary	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X		X					X	X	X	X	X	
Madison Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Mcleansville Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X					X	X			X	X	X	X	X	
McNair Elementary	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Meredith Leigh Haynes-Bennie Lee Inman Education Center	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
Monticello-Brown Summit Elementary Sch.	School- Public	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	
Nathanael Greene Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X	X	X	
Northern Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Northeast High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Northeast Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Northern Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Northern High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
Northwest High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	
Northwest Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Southeast High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X				X	X	X	X	X	X	
Southeast Middle School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X				X	X	X	X	X	X	
Southern Elementary School	School- Public	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Southern High School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Southern Middle School	School- Public	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Sumner Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X			X	X					X	X	X	X	X	
The Middle College at GTCC - Jamestown	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Vandalia Elementary School	School- Public	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X			X	X	X	X	X	
Alamance Presbyterian Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
Bethlehem United Methodist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	
Horneytown Fire Department	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X				X					X	X	X	X	X	
Mcleansville First Baptist Church	Shelter	X	X	X	X				X	X	X	X	X	X	X	X	X	X						X		X	X	X	X	X	X	
Piedmont Triad International Airport (PTIA)	Transportation Facilities	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	
Broad Street Sewage Pump Station	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	
Travis Creek Sewage Pump Station	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	

FACILITY NAME	FACILITY TYPE	NATURAL												BIO		TECHNOLOGICAL															MAN MADE		
		Drought	Earthquake	Extreme Cold	Extreme Heat	Fire	Flooding- 100 year	Flooding- 500 year	Hail	Hurricane	Thunderstorm	Tornado	Winter Storm	Bioterrorism	Public Health Threat	Building Collapse	Communications Failure	Energy/Utility Failure	Fixed HAZMAT 0.5-mile	Fixed HAZMAT 1.0-mile	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT0.5-mile (rail)	Mobile HAZMT1.0-mile (rail)	Nuclear Accident 10-mile	Nuclear Accident 50-mile	Pipeline Failure	Resource Shortage	Transportation Incident	Civil Disturbance	Cyberterrorism	Terrorism
Westside Wastewater Treatment Plant	Wastewater And Water Treatment	X	X	X	X				X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	

SECTION 7
CAPABILITY ASSESSMENT

This section of the Plan discusses the capability of the jurisdictions in Guilford County to implement hazard mitigation activities. It consists of the following four subsections:

- 7.1 What is a Capability Assessment?
- 7.2 Conducting the Capability Assessment
- 7.3 Capability Assessment Findings
- 7.4 Conclusions on Local Capability

7.1 WHAT IS A CAPABILITY ASSESSMENT

The purpose of conducting a capability assessment is to determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects[1]. As in any planning process, it is important to try to establish which goals, objectives, and/or actions are feasible based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical, and likely to be implemented over time, given a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources, and current political climate.

A capability assessment has two primary components: 1) an inventory of a local jurisdiction's relevant plans, ordinances, or programs already in place and 2) an analysis of its capacity to carry them out. Careful examination of local capabilities will detect any existing gaps, shortfalls, or weaknesses with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. A capability assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should continue to be supported and enhanced through future mitigation efforts.

The capability assessment completed for Guilford County and its municipalities serves as a critical planning step and an integral part of the foundation for designing an effective hazard mitigation strategy. Coupled with the Risk Assessment, the Capability Assessment helps identify and target meaningful mitigation actions for incorporation in the Mitigation Strategy portion of the Hazard Mitigation Plan. It not only helps establish the goals and objectives for the county to pursue under this Plan, but it also ensures that those goals and objectives are realistically achievable under given local conditions.

[1] While the Final Rule for implementing the Disaster Mitigation Act of 2000 does not require a local capability assessment to be completed for local hazard mitigation plans, it is a critical step in developing a mitigation strategy that meets the needs of the region while taking into account their own unique abilities. The Rule does state that a community's mitigation strategy should be "based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools" (44 CFR, Part 201.6(c)(3)).

7.2 CONDUCTING THE CAPABILITY ASSESSMENT

In order to facilitate the inventory and analysis of local government capabilities for Guilford County and its municipalities, a detailed Capability Assessment Survey was completed for each of the participating jurisdictions based on the information found in the existing hazard mitigation plan and local government websites. The survey questionnaire compiled information on a variety of "capability indicators" such as existing local plans, policies, programs, or ordinances that contribute to and/or hinder the jurisdictions' ability to implement hazard mitigation actions. Other indicators included information related to the communities' fiscal, administrative, and technical capabilities, such as access to local budgetary and personnel resources for mitigation purposes. The current political climate, an important consideration for any local planning or decision making process, was also evaluated with respect to hazard mitigation.

At a minimum, survey results provide an extensive inventory of existing local plans, ordinances, programs, and resources that are in place or under development in addition to their overall effect on hazard loss reduction. However, the survey instrument can also serve to identify gaps, weaknesses, or conflicts that the county and local jurisdictions can recast as opportunities for specific actions to be proposed as part of the hazard mitigation strategy.

The information collected in the survey questionnaire was incorporated into a database for further analysis. A general scoring methodology[2] was then applied to quantify each jurisdiction's overall capability. According to the scoring system, each capability indicator was assigned a point value based on its relevance to hazard mitigation

Using this scoring methodology, a total score and an overall capability rating of "high," "moderate," or "limited" could be determined according to the total number of points received. These classifications are designed to provide nothing more than a general assessment of local government capability. The results of this capability assessment provide critical information for developing an effective and meaningful mitigation strategy.

7.3 CAPABILITY ASSESSMENT FINDINGS

The findings of the capability assessment are summarized in this Plan to provide insight into the relevant capacity of the jurisdictions in Guilford County to implement hazard mitigation activities. All information is based upon the review of the existing hazard mitigation plan and local government websites through the Capability Assessment Survey and input provided by local government officials during meetings of the Guilford County Hazard Mitigation Planning Team.

7.3.1 Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances, and programs that demonstrate a local jurisdiction's commitment to guiding and managing growth, development, and redevelopment in a responsible manner while maintaining the general welfare of the community. It includes emergency response and mitigation planning, comprehensive land use planning, and transportation planning; the enforcement of zoning or subdivision ordinances and building codes that regulate how land is developed and structures are built; as well as protecting environmental, historic,

[2] The scoring methodology used to quantify and rank the jurisdictions' capability can be found in Appendix B.

and cultural resources in the community. Although some conflicts can arise, these planning initiatives generally present significant opportunities to integrate hazard mitigation principles and practices into the local decision making process.

This assessment is designed to provide a general overview of the key planning and regulatory tools and programs that are in place or under development for the jurisdictions in Guilford County along with their potential effect on loss reduction. This information will help identify opportunities to address existing gaps, weaknesses, or conflicts with other initiatives in addition to integrating the implementation of this Plan with existing planning mechanisms where appropriate.

Table 7.1 provides a summary of the relevant local plans, ordinances, and programs already in place or under development for the jurisdictions in Guilford County. A checkmark (✓) indicates that the given item is currently in place and being implemented. An asterisk (*) indicates that the given item is currently being developed for future implementation. Each of these local plans, ordinances, and programs should be considered available mechanisms for incorporating the requirements of the Guilford County Hazard Mitigation Plan.

TABLE 7.1: RELEVANT PLANS, ORDINANCES, AND PROGRAMS

Planning / Regulatory Tool	GUILFORD COUNTY	Gibsonville	Greensboro	High Point	Jamestown	Oak Ridge	Pleasant Garden	Sedalia	Stokesdale	Summerfield	Whitsett
Hazard Mitigation Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Comprehensive Land Use Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Floodplain Management Plan											
Open Space Management Plan (Parks & Rec/Greenway Plan)	✓		✓	✓	✓	✓	✓		✓	*	
Stormwater Management Plan/Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Natural Resource Protection Plan	✓			✓						✓	
Flood Response Plan	*	*	*	*	*	*	*	*	*	*	*
Emergency Operations Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Continuity of Operations Plan	✓	*	✓	✓		*	✓	✓		✓	✓
Evacuation Plan											
Disaster Recovery Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Capital Improvements Plan	✓	✓	✓	✓	✓	✓	✓			*	
Economic Development Plan	✓		✓	✓							

Planning / Regulatory Tool	GUILFORD COUNTY	Gibsonville	Greensboro	High Point	Jamestown	Oak Ridge	Pleasant Garden	Sedalia	Stokesdale	Summerfield	Whitsett
Historic Preservation Plan	*		✓								
Flood Damage Prevention Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zoning Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subdivision Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unified Development Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Post-Disaster Redevelopment Ordinance											
Building Code	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fire Code	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
National Flood Insurance Program (NFIP)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NFIP Community Rating System	✓		✓								

A more detailed discussion on the county's planning and regulatory capability follows.

7.3.2 Emergency Management

Hazard mitigation is widely recognized as one of the five mission areas of emergency management. The other four phases include prevention, protection, response, and recovery. In reality, each phase is interconnected with hazard mitigation, as **Figure 7.1** suggests. Opportunities to reduce potential losses through mitigation practices are most often implemented before disaster strikes, such as the elevation of flood prone structures or the continuous enforcement of policies that prevent and regulate development that is vulnerable to hazards due to its location, design, or other characteristics. Mitigation opportunities will also be presented during immediate preparedness or response activities, such as installing storm shutters in advance of a hurricane, and certainly during the long-term recovery and redevelopment process following a hazard event.

FIGURE 7.1: THE FIVE MISSION AREAS OF EMERGENCY MANAGEMENT

Source: FEMA

Planning for each mission area is a critical part of a comprehensive emergency management program and a key to the successful implementation of hazard mitigation actions. As a result, the Capability Assessment Survey asked several questions across a range of emergency management plans in order to assess the participating jurisdictions' willingness to plan and their level of technical planning proficiency.

Hazard Mitigation Plan: A hazard mitigation plan represents a community's blueprint for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment, and mitigation strategy.

- Guilford County has previously adopted a hazard mitigation plan. Each participating municipality was included in the county's plan.

Disaster Recovery Plan: A disaster recovery plan serves to guide the physical, social, environmental, and economic recovery and reconstruction process following a disaster. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing on opportunities to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

- Guilford County has developed a recovery framework plan that serves as the county's disaster recovery plan. This recovery framework pertains to all participating municipalities and each community acts as an integral part of the framework.

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

- Guilford County maintains an emergency operations plan through the County Emergency Management Department. All 10 participating municipalities have adopted the county plan.
- The City of High Point has also adopted a municipal-level emergency operations plan.

Continuity of Operations Plan: A continuity of operations plan establishes a chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster event.

- Guilford County has adopted a continuity of operations planning program that allows all county departments to develop a department specific continuity of operations plan. As part of this program, Guilford County has also developed and adopted a continuity of government plan.
- Various departments within the Cities of Greensboro and High Point have developed department specific continuity of operations plans.
- Several of the municipal jurisdictions within Guilford County have developed or are in the process of developing a continuity of government and/or continuity of operations plan for their jurisdiction.

Flood Response Plan: A flood response plan establishes procedures for responding to a flood emergency including coordinating and facilitating resources to minimize the impacts of flood.

- The county is currently in the process of developing a flood response plan which has an estimated completion date of January 2017. Once developed, this plan will include all of the participating municipalities.

7.3.3 General Planning

The implementation of hazard mitigation activities often involves agencies and individuals beyond the emergency management profession. Stakeholders may include local planners, public works officials, economic development specialists, and others. In many instances, concurrent local planning efforts will help to achieve or complement hazard mitigation goals, even though they are not designed as such. Therefore, the Capability Assessment Survey also asked questions regarding general planning capabilities and the degree to which hazard mitigation is integrated into other on-going planning efforts in Guilford County.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide for future governmental decision making. Typically a comprehensive plan contains sections on demographic conditions, land use, transportation elements, and community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives, and actions.

- Guilford County has adopted a county comprehensive plan.
- Each of the 10 participating municipalities has adopted a municipal land use plan.

Capital Improvements Plan: A capital improvements plan guides the scheduling of spending on public improvements. A capital improvements plan can serve as an important mechanism for guiding future development away from identified hazard areas. Limiting public spending in hazardous areas is one of the most effective long-term mitigation actions available to local governments.

- Guilford County, Gibsonville, Greensboro, High Point, Jamestown, Oak Ridge, and Pleasant Garden have capital improvement plans in place.
- The Town of Summerfield is currently in the process and developing a capital improvements plan.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards and the identification of ways to reduce future damages. This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards or are within a historic district that cannot easily be relocated out of harm's way.

- Guilford County is the process of developing a historic preservation plan and the City of Greensboro has a Preservation Plan that is a sub-section of the city's Comprehensive Plan.
- None of the remaining participating municipalities have adopted a historic preservation plan.

Zoning Ordinance: Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the public health, safety, and welfare of those in a given jurisdiction that maintains zoning authority. A zoning ordinance is the mechanism through which zoning is typically implemented. Since zoning regulations enable municipal governments to limit the type and density of development, a zoning ordinance can serve as a powerful tool when applied in identified hazard areas.

- Guilford County and all 10 participating municipalities have adopted zoning ordinances.
- The county and all of the participating municipalities, except the Town of Whitsett, include zoning regulations as part of their local unified development ordinances. Whitsett has adopted a standalone zoning ordinance.

Subdivision Ordinance: A subdivision ordinance is intended to regulate the development of residential, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development.

- Guilford County and all 10 participating municipalities have adopted subdivision ordinances.
- The county and all of the participating municipalities, except the Town of Whitsett, include subdivision regulations as part of their local unified development ordinances. Whitsett has adopted a standalone subdivision ordinance.

Building Codes, Permitting, and Inspections: Building codes regulate construction standards. In many communities, permits and inspections are required for new construction. Decisions regarding the adoption of building codes (that account for hazard risk), the type of permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community.

- North Carolina has a state compulsory building code, which applies throughout the state; however, jurisdictions may adopt codes if approved as providing adequate minimum standards. The county and all 10 participating municipalities have adopted a building code.
- Guilford County provides building inspection services for all unincorporated areas of the county and through contractual agreements for the Towns of Jamestown, Oak Ridge, Pleasant Garden, Sedalia, Stokesdale, Summerfield, and Whitsett.
- Gibsonville, Greensboro, and High Point are responsible for enforcement of the building codes within their planning jurisdictions.

The adoption and enforcement of building codes by local jurisdictions is routinely assessed through the Building Code Effectiveness Grading Schedule (BCEGS) program developed by the Insurance Services Office, Inc. (ISO).[3] In North Carolina, the North Carolina Department of Insurance assesses the building codes in effect in a particular community and how the community enforces its building codes *with special emphasis on mitigation of losses from natural hazards*. The results of BCEGS assessments are routinely provided to ISO's member private insurance companies, which in turn may offer ratings credits for new buildings constructed in communities with strong BCEGS classifications. The concept is that communities with well-enforced, up-to-date codes should experience fewer disaster-related losses and, as a result, should have lower insurance rates.

In conducting the assessment, ISO collects information related to personnel qualification and continuing education as well as the number of inspections performed per day. This type of information combined with local building codes is used to determine a grade for that jurisdiction. The grades range from 1 to 10 with a BCEGS grade of 1 representing exemplary commitment to building code enforcement and a grade of 10 indicating less than minimum recognized protection.

Specific BCEGS rating for the participating jurisdictions can be obtained by contacting the department for building inspections within that jurisdiction.

7.3.4 Floodplain Management

Flooding represents the greatest natural hazard facing the nation. At the same time, the tools available to reduce the impacts associated with flooding are among the most developed when compared to other hazard-specific mitigation techniques. In addition to approaches that cut across hazards such as education, outreach, and the training of local officials, the *National Flood Insurance Program* (NFIP) contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary for local governments; however, program participation is strongly encouraged by FEMA as a first step for implementing and sustaining an effective hazard mitigation program. It is therefore used as part of this assessment as a key indicator for measuring local capability.

In order for a county or municipality to participate in the NFIP, they must adopt a local flood damage prevention ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. These standards require that all new buildings and substantial improvements to existing

[3] Participation in BCEGS is voluntary and may be declined by local governments if they do not wish to have their local building codes evaluated.

buildings will be protected from damage by a 100-year flood event and that new development in the floodplain will not exacerbate existing flood problems or increase damage to other properties.

A key service provided by the NFIP is the mapping of identified flood hazard areas. Once completed, the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices, and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials, and the private sector about the likelihood of flooding in their community.

Table 7.2 provides NFIP policy and claim information for each participating jurisdiction in Guilford County.

TABLE 7.2: NFIP POLICY AND CLAIM INFORMATION

Jurisdiction	Date Joined NFIP	Current Effective Map Date	NFIP Policies in Force	Insurance in Force	Closed Claims	Total Payments to Date
GUILFORD COUNTY†	06/04/80	03/16/09	136	$34,409,900	42	$471,439
Gibsonville	05/15/80	01/02/08	26	$5,316,800	0	$0
Greensboro	04/16/71	03/16/09	620	$162,201,800	268	$4,161,371
High Point	11/01/79	06/16/09	280	$63,159,900	61	$288,904
Jamestown	03/04/80	03/16/09	10	$3,047,500	0	$0
Oak Ridge	08/13/02	03/16/09	3	$728,000	1	$17,950
Pleasant Garden	03/17/09	03/16/09	2	$630,000	0	$0
Sedalia	10/09/08	03/16/09	2	$482,700	0	$0
Stokesdale	05/05/97	03/16/09	1	$93,200	0	$0
Summerfield	08/12/02	03/16/09	14	$3,962,000	0	$0
Whitsett	11/07/08	(NSFHA)	1	$350,000	0	$0

†Includes unincorporated areas of county only
(NSFHA) – No Special Flood Hazard Area - All Zone C
Source: NFIP Community Status information as of 2/18/15; NFIP claims and policy information as of 11/30/14

Community Rating System: An additional indicator of floodplain management capability is the active participation of local jurisdictions in the Community Rating System (CRS). The CRS is an incentive-based program that encourages counties and municipalities to undertake defined flood mitigation activities that go beyond the minimum requirements of the NFIP by adding extra local measures to provide protection from flooding. All of the 18 creditable CRS mitigation activities are assigned a range of point values. As points are accumulated and reach identified thresholds, communities can apply for an improved CRS class rating. Class ratings, which range from 10 to 1, are tied to flood insurance premium reductions as shown in **Table 7.3**. As class rating improves (the lower the number the better), the percent reduction in flood insurance premiums for NFIP policyholders in that community increases.

TABLE 7.3: CRS PREMIUM DISCOUNTS, BY CLASS

CRS Class	Premium Reduction
1	45%
2	40%
3	35%
4	30%
5	25%
6	20%
7	15%
8	10%
9	5%
10	0

Source: *FEMA*

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10. The CRS application process has been greatly simplified over the past several years based on community comments. Changes were made with the intent to make the CRS more user-friendly and make extensive technical assistance available for communities who request it.

- Guilford County (Class 8) and the City of Greensboro (Class 8) are the only two jurisdictions that currently participate in the CRS. Participation in the CRS program should be considered as a mitigation action by the other participating municipalities. The program would be most beneficial to the City of High Point, which has 280 NFIP policies.

Flood Damage Prevention Ordinance: A flood damage prevention ordinance establishes minimum building standards in the floodplain with the intent to minimize public and private losses due to flood conditions.

- All communities participating in the NFIP are required to adopt a local flood damage prevention ordinance. The county and all 10 participating municipalities participate in the NFIP and they all have adopted flood damage prevention regulations.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for action regarding corrective and preventative measures to reduce flood-related impacts.

- Neither the county nor any of the participating municipalities have adopted floodplain management plans.

Open Space Management Plan*:* An open space management plan is designed to preserve, protect, and restore largely undeveloped lands in their natural state and to expand or connect areas in the public domain such as parks, greenways, and other outdoor recreation areas. In many instances, open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state in perpetuity.

- Guilford County participated in the development of the Piedmont Triad Regional Open Space Strategy which identifies a wide variety of key conservation opportunities across the region as well as a strategy meant to serve as the foundation for future conservation planning efforts within the county.
- Greensboro, High Point, Jamestown, Oak Ridge, Pleasant Garden, and Stokesdale have adopted parks, recreation, greenways, and/or open space plans.
- The Town of Summerfield is currently in the process and developing an open space management plan.

Stormwater Management Plan: A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding.

- Guilford County and the City of Greensboro are the only jurisdictions that have adopted a stormwater management plan.
- Guilford County and all 10 of the participating municipalities have adopted a stormwater management ordinance.

7.3.5 Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability for the implementation and success of proposed mitigation activities.

Technical capability can generally be evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using Geographic Information Systems (GIS) to analyze and assess community hazard vulnerability. The Capability Assessment Survey was used to capture information on administrative and technical capability through the identification of available staff and personnel resources.

Table 7.4 provides a summary of the capability assessment results for Guilford County with regard to relevant staff and personnel resources. A checkmark (✓) indicates the presence of a staff member(s) in that jurisdiction with the specified knowledge or skill.

TABLE 7.4: RELEVANT STAFF / PERSONNEL RESOURCES

Staff / Personnel Resource	GUILFORD COUNTY	Gibsonville	Greensboro	High Point	Jamestown	Oak Ridge	Pleasant Garden	Sedalia	Stokesdale	Summerfield	Whitsett
Planners with knowledge of land development / land management practices	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Engineers or professionals trained in construction practices related to buildings and/or infrastructure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Planners or engineers with an understanding of natural and/or human-caused hazards	✓	✓	✓							✓	
Emergency Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Floodplain Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Land Surveyors	✓		✓	✓							
Scientists familiar with the hazards of the community	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Staff with education or expertise to assess the community's vulnerability to hazards	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Personnel skilled in GIS and/or Hazus	✓		✓	✓	✓	✓				✓	
Resource development staff or grant writers	✓					✓				✓	

Credit for having a floodplain manager was given to those jurisdictions that have a flood damage prevention ordinance, and therefore an appointed floodplain administrator, regardless of whether the appointee was dedicated solely to floodplain management. Credit was given for having a scientist familiar with the hazards of the community if a jurisdiction has a Cooperative Extension Service or Soil and Water Conservation Department. Credit was also given for having staff with education or expertise to assess the community's vulnerability to hazards if a staff member from the jurisdiction was a participant on the existing hazard mitigation plan's planning committee.

7.3.6 Fiscal Capability

The ability of a local government to take action is often closely associated with the amount of money available to implement policies and projects. This may take the form of outside grant funding awards or locally-based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied primarily to staff time or administrative

costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project, such as the acquisition of flood-prone homes, which can require a substantial commitment from local, state, and federal funding sources.

The Capability Assessment Survey was used to capture information on the county's fiscal capability through the identification of locally available financial resources.

Table 7.5 provides a summary of the results for Guilford County with regard to relevant fiscal resources. A checkmark (✓) indicates that the given fiscal resource is locally available for hazard mitigation purposes (including match funds for state and federal mitigation grant funds).

TABLE 7.5: RELEVANT FISCAL RESOURCES

Fiscal Tool / Resource	GUILFORD COUNTY	Gibsonville	Greensboro	High Point	Jamestown	Oak Ridge	Pleasant Garden	Sedalia	Stokesdale	Summerfield	Whitsett
Capital Improvement Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Community Development Block Grants (CDBG)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Special Purpose Taxes (or taxing districts)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gas / Electric Utility Fees											
Water / Sewer Fees											
Stormwater Utility Fees			✓								
Development Impact Fees											
General Obligation, Revenue, and/or Special Tax Bonds											
Partnering Arrangements or Intergovernmental Agreements	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other: PDM, FMA, HMGP, PA, SBA, other Federal, state, and non-governmental funding sources, etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

7.3.7 Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of future hazard events. Hazard mitigation may not be a local priority or may conflict with or be seen as an impediment to other goals of the community, such as growth and economic development. Therefore, the local political climate must be considered in designing mitigation strategies as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

The Capability Assessment Survey was used to capture information on political capability of Guilford County. The previous hazard mitigation plan was reviewed for general examples of local political capability, such as guiding development away from identified hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (i.e., building codes, floodplain management, etc.).

- The previous local hazard mitigation plan identified existing ordinances that address natural hazards or are related to hazard mitigation such as flood damage prevention, watershed protection, soil erosion and sediment control, stormwater management, zoning, and subdivision.
- Most Guilford County residents are quite knowledgeable about the potential hazards that their community faces, and in recent years, they have become more familiar with the practices and principles of mitigation. Many flood prone structures have been acquired and relocated or replaced out of harm's way. It is strongly believed that such tangible and visual changes within the community have created a greater sense of awareness among local residents, and that hazard mitigation is a concept that citizens are beginning to readily accept and support. Because of this fact, coupled with Guilford County's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

7.4 CONCLUSIONS ON LOCAL CAPABILITY

In order to form meaningful conclusions on the assessment of local capability, a quantitative scoring methodology was designed and applied to results of the Capability Assessment Survey. This methodology, further described in Appendix B, attempts to assess the overall level of capability of Guilford County to implement hazard mitigation actions.

The overall capability to implement hazard mitigation actions varies among the participating jurisdictions. For planning and regulatory capability, the majority of the jurisdictions are in the moderate range. There is also some variation in the administrative and technical capability among the jurisdictions with larger jurisdictions generally having greater staff and technical resources. All of jurisdictions are in the limited range for fiscal capability.

Table 7.6 shows the results of the capability assessment using the designed scoring methodology. The capability score is based on the information found in the existing hazard mitigation plan and readily available on the jurisdictions' government websites. This information was reviewed by all jurisdictions reviewed and each jurisdiction provided feedback on the information included in the capability assessment. Local government input was vital to identifying capabilities According to the assessment, the average local capability score for all jurisdictions is 39.6, which falls into the moderate capability ranking and nearly reaches the 40-point threshold for high capability.

TABLE 7.6: CAPABILITY ASSESSMENT RESULTS

Jurisdiction	Overall Capability Score	Overall Capability Rating
GUILFORD COUNTY	55	High
Gibsonville	37	Moderate
Greensboro	48	High
High Point	45	High
Jamestown	36	Moderate
Oak Ridge	38	Moderate
Pleasant Garden	36	Moderate
Sedalia	33	Moderate
Stokesdale	33	Moderate
Summerfield	42	High
Whitsett	32	Moderate

As previously discussed, one of the reasons for conducting a Capability Assessment is to examine local capabilities to detect any existing gaps or weaknesses within ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. These gaps or weaknesses have been identified for each jurisdiction in the tables found throughout this section. The participating jurisdictions used the Capability Assessment as part of the basis for the Mitigation Actions that are identified in Section 9; therefore, each jurisdiction addresses their ability to expand on and improve their existing capabilities through the identification of their Mitigation Actions.

7.4.1 Linking the Capability Assessment with the Risk Assessment and the Mitigation Strategy

The conclusions of the Risk Assessment and Capability Assessment serve as the foundation for the development of a meaningful hazard mitigation strategy. During the process of identifying specific mitigation actions to pursue, the Hazard Mitigation Planning Team considered not only each jurisdiction's level of hazard risk, but also their existing capability to minimize or eliminate that risk.

SECTION 8
MITIGATION STRATEGY

This section of the Plan provides the blueprint for the participating jurisdictions in Guilford County to follow in order to become less vulnerable to its identified hazards. It is based on general consensus of the Guilford County Hazard Mitigation Planning Team and the findings and conclusions of the *Capability Assessment* and *Risk Assessment*. It consists of the following five subsections:

- 8.1 Introduction
- 8.2 Mitigation Goals
- 8.3 Identification and Analysis of Mitigation Techniques
- 8.4 Selection of Mitigation Techniques for Guilford County
- 8.5 Plan Update Requirement

8.1 INTRODUCTION

The intent of the Mitigation Strategy is to provide Guilford County with the goals that will serve as guiding principles for future mitigation policy and project administration, along with an analysis of mitigation techniques available to meet those goals and reduce the impact of identified hazards. It is designed to be comprehensive, strategic, and functional in nature:

- In being *comprehensive*, the development of the strategy includes a thorough review of all hazards and identifies extensive mitigation measures intended to not only reduce the future impacts of high risk hazards, but also to help the region achieve compatible economic, environmental, and social goals.
- In being *strategic*, the development of the strategy ensures that all policies and projects proposed for implementation are consistent with pre-identified, long-term planning goals.
- In being *functional,* each proposed mitigation action is linked to established priorities and assigned to specific departments or individuals responsible for their implementation with target completion deadlines. When necessary, funding sources are identified that can be used to assist in project implementation.

The first step in designing the Mitigation Strategy includes the identification of mitigation goals. Mitigation goals represent broad statements that are achieved through the implementation of more specific mitigation actions. These actions include both hazard mitigation policies (such as the regulation of land in known hazard areas through a local ordinance) and hazard mitigation projects that seek to address specifically targeted hazard risks (such as the acquisition and relocation of a repetitive loss structure).

The second step involves the identification, consideration, and analysis of available mitigation measures to help achieve the identified mitigation goals. This is a long-term, continuous process sustained through the development and maintenance of this Plan. Alternative mitigation measures will continue

to be considered as future mitigation opportunities are identified, as data and technology improve, as mitigation funding becomes available, and as this Plan is maintained over time.
The third and last step in designing the Mitigation Strategy is the selection and prioritization of specific mitigation actions for Guilford County and its municipalities (provided separately in Section 9: *Mitigation Action Plan*). The county and each participating jurisdiction has its own Mitigation Action Plan (MAP) that reflects the needs and concerns of that jurisdiction. The MAP represents an unambiguous and functional plan for action and is considered to be the most essential outcome of the mitigation planning process.

The MAP includes a prioritized listing of proposed hazard mitigation actions (policies and projects) for Guilford County and its municipalities to complete. Each action has accompanying information, such as those departments or individuals assigned responsibility for implementation, potential funding sources, and an estimated target date for completion. The MAP provides those departments or individuals responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring success or progress over time. The cohesive collection of actions listed in the MAP can also serve as an easily understood menu of mitigation policies and projects for those local decision makers who want to quickly review the recommendations and proposed actions of the Hazard Mitigation Plan.

In preparing each Mitigation Action Plan for Guilford County, officials considered the overall hazard risk and capability to mitigate the effects of hazards as recorded through the risk and capability assessment process, in addition to meeting the adopted mitigation goals and unique needs of the community.

8.1.1 Mitigation Action Prioritization

Prioritization of the proposed mitigation actions was based on the following six factors:

- Effect on overall risk to life and property
- Ease of implementation
- Political and community support
- A general economic cost/benefit review[1]
- Funding availability
- Continued compliance with the NFIP

The point of contact for each jurisdiction helped coordinate the prioritization process by reviewing each action and working with the lead agency/department responsible to determine a priority for each action using the six factors listed above.

[1] Only a general economic cost/benefit review was considered by the Hazard Mitigation Planning Team through the process of selecting and prioritizing mitigation actions. Mitigation actions with "high" priority were determined to be the most cost effective and most compatible with the participating jurisdictions' unique needs. Actions with a "moderate" priority were determined to be cost-effective and compatible with jurisdictional needs, but may be more challenging to complete administratively or fiscally than "high" priority actions. Actions with a "low" priority were determined to be important community needs, but the community likely identified several potential challenges in terms of implementation (e.g. lack of funding, technical obstacles). A more detailed cost/benefit analysis will be applied to particular projects prior to the application for or obligation of funding, as appropriate.

Using these criteria, actions were classified as high, moderate, or low priority by the participating jurisdiction officials.

8.2 MITIGATION GOALS

44 CFR Requirement
44 CFR Part 201.6(c)(3)(i): The mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The primary goal of all local governments is to promote the public health, safety, and welfare of its citizens. In keeping with this standard, Guilford County and the participating municipalities have developed four goal statements for local hazard mitigation planning in the county. In developing these goals, the previous hazard mitigation plan was reviewed to determine if the goals remained applicable. The existing goals were presented, reviewed, voted on, and accepted by the Hazard Mitigation Planning Team (all of the goals remain unchanged). Each goal, purposefully broad in nature, serves to establish parameters that were used in developing mitigation actions. The Guilford County Mitigation Goals are presented in **Table 8.1**. Consistent implementation of actions over time will ensure that community goals are achieved.

TABLE 8.1: GUILFORD COUNTY MITIGATION GOALS

	Goal
Goal #1	Increase the internal capabilities of Guilford County and its municipalities to mitigate the effects of natural, biological, technical, and man-made hazards
Goal #2	Enhance existing or implement new County, City, and Town policies that will reduce the potential damaging effects of hazards without hindering other community goals.
Goal #3	Protect the most vulnerable populations, public buildings, and critical facilities in Guilford County, and its municipalities, through the implementation of cost-effective and technically-feasible mitigation projects.
Goal #4	Protect public health, safety, and welfare by increasing the public awareness of existing hazards and by enhancing both individual and public responsibility in mitigating risks due to those hazards throughout Guilford County and its municipalities.

8.3 IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

44 CFR Requirement
44 CFR Part 201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effect of each hazard, with particular emphasis on new and existing buildings and infrastructure.

In formulating the Mitigation Strategy for Guilford County, a wide range of activities were considered in order to help achieve the established mitigation goals, in addition to addressing any specific hazard concerns. These activities were discussed during the Guilford County Hazard Mitigation Planning Team meetings. In general, all activities considered by the Hazard Mitigation Planning Team can be classified under one of the following six broad categories of mitigation techniques: Prevention, Property Protection, Natural Resource Protection, Structural Projects, Emergency Services, and Public Awareness and Education. These are discussed in detail below.

8.3.1 Prevention

Preventative activities are intended to keep hazard problems from getting worse, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are built. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Building codes
- Open space preservation
- Floodplain regulations
- Stormwater management regulations
- Drainage system maintenance
- Capital improvements programming
- Riverine / fault zone setbacks

8.3.2 Property Protection

Property protection measures involve the modification of existing buildings and structures to help them better withstand the forces of a hazard, or removal of the structures from hazardous locations. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting (e.g., windproofing, floodproofing, seismic design techniques, etc.)
- Safe rooms, shutters, shatter-resistant glass
- Insurance

8.3.3 Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Such areas include floodplains, wetlands, steep slopes, and sand dunes. Parks, recreation, or conservation agencies and organizations often implement these protective measures. Examples include:

- Floodplain protection
- Watershed management
- Riparian buffers
- Forest and vegetation management (e.g., fire resistant landscaping, fuel breaks, etc.)

- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization

8.3.4 Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event through construction. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Dams / levees / dikes / floodwalls
- Diversions / detention / retention
- Channel modification
- Storm sewers

8.3.5 Emergency Services

Although not typically considered a "mitigation" technique, emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Sandbagging for flood protection
- Installing temporary shutters for wind protection

8.3.6 Public Education and Awareness

Public education and awareness activities are used to advise residents, elected officials, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Outreach projects
- Speaker series / demonstration events
- Hazard map information
- Real estate disclosure
- Library materials
- School children educational programs

- Hazard expositions

8.4 PIEDMONT TOGETHER CLIMATE ADAPTATION STRATEGIES

The *Piedmont Together Climate Adaptation Report* identifies strategies that will be necessary to ensure the health of the Piedmont Triad's people, economy, and ecosystems as the region grows to 2 million people and North Carolina ascends to a greater role nationally with its greater constituency. Although the strategies listed below in **Table 8.2** are not official actions included in the Hazard Mitigation Plan (Section 9: *Mitigation Action Plan*), they are potential strategies that can be considered by Guilford County and its municipalities to help to reduce the impacts and risks of climate change.

TABLE 8.2: GUILFORD COUNTY MITIGATION GOALS

Piedmont Together Resilient Climate Adaptation Strategy		
Goal	**Objective**	**Example Strategy**
Decrease the Piedmont Triad's Vulnerability to Climate Change	Decrease the Piedmont Triad's Vulnerability to Extreme Heat	Update county hazard mitigation plans to include extreme heat response strategies
	Decrease the Piedmont Triad's Vulnerability to Frozen Precipitation and Extreme Low Temperatures	Focus household weatherization programs on vulnerable populations
	Protect the Piedmont Triad's Water Supply and Quality	Develop source water protection plans for all drinking water sources
	Protect the Piedmont Triad's Air Quality	Promote and support the enhancement of the available alternative transportation infrastructure to reduce vehicle miles traveled
	Preserve Piedmont Triad Plants, Trees and Natural Landscapes	Enhance urban forest canopies so that all Triad municipalities have a 40% canopy cover
	Decrease the Piedmont Triad's Vulnerability to Wildfires	Partner with the county EMS and the NC Division of Parks and Recreation staffs to improve public awareness of wildfire risks
	Reduce the Vulnerability of Piedmont Triad Residents to Health Risks	Work with hospitals to monitor and respond to extreme heat conditions
	A Climate-Educated Piedmont Triad Public	Share Piedmont Together work with vested parties and develop a public engagement campaign
	Plan for Future Challenges	Adopt a regional green infrastructure plan to anticipate needs an mitigate their impacts to the public and ecology

Reduce Energy Consumption	Retrofit Commercial and Industrial Buildings	Develop weatherization program that targets those most vulnerable to extreme weather events
	Increase the Use of Energy-Efficient Appliances	Collaborate with retail partners to build upon existing appliance buy-back programs
	Promote Energy Reduction Through Water Conservation	Develop leak detection programs for water utility in the region
	Streamline Resources	Work with public and private sector partners to make structural and programmatic retrofits simpler and easier to implement
	Promote Clean and Renewable Energy Sources	Diversify the sources of energy generation used by power plants
	Improve Transportation Options	Promote transit-oriented development patterns
	Reduce Waste and Industrial Pollution	Switch to newer, less-toxic refrigerants

Additionally, many organizations in the Piedmont Triad, such as the Dan River Basin Association (DRBA), North Carolina Interagency Leadership Team, US Centers for Disease Control (CDC), and the National Oceanic and Atmospheric Administration (NOAA), have begun implementing climate adaptation strategies. Additional details on these strategies can be found in the *Piedmont Together Climate Adaptation Report*.

8.5 SELECTION OF MITIGATION TECHNIQUES FOR GUILFORD COUNTY

In order to determine the most appropriate mitigation techniques for the communities in Guilford County, the Hazard Mitigation Planning Team thoroughly reviewed and considered the findings of the *Capability Assessment* and *Risk Assessment* to determine the best activities for their respective communities. Other considerations included the effect of each mitigation action on overall risk to life and property, its ease of implementation, its degree of political and community support, its general cost-effectiveness, and funding availability (if necessary).

8.6 PLAN UPDATE REQUIREMENT

In keeping with FEMA requirements for plan updates, the Mitigation Actions identified in the previous plans were evaluated to determine their 2015 implementation status. Updates on the implementation status of each action are provided. The mitigation actions provided in Section 9: *Mitigation Action Plan* include the mitigation actions from the previous plans as well as any new mitigation actions proposed through the 2015 planning process.

SECTION 9
MITIGATION ACTION PLAN

This section includes the listing of the mitigation actions proposed by the participating jurisdictions in Guilford County. It consists of the following two subsections:

- 9.1 Overview
- 9.2 Mitigation Action Plans

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44 CFR Requirement
44 CFR Part 201.6(c)(3)(iii): The mitigation strategy shall include an action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction.

9.1 OVERVIEW

As described in the previous section, the Mitigation Action Plan, or MAP, provides a functional plan of action for each jurisdiction. It is designed to achieve the mitigation goals established in Section 8: *Mitigation Strategy* and will be maintained on a regular basis according to the plan maintenance procedures established in Section 10: *Plan Maintenance*.

Each proposed mitigation action has been identified as an effective measure (policy or project) to reduce hazard risk for Guilford County. Each action is listed in the MAP in conjunction with background information such as hazard(s) addressed and relative priority. Other information provided in the MAP includes potential funding sources to implement the action should funding be required (not all proposed actions are contingent upon funding). Most importantly, implementation mechanisms are provided for each action, including the designation of a lead agency or department responsible for carrying the action out as well as a timeframe for its completion. These implementation mechanisms ensure that the Guilford County Multi-Jurisdictional Hazard Mitigation Plan remains a functional document that can be monitored for progress over time. The proposed actions are not listed in priority order, though each has been assigned a priority level of “high,” “moderate,” or “low” as described below and in Section 8 (page 8.2).

The Mitigation Action Plan is organized by mitigation strategy category (Prevention, Property Protection, Natural Resource Protection, Structural Projects, Emergency Services, or Public Education and Awareness). The following are the key elements described in the Mitigation Action Plan:

- Hazard(s) Addressed—Hazard which the action addresses.
- Relative Priority—High, moderate, or low priority as assigned by the jurisdiction.
- Lead Agency/Department—Department responsible for undertaking the action.
- Potential Funding Sources—Local, State, or Federal sources of funds are noted here, where applicable.
- Implementation Schedule—Date by which the action the action should be completed. More information is provided when possible.

- Implementation Status (2015)—Indication of completion, progress, deferment, or no change since the previous plan. If the action is new, that will be noted here.

9.2 MITIGATION ACTION PLANS

The mitigation actions proposed by each of the participating jurisdictions are listed in 11 individual MAPs on the following pages. **Table 9.1** shows the location of each jurisdiction's MAP within this section as well as the number of mitigation actions proposed by each jurisdiction.

TABLE 9.1: INDIVIDUAL MAP LOCATIONS

Location	Page	Number of Mitigation Actions
Guilford County	**9:3**	**24**
Gibsonville	9:7	6
Greensboro	9:8	14
High Point	9:12	11
Jamestown	9:19	4
Oak Ridge	9:20	7
Pleasant Garden	9:22	5
Sedalia	9:23	4
Stokesdale	9:24	4
Summerfield	9:25	9
Whitsett	9:27	4

Guilford County Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Maintain Geographic Information System (GIS) to maintain current cadastral (building/parcel) data for purposes of conducting more detailed hazard risk assessments and for tracking permitting and land use patterns.	All	High	Guilford County IS	NC DEM	Deferred, 2020	The county has created and currently maintains cadastral data through the GIS division of Guilford County Information Services. Guilford County would like to continue updating the GIS information with the most up-to-date building, parcel, and hazard data.
P-2	Regularly calculate and document the amount of flood prone property that is preserved as open space for additional credit points under the Community Rating System (CRS).	Flood	High	Guilford County NFIP/CRS; City of Greensboro Engineering Department; City of High Point Engineering Department	N/A	Deferred, Annually	The Guilford County Planning Department calculates and documents the amount of flood prone property that is preserved as open space for additional CRS points. Guilford County would like to continue this effort to maximize CRS points.
P-3	Identify the county's most at-risk vital/critical facilities, and evaluate the potential mitigation techniques for protecting each facility to the maximum extent possible.	All	Moderate	Guilford County Emergency Management Coordinator	NC DEM; others as available	Deferred, 2017	The county has identified critical facilities; however, we would like to continue this effort to identify potential mitigation techniques and funding sources to protect these facilities.
P-4	Monitor grant opportunities for funding to establish a local reserve fund for repairing and/or incorporating hazard mitigation measures for public facilities and infrastructure damaged by natural hazards.	All	Moderate	Guilford County Emergency Services	N/A	Deferred, Annually	A local reserve fund was not achieved in the 2010-2015 timeframe; however, we would like to continue this effort as funding becomes available.
P-5	Revise the county's Flood Damage Prevention Ordinance to incorporate cumulative substantial damage or improvement requirements.	Flood	Moderate	Guilford County NFIP/CRS; City of High Point	All options will be explored	Completed	Flood Damage Prevention Ordinance regarding the substantial improvement was addressed as per the Section 7-5.8(50(a)(ii).

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
P-6	Augment enforcement of the State Building Code and related County ordinances by encouraging wind-resistant design techniques for new residential construction during the county's permit process.	Hurricanes and Tropical Storms, Tornadoes, Nor'easters	High	County and municipal code enforcement officials	None identified at this time	Deferred, 2018	This was not achieved during the 2010-2015 timeframe; however, we would like to defer this action item into the 2015 plan.
P-7	Invest in cyber security equipment and training to mitigate future cyber incidents.	Cyber Terrorism	High	Guilford County Information Services	Local	January 2016	New Action/Project
Property Protection							
PP-1	Continue to acquire and preserve parcel land subject to repetitive flooding from willing and voluntary property owners.	Flood	High	Guilford County Planning and Development Department; City of Greensboro Water Resources; City of High Point	FEMA; NC DEM	Deferred. 2020	Although the county has acquired several properties that experienced repetitive flooding, there are still some properties that the county would like to evaluate for future acquisitions so this action will be retained in the plan.
PP-2	Incorporate the inspection and management of hazardous trees into the county's routine drainage system maintenance program.	Hurricanes and Tropical Storms	Moderate	Guilford County NFIP/CRS; City of Greensboro	Local	Deleted	Guilford County does not have a storm water program thus we will be removing this action item from the Guilford County Actions. The City of Greensboro may elect to conduct this program as they do have a storm water program.
PP-3	Research and implement, if feasible, zoning regulations for critical facilities (schools and/or other vulnerable population facilities) located near hazardous materials and pipeline locations.	Hazardous Materials and Pipeline Failure	High	Guilford County Planning and Development, Information Services, and Emergency Management	Local	January 2017	New Action
PP-4	Research and implement, if feasible, residential sprinkler code in Guilford County	Fire	Moderate	Guilford County Fire Marshal's Office	Local	January 2018	New Action

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PP-5	Research and create a Historic Preservation Plan.	All	Moderate	Guilford County Planning and Development	Local	January 2017	New Action
Structural Projects							
SP-1	Research safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action
SP-2	Research and implement, if feasible, a local building code that requires new and modified commercial buildings to install communication repeaters/amplifiers within the structure to augment public safety radio systems.	Communicatio ns Disruption	Moderate	Guilford County Emergency Management	Local	January 2019	New Action
SP-3	Research and implement, if feasible, a building code modifications to require that all vulnerable population facilities (assisted care facilities, group homes, etc.) have an alternate power source to sustain operations during power outages.	Power Outages	High	Guilford County Emergency Management	Local	January 2018	New Action
SP-4	Research grant funding opportunities for alternate power sources for identified critical facilities.	Power Outages	Moderate	Guilford County Emergency Management	Various	January 2018	New Action
Emergency Services							
ES-1	Develop a Flood Response Plan to address the specific response to flooding events within the county.	Flood	High	Guilford County Emergency Management	Local	January 2017	New Action
ES-2	Offer additional training to law enforcement officers regarding civil disturbances and provide necessary equipment to officers.	Civil Disturbance	High	Guilford County Sheriff's Office	Local	At least Annually	New Action
Public Education and Awareness							
PEA-1	Promote the availability of flood insurance to County and City property owners.	Flood	High	Guilford County, City of Greensboro; City of Highpoint	Local	Deferred, 2020	While this was an ongoing effort for the 2010-2015 timeframe, this is an effort that Guilford County would like to continue to ensure residents are aware of flood insurance availability.

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PEA-2	As new Repetitive Loss Properties are identified within the County and municipalities, contact all owners and inform them of the assistance available through the federal flood assistance programs, in additional to other flood protection measures.	Flood	High	Guilford County NFIP/CRS; City of Greensboro; City of High Point	Local	Deferred, 2020	Guilford County only had one case of repetitive loss in the 2010-2015 timeframe, in which a letter was sent; however, this is an action we would like to continue to ensure as new repetitive loss properties are identified those property owners are informed of the assistance available.
PEA-3	Maintain an all-hazards public education program to educate and prepare residents for all hazards identified in Guilford County.	All	High	Guilford County Emergency Management	Local	2020	New Action
PEA-4	Develop outreach program to local school administrators to help them identify sheltering areas for all schools	Tornadoes	Moderate	Guilford County Emergency Management	Local	2020	New Action
PEA-5	Explore Firewise program implementation in Guilford County.	Fire	Moderate	Guilford County Fire Marshal's Office	Various	January 2017	New Action
PEA-6	Re-Certify as a StormReady Community through the National Weather Service	Thunderstorms and Tornadoes	Moderate	Guilford County Emergency Management	Local	January 2017	New Action

Town of Gibsonville Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Gibsonville Town Planner	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Gibsonville Town Planner	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Gibsonville Town Planner	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
P-4	Promote the availability of flood insurance to City property owners.	Flood		Town of Gibsonville	Local When Available	2020	New Action
P-5	Prevent encroachments, including fill, new construction, substantial improvements, and other developments within areas designated as floodways or non-encroachment areas	Flood	Low	Town of Gibsonville	Local	2020	New Action
Property Protection							
PP-1	Continue to evaluate and update facilities and infrastructure that may be deemed “High Risk” facilities for various threats.	All	Moderate	Town of Gibsonville All Departments	Local	2020	New Action

City of Greensboro Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Maintain Geographic Information System (GIS) to maintain current cadastral (building/parcel) data for purposes of conducting more detailed hazard risk assessments and for tracking permitting and land use patterns.	All	High	City of Greensboro Planning Department, Information Technology Department, GIS Department	NC DEM	Deferred, 2020	The city maintains a GIS systems with building and parcel data. The city would like to continue updating the GIS system with the most up-to-date information possible.
P-2	Regularly calculate and document the amount of flood prone property that is preserved as open space for additional credit points under the Community Rating System (CRS).	Flood	High	City of Greensboro Water Resources Department	N/A	Deferred, Annually	The city calculates and documents the amount of flood prone property that is preserved as open space for additional CRS points. The city would like to continue increasing the amount of open space it has to maximize CRS points.
P-3	Identify the city's most at-risk vital/critical facilities, and evaluate the potential mitigation techniques for protecting each facility to the maximum extent possible.	All	Moderate	City of Greensboro Emergency Management Coordinator	NC DEM; others as available	Deferred, 2017	The city has identified a number of critical facilities and implemented projects on facilities where possible. However, the city would like to continue this effort to reduce risk to critical facilities and infrastructure.
P-4	Monitor grant opportunities for funding to establish a local reserve fund for repairing and/or incorporating hazard mitigation measures for public facilities and infrastructure damaged by natural hazards.	All	Moderate	Guilford County Emergency Services	N/A	Deferred, 2020	The city has had some grant opportunities in the past, but it would like to continue looking towards establishing a fund for mitigating public facilities damaged by hazards.
P-5	Work with the County to revise the county's Flood Damage Prevention Ordinance to incorporate cumulative substantial damage or improvement requirements.	Flood	Moderate	City of Greensboro	All options will be explored	Completed	Flood Damage Prevention Ordinance regarding the substantial improvement was addressed as per the Section 7-5.8(50(a)(ii).

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
P-6	Revise the Flood Damage Prevention Ordinance on as needed basis	Flood	High	City of Greensboro	All options will be explored	Deferred, 2020	Although the ordinance has been updated concerning substantial damage, it will need to be updated again in the future.
P-7	Invest in cyber security equipment and training to mitigate future cyber incidents. This includes deploying Malware prevention technology to detect zero-day and advanced persistent threats and gain visibility into advanced threat activity. Additionally, IT Security offers and conducts security awareness and training to all of the departments (onsite and online), sends monthly security bulletins (advisories) and sometimes alerts via email as needed, as well as a quarterly Cyber Security newsletter to the organization. The City now has Cyber Liability Insurance for the organization in the case of a breach that provides an end-to-end risk management solution to stay ahead of the curve of cyber risk and offers additional services that provide loss prevention tools to educate (training portal IT Security can use) and potentially prevent a breach.	Cyber Terrorism	High	Guilford County Information Services	Local	January 2016	New Action/Project
Property Protection							
PP-1	Continue to acquire and preserve parcels of land subject to repetitive flooding from willing and voluntary property owners.	Flood	High	City of Greensboro Water Resources	FEMA; NC DEM	Deferred, 2020	The City of Greensboro has attempted to acquire parcels subject to flooding in the past, but will continue to apply for grant funding to acquire flood prone parcels from voluntary and willing property owners.

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PP-2	Augment enforcement of the State Building Code and related City of Greensboro ordinances by encouraging wind-resistant design techniques for new residential construction during the city's permit process.	Hurricanes and Tropical Storms, Tornadoes, Nor'easters	High	City of Greensboro code enforcement officials	None identified at this time	Deferred, 2018	The city has implemented measures to reduce the impacts of wind-related hazards on some structures, but it would like to implement provisions in the building code to include more wind-resistant designs.
Emergency Services							
ES-1	Inventory and evaluate the City's emergency response activities. Identify the resources needed to accomplish specific response activities. Reviews shall include the needs of personnel, equipment, and required resources for emergency deployment.	All	Moderate	City of Greensboro Fire, GDOT and Police Departments	Local	Deferred, Annually	This has been done on yearly basis as a major part of the budgetary preparation program. This should be extended to each department for their specific resource needs to determine operational readiness going forward. This should be conducted as normal staff activities.
ES-2	Offer additional training to law enforcement officers regarding civil disturbances and provide necessary equipment to officers.	Civil Disturbance	High	Greensboro Police Department	Local	At least Annually	New Action
Public Education and Awareness							
PEA-1	Advertise and promote the availability of flood insurance to property owners that are located in flood hazard areas. Continue to review FEMA-identified repetitive loss properties for potential mitigation through the federal Flood Mitigation Assistance (FMA) program or other flood protection measures.	Flood	High	City of Greensboro	Local when available	Deferred, 2020	Greensboro is actively involved in the National Flood Insurance Program and promoted flood insurance to property owners. The city would like to continue this and make a substantial effort to educate owners of repetitive loss properties.

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PEA-2	As new Repetitive Loss Properties are identified within the City of Greensboro, contact all owners and inform them of the assistance available through the federal flood assistance programs, in addition to other flood protection measures.	Flood	High	City of Greensboro Water Resources Department	Local	Deferred, 2020	A list of FEMA-identified repetitive loss properties has been maintained and regularly updated by the Emergency Services department. The city would like to initiate a more substantial effort at mitigating these properties going forward.
PEA-3	Continue to collect education materials as budgeting will allow for pamphlets to educate the public on family preparedness as well as mitigation measures that are available to property owners. These pamphlets shall remain on display for the public at the following locations: the City Library and designated City Facilities.	Flood	High	City of Greensboro	Local	Deferred, 2020	The city has collected a significant number of educational materials related to hazards and mitigation, but it will need to continue to work on this effort to ensure it has the most up-to-date materials and information available for citizens.
PEA-4	Continue to provide technical assistance for property owners located in flood hazard areas.	Flood	High	City of Greensboro Water Resources Department	Local	2020	New action

City of High Point Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Prevent encroachments, including fill, new construction, substantial improvements, and other developments within areas designated as floodways or non-encroachment areas. Consider revising Chapter 7, Article C, Flood Damage Prevention, of the High Point Development Ordinance to prevent new development within all Special Flood Hazard Areas.	Flood	Low	City of High Point Engineering Services Department	Local	Completed	Floodways and non-encroachment areas are extremely hazardous areas due to the velocity of floodwaters that have erosion potential and carry debris and potential projectiles. Within the Special Flood Hazard Areas designated as Approximate A Zone, where no Base Flood Elevation (BFE) data has been provided by FEMA, no fill, new construction, substantial improvements, or new development shall be permitted within a distance of twenty (20) feet from the top of the bank on each side of a stream , or five times the width of the stream, whichever is greater, unless certification with supporting technical data by a registered professional engineer is provided, demonstrating that such encroachments shall not result in any increase in flood levels during the 100-year storm event. **This would be accomplished as a part of normal staff activities so this is completed.**

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
P-2	Continue to identify areas in the city subject to repetitive flooding and institute mitigation measures as funds allow.	Flood	High	City of High Point Public Services Department	Local	Partially completed, deferred 2020	A $15.4 million stormwater bond was voted on and approved by the citizens of the City of High Point in 2004. Drainage and watershed studies have been completed in seven high priority areas. The seven areas were chosen for having the highest level of citizen complaints and for having stormwater problem areas with a greater potential loss of life and property damage. Capital improvement projects will continue to be designed and constructed in the seven identified areas. **Although a number of stormwater projects have been implemented, there are still repetitive flooding areas in the city that will require mitigation measures and funding to complete.**

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Property Protection							
PP-1	Continue to update City of High Point facilities and infrastructure that may be deemed "High Risk" facilities for various threats. As budgetary resources allow, redefine the criteria and evaluate the aid of establishment of protective measures that may be required to mitigate and respond to incidents within the high risk facilities.	All	Moderate	All City of High Point Departments	Local	2020	An evaluation of each department is crucial to this action item. Outside expertise may be required to perform this evaluation and ensure proper planning and utilization of resources to address identified risks. This evaluation must be maintained and addressed by each department, through available planning methods and mitigative strategies. **Some local level projects have been implemented to strengthen high risk facilities, but the city will need to continue to implement projects on facilities and infrastructure that are considered to be at high risk in order to reduce overall risk to these facilities.**

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PP-2	Each city department should have an established system to identify potential hazards within their supervised departments. This system should provide for mitigation strategies of known hazards in the department's planning and budget processes as needed. The list of hazard mitigation need should be periodically revised and updated.	All	Moderate	All City of High Point Departments	Local	2020	Numerous city departments manage facilities that are considered vital infrastructure. This system will be maintained to ensure that departmental capabilities will not be interrupted. Review cost can be accomplished as part of normal staff activities. Mitigative costs will vary, dependent upon mitigative strategies to be implemented. **The city will continue updating its list of facilities that have been deemed a high threat to future hazards and will work to implement projects as funding allows.**
Structural Projects							
SP-1	Continue utility pole inspection program	Energy/Power/ Utility Failure	Medium	Local	Electric Utilities	2020	New action
Emergency Services							
ES-1	Inventory and evaluate the City's emergency response activities. Identify the resources needed to accomplish specific response activities. Reviews shall include the needs of personnel, equipment, and required resources for emergency deployment.	All	Moderate	City of High Point Fire and Police Departments	Local	Revised on An Annual Basis	This is done normally on a yearly basis as a major part of the budgetary preparation program. This should be extended to each department for their specific resource needs to determine operational readiness. This should be conducted as normal staff activities. **This action has been completed but will generally be revised on an annual basis.**
ES-2	Pursue grant funding as possible to allow for the purchase and installation of generators at critical facilities lacking same	All	High	Federal, State	Led by OEM, departments with such facilities assisting	2018	New action

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
ES-3	Continue to receive intelligence on law enforcement/security matters and monitor developments/best practices for management of same	All	High	Local	Police Department	2020	New action
Public Education and Awareness							
PEA-1	Advertise and promote the availability of flood insurance to property owners that are located in flood hazard areas. Continue to review FEMA-identified repetitive loss properties for potential mitigation through the federal Flood Mitigation Assistance (FMA) program or other flood protection measures.	Flood	High	City of High Point Public Services Department	FEMA	2020	High Point joined the National Flood Insurance Program in 1978. FEMA uses a formula that combines the monetary cost of damage and damage frequency to determine repetitive loss status. NFIP flood insurance policies protect property owners by offering affordable rates for protecting both structures and contents. There are fewer than 10 repetitive loss properties in High Point. **The city has encouraged property owners located in high risk areas to purchase flood insurance. However, this will need to be a continual effort so the city will work on improving its outreach.**

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PEA-2	Continue to collect education materials as budgeting will allow for pamphlets to educate the public on family preparedness as well as mitigation measures that are available to property owners. These pamphlets shall be posted on the High Point Emergency Management Website and will remain on display for the public at the following locations: the City Library, Public Services, and the Fire Department/City's Office of Emergency Management as budget and conditions allow.	All	High	City of High Point Fire Department/ Emergency Management	Local	2018	FEMA, the National Weather Service, and the NC Division of Emergency Management as well as other agencies provide to the general public informational bulletins and pamphlets to educate the general public on property protection measures at no cost to the local governments. City of High Point Emergency Management and the Fire Department have placed for public review a number of these pamphlets and brochures at various locations throughout the city. This would be a matter of routinely checking on the selection and quality of these materials and ordering new ones as they become available. **There has been a continuous push to collect more materials on mitigation and emergency situations. The posting of such materials on the High Point Emergency Management website will be emphasized in the future.**

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
PEA-3	Update the educational pamphlet on the ICC (Increased Cost of Compliance) and how it associates with the policy holders within the City of High Point. This informational pamphlet should be distributed to the city property owners that receive substantial damage during a flood type event.	Flood	High	City of High Point Fire Department and Public Services	Local	2020	Current flood insurance policy holders may be required to bring flood-damaged structures into a state of compliance with the goal building regulations under certain circumstances. Increased Cost of Compliance coverage will provide up to $30,000 for this stated purpose. The owner may choose one of four options: 1) elevating the structure; 2) relocating the structure; 3) demolishing the structure; or 4) floodproofing the structure (this is primarily done to those non-residential buildings). This can be accomplished under normal staff activities. A number of these types of activities are already ongoing. Non-localized funding may be available for of these types of activities. **Currently, the ICC Brochure is on hand for distribution in such cases. Going forward, the city will place renewed emphasis on pushing this material out to citizens.**

Town of Jamestown Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Jamestown Town Clerk	State and Federal funding as available	2020	The Town of Jamestown participated and will continue participation in the future.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Jamestown Town Clerk	State and Federal funding as available; Town planning expertise	2020	The Town of Jamestown has participated in the Guilford County Multi-Jurisdictional Hazard Mitigation Plan 2015 Update.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Jamestown Town Clerk	Town planning expertise	2020	No mitigation projects were undertaken during the 2010-2015 timeframe; however, the Town of Jamestown would like to continue this action moving forward.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action

Town of Oak Ridge Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Oak Ridge Town Clerk	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Oak Ridge Town Clerk	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Oak Ridge Town Clerk	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
Property Protection							
PP-1	Continue to identify potential mitigation projects and continue to require floodplain dedication.	Flood	Moderate	Town of Oak Ridge Town Clerk	Town planning expertise	2020	The town has not implemented any major mitigation projects through FEMA grant programs previously, but it will continue to identify potential projects in the future.
Natural Resource Protection							
NRP-1	Continue to require floodplain dedication and enforce tree preservation ordinance.	Flood	Moderate	Town of Oak Ridge Town Clerk	Town planning expertise	Completed	The town requires floodplain dedication and enforces its tree preservation ordinance.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Public Education and Awareness							
PEA-1	Work with Guilford County to promote education and awareness through Town website and Facebook	All	High	Town of Oak Ridge Town Clerk	Town of Oak Ridge	2020	Although the town and county have taken steps to increase public awareness, additional effort is required to outreach to the public going forward.

Town of Pleasant Garden Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Pleasant Garden Town Clerk	State and Federal funding as available	Completed/deferred, 2020	This action was ongoing in the 2010-15 plan and we would like to continue these efforts in the updated plan.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Pleasant Garden Town Clerk	State and Federal funding as available; Town planning expertise	Completed/deferred, 2020	This action was ongoing in the 2010-15 plan and we would like to continue these efforts in the updated plan.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Pleasant Garden Town Clerk	Town planning expertise	Completed/deferred, 2020	This action was ongoing in the 2010-15 plan and we would like to continue these efforts in the updated plan.
Structural Projects							
SP-1	Install a back-up generator in Town Hall so the site can function as a staging or communications site during incidents	All	High	Town of Pleasant Garden Town Clerk	Town/grants	2018	New Action. Preliminary planning to begin in 2015
Public Education and Awareness							
PEA-1	Provide information, prevention tips, safety ideas, etc. in the town newsletter and on the town website for hazards pertinent to town residents	All	Moderate	Town of Pleasant Garden Town Clerk	Town	2016	New Action. Winter hazard tips were published during the 2014-15 winter period; will publish pertinent information for each “hazard season” from this point forward.

Town of Sedalia Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP based on the Stormwater Management Ordinance and the Watershed Protection Ordinance.	Flood	High	Town of Sedalia Town Clerk	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Sedalia Town Clerk	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Sedalia Town Clerk	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action

Town of Stokesdale Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Stokesdale Town Clerk	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Stokesdale Town Clerk	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Stokesdale Town Clerk	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action

Town of Summerfield Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Summerfield Town Planner	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Summerfield Town Manager	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Summerfield Town Planner	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
P-4	Require the installation of underground utilities to minimize outages during winter storms, tornadoes, hurricanes and other wind related storms - residential	Winter Storms Tornadoes/winds Hurricanes	Moderate	Summerfield Planning Department	Developer installed	2020	New action
P-5	Explore the installation of underground utilities to minimize outages during winter storms, tornadoes, hurricanes and other wind related storms – all other uses	Winter Storms Tornadoes/winds Hurricanes	Moderate	Summerfield Planning Department	Joint Town/Developer/ Utility Effort	Initiating, 2020	New action
Natural Resource Protection							
NRP-1	Modify land regulation to reduce the amount of impervious surfaces and limit uses which may impact surface and groundwater quality	Resources – water/Public Health	High	Summerfield Planning Department	Watershed programs and State Water quality	2016	New action. Adoption in the 2015-2016 FY.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New action

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Emergency Services							
ES-1	Explore joint ventures with commercial development to acquire water storage capacity for emergency services	Resources - water	Moderate	Summerfield Planning Department/consulting engineers	Private/public	2020	New action
Public Education and Awareness							
PEA-1	Develop web pages to add to Community Website for information distribution regarding hazard education, risk awareness, and mitigation techniques.	All	High	Summerfield Planning Department	Local	2017	New action

Town of Whitsett Mitigation Action Plan

Action #	Description	Hazard(s) Addressed	Relative Priority	Lead Agency/ Department	Potential Funding Sources	Implementation Schedule	Implementation Status (2015)
Prevention							
P-1	Continue to participate in the NFIP.	Flood	High	Town of Whitsett Town Clerk	State and Federal funding as available	2020	The town is a participant in the NFIP and will continue to work towards meeting all requirements of the NFIP going forward.
P-2	Work with the County and State to complete hazard mitigation plan updates.	All	High	Town of Whitsett Town Clerk	State and Federal funding as available; Town planning expertise	2020	The town has been an active participant in this update of the hazard mitigation plan and will take an active role in future updates.
P-3	Continue to identify and document hazard occurrences and potential mitigation projects.	All	High	Town of Whitsett Town Clerk	Town planning expertise	2020	The town has identified and documented hazards in the past and will work to improve its recording of hazards looking forward as it continues to look at future mitigation projects.
Structural Projects							
SP-1	Support county as it researches safe room grant opportunities to construct safe rooms in schools and vulnerable population locations.	Tornado	Moderate	Guilford County Emergency Management	Various	January 2017	New Action

SECTION 10
PLAN MAINTENANCE

This section discusses how the Guilford County Mitigation Strategy and Mitigation Action Plan will be implemented and how the Multi-jurisdictional Hazard Mitigation Plan will be evaluated and enhanced over time. This section also discusses how the public will continue to be involved in a sustained hazard mitigation planning process. It consists of the following three subsections:

- 10.1 Implementation and Integration
- 10.2 Monitoring, Evaluation, and Enhancement
- 10.3 Continued Public Involvement

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44 CFR Requirement
44 CFR Part201.6(c)(4)(i): The plan shall include a plan maintenance process that includes a section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle. ***44 CFR Part 201.6(c)(4)(ii):*** The plan maintenance process shall include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

10.1 MONITORING AND EVALUATING THE PREVIOUS PLAN

Since the previous plan was adopted, each jurisdiction has worked to ensure that mitigation was integrated into local activities and that the mitigation plan was appropriately implemented. The participants jointly outlined a process in the previous mitigation plan for monitoring and evaluating the plan throughout the interim period between plan updates.

All participants were ultimately successful in implementing the monitoring and evaluation processes that were outlined in previous plan as all eleven jurisdictions participated in annual meetings to discuss the mitigation plan and the priorities that were outlined in it. The specific process is outlined below with an explanation of how the monitoring and evaluating process was carried out as well as any changes that were identified that would be useful to implement during the next update.

Guilford County
The Guilford County Hazard Mitigation Plan included a review process and progress report on the plan. This review process was carried out by the Emergency Services Director at the request of the County Manager and Board of County Commissioners. During this review process, the Emergency Services Director solicited comments from all affected county departments and local governments via the hazard mitigation planning team.

During this review, the County Board of Commissioners received a report on the implementation status of the plan which included a review of mitigation actions in the plan and progress that had been made towards completing those actions.

Although there were some minor revisions made to the plan during the interim update period, there were few major revisions identified during this time and the HMP planning team generally agreed that the plan was on course and that the monitoring and evaluating process itself was sufficient to ensure implementation of the plan.

The planning team noted that while reporting was done on the progress of the plan through the interim review period, one area of deficiency was that there was a failure to hold annual meetings to discuss these progress reports. Going forward, the planning team will look to address that deficiency by conducting an annual Hazard Mitigation Planning Team meeting every year. This meeting will include monitoring, evaluating, and updating the plan

10.2 IMPLEMENTATION AND INTEGRATION

Each agency, department, or other partner participating under the Guilford County Multi-jurisdictional Hazard Mitigation Plan is responsible for implementing specific mitigation actions as prescribed in the Mitigation Action Plan. Every proposed action listed in the Mitigation Action Plan is assigned to a specific "lead" agency or department in order to assign responsibility and accountability and increase the likelihood of subsequent implementation.

In addition to the assignment of a local lead department or agency, an implementation time period or a specific implementation date has been assigned in order to assess whether actions are being implemented in a timely fashion. When applicable, potential funding sources have been identified for proposed actions listed in the Mitigation Action Plan.

The participating jurisdictions will integrate this Hazard Mitigation Plan into relevant city and county government decision-making processes or mechanisms, where feasible. This includes integrating the requirements of the Hazard Mitigation Plan into other local planning documents, processes, or mechanisms, such as comprehensive or capital improvement plans, when appropriate. The members of the Guilford County Hazard Mitigation Planning Team will remain charged with ensuring that the goals and mitigation actions of new and updated local planning documents for their agencies or departments are consistent, or do not conflict with, the goals and actions of the Hazard Mitigation Plan, and will not contribute to increased hazard vulnerability in Guilford County.

Since the previous plan was adopted, each jurisdiction has worked to integrate the hazard mitigation plan into other planning mechanisms where applicable/feasible. Examples of how this integration has occurred have been documented in the Implementation Status discussion provided for each of the mitigation actions found in Section 9. Specific examples of how integration has occurred include:

- Integrating the mitigation plan into reviews and updates of floodplain management ordinances;
- Integrating the mitigation plan into reviews and updates of emergency operations plans;
- Integrating information in the mitigation plan into county Geographic Information Systems; and
- Integrating the mitigation plan into the local reserve fund through identification of mitigation actions that require local funding

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

10.3 MONITORING, EVALUATION, AND ENHANCEMENT

Periodic revisions and updates of the Hazard Mitigation Plan are required to ensure that the goals of the Plan are kept current, taking into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with applicable federal and state regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to the Mitigation Action Plan.

The Hazard Mitigation Planning Team shall meet once every year to evaluate the progress attained and to revise, where needed, the activities set forth in the Plan. This meeting shall be held in the month upon which final plan approval is attained, however, it may be necessary to schedule in the month prior or after in any given year, depending on the schedules of local officials. The findings and recommendations of the Planning Team will be documented in the form of a report that can be shared with interested cities, the county, and other stakeholders. The Hazard Mitigation Planning Team will also meet following any disaster events warranting a reexamination of the mitigation actions being implemented or proposed for future implementation. This will ensure that the Plan is continuously updated to reflect changing conditions and needs within Guilford County. The Guilford County Emergency Management Coordinator will be responsible for reconvening the Hazard Mitigation Planning Team for these reviews.

Five Year Plan Review

The Plan will be thoroughly reviewed by the Hazard Mitigation Planning Team every five years to determine whether there have been any significant changes in Guilford County that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, an increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the necessary content of the Plan.

The plan review provides Guilford County/municipal officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented as assigned. The Guilford County Emergency Management Coordinator will be responsible for reconvening the Hazard Mitigation Planning Team and conducting the five-year review.

During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals address current and expected conditions?

- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the Plan?
- Are there implementation problems, such as technical, political, legal or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did County departments participate in the plan implementation process as assigned?

Following the five-year review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and plan amendment process outlined herein. Upon completion of the review and update/amendment process, the Guilford County Multi-jurisdictional Hazard Mitigation Plan will be submitted to the State Hazard Mitigation Officer at the North Carolina Division of Emergency Management (NCDEM) for final review and approval in coordination with the Federal Emergency Management Agency (FEMA).

Because the plan update process can take several months to complete, and because Federal funding may be needed to update the plan, it is recommended that the five-year review process begin at the beginning of the third year after the plan was last approved. This will allow the participants in the Guilford County Multi-jurisdictional Hazard Mitigation Plan to organize in order to seek Federal funding if necessary and complete required plan update documentation before the plan expires at the end of the fifth year.

Disaster Declaration

Following a disaster declaration, the Guilford County Multi-jurisdictional Hazard Mitigation 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 the Guilford County Emergency Management Coordinator to reconvene the Hazard Mitigation Planning Team and ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Reporting Procedures

The results of the five-year review will be summarized by the Hazard Mitigation Planning Team in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include an evaluation of implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion along with recommended strategies to overcome them.

Plan Amendment Process

Upon the initiation of the amendment process, representatives from Guilford County and the participating municipalities will forward information on the proposed change(s) to all interested parties including, but not limited to, all directly affected County/municipal departments, residents, and businesses. Information will also be forwarded to the North Carolina Division of Emergency Management. This information will be disseminated in order to seek input on the proposed amendment(s) for no less than a 45-day review and comment period.

At the end of the 45-day review and comment period, the proposed amendment(s) and all comments will be forwarded to the Hazard Mitigation Planning Team for final consideration. The Hazard Mitigation Planning Team will review the proposed amendment along with the comments received from other

parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered by the Hazard Mitigation Planning Team:

- There are errors, inaccuracies, or omissions made in the identification of issues or needs in the Plan.
- New issues or needs have been identified which are not adequately addressed in the Plan.
- There has been a change in information, data, or assumptions from those on which the Plan is based.

Upon receiving the recommendation from the Hazard Mitigation Planning Team, and prior to adoption of the Plan, the participating jurisdictions will hold a public hearing. The governing bodies of each participating jurisdiction will review the recommendation from the Hazard Mitigation Planning Team (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the governing bodies will take one of the following actions:

- Adopt the proposed amendments as presented;
- Adopt the proposed amendments with modifications;
- Refer the amendments request back to the Hazard Mitigation Planning Team for further revision; or
- Defer the amendment request back to the Hazard Mitigation Planning Team for further consideration and/or additional hearings.

Incorporation Into Existing Planning Documents

The Guilford County Hazard Mitigation Planning Team intends to make available to all of Guilford County and its municipalities a process by which the requirements of this hazard mitigation plan will be incorporated into other plans. During the planning process for new and updated local planning documents, such as a comprehensive plan, capital improvements plan, or emergency management plan to name a few examples, the Emergency Services Department will provide a copy of the hazard mitigation plan to the advisory committee of each relevant planning document. The Emergency Services Department will advise the advisory committee members to ensure that all goals and strategies of new and updated local planning documents are consistent with the hazard mitigation plan and will not increase hazards in the jurisdictions.

This process will be carried out for each of the planning documents described in *Section 7: Capability Assessment* of this document. It should also be noted that most jurisdictions within the county are participants in the county-level version of each type of plan and do not have stand-alone jurisdictional plans of their own. Therefore, when the Emergency Services Department shares and advises on the hazard mitigation plan, they are acting on behalf of the municipalities. It should be further noted that due to the smaller size of many municipalities, municipal representatives of the Hazard Mitigation Planning Team are often the same person who participates in the update of comprehensive plans, zoning ordinances, and other planning documents. As such, much of the engrained knowledge these officials have gained from participating in the hazard mitigation planning process is transferred to these processes.

Therefore, each municipality's process for integrating the hazard mitigation plan into other planning mechanisms is the same as the county level process because these planning mechanisms are carried out as countywide plans or ordinances and each community's stake in each process is intricately linked.

10.4 CONTINUED PUBLIC INVOLVEMENT

44 CFR Requirement
44 CFR Part 201.6(c)(4)(iii): The plan maintenance process shall include a discussion on how the community will continue public participation in the plan maintenance process.

Public participation is an integral component to the mitigation planning process and will continue to be essential as this Plan evolves over time. As described above, significant changes or amendments to the Plan shall require a public hearing prior to any adoption procedures.

Other efforts to involve the public in the maintenance, evaluation, and revision process will also be made. These efforts include:

- Advertising meetings of the Hazard Mitigation Planning Team in local newspapers, public bulletin boards and/or County and municipal office buildings;
- Designating willing and voluntary citizens and private sector representatives as official members of the Hazard Mitigation Planning Team;
- Utilizing local media to update the public on any maintenance and/or periodic review activities taking place;
- Utilizing the websites of participating jurisdictions to advertise any maintenance and/or periodic review activities taking place; and
- Keeping copies of the Plan in public libraries.

Appendix A
Plan Adoption

This appendix includes the local adoption resolutions for each of the participating jurisdictions.

Appendix B
Planning Tools

This appendix includes the following:

1. List of Recommended Stakeholders
2. Blank Public Survey
3. GIS Data Inventory Sheet
4. Scoring Criteria for Capability Assessment
5. Blank Mitigation Action Worksheet

In establishing a planning team, you want to ensure that you have a broad range of backgrounds and experiences represented. Below are some suggestions for agencies to include in a planning team. There are many organizations, both governmental and community-based, that should be included when creating a local team. In addition, state organizations can be included on local teams, when appropriate, to serve as a source of information and to provide guidance and coordination.

Use the checklist as a starting point for forming your team. Check the boxes beside any individuals or organizations that you have in your community/state that you believe should be included on your planning team so you can follow up with them.

Task A. Create the planning team – *Suggestions for team members.* Date:_____

Local/Tribal

- ☐ Administrator/Manager's Office
- ☐ Budget/Finance Office
- ☐ Building Code Enforcement Office
- ☐ City/County Attorney's Office
- ☐ Economic Development Office
- ☐ Emergency Preparedness Office
- ☐ Fire and Rescue Department
- ☐ Hospital Management
- ☐ Local Emergency Planning Committee
- ☐ Planning and Zoning Office
- ☐ Police/Sheriff's Department
- ☐ Public Works Department
- ☐ Sanitation Department
- ☐ School Board
- ☐ Transportation Department
- ☐ Tribal Leaders

Special Districts and Authorities

- ☐ Airport and Seaport Authorities
- ☐ Business Improvement District(s)
- ☐ Fire Control District
- ☐ Flood Control District
- ☐ Redevelopment Agencies
- ☐ Regional/Metropolitan Planning Organization(s)
- ☐ School District(s)
- ☐ Transit/Transportation Agencies

Others

- ☐ Architectural/Engineering/Planning Firms
- ☐ Citizen Corps
- ☐ Colleges/Universities
- ☐ Land Developers
- ☐ Major Employers/Businesses
- ☐ Professional Associations
- ☐ Retired Professionals

State

- ☐ Adjutant General's Office (National Guard)
- ☐ Board of Education
- ☐ Building Code Office
- ☐ Climatologist
- ☐ Earthquake Program Manager
- ☐ Economic Development Office
- ☐ Emergency Management Office/State Hazard Mitigation Officer
- ☐ Environmental Protection Office
- ☐ Fire Marshal's Office
- ☐ Geologist
- ☐ Homeland Security Coordinator's Office
- ☐ Housing Office
- ☐ Hurricane Program Manager
- ☐ Insurance Commissioner's Office
- ☐ National Flood Insurance Program Coordinator
- ☐ Natural Resources Office
- ☐ Planning Agencies
- ☐ Police
- ☐ Public Health Office
- ☐ Public Information Office
- ☐ Tourism Department

Non-Governmental Organizations (NGOs)

- ☐ American Red Cross
- ☐ Chamber of Commerce
- ☐ Community/Faith-Based Organizations
- ☐ Environmental Organizations
- ☐ Homeowners Associations
- ☐ Neighborhood Organizations
- ☐ Private Development Agencies
- ☐ Utility Companies
- ☐ Other Appropriate NGOs

PUBLIC PARTICIPATION SURVEY
FOR HAZARD MITIGATION PLANNING

We need your help!

Guilford County is currently engaged in a planning process to become less vulnerable to disasters caused by natural, technological, biological, and man-made/intentional hazards, and your participation is important to us!

The county, along with participating local jurisdictions and other participating partners, is now working to prepare a multi-jurisdictional *Hazard Mitigation Plan*. The purpose of this Plan is to identify and assess our community's hazard risks and determine how to best minimize or manage those risks. Upon completion, the Plan will represent a comprehensive multi-jurisdictional *Hazard Mitigation Plan* for the county.

This survey questionnaire provides an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that should help lessen the impact of future hazard events.

Please help us by completing this survey by April 30, 2015 and returning it to:

Sara Reynolds, Atkins
1616 E Millbrook Road, Suite 310
Raleigh, NC 27609

Surveys can also be faxed to: (919) 876-6848 or emailed to sara.reynolds@atkinsglobal.com

If you have any questions regarding this survey or would like to learn about more ways you can participate in the development of the *Guilford County Hazard Mitigation Plan*, please contact Atkins, planning consultant for the project. You may reach Nathan Slaughter (Atkins) at 919-431-5251 or by email at nathan.slaughter@atkinsglobal.com.

1. Where do you live?

- ❑ Unincorporated Guilford County
- ❑ Gibsonville
- ❑ Greensboro
- ❑ High Point
- ❑ Jamestown
- ❑ Oak Ridge
- ❑ Pleasant Garden
- ❑ Sedalia
- ❑ Stokesdale
- ❑ Summerfield
- ❑ Whitsett
- ❑ Other: _____

2. Have you ever experienced or been impacted by a disaster?

- ❑ Yes
- ❑ No

a. If "Yes," please explain:

3. How concerned are you about the possibility of our community being impacted by a disaster?

- ❑ Extremely concerned
- ❑ Somewhat concerned
- ❑ Not concerned

4. Please select the <u>one</u> hazard you think is the *highest threat* to your neighborhood:

<u>Natural Hazards</u>
- ❑ Drought
- ❑ Earthquakes
- ❑ Extreme Cold
- ❑ Extreme Heat
- ❑ Fire
- ❑ Flooding
- ❑ Hail
- ❑ Hurricanes/Other Tropical Disturbances
- ❑ Thunderstorms
- ❑ Tornadoes/Damaging Winds
- ❑ Winter Storms

<u>Technological Hazards</u>
- ❑ Building/Structure Collapse
- ❑ Communications Systems Disruptions/Failures
- ❑ Energy/Power/Utility Failure
- ❑ Hazardous Materials
- ❑ Nuclear Power Plant Emergencies
- ❑ Pipeline Failures
- ❑ Resource Shortages (Water/Fuel)
- ❑ Transportation Incidents

<u>Biological Hazards</u>
- ❑ Bioterrorism
- ❑ Public Health/Emerging Disease Threats

<u>Man-made / Intentional Hazards</u>
- ❑ Civil Disturbances/Insurrection
- ❑ Cyberterrorism
- ❑ Terrorism

5. Please select the <u>one</u> hazard you think is the *second highest threat* to your neighborhood:

<u>Natural Hazards</u>
- ❑ Drought
- ❑ Earthquakes
- ❑ Extreme Cold
- ❑ Extreme Heat
- ❑ Fire
- ❑ Flooding
- ❑ Hail
- ❑ Hurricanes/Other Tropical Disturbances
- ❑ Thunderstorms
- ❑ Tornadoes/Damaging Winds
- ❑ Winter Storms

<u>Technological Hazards</u>
- ❑ Building/Structure Collapse
- ❑ Communications Systems Disruptions/Failures
- ❑ Energy/Power/Utility Failure
- ❑ Hazardous Materials
- ❑ Nuclear Power Plant Emergencies
- ❑ Pipeline Failures
- ❑ Resource Shortages (Water/Fuel)
- ❑ Transportation Incidents

<u>Biological Hazards</u>
- ❑ Bioterrorism
- ❑ Public Health/Emerging Disease Threats

<u>Man-made / Intentional Hazards</u>
- ❑ Civil Disturbances/Insurrection
- ❑ Cyberterrorism
- ❑ Terrorism

6. Is there another hazard not listed above that you think is a wide-scale threat to your neighborhood?

- ❑ Yes (please explain): _____
- ❑ No

7. Is your home located in a floodplain?

- ❑ Yes
- ❑ No
- ❑ I don't know

8. Do you have flood insurance?

- ❑ Yes
- ❑ No
- ❑ I don't know

a. If "No," why not?

- ❑ Not located in floodplain
- ❑ Too expensive
- ❑ Not necessary because it never floods
- ❑ Not necessary because I'm elevated or otherwise protected
- ❑ Never really considered it
- ❑ Other (please explain): _____

9. **Have you taken any actions to make your home or neighborhood more resistant to hazards?**

   - ❑ Yes
   - ❑ No

   a. **If "Yes," please explain:**

10. **Are you interested in making your home or neighborhood more resistant to hazards?**

    - ❑ Yes
    - ❑ No

11. **Do you know what office to contact regarding reducing your risks to hazards in your area?**

    - ❑ Yes
    - ❑ No

12. **What is the most effective way for you to receive information about how to make your home and neighborhood more resistant to hazards?**

    - ❑ Newspaper
    - ❑ Television
    - ❑ Radio
    - ❑ Internet
    - ❑ Mail
    - ❑ Public workshops/meetings
    - ❑ School meetings
    - ❑ Other (please explain): _____

13. In your opinion, what are some steps your local government could take to reduce or eliminate the risk of future hazard damages in your neighborhood?

14. Are there any other issues regarding the reduction of risk and loss associated with hazards or disasters in the community that you think are important?

15. A number of community-wide activities can reduce our risk from hazards. In general, these activities fall into one of the following six broad categories. Please tell us how important you think each one is for your community to consider pursuing.

Category	Very Important	Somewhat Important	Not Important
1. Prevention Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning and zoning, building codes, open space preservation, and floodplain regulations.	❑	❑	❑
2. Property Protection Actions that involve the modification of existing buildings to protect them from a hazard or removal from the hazard area. Examples include acquisition, relocation, elevation, structural retrofits, and storm shutters.	❑	❑	❑
3. Natural Resource Protection Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. Examples include: floodplain protection, habitat preservation, slope stabilization, riparian buffers, and forest management.	❑	❑	❑
4. Structural Projects Actions intended to lessen the impact of a hazard by modifying the natural progression of the hazard. Examples include dams, levees, detention/retention basins, channel modification, retaining walls, and storm sewers.	❑	❑	❑
5. 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.	❑	❑	❑
6. Public Education and Awareness Actions to inform citizens about hazards and the techniques they can use to protect themselves and their property. Examples include outreach projects, school education programs, library materials, and demonstration events.	❑	❑	❑

THANK YOU FOR YOUR PARTICIPATION!

This survey may be submitted anonymously; however, if you provide us with your name and contact information below we will have the ability to follow up with you to learn more about your ideas or concerns (optional):

Name: _____

Address: _____

_____

Phone: _____ **E-Mail:** _____

GIS Data Request Sheet
Guilford County Multi-Jurisdictional Hazard Mitigation Plan

Data requested	Available?	Received?	Potential Sources
Tax Parcel Data			Tax Assessor
including replacement value			
Building Footprints			Tax Assessor/GIS office
Critical Facilities (in GIS or list form with addresses)			Tax Assessor/GIS office
examples include:			
government buildings			
hospitals			
senior care			
police/fire/EMS/EOC			
locally significant buildings			
schools			
Local hazard studies			public works, natural resources, planning
examples include:			
Flood Studies (HEC-RAS, Risk MAP)			
Local Hazard History Articles			
Areas of Concern Studies			

If you have any questions, please contact:

Ryan Wiedenman
ryan.wiedenman@gmail.com
919-431-5295

Points System for Capability Ranking

0-19 points = Limited overall capability
20-39 points = Moderate overall capability
40-68 points = High overall capability

I. Planning and Regulatory Capability
(Up to 43 points)

Yes = 3 points
Under Development = 1 point
Included under County plan/code/ordinance/program = 1 point
No = 0 points

- Hazard Mitigation Plan
- Comprehensive Land Use Plan
- Floodplain Management Plan
- National Flood Insurance Program
- NFIP Community Rating System

Yes = 2 points
Under Development = 1 point
Included under County plan/code/ordinance/program = 1 point
No = 0 points

- Open Space Management Plan / Parks & Recreation Plan
- Stormwater Management Plan
- Natural Resource Protection Plan
- Flood Response Plan
- Emergency Operations Plan
- Continuity of Operations Plan
- Evacuation Plan
- Disaster Recovery Plan
- Flood Damage Prevention Ordinance
- Post-disaster Redevelopment / Reconstruction Ordinance

Yes = 1 point
No = 0 points

- Capital Improvements Plan
- Economic Development Plan
- Historic Preservation Plan
- Zoning Ordinance
- Subdivision Ordinance
- Unified Development Ordinance
- Building Code
- Fire Code

II. Administrative and Technical Capability
(Up to 15 points)

Yes = 2 points
Service provided by County = 1 point
No = 0 points

- Planners with knowledge of land development and land management practices
- Engineers or professionals trained in construction practices related to buildings and/or infrastructure
- Planners or engineers with an understanding of natural and/or human-caused hazards
- Emergency manager
- Floodplain manager

Yes = 1 point
No = 0 points

- Land surveyors
- Scientist familiar with the hazards of the community
- Staff with education or expertise to assess the community's vulnerability to hazards
- Personnel skilled in Geographical Information Systems (GIS) and/or Hazus
- Resource development staff or grant writers

III. Fiscal Capability
(Up to 10 points)

Yes = 1 point
No = 0 points

- Capital Improvement Programming
- Community Development Block Grants (CDBG)
- Special Purpose Taxes (or tax districts)
- Gas / Electric Utility Fees
- Water / Sewer Fees
- Stormwater Utility Fees
- Development Impact Fees
- General Obligation / Revenue / Special Tax Bonds
- Partnering arrangements or intergovernmental agreements
- Other

MITIGATION ACTION WORKSHEETS

Mitigation Action Worksheets are used to identify potential hazard mitigation actions that participating jurisdictions in Guilford County will consider to reduce the negative effects of identified hazards. The worksheets provide a simple yet effective method of organizing potential actions in a user-friendly manner that can easily be incorporated into the County's Hazard Mitigation Plan.

The worksheets are to be used as part of a strategic planning process and are designed to be:

a.) completed electronically (worksheets and instructions will be e-mailed to members of the Hazard Mitigation Planning Team following the Mitigation Strategy Workshop);
b.) reviewed with your department/organization for further consideration; and
c.) returned according to the contact information provided below.

Please return all completed worksheets no later than May 15, 2015 to:

Ryan Wiedenman, Project Manager Atkins
Electronic copies may be e-mailed to: ryan.wiedenman@atkinsglobal.com
Hard copies may be faxed to: 919-876-6848 (Attn: Ryan Wiedenman)

INSTRUCTIONS

Each mitigation action should be considered to be a separate local project, policy or program and each individual action should be entered into a separate worksheet. By identifying the implementation requirements for each action, the worksheets will help lay the framework for engaging in distinct actions that will help reduce the community's overall vulnerability and risk. Detailed explanations on how to complete the worksheet are provided below.

Proposed Action: Identify a specific action that, if accomplished, will reduce vulnerability and risk in the impact area. Actions may be in the form of local policies (i.e., regulatory or incentive-based measures), programs or structural mitigation projects and should be consistent with any pre-identified mitigation goals and objectives.

Site and Location: Provide details with regard to the physical location or geographic extent of the proposed action, such as the location of a specific structure to be mitigated, whether a program will be citywide, countywide or regional, etc.

History of Damages: Provide a brief history of any known damages as it relates to the proposed action and the hazard(s) being addressed. For example, the proposed elevation of a repetitive loss property should include an overview of the number of times the structure has flooded, total dollar amount of damages if available, etc.

Hazard(s) Addressed: List the hazard(s) the proposed action is designed to mitigate against.

Category: Indicate the most appropriate category for the proposed action as discussed during the Mitigation Strategy Workshop (Prevention; Property Protection; Natural Resource Protection; Structural Projects; Emergency Services; Public Education and Awareness).

Priority: Indicate whether the action is a "high" priority, "moderate" priority or "low" priority based generally on the following criteria:

1. Effect on overall risk to life and property
2. Ease of implementation / technical feasibility
3. Project costs versus benefits
4. Political and community support
5. Funding availability

Estimated Cost: If applicable, indicate what the total cost will be to accomplish this action. This amount will be an estimate until actual final dollar amounts can be determined. Some actions (such as ordinance revisions) may only cost "local staff time" and should be noted so.

Potential Funding Sources: If applicable, indicate how the cost to complete the action will be funded. For example, funds may be provided from existing operating budgets or general funds, a previously established contingency fund, a cost-sharing federal or state grant program, etc.

Lead Agency/Department Responsible: Identify the local agency, department or organization that is best suited to implement the proposed action.

Implementation Schedule: Indicate when the action will begin and when the action is expected to be completed. Remember that some actions will require only a minimal amount of time, while others may require a long-term or continuous effort.

Comments: This space is provided for any additional information or details that may not be captured under the previous headings.

MITIGATION ACTION	
Proposed Action:	
BACKGROUND INFORMATION	
Site and Location:	
History of Damages:	

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	
Category:	
Priority (High, Moderate, Low):	
Estimated Cost:	
Potential Funding Sources:	
Lead Agency/Department Responsible:	
Implementation Schedule:	

COMMENTS

Appendix C
Local Mitigation Plan Review Tool

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* 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 community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Guilford County	**Title of Plan:** Guilford County Multi-Jurisdictional Hazard Mitigation Plan	**Date of Plan:** May 2015
Local Point of Contact: **Zach Smith**	**Address:** **Guilford County Emergency Services** **1002 Meadowood Street** **Greensboro, NC 27409**	
Title: **Emergency Management Coordinator**		
Agency: **Guilford County Emergency Management**		
Phone Number: **336-641-6569**	**E-Mail:** **Zach.smith@guilford-es.com**	

State Reviewer:	**Title:**	**Date:**

FEMA Reviewer:	**Title:**	**Date:**
Date Received in FEMA Region ***(insert #)***		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

SECTION 1:
REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 2; App. D		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 2.4-2.6, Section 2.7; App. D		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 2.6; App. F		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 7.3		
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 10.3		
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 10.2		
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 4; Section 5		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Section 5		
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Section 5; Section 6		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Section 5.8.5		
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Section 7		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 5.8.4; Section 7.3.4		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 8.2		
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 §201.6(c)(3)(ii))	Section 8.3-8.4; Section 9.2		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Section 8.1.1; Section 9.2		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 7.3.1 (Table 7.1); Section 10.1		
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 6.4.3		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section 2.8; Section 8.5; Section 9		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 5.27 (Table 5.46); Section 9.2		
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	App. A		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	App. A		
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2:
PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. The Plan Assessment must be completed by FEMA. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item, and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature, and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the overall plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- *Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- *Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- *Diverse methods of participation (meetings, surveys, online, etc.); and*
- *Reflective of an open and inclusive public involvement process.*

Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

1) *A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
2) *The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
3) *A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- *Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;*
- *Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);*
- *Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;*
- *Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and*
- *Identification of any data gaps that can be filled as new data became available.*

Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- *Key problems identified in, and linkages to, the vulnerability assessment;*
- *Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- *Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- *An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- *Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- *Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- *Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*
- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

SECTION 3:
MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Guilford County	County	Zach Smith									
2	Town of Gibsonville	Town	Brandon Parker									
3	City of Greensboro	Town	Brian Shoemaker									
4	City of High Point	Town	Glenn Clapp									
5	Town of Jamestown	Town	Jeff Greeson									
6	Town of Oak Ridge	Town	Sandra Smith									
7	Town of Pleasant Garden	Town	Sandy Carmany									
8	Town of Sedalia	Town	LaDonna Woodruff									

MULTI-JURISDICTION SUMMARY SHEET													
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
9	Town of Stokesdale	City	Joe Thacken									
10	Town of Summerfield	Town	Julie Reid									
11	Town of Whitsett	Town	Gary Deal									
12												
13												
14												
15												
16												
17												
18												
19												
20												

Appendix D
Planning Process Documentation

This appendix includes:

1. Meeting Agendas
2. Meeting Minutes
3. Meeting Sign-In Sheets

AGENDA

Guilford County Multi-Jurisdictional Hazard Mitigation Plan Update

November 24, 2014

2:00 – 3:30 PM

1002 Meadowood St. Greensboro, NC 27409

Guilford County EOC

1) Overview of Mitigation Planning
    i) What is Mitigation and Why Do We Plan?
    ii) History of Mitigation Planning

2) Scope of Work

3) Timeframes for Plan Development

4) Roles and Responsibilities

5) Initiate Data Collection
    a) Risk Assessment Information
    b) GIS Data

6) Next Steps
    a) Schedule Stakeholder Group Meetings

AGENDA

Guilford County Hazard Mitigation Plan
Kickoff Meeting

January 13, 2015
10:00 AM – 1:00 PM
Deep River Event Center
606 Millwood School Rd, Greensboro, NC 27409

1) **Introductions**

2) **Overview of Mitigation**
   a) **Ice Breaker Exercise**

3) **Project Overview**
   a) **Key Objectives**
   b) **Project Tasks**
   c) **Project Schedule**
   d) **Project Staffing**

4) **Data Collection**

5) **Roles & Responsibilities**

6) **Next Steps**

7) **Questions, Issues, or Concerns**

ATKINS

AGENDA

Guilford County Hazard Mitigation Plan
Public Meeting

March 12, 2015
J. Edward Kitchen Operations Center
2602 S. Elm Eugene Street, Greensboro, NC 27406
3:45 PM – 5:00 PM

1) **Introductions**

2) **Overview of Mitigation**
   a) **Ice Breaker Exercise**

3) **Project Overview**
   a) **Key Objectives**
   b) **Project Tasks**
   c) **Project Schedule**

4) **Roles & Responsibilities**

5) **Next Steps**

6) **Questions, Issues, or Concerns**

ATKINS

AGENDA

Guilford County Hazard Mitigation Plan
Public Meeting

April 9, 2015
City of Greensboro Police Department
1106 Maple Street, Greensboro, NC 27405

1) **Introductions**

2) **Project Overview**
   a) **Key Objectives**
   b) **Project Tasks**
   c) **Project Schedule**

3) **Roles & Responsibilities**

4) **Findings So Far**

5) **Next Steps**

6) **Questions, Issues, or Concerns**

ATKINS

AGENDA

Guilford County Hazard Mitigation Plan
Mitigation Strategy Meeting

April 30, 2015
10:00 AM – Noon
Guilford Metro 9-1-1
1201 Coliseum Blvd., Greensboro, NC 27403

1) **Introductions**

2) **Mitigation Refresher**

3) **Project Schedule**

4) **Risk Assessment Findings**
   a) Hazard History and Profiles
   b) Conclusions on Risk: PRI

5) **Capability Assessment Findings**
   a) Indicators
   b) Results

6) **Public Involvement Activities**

7) **Mitigation Strategy**
   a) Current Goals/Actions
   b) New Actions
   c) Discussion

8) **Next Steps**
   a) Mitigation Actions
   b) Continue Public Outreach

9) **Questions, Issues, or Concerns**

ATKINS

AGENDA

Guilford County Hazard Mitigation Plan
Public Meeting

June 11, 2015
City of Greensboro Water Resources Office
2602 S. Elm Eugene Street, Greensboro, NC 27406
1:30-2:30 PM

1) **Introductions**

2) **Overview of Mitigation**

3) **Project Overview**
   a) **Key Objectives**
   b) **Project Tasks**
   c) **Project Schedule**

4) **Findings**

5) **Next Steps**

6) **Questions, Issues, or Concerns**

ATKINS

Meeting Minutes
Guilford County Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Call
November 24, 2014

A coordination call was held with Atkins and the county lead for the project. The primary discussion revolved around the project's schedule and which hazards would ultimately be addressed. It was determined that Atkins would set a goal to have a draft of the plan by May of 2015 and that the plan would address both natural and man-made hazards.

Meeting Minutes
Guilford County Multi-Jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting
January 13, 2015

Don Campbell, Guilford County Emergency Management Director, started the meeting by welcoming the representatives from the County, participating municipal jurisdictions, and other stakeholders. Mr. Campbell then introduced Nathan Slaughter, Project Manager from the project consulting team, Atkins.

Mr. Slaughter led the kickoff meeting and began by providing an overview of the items to be discussed at the meeting and briefly reviewed each of the handouts that were distributed in the meeting packets (agenda, project description, and presentation slides). He then provided a brief overview of mitigation and discussed the Disaster Mitigation Act of 2000 and NC Senate Bill 300.

He gave a list of the participating jurisdictions for the multi-jurisdictional plan, noting all local governments in the County are participating in the existing county-level hazard mitigation plan. This plan expires in January of 2016, so the planning team will plan to develop a draft to submit to FEMA by June of 2015.

Ryan Wiedenman from Atkins then explained the six different categories of mitigation techniques (emergency services; prevention; natural resource protection; structural projects; public education and awareness; and property protection) and gave examples of each. This explanation culminated with an Ice Breaker Exercise for the attendees.

Mr. Wiedenman instructed attendees on how to complete the exercise. Attendees were divided into small groups and given an equal amount of fictitious FEMA money and asked to spend it in the various mitigation categories. Money could be thought of as grant money that communities received towards mitigation. Attendees were asked to target their money towards areas of mitigation that are of greatest concern for their community. Ideally, the exercise helps pinpoint areas of mitigation that the community may want to focus on when developing mitigation grants. Nathan Slaughter from Atkins also presented the Ice Breaker Exercise results which were:

- Public Education and Awareness- 97
- Prevention- 82
- Property Protection- 77
- Emergency Services- 72
- Structural Projects- 47
- Natural Resource Protection- 40

Mr. Wiedenman then discussed the key objectives and structure of the planning process, explaining the specific tasks to be accomplished for this project, including the planning process, risk assessment, vulnerability assessment, capability assessment, mitigation strategy and action plan, plan maintenance procedures, and documentation. The project schedule was presented along with the project staffing chart, which demonstrates the number of experienced individuals that will be working on this project. The data collection needs and public outreach efforts were also discussed.

Mr. Wiedenman then reviewed the roles and responsibilities of Atkins, participating jurisdictions, and stakeholders. The presentation concluded with a discussion of the next steps to be taken in the project development, which included discussing data collection efforts, continuing public outreach, and the next meeting for the HMPT.

The meeting was opened for questions and comments and several topics were raised, including public survey availability and distribution.

Zach Smith thanked everyone for attending and identified himself as the first point of contact for any questions or issues. The meeting was adjourned.

Guilford County Public Meeting

March 12, 2015

A public meeting was held to incorporate the public's input on the planning process.

Nathan Slaughter from Atkins opened by describing the Hazard Mitigation Planning process and explained the six different categories of mitigation techniques (emergency services; prevention; natural resource protection; structural projects; public education and awareness; and property protection) and gave examples of each. This explanation culminated with an Ice Breaker Exercise for the attendees.

Mr. Slaughter instructed attendees on how to complete the exercise. Attendees were divided into small groups and given an equal amount of fictitious FEMA money and asked to spend it in the various mitigation categories. Money could be thought of as grant money that communities received towards mitigation. Attendees were asked to target their money towards areas of mitigation that are of greatest concern for their community. Ideally, the exercise helps pinpoint areas of mitigation that the community may want to focus on when developing mitigation grants. Nathan Slaughter from Atkins also presented the Ice Breaker Exercise results which were:

Prevention $28

Structural Projects $26

Property Protection $17

Natural Resource Protection $14

Emergency Services $12

Public Education and Awareness $3

The floor was then opened for questions about the plan and process, but no major comments were received.

Guilford County Public Meeting

April 9, 2015

A public meeting was held to incorporate the public's input on the planning process as part of the county's regularly scheduled LEPC meeting

Nathan Slaughter from Atkins opened by describing the Hazard Mitigation Planning process and explained the six different categories of mitigation techniques (emergency services; prevention; natural resource protection; structural projects; public education and awareness; and property protection) and gave examples of each.

Mr. Slaughter then went on to describe the key objectives of the hazard mitigation plan development process and described some of the key findings that had been produced as a result of the process so far.

The floor was then opened for questions about the plan and process, but no major comments were received.

Meeting Minutes
Guilford County Hazard Mitigation Plan
Mitigation Strategy Meeting
April 30, 2015

Mr. Zach Smith with Guilford County Emergency Services welcomed everyone to the meeting and went over safety and administrative topics. He then passed the meeting over to Mr. Ryan Wiedenman to discuss the findings and information that Atkins pulled together.

Mr. Wiedenman initiated the meeting with a review of the meeting handouts, which included an agenda, presentation slides, proposed goals for the plan, mitigation actions from the county's existing plan, and mitigation action worksheets for collecting information for any new mitigation actions. Mr. Wiedenman reviewed the project schedule and stated that a draft of the Hazard Mitigation Plan would be presented to the Hazard Mitigation Planning team at the end of May.

He then presented the findings of the risk assessment, starting with a review of the Presidential Disaster Declarations that have impacted the county. He then explained the process for preparing Hazard Profiles and discussed how each hazard falls into one of four categories: Natural, Biological, Technological, and Intentional. He indicated that each hazard must be evaluated and then profiled and assessed to determine a relative risk for each hazard.

Mr. Wiedenman reviewed the Hazard Profiles and the following bullets summarize the information presented:

<u>Natural Hazards</u>

- DROUGHT. There have been eight years (out of the past fourteen, 2000-2013) where drought conditions have been reported as moderate to extreme in Guilford County and future occurrences are likely.

- EARTHQUAKES. There have been 5 recorded earthquake events in Guilford County since 1852. The strongest had a recorded magnitude of IV MMI. Future occurrences are possible.

- EXTREME COLD. There has been 1 recorded extreme cold event reported by the National Climatic Data Center (NCDC) since 1996. However, heat extents of -8 degrees indicate that extreme cold is a hazard of concern for the county. Future occurrences are possible.

- EXTREME HEAT. There have been 2 recorded extreme heat events reported by the National Climatic Data Center (NCDC) since 1998. Heat extents of 106 degrees indicate that extreme heat is a hazard of concern for the county. Future occurrences are possible.

- FIRE/WILDFIRE. There is an average of 33 fires per year reported in Guilford County. Future occurrences are likely, but major events are not common.

- FLOOD. There have been 73 flood events recorded in Guilford County since 1996, resulting in $2.6 million in property damage per NCDC. There have been 372 NFIP losses since 1978 and approximately $4.9 million in claims. 9 severe repetitive loss properties in the county account for 55 of the recorded losses. Future occurrences are highly likely.

- HAILSTORM. There have been 164 recorded events since 1967. Future occurrences are highly likely.

- HURRICANES AND TROPICAL STORMS. NOAA data shows that 59 storm tracks have come within 75 miles of Guilford County since 1854. Future occurrences are likely.

- THUNDERSTORM WIND. There have been 254 severe thunderstorm events reported since 1956 with $2.0 million in reported property damages. Two deaths have been reported. Future occurrences are highly likely.

- THUNDERSTORM LIGHTNING. There have been 9 recorded lightning events since 1997. There has been $2.5 million in reported property damages. Future occurrences are highly likely.

- TORNADOES. There have been 13 recorded tornado events reported in the county since 1954. $19.9 million in property damages. 1 death and 5 injuries have been reported. Future occurrences are likely.

- WINTER STORM. There have been 54 recorded winter weather events in Guilford County since 1996 resulting in $8.2 million in reported property damages. Future occurrences are highly likely.

Biological Hazards

- BIOTERRORISM. There have not been any major bioterrorism incidents in the county but future occurrences are possible and may cause major impacts to hospitals and loss of economic productivity.

- PUBLIC HEALTH/EMERGING DISEASE. There have been several disease outbreaks in the county, notably in 1999 (SARS) and 2003 (West Nile). Impacts could be widespread, affecting thousands.

Technological Hazards

- BUILDING/STRUCTURE COLLAPSE. Few past incidents have been recorded. Future occurrences are possible but damage would be highly localized.

- COMMUNICATIONS SYSTEMS DISRUPTION/FAILURE. At least one past event occurred in 2011 and there would potentially be delays in providing emergency service response time during these events.

- ENERGY/POWER/UTILITY FAILURE. These events are often caused by ice storms and are likely to happen in the future, causing downed power lines and traffic lights as well as loss of power to homes and businesses.

- HAZARDOUS MATERIALS INCIDENTS. There have been 2,220 reported hazardous materials events reported in the county. 40 serious events were reported with 1 death and 28 injuries. Future occurrences are highly likely.

- NUCLEAR ACCIDENT. Some of the county falls within the 50 mile buffer of Shearon Harris Nuclear Station, but there have been no major incidents and future occurrences are unlikely.

- PIPELINE FAILURE. During Hurricane Katrina, the county experienced disruptions to the distribution network, but there have been no failures in the county itself. A failure would cause downtime and loss of services as well as the danger of fire and explosions.

- RESOURCE SHORTAGE (WATER/FUEL). Several water and fuel shortages have impacted the county and future occurrences are likely in the future. This could have major impacts on businesses and consumers.

- TRANSPORTATION INCIDENT. Several plane and train incidents have occurred in the county in past years in addition to numerous car incidents. Future occurrences are likely, though the impacts would be very localized.

Man-Made/Intentional Hazards

- CIVIL DISTURBANCE. Few recent events but future occurrences are possible and may occur in prominent locations causing work stoppages and loss of productivity.

- CYBERTERRORISM. No large-scale cyber-attacks have been recorded in Guilford County, but these could occur anywhere and may result in theft, loss of IT functions, or dissemination of misinformation.

- TERROR THREAT. There have been no historic terror events in the county, but several facilities were identified as potential targets and confirmed by the planning team. The likelihood of a major event is relatively low.

The results of the hazard identification process were used to generate a Priority Risk Index (PRI), which categorizes and prioritizes potential hazards as high, moderate or low risk based on probability, impact, spatial extent, warning time, and duration. The highest PRI was assigned to Winter Storm followed by Thunderstorm-Wind, Flooding, Hazardous Materials Incident, Resource Shortage, and Tornado.

Hazard Mitigation Planning Team members identified several recent events that were not captured in the data collected by Atkins including additional transportation incidents and ice events. In addition, the Planning Team recommended raising the relative risk level for Civil Disturbance and Energy/Utility Failure.

In concluding the review of Hazard Profiles, Mr. Wiedenman stated if anyone had additional information for the hazard profiles, or had concerns with any of the data presented, they should call or email him.

Mr. Wiedenman presented the Capability Assessment Findings. Atkins has developed a scoring system that was used to rank the participating jurisdictions in terms of capability in four major areas (Planning and Regulatory; Administrative and Technical; Fiscal; Political). Important capability indicators include National Flood Insurance Program (NFIP) participation, Building Code Effective Grading Schedule (BCEGS) score, Community Rating System (CRS) participation, and the Local Capability Assessment Survey conducted by Atkins.

Mr. Wiedenman reviewed the Relevant Plans and Ordinances, Relevant Staff/Personnel Resources, and Relevant Fiscal Resources. All of these categories were used to rate the overall capability of the participating counties and jurisdictions. Most jurisdictions are in the moderate to high range for Planning and Regulatory Capability and in the limited range for Fiscal Capability. There is variation between the jurisdictions for Administrative and Technical Capability, mainly with respect to availability staff skilled in GIS. Based upon the scoring methodology developed by Atkins, it was determined that most of the participating jurisdictions have moderate to high capability to implement hazard mitigation programs and activities.

Mr. Wiedenman also discussed the results of the public participation survey that was posted on several of the participating counties' and municipal websites. As of the meeting date, 226 responses had been received. Mr. Wiedenman explained that the survey would close on May 4th, so the HMPT could make one final push to get the survey out to the public. Based on preliminary survey results, respondents felt that energy/utility failure posed the greatest threat to their neighborhood, followed by Winter Storm, and Tornado. 87 percent of the respondents were interested in making their homes more resistant to hazards. However, 54 percent don't know who to contact regarding reducing their risks to hazards.

Mr. Wiedenman then reminded team members of the results of the icebreaker exercise from the first Hazard Mitigation Team meeting, where attendees were given "money" to spend on various hazard mitigation techniques. The results were as follows:

- Public Education and Awareness $97
- Prevention $82
- Property Protection $77
- Emergency Services $72
- Structural Projects $47
- Natural Resource Protection $40

Mr. Wiedenman gave an overview of Mitigation Strategy Development and presented the existing goals for the plan and explained that Atkins recommended keeping the goals as they are. The Hazard Mitigation Team accepted the existing goals for the plan. Mr. Wiedenman then provided an overview and examples of suggested mitigation actions tailored for Guilford County. Mr. Wiedenman then asked each county and the municipalities to provide a status update for their existing mitigation actions (completed, deleted, or deferred) by May 15, 2015. Mr. Wiedenman also asked planning team members to include any new mitigation actions by May 15, 2015.

Mr. Wiedenman thanked the group for taking the time to attend and Mr. Smith explained that if team members had any issues or questions about the planning process or their next steps, they could contact him or Mr. Wiedenman. The meeting was adjourned.

Guilford County Public Meeting

June 11, 2015

A public meeting was held to incorporate the public's input on the planning process.

Ryan Wiedenman from Atkins opened by describing the Hazard Mitigation Planning process and the key objectives of the hazard mitigation plan development process. He then went on to describe some of the key findings that had been produced as a result of the process so far including data from the risk assessment, capability assessment, and mitigation action plan.

The floor was then opened for questions about the plan and process, but and several questions were raised regarding the hazard selection process and how the mitigation process generally worked. After these questions were addressed, members of the public were informed that the draft plan could be viewed by visiting the county website.

Guilford County Multi-jurisdictional Hazard Mitigation Plan
Project Kickoff Meeting

November 24, 2014

2:00 -3:30 PM

Name	Jurisdiction	Department	Phone Number	E-mail Address
Zach Smith	Guilford County NC	Emergency Services - Emergency Mgmt	[redacted]	
Dervin Spell	Guilford County	Planning & Development		
Glenn Clapp	High Point	High Point EM		
G.J. Robinson	Greensboro	CSO Fire/EM		
Don Campbell	Guilford EM	Emergency Mgmt		

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Kickoff Meeting

January 13, 2015
10:00 AM - 1:00 PM

Name	Agency	City	Phone Number	E-mail Address
Jarid Hill	Guilford County Emergency Management	Guilford County / Greensboro	[redacted]	[redacted]
Alyson Best	GCDPH.	guilford County		
JERRY COBLE	GCFMO	GUILFORD COUNTY		
Jim Albright	Guilford County Emergency Services	Guilford County		
Don Campbell	Guilford Emergency Management	Guilford County		
TIMOTHY JOHNSON	NC A+T STATE UNIV. EMER. MGMT.	GREENSBORO, NC		
Carla Strickland		Town of Pleasant Garden		
Sandy Carmany		Pleasant Garden		

over →

Scott Whitaker	Town of Summerfield
JULIE A REID	TOWN OF SUMMERFIELD
Thomas Reid	City of H.P. Fire
KEITH PUGH	CITY OF HIGHPOINT ENGINEERING

[redacted]

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Kickoff Meeting

January 13, 2015
10:00 AM - 1:00 PM

Name	Agency	City	Phone Number	E-mail Address
Rachel Fawcette	Guilford County Emergency Management	Greensboro	[redacted]	
Mindy Lepard	Guilford County Emergency Management	Greensboro		
JASON STOGNER	UNCG EMERGENCY MGT.	GREENSBORO		
J. LESLIE BELL	Guilford Cty PLNG & DEV.			
Dervin Spell	// //	Greensboro		
FRANK PARK	Guilford County Planning & DEV	@		
Brandon Parker	Gibsonville Planning	Gibsonville		
Katie Buckner	Greensboro Fire	Greensboro		
STEVE GALANTI	GSO-PLANNING	GSO		
CHRIS FREEMAN	GSO-GIS	GSO		
Alex Street	Greensboro Police	GSO		

Michael Maul	Greensboro PD	[redacted]
Jim Robinson	Greensboro Fire/EM	
Zach Smith	Guilford EM	
Glenn Clapp	High Point OEM	
Jeff Greeson	Jamestown	

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Kickoff Meeting

January 13, 2015

10:00 AM - 1:00 PM

Name	Agency	City	Phone Number	E-mail Address
LaDonna Woodruff	Planning Board Member	Sedalia	[redacted]	
Gary Dead	Town Administrator	Whitsett		
Joe Thacker	Town Council	Stokesdale		
Vicki White-Lawrence	Town Council	Stokesdale		
Frank Bruno	Town Council	Stokesdale		
Allen Averill	ELECTRIC ~~ELECTRIC~~	HIGH POINT		
Lalelle Dorrell	City of GSO Water Resources Dept.	Greensboro		
Virginia Spillman	City of Greensboro Water Resources	Greensboro		
J.D. Stewart	Piedmont Auth. for Regional Transportation	Greensboro		

Brian W. Hall	Guilford County SO	Greensboro
Chris A. Martin	Guilford County SO	Greensboro
Brian W. Shoemaker	City of Greensboro	Greensboro
Peter Schneider	City of GSO; WR Dept	Greensboro
Robert Elliott	Guilford Co. S.O.	GSO
Michael Kirk	HPPD	H.P.D.
Martha Wolfe	Town of Jamestown	Jamestown
TERRY L. Houk	CITY OF High POINT	High POINT
Stephen Dew	Guilford County GIS	Guilford

[redacted]

Guilford County Hazard Mitigation Plan
Public Meeting

March 12, 2015

3:45 PM - 5:00 PM

Name	Address	Phone	Email Address
JIM FARLEY	[redacted]		
Zach Smith			
Frank Parr			
VIRGINIA SPIVEY			
JUSTIN GRAY			
William Smith			
Trey Womble			

Month of April 2015

Guilford County LEPC
Meeting Sign In

NAME	ORGANIZATION	VOTING MEMBER?	PHONE #	EMAIL	INITIALS
Carter, Buddy	Duke Energy	yes	[redacted]	[redacted]	
Chestnut, Michael	Piedmont Chemical	yes			
Clapp, Glenn (Chair)	High Point Fire	yes			
Cobb, Billy	citizen member	yes			
Cole, Scott	GC Environmental Health	yes			
DeBruhl, Ralph	Cone Health	yes			
Drescher, Sharon	Syngenta	yes			
Dudley, Ray	Ecoflo	yes			
Dunmire, Dick	Evonik	yes			
Furr, Barry	Kinder Morgan Southeast	yes			
Husted, Jim	Husted and Associates	yes			
Johnson, Holly	City of Greensboro	yes			
Kabler, Cindy	citizen member	yes			
Kareis, Michelle	Vertellus	yes			
Leigh, Faron	Colonial Pipeline	yes			
Lepard, Mindy (Secretary)	Guilford County EM	yes			
Maul, Mike	Greensboro Police	yes			
Meurs, Debbie	City of High Point	yes			
Moore, Scott (Vice Chair)	Syngenta Crop Protection	yes			
Nieland, Bill (Co-Treasurer)	ZINK Imaging, Inc.	yes			
Raynard, Eddie	City of Greensboro	yes			
Rimmer, Roy	Guilford County Fire	yes			
Robinson, Jim	Greensboro Fire	yes			
Shultz, Kenneth	High Point Police	yes			
Shepherd, Randy	Guilford County Sheriff's Office	yes			
Stennis, Natalie	Solenis LLC	yes			
Vannoy, Dorothy	Lorillard Tobacco	yes			
Weeman, Ken	High Point Red Cross	yes			
Wesselman, Alice	Thomas Built Buses	yes			
Wyrick, Terry	citizen member	yes			
Young, Drew	Lanxess Corp	yes			

Month of April 2015

Guilford County LEPC
Meeting Sign In

NAME	ORGANIZATION	VOTING MEMBER?	PHONE #	EMAIL	INITIALS
Bartlett, Pam	Piedmont Chemicals	alternate	[redacted]	[redacted]	PB
Best, Alyson	Guilford County Health Dept	no			
Brown, Tania	Cone Health	no			
Bryson, Kristi	Akzo Nobel	no			
Butenhoff, Joni	citizen	no			
Campbell, Don	Guilford County EM	alternate			
Cooper, James	Pyramid Environmental	no			
Corey, Dr. Jim	citizen	no			
Cox, Darren	S&ME	no			
Cox, Steve	Honda Aircraft	no			
Davis, Cynthia Y.	High Point City Council	no			
Davis, Marguerite	American Red Cross	no			
Davis, Tracy	Teva Pharmaceutical	no			
Dearing, Josh	SWS Environmental	no			
Dudley, Ray	citizen member	no			
Dulin, David	High Point Police	alternate			
Edgerton, Ronica	Dow Corning	no			
Faucette, Rachel	Guilford County EM	no			
Greene, Scott	GC Environmental Health	alternate			
Gwyn, Jim	City of High Point	alternate			
Herron, Charley	Brenntag Mid-South Inc.	no			CH
Hill, Jared	Guilford County EM	no			
Husted, Mary	Husted and Associates	alternate			
Hoover, Kyle	High Point Fire Dept.	no			
Johnson, Van	Lorillard Tobacco	no			
Joseph, Lisa	City of High Point	no			
Kabler, Robert	citizen	no			
Kane, Mike	GHP/Davidson Red Cross	no			
Kaserman, Don (Co-Treasurer)	KAO Specialties	no			
Kelley, Richard	Olympic Products, LLC	no			
Lovett, Richard	Golder Associates	no			
Manuel, Roger	City of Burlington	no			RM

Month of April 2015

Guilford County LEPC
Meeting Sign In

NAME	ORGANIZATION	VOTING MEMBER?	PHONE #	EMAIL	INITIALS
McCallister, Mitch	Shamrock Environmental	no			
McClintock, Jeff	RFMD	no			
McWhorter, Kasey	S&ME	no			
Meyer, Ken	Evonik	no			
Money, Beth	Gilbarco	no			
Moody, Rick	Procter and Gamble	no			
Moon, Marshall	Guilford County Fire	alternate			
Myers, Geoff	Garco Inc.	no			
Patterson, Jenny	NCDENR- Hazardous Waste	no			
Permar, Jeff	Ameritox, Ltd	no			
Plaster, Kim	Kay Chemical/Ecolab	no			
Pool, Rachel	Dow Corning	no			
Raschke, Jim	Williams Pipeline/Pine Needle	no			
Roberts, Jimmy	Williams Pipeline/Pine Needle	no			
Schneider, Peter	City of Greensboro	no			
Shields, Mandy	American Red Cross	no			
Sizemore, Ken	Golder Associates	no			
Sizemore, James	Shamrock Environmental	no			
Smith, Susan	American Red Cross	no			SBS
Smith, Zach	Guilford County EM	no			Z.S.
Snover, Bradley	Quality Oil and Reliable Tank	no			
Sparks, Randy	Ecoflo	no			
Sumner, Larry (Rock)	Cone Health	alternate			
Taintor, Todd	Enpuricon	no			
Talbert, Gary	ITG-Cone Denim	no			
Tatum, Tyres	NCEM	no			
Tucker, Shawn	A&D Environmental	no			
Walker, Trent	Greensboro Police	alternate			
Webb, Ken	Ecoflo	no			
Welborn, Darrell	High Point Fire Dept.	no			
Whitworth, Chuck	Greensboro Fire	alternate			
Wood, Joel	Greensboro Fire	no			

Month of April 2015

Guilford County LEPC
Meeting Sign In

NAME	ORGANIZATION	VOTING MEMBER?	PHONE #	EMAIL	INITIALS
Ashley Dinkins	Guilford Co. Env. Hth	N	[redacted]	[redacted]	AFD
Patricia Rissler	Colonial Pipeline	N			PR
ASHLEY WOODLIEF	JWC	N			
JASON STOGNIEW	UNCG	N			JKS

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Mitigation Strategy Meeting

April 30, 2015

10:00 AM - 12:00 PM

Name	Agency	City	Phone Number	E-mail Address
Glenn Clapp	High Point OEM	High Point	[redacted]	
Sandy Carmany	Pleasant Garden	Pleasant Garden		
Scott Whitaker	Summerfield →			
Jim Albright	GCES	Guilford Co.		
LaDonna Woodruff	Planning board	Sedalia		
Virgin Spillman	CO Greensboro	Greensboro		
Sandra Smith	Town of Oak Ridge	Oak Ridge		
JERRY COPLE	GUILFORD CO. FMO			

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Mitigation Strategy Meeting

April 30, 2015

10:00 AM - 12:00 PM

Name	Agency	City	Phone Number	E-mail Address
Jim Gwyn	City of High Point Public Services Dept	High Point	[redacted]	[redacted]
David Morris	PART	Greensboro		
Andrew O'Brien	Greensboro Police	Greensboro		
Lavelle Dunnell	City of Greensboro Water Department	Greensboro		
Alex Tobergte	City of Greensboro water dept.	Greensboro		
Don Campbell	Guilford EM	County		
Jared Hill	Guilford EM	County		
Alyson Best	Health	County		

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Mitigation Strategy Meeting

April 30, 2015
10:00 AM - 12:00 PM

Name	Agency	City	Phone Number	E-mail Address
Zach Smith	Guilford Co. EM	Greensboro	[redacted]	
Mike Kirk	HPD	HP		
Alex Stout	Greensboro Police	GSO.		
Brent Cotten	NCEM	State of NC		
Steve Galanti	COG-Planning	GSO		
Chris Freeman	COG - GIS.	GSO		
Frank Bruno	Town of Stokesdale	Stokesdale		
Gary Dodd	Town of Whitsett	Whitsett		

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Mitigation Strategy Meeting

April 30, 2015
10:00 AM - 12:00 PM

Name	Agency	City	Phone Number	E-mail Address
J.D. Stewart	PART	Greensboro	[redacted]	
Frank Powell	Guilford County Planning Dept	Greensboro		
Derwin Spell	Guilford Co Planning	Greensboro		
Chris Martin	GCSO	Greensboro		
George Moore	GCSO	Greensboro		
Rachel Faucette	GCEM	Greensboro		
Jason Stogner	UNCG EM	Greensboro		
Katie Buckner	GSO GFD	GSO		

Guilford County Hazard Mitigation Plan
Hazard Mitigation Planning Team Mitigation Strategy Meeting

April 30, 2015

10:00 AM - 12:00 PM

Name	Agency	City	Phone Number	E-mail Address
JUSTIN GRAY	GUILFORD COUNTY		[redacted]	
Brian Hall	Guilford Co SO			
Brian Shoemaker	GDOT	Greensboro		
Paul Blanchard	Town of Jamestown	Jamestown Public Safety		
Jim Robinson	GSO Fire	GSO		
Mindy Lepard	Guilford County EM			
Brandon Parker	Town of Gibsonville	Planning		
Allen Averill	HIGH POINT	ELECTRIC		

Guilford County Hazard Mitigation Plan
Public Meeting

June 11, 2015

1:30 PM - 2:30 PM

Name	Address	Phone	Email Address
Lynn Allison	[redacted]		
Virginia Spilman			
Lavelle Donnell			
JUSTIN GRAY			

Appendix E
Community Rating System

This section of the Plan provides a summary of mitigation measures that were considered by the participating jurisdictions in Guilford County to reduce their risk to the flood hazard specifically, thereby achieving the requirements set forth in Section 510 of the Community Rating System (specifically Step 7). These flood mitigation measures are based on suggested activities that have been shown to significantly reduce flood risk and have been analyzed by each of the respective communities that participate in the Guilford County Hazard Mitigation Plan. The measures are broken down into one of the following six categories of activities that fall within the sphere of prevention activities:

PREVENTION ACTIVITIES

- Floodplain Management
- Comprehensive or Land Use Planning
- Zoning
- Subdivision Regulations
- Stormwater Management
- Building Codes

E.1 INTRODUCTION

This appendix to the Hazard Mitigation Plan was developed in order to enhance each jurisdiction's overall resilience to the flood hazard by documenting the steps taken, and those that need to be taken to help improve each jurisdiction's regulatory environment through preventative actions. In order to maximize points that can be awarded to reduce flood insurance rates through the Community Rating System, communities must thoroughly evaluate preventative mitigation measures.

These measures are often considered the most exemplary type of mitigation actions that can be implemented because their purpose is to prevent issues related to flooding from occurring at all. For instance, if a community were to prohibit any construction within the floodplain, this would prevent any structures that might have been built in that area from being flooded because they won't be located in a high risk area.

Preventative measures are often associated with planning and regulatory activities such as zoning and building codes. The six main categories of prevention activities are outlined above and each of these types of activities are assessed in greater detail below. For each community that participated in this plan, an evaluation of several measures for each category was carried out to determine the community's willingness to implement preventative measures and outline a plan for reducing flood risk.

Within this evaluation, current standards and regulations are identified along with an explanation of local implementation of the specific standard or regulation. In addition, recommendations for future implementation have been discussed and any changes that were considered but discounted as not feasible have been identified along with an explanation concerning why that determination was made.

E.1.1 Floodplain Management

Floodplain Management is a broad category that generally overlaps many of the other prevention-related categories identified herein. However, while other categories of prevention activities such as zoning often exist for purposes beyond mitigation and risk reduction, floodplain management is the primary activity designed to reduce flood risk. A number of jurisdictions that participated in the hazard mitigation planning process considered several activities that attempt to reduce flood risk through better management of identified floodplain areas.

As described in **Table E.1**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing floodplain management activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.1: FLOODPLAIN MANAGEMENT ACTIVITIES

Preventative Activities				
Floodplain Management Regulations— There are a number of regulations that a local government can put into place that can be considered under the category of floodplain management regulations. For example, a jurisdiction could adopt a flood damage prevention ordinance, develop a floodplain management plan, or participate in the National Flood Insurance Program. Each of these activities may help reduce the impact of flooding by providing regulatory guidance aimed at the specific areas within the jurisdiction that are most vulnerable to flooding. Floodplain management regulations are an appropriate activity that Guilford County and its municipalities can use to reduce future flood losses since each community has some type of floodplain management regulation in place.				
Jurisdiction	**Current Standards/ Regulations**	**Local Implementation**	**Recommendations for Future Implementation**	**Changes Considered but Discounted as Not Feasible**
Guilford County	UDO, Article 7.5: Flood Damage Prevention Ordinance	The Guilford County Flood Damage Prevention Ordinance includes a number of requirements for submitting a permit prior to any construction in areas designated as a floodplain. For example, base flood elevation must be provided before development is allowed and encroachments of the floodplain are heavily regulated.	• The county is willing to consider possibly implementing higher freeboard requirements for properties located in the floodplain. • The county should continue to prohibit any fill in floodplain areas. • The county is willing to consider possibly adopting a "no-rise" in base flood elevation clause.	• The county has considered a number of options regarding floodplain management regulations as is evident in previous columns. It is at least considering implementation of all options that were considered.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Greensboro	Land Development Ordinance, Article 12-2: Flood Damage Prevention	The Greensboro Land Develop Ordinance includes an article that establishes flood damage prevention regulations to all areas of special flood hazard and future conditions flood hazard areas within the city and its extra-territorial jurisdiction.	• The city is willing to consider possibly implementing higher freeboard requirements for properties located in the floodplain and already has higher standards in place regarding freeboard • The city should continue to implement its "no-rise" in base flood elevation cause.	• The city considered establishing a provision that prohibits any fill in floodplain areas, but it was determined to be not politically feasible
Stokesdale	Stokesdale Development Ordinance	The Stokesdale Development Ordinance includes provisions that attempt to reduce risk in high flood hazard areas by reducing development in these areas.	• The town is willing to consider implementing a higher freeboard requirements for properties located in the floodplain. • The town is willing to consider prohibiting fill in floodplain areas. • The town is willing to consider adopting a "no-rise" in base flood elevation clause.	• The town has considered a number of options regarding floodplain management regulations as is evident in previous columns. It is at least considering implementation of all options that were considered.

E.1.2 Comprehensive or Land Use Planning

Comprehensive or Land Use Planning is one of the most impactful means of reducing flood risk because it can provide an overall plan for the community in terms of where development takes place. As a result, comprehensive/land use planning can help direct people and property out of known flood prone areas and reduce the threat of future flood losses. A number of jurisdictions that participated in the Hazard Mitigation Planning process considered several activities that attempt to reduce flood risk through better either a comprehensive or land use plan.

As described in **Table E.2**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing comprehensive or land use planning activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.2: COMPREHENSIVE/LAND USE PLANNING ACTIVITIES

Preventative Activities

Comprehensive/Land Use Plan— A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide for future governmental decision making. Typically a comprehensive plan contains sections on demographic conditions, land use, transportation elements, and community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives, and actions. For example, the comprehensive plan can help reduce future flood risk by including a policy to prohibit new development within the 100-year floodplain or by including a goal to maximize open space in the floodplain. Comprehensive planning is an appropriate activity that Guilford County and its municipalities can use to reduce future flood losses since each community already has a comprehensive or future land use plan in place.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Guilford County	Guilford County Comprehensive Plan	The Guilford County Comprehensive Plan includes a section on water shed protection policies which includes policies ensure erosion control, watershed protection and compliance with floodplain regulations. Specific policies include utilizing site inspections to identify infractions, thereby reducing flood risk.	• The county is willing to consider possibly increasing the amount of its land area classified as open space. • The county is willing to consider possibly classifying all areas delineated as floodplain as open space. • The county is willing to consider possibly preventing infrastructure expansion in areas exposed to flood hazards.	• The county has considered a number of options regarding comprehensive planning as is evident in previous columns. It is at least considering implementation of all options that were considered.
Greensboro	Greensboro Connections 2025 Comprehensive Plan	Connections 2025 includes a Parks, Open Space, and Natural Resources element. This element includes goals and policies related to strengthening floodplain management standards. One policy proposes that the current standards for development within the 100-year floodplain be "fine-tuned" to better protect floodplain values with an emphasis on providing feasible options and incentives for development to reduce floodplain impacts (e.g., by clustering buildings away from frequently inundated areas.	• The city is willing to consider possibly increasing the amount of its land area that is classified as open space. • The city should continue to classify all areas delineated as floodplain as open space.	• The city considered preventing infrastructure expansion in areas exposed to flood hazards, but it was determined to be not politically feasible.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Stokesdale	Town of Stokesdale Future Land Use Plan	Stokesdale's land use plan includes provisions for areas of open space which help reduce flood losses and flood risk by reducing impermeable surface areas and allowing water to naturally flow into the groundwater supply.	• The town is willing to consider possibly increasing the amount of its land area classified as open space. • The town is willing to consider possibly classifying all floodplain areas as open space. • The town is willing to consider possibly establishing a provision that prevents infrastructure expansion in areas expose to flood hazards.	• The town has considered a number of options regarding floodplain management regulations as is evident in previous columns. It is at least considering implementation of all options that were considered.

E.1.3 Zoning

Zoning is often considered an arm of land use planning and is generally designed to regulate certain functions or characteristics of development that are allowed in an area of the jurisdiction. Much like land use planning, zoning can help direct development outside of high risk areas and also regulate the density of development that is allowed in those areas. A number of jurisdictions that participated in the Hazard Mitigation Planning process considered several activities that attempt to reduce flood risk through some form of zoning.

As described in **Table E.3**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing zoning activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.3: ZONING ACTIVITIES

Preventative Activities

Zoning— Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the public health, safety, and welfare of those in a given jurisdiction that maintains zoning authority. A zoning ordinance is the mechanism through which zoning is typically implemented. Since zoning regulations enable municipal governments to limit the type and density of development, a zoning ordinance can serve as a powerful tool when applied in identified hazard areas. For example, the comprehensive plan can help reduce future flood risk by prohibit or limit future construction in the 100-year floodplain or by limiting the density of development in the floodplain. Zoning is an appropriate activity that Guilford County and its municipalities can use to reduce future flood losses since each community has some degree of zoning in place.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Guilford County	UDO, Article 4: Zoning	The Guilford County Zoning Ordinance includes sections that prevent development in floodways and other floodprone areas. Specific policies state that environmentally sensitive areas such as floodways should be left natural and as open space other than recreation facilities, walkways, and other similar construction.	• The county is willing to consider possibly requiring a higher ratio of permeable to impermeable surface area in new commercial construction than is currently in place. • The county is willing to consider possibly prohibiting or limiting future construction in the floodplain. • The county is willing to consider possibly establishing a provision that limits the density of development in the floodplain.	• The county has considered a number of options regarding zoning as is evident in previous columns. It is at least considering implementation of all options that were considered.
Greensboro	Land Development Ordinance, Article 6: Zoning Districts	Article 6 of the Greensboro Land Development Ordinance regulates the type of development that can take place in certain areas of the jurisdiction. Zoning for large size (>10 acres) public and quasi-public lands, such as parks, recreation, conservation, and natural areas, is in place and can be used for open space preservation which can reduce the amount of impermeable surface area in the jurisdiction.	• The city should continue requiring a high ratio of permeable to impermeable surface area in new commercial construction	• The city considered prohibiting future construction in the floodplain, but it was determined to be not politically feasible. • The city considered limiting the density of development in the floodplain, but it was determined to be not politically feasible.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Stokesdale	Development Ordinance: Zoning	The Stokesdale Development Ordinance includes appropriate zoning maps and regulates the type of development that can take place in certain areas of the jurisdiction. Zoning for can be used to create open space preservation which can reduce the amount of impermeable surface area in the jurisdiction.	• The town is willing to consider requiring a higher ration than is currently in place of permeable to impermeable surface area in new commercial construction. • The town is willing to consider prohibiting or limiting future construction in the floodplain. • The town is willing to consider limiting the density of development in the floodplain.	• The town has considered a number of options regarding zoning as is evident in previous columns. It is at least considering implementation of all options that were considered.

E.1.4 Subdivision Regulations

Subdivision ordinances are typically enacted on a much smaller scale than any of the previously discussed types of prevention activities. Often, subdivision regulations address specific neighborhoods and the types of activities that might be carried out there. Many subdivision ordinances govern standards that must be put in to place when a new development is being designed, but subdivision ordinances also often provide incentives for the inclusion of best practices in flood management into development. A number of jurisdictions that participated in the Hazard Mitigation Planning process considered several activities that attempt to reduce flood risk through subdivision ordinances.

As described in **Table E.4**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing subdivision ordinance activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.4: SUBDIVISION ORDINANCE ACTIVITIES

Preventative Activities

Subdivision Ordinance— A subdivision ordinance is intended to regulate the development of residential, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development. For example, a subdivision ordinance can help reduce future flood risk by including risk reducing actions on a lot level such as tree planting requirements or encouraging the use of rain barrels. These ordinances are an appropriate activity that Guilford County and its municipalities can use to reduce future flood losses since each community already has a form of subdivision ordinance in place.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Guilford County	UDO, Article 6: Subdivisions: Procedures and Standards	The Guilford County Subdivision Ordinance includes requirements that new subdivisions include special flood hazard areas as part of the drainage maintenance and utility easement area. The ordinance also states that all subdivision proposals shall have adequate drainage necessary to reduce exposure to flood hazards.	• The county is willing to consider possibly incentivizing the use of rain barrels or rain gardens. • The county is willing to consider possibly requiring more trees be preserved and planted in landscape designs to reduce stormwater runoff. • The county is willing to consider possibly requiring a drainage study with new development.	• The county has considered a number of options regarding subdivision ordinances as is evident in previous columns. It is at least considering implementation of all options that were considered.
Greensboro	Land Development Ordinance, Article 13: Subdivision Standards	The Greensboro Subdivision Ordinance includes a requirement that every lot must have a contiguous buildable area that must lie at or be filled to an elevation at least one foot above the base flood elevation.	• The city would be willing to consider implementing a program to incentivize the use of rain barrels and/or rain gardens. • The city should continue to require more trees be preserved and planted in landscape designs to reduce stormwater runoff • The city should continue to require a drainage study with new development.	• The city has considered a number of options regarding subdivision ordinances as is evident in previous columns. It is at least considering implementation of all options that were considered.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Stokesdale	Stokesdale Development Ordinance	The Stokesdale Development Ordinance includes provisions that determine how new subdivisions can be built and requires several requirements that are intended to reduce the amount of flooding in the jurisdiction	• The town is willing to consider incentivizing the use of rain barrels and/or rain gardens. • The town is willing to consider requiring more trees be preserved and planted in landscape designs to reduce stormwater runoff. • The town is willing to consider possibly requiring a drainage study with new development.	• The town has considered a number of options regarding subdivision ordinances as is evident in previous columns. It is at least considering implementation of all options that were considered.

E.1.5 Stormwater Management

Somewhat distinct from many of the other categories of prevention activities, stormwater management encompasses activities that deal with water runoff during storm events that is managed and directed by the local government entity. Stormwater management issues have become an especially prominent discussion point in the arena of flood risk reduction for local governments because of this responsibility. A number of jurisdictions that participated in the Hazard Mitigation Planning process considered several activities that attempt to reduce flood risk through stormwater management.

As described in **Table E.5**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing stormwater management activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.5: STORMWATER MANAGEMENT ACTIVITIES

Preventative Activities

Stormwater Management— A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding. For example, stormwater management regulations or plans can help reduce future flood risk by requiring restrictions on development in upland areas to reduce stormwater run-off or adopting Phase II stormwater regulations. Stormwater management plans are an appropriate activity that Guilford County and its municipalities can use to reduce future flood losses since each community is working to develop or already has a form of stormwater management in place.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Guilford County	UDO, Article 7: Stormwater Management/ Watershed Protection Districts	The Guilford County Stormwater Management ordinance includes two overlay districts: the National Pollutant Discharge Elimination System (NPDES) and the Water Supply Watershed. The county is committed to effectively managing stormwater quality issues and is continuously working to identify and eliminate illicit connections and illegal dumping, educate residents and businesses about various stormwater related issues, and insure development meets the county's watershed regulations.	• The county is willing to consider possibly setting compensatory storage requirements for new construction. • The county is willing to consider possibly regulating development in upland areas in order to reduce stormwater runoff. • The county is willing to consider possibly linking flood hazard mitigation objectives with EPA Stormwater Phase II initiatives.	• The county considered a number of options regarding stormwater management as is evident in previous columns. It is at least considering implementation of all options that were considered.
Greensboro	Land Development Ordinance, Article 12-7: Stormwater Management	The City of Greensboro has developed a comprehensive stormwater management program that is committed to the preservation and enhancement of residents' quality of life through water quality improvement, drainage infrastructure management, flood hazard minimization, and public awareness. In addition to the stormwater management ordinance, the city has developed a Stormwater Management Manual which includes BMP requirements and guidelines as well as NPDES Phase II permit requirements.	• The city is willing to consider possibly setting compensatory storage requirements for new construction and already has some such standards in place. • The city is willing to possibly consider regulating development in upland areas in order to reduce stormwater run-off • The city is willing to possibly consider linking flood hazard mitigation objectives with EPA Stormwater Phase II initiatives	• The city considered a number of options regarding stormwater management as is evident in previous columns. It is at least considering implementation of all options that were considered.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Stokesdale	Stokesdale Development Ordinance	The Town of Stokesdale has developed stormwater management provisions as part of its Development Ordinance. These help identify designated water supply areas on the watershed map.	• The town is willing to consider possibly setting compensatory water storage requirements for new construction. • The town is willing to possibly consider regulating development in upland areas in order to reduce stormwater runoff • The town is willing to possibly consider linking flood hazard mitigation objectives with EPA Stormwater Phase II initiatives.	• The town has considered a number of options regarding stormwater management as is evident in previous columns. It is at least considering implementation of all options that were considered.

E.1.6 Building Codes

Building Codes are can help in the reduction of risk to flooding events in a number of ways. For instance, stronger building codes can help to ensure that structures are built to a standard which will allow them to resist the hydrostatic and hydrodynamic forces of flood waters. Building codes are often implemented at the local level, but in many cases, states set the actual provisions of the building code through minimum standards that communities must adopt. A number of jurisdictions that participated in the Hazard Mitigation Planning process considered several activities that attempt to reduce flood risk through better management of identified floodplain areas.

As described in **Table E.6**, in some cases, it was determined that local governments were already implementing risk reducing activities and merely needed to formalize their commitment to continue to enact these measures. In general, communities were either already implementing building code activities or were working towards implementing these activities in the near future. However, some activities that were considered for implementation could not be incorporated into the local government's implementation structure. In cases where activities were considered, but could not be moved forward, the activity has been identified and an explanation of why it would not be feasible has been included.

TABLE E.6: BUILDING CODE ACTIVITIES

Preventative Activities

Building Code—Building codes regulate construction standards. In many communities, permits and inspections are required for new construction. Decisions regarding the adoption of building codes (that account for hazard risk), the type of permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community. An example of how building codes can reduce flood risk is by implementing a code that requires that new buildings constructed in the floodplain are built with materials that are resistant to the anticipated velocity of floodwaters.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Guilford County	Adopted 2012 North Carolina State Building Code	Appendix G of the NC State Building Code outlines regulations for flood resistant construction. Among other regulations, the code states that all permit applications for construction or substantial improvement to structures in the floodplain must by designed and constructed with methods, practices, and materials that minimize flood damage.	• Continue adopting future updates to the North Carolina State Building Code and enforcing it throughout the jurisdiction. • The county is willing to consider possibly adopting higher building code standards such as the International Building Code or International Residential Code. • The county is willing to consider possibly adopting ASCE 24-05 which specifies minimum requirement and expected performance for the design and construction of buildings and structures in flood hazard areas to make them more resistant to flood loads and flood damage.	• The county considered a number of options regarding building codes as is evident in previous columns. It is at least considering implementation of all options that were considered.

Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Greensboro	Adopted 2012 North Carolina State Building Code	Appendix G of the NC State Building Code outlines regulations for flood resistant construction. Among other regulations, the code states that all permit applications for construction or substantial improvement to structures in the floodplain must by designed and constructed with methods, practices, and materials that minimize flood damage.	• Continue adopting future updates to the North Carolina State Building Code and enforcing it throughout the jurisdiction. • The city is willing to consider possibly adopting higher building code standards such as the International Building Code or the International Residential Code. • The city is willing to consider possibly adopting ASCE 24-05 which specifies minimum requirement and expected performance for the design and construction of buildings and structures in flood hazard areas to make them more resistant to flood loads and flood damage.	• The city considered a number of options regarding building codes as is evident in previous columns. It is at least considering implementation of all options that were considered.

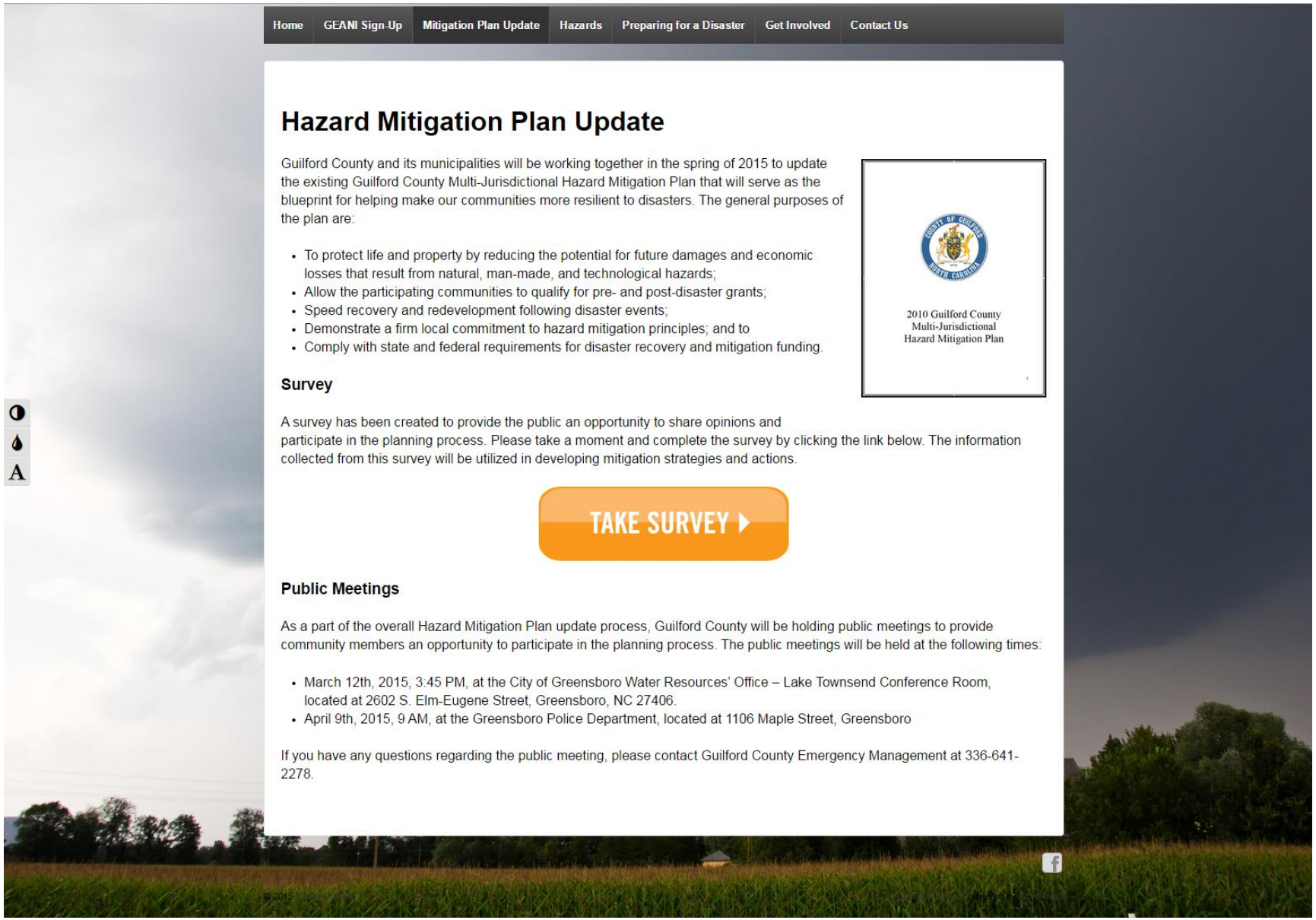
Jurisdiction	Current Standards/ Regulations	Local Implementation	Recommendations for Future Implementation	Changes Considered but Discounted as Not Feasible
Stokesdale	Adopted 2012 North Carolina State Building Code	Appendix G of the NC State Building Code outlines regulations for flood resistant construction. Among other regulations, the code states that all permit applications for construction or substantial improvement to structures in the floodplain must by designed and constructed with methods, practices, and materials that minimize flood damage.	• Continue adopting future updates to the North Carolina State Building Code and enforcing it throughout the jurisdiction • The town is willing to consider possibly adopting higher building code standards such as the International Building Code or International Residential Code • The town is willing to consider possibly adopting ASCE 24-05 which specifies minimum requirement and expected performance for the design and construction of buildings and structures in flood hazard areas to make them more resistant to flood loads and flood damage.	• The town considered a number of options regarding building codes as is evident in previous columns. It is at least considering implementation of all options that were considered.

Appendix F
Public Involvement

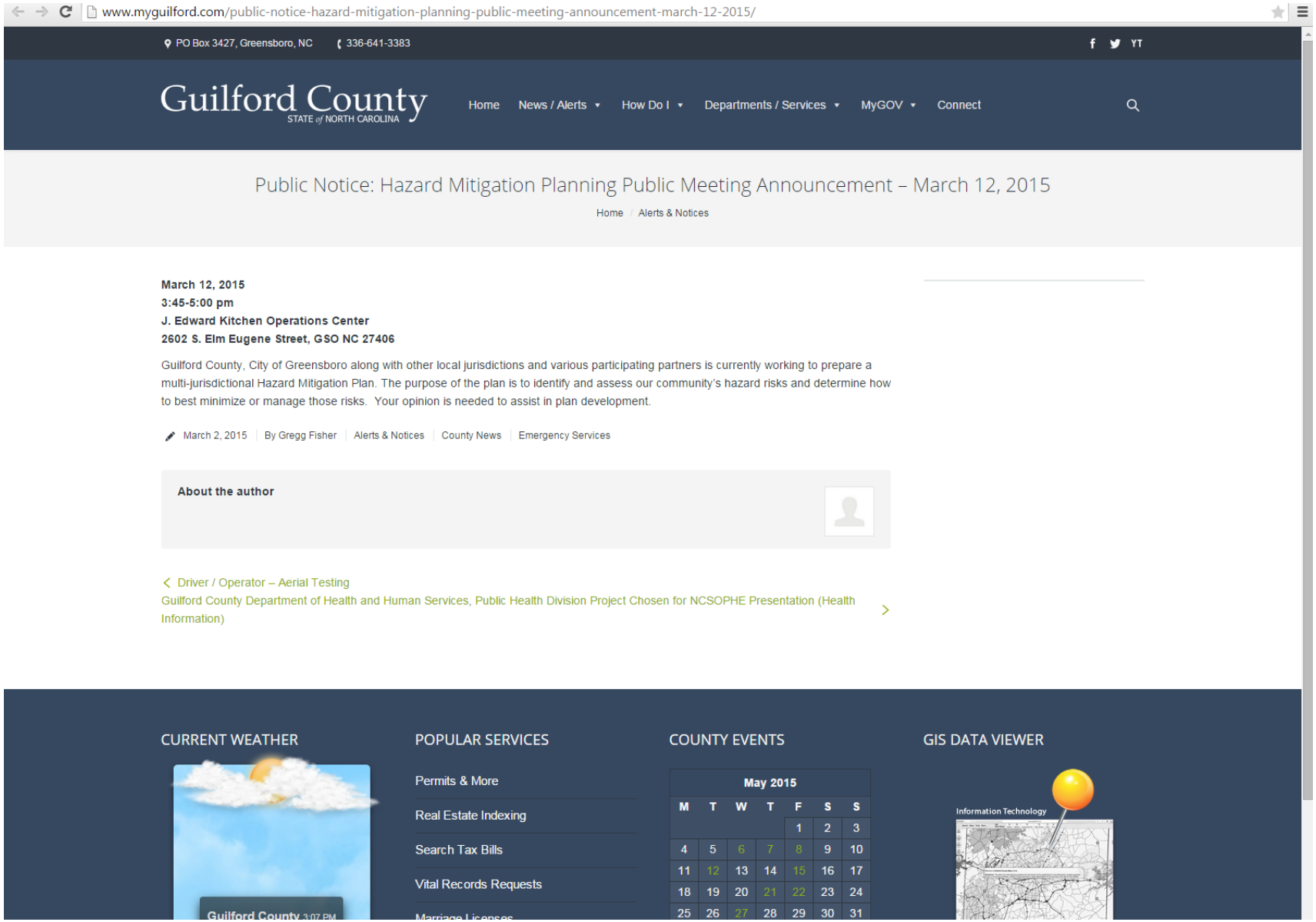
This appendix includes:

1. Public Outreach Documentation
2. Public Survey Summary Results

Public Survey Advertisement



Advertisement of Public Meeting (March 12)



Advertisement of Public Meeting (April 9)

PO Box 3427, Greensboro, NC 336-641-3383

Guilford County
STATE of NORTH CAROLINA

Home | News / Alerts | How Do I | Departments / Services | MyGOV | Connect

PUBLIC NOTICE: Hazard Mitigation Planning Public Meeting – April 9, 2015

Home / County News

Guilford County, along with other local jurisdictions and various participating partners, is currently working to prepare a Multi-Jurisdictional Hazard Mitigation Plan. The purpose of the plan is to identify and assess our community's hazard risks and determine how to best minimize or manage those risks. Your opinion is needed to assist in plan development.

Date: April 9th, 2015
Time: 9:00 AM to 10 AM
Location: City of Greensboro Police Department
1106 Maple Street, Greensboro, NC 27405

March 30, 2015 | By Gregg Fisher | County News | Emergency Services

About the author

Guilford County Department of Health and Human Services, Division of Public Health Receives $99,987 National Food Insecurity Nutrition Incentive (FINI) Grant

Firefighter I & II — Health & Wellness

CURRENT WEATHER

POPULAR SERVICES

Permits & More
Real Estate Indexing
Search Tax Bills

COUNTY EVENTS

May 2015

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17

GIS DATA VIEWER

Information Technology

Flooding along Wendover Avenue in Greensboro
Photo Source: Fox 8

Guilford County
Hazard Mitigation Plan

Public Participation Survey Results

ATKINS

Public Participation Survey

- Provides an opportunity for the public to share opinions and participate in the planning process
- Link to survey posted on County website
- 432 completed surveys received

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Public Participation Survey Highlights

- 87% of respondents are interested in making their homes more resistant to hazards
- 37% have already taken action to make their homes more hazard resistant
- 55% do not who to contact regarding risk reduction

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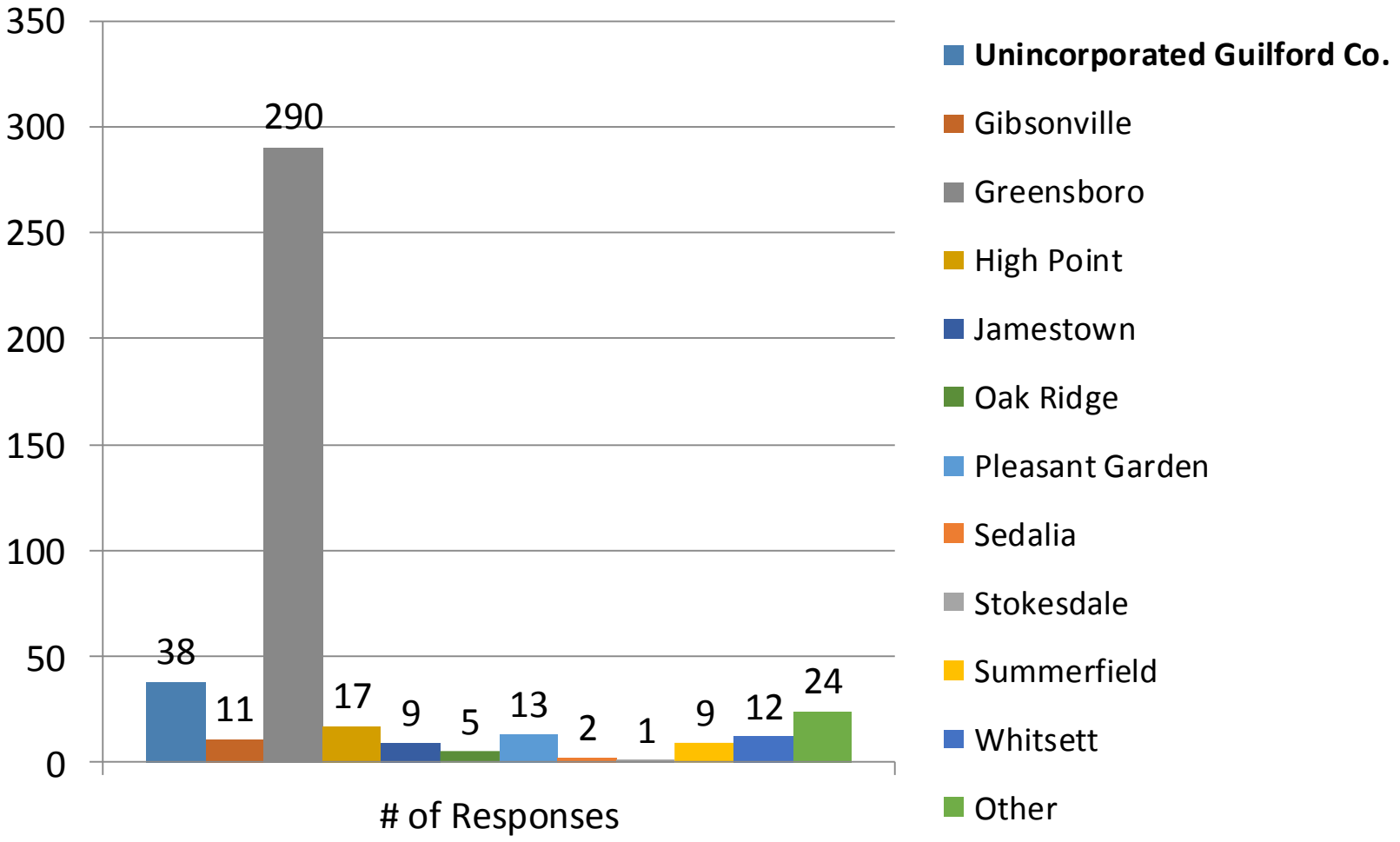
1. Where do you live?



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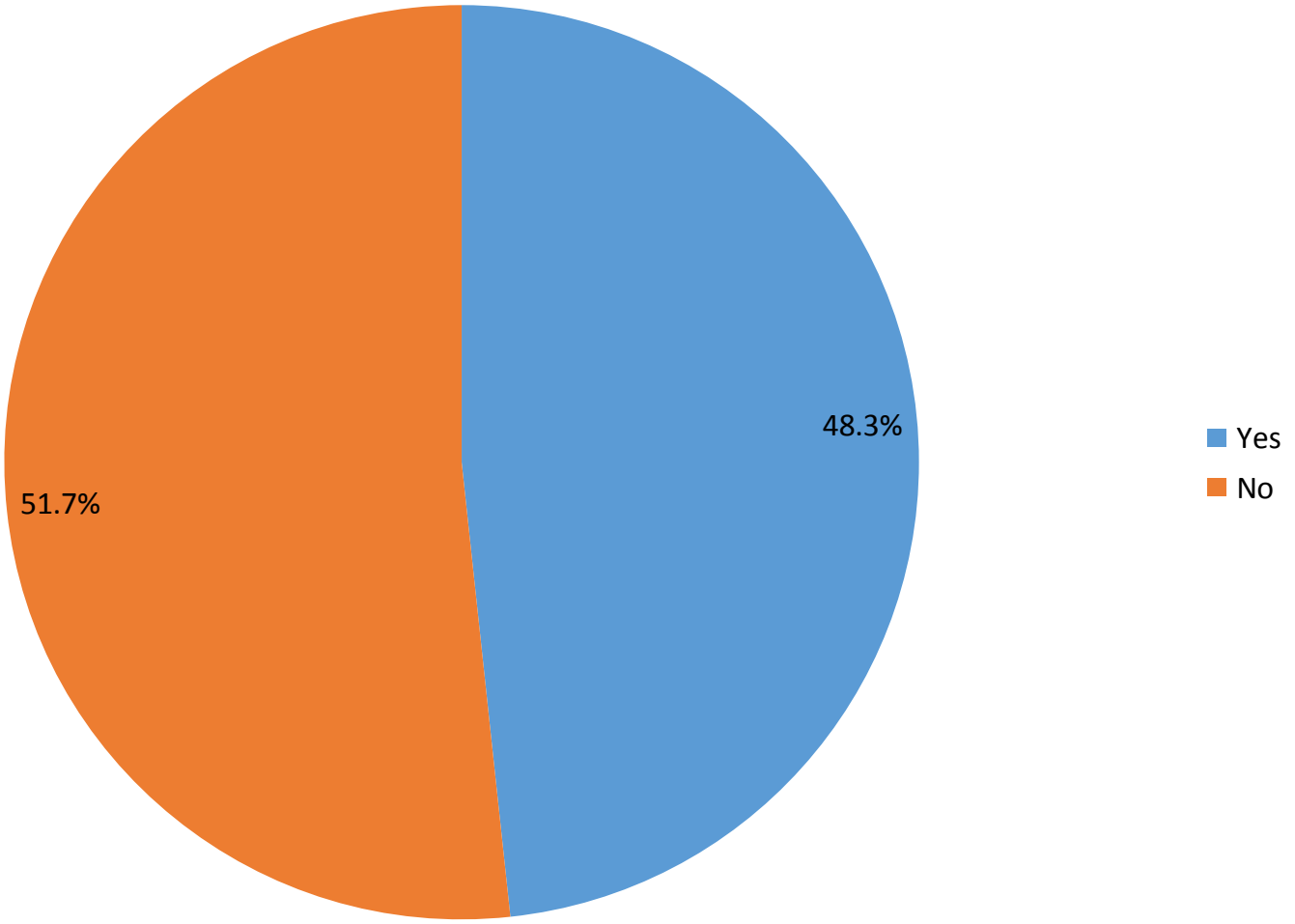
2. Have you experienced a disaster?



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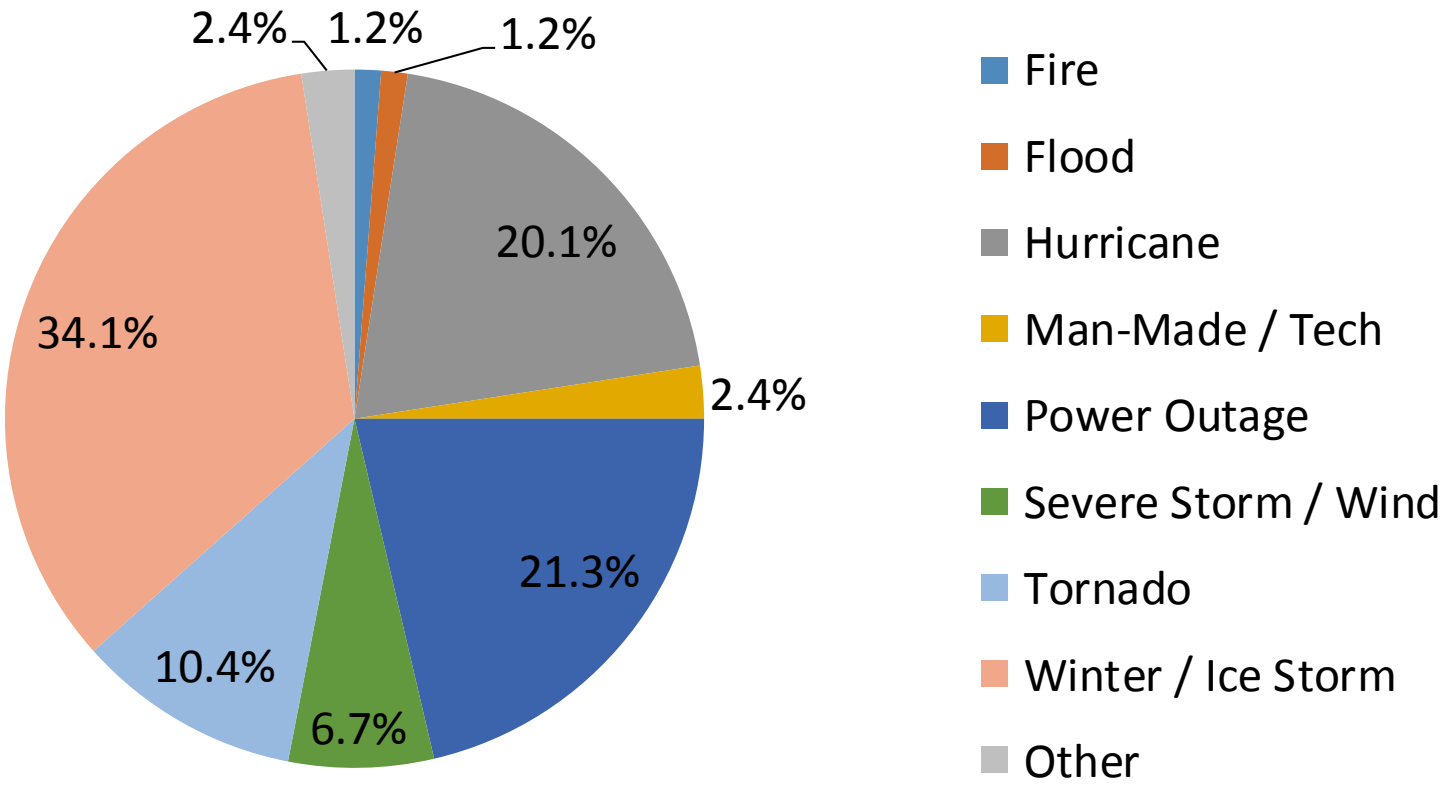
2. Examples of disasters experienced



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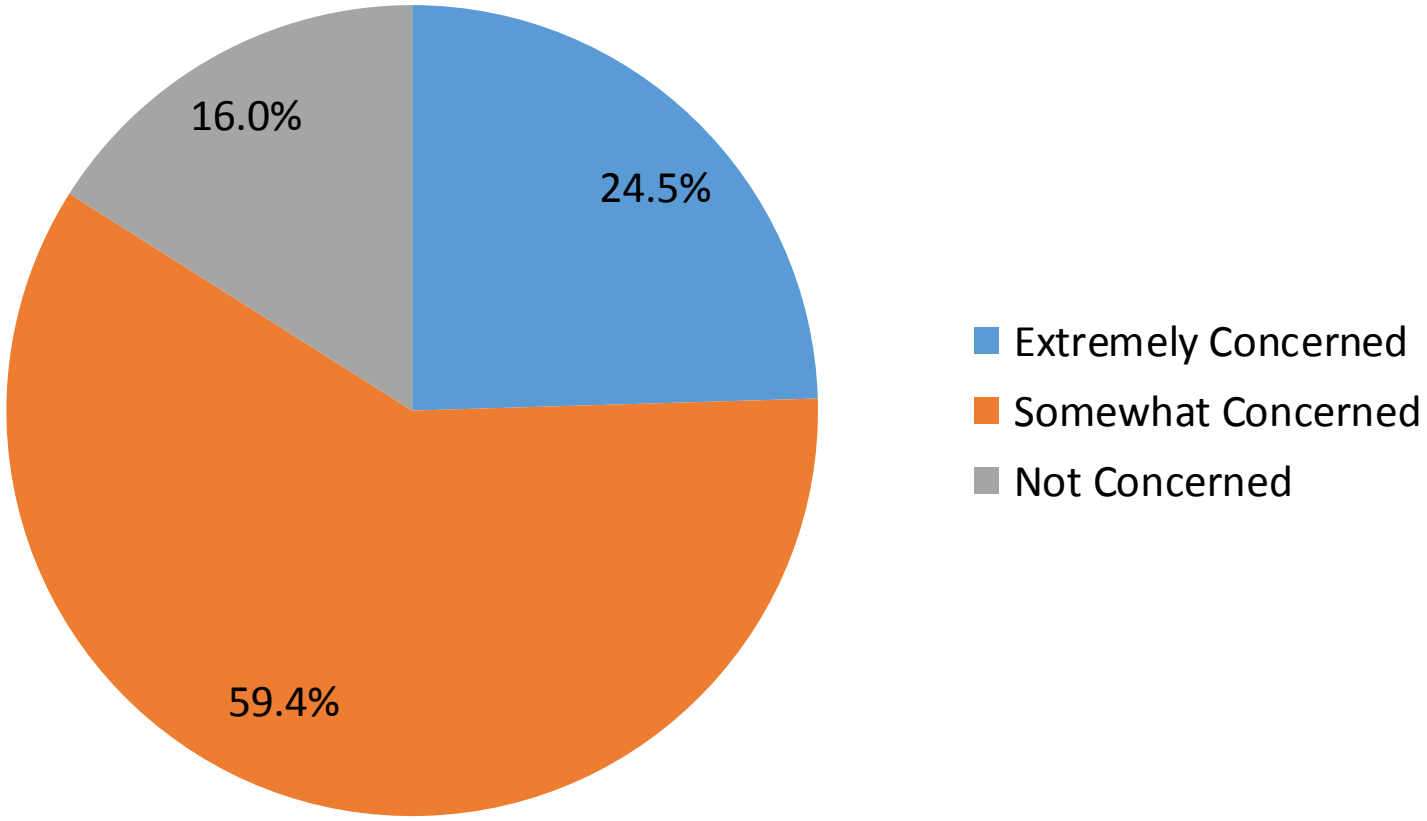
3. How concerned about possibility of disaster?



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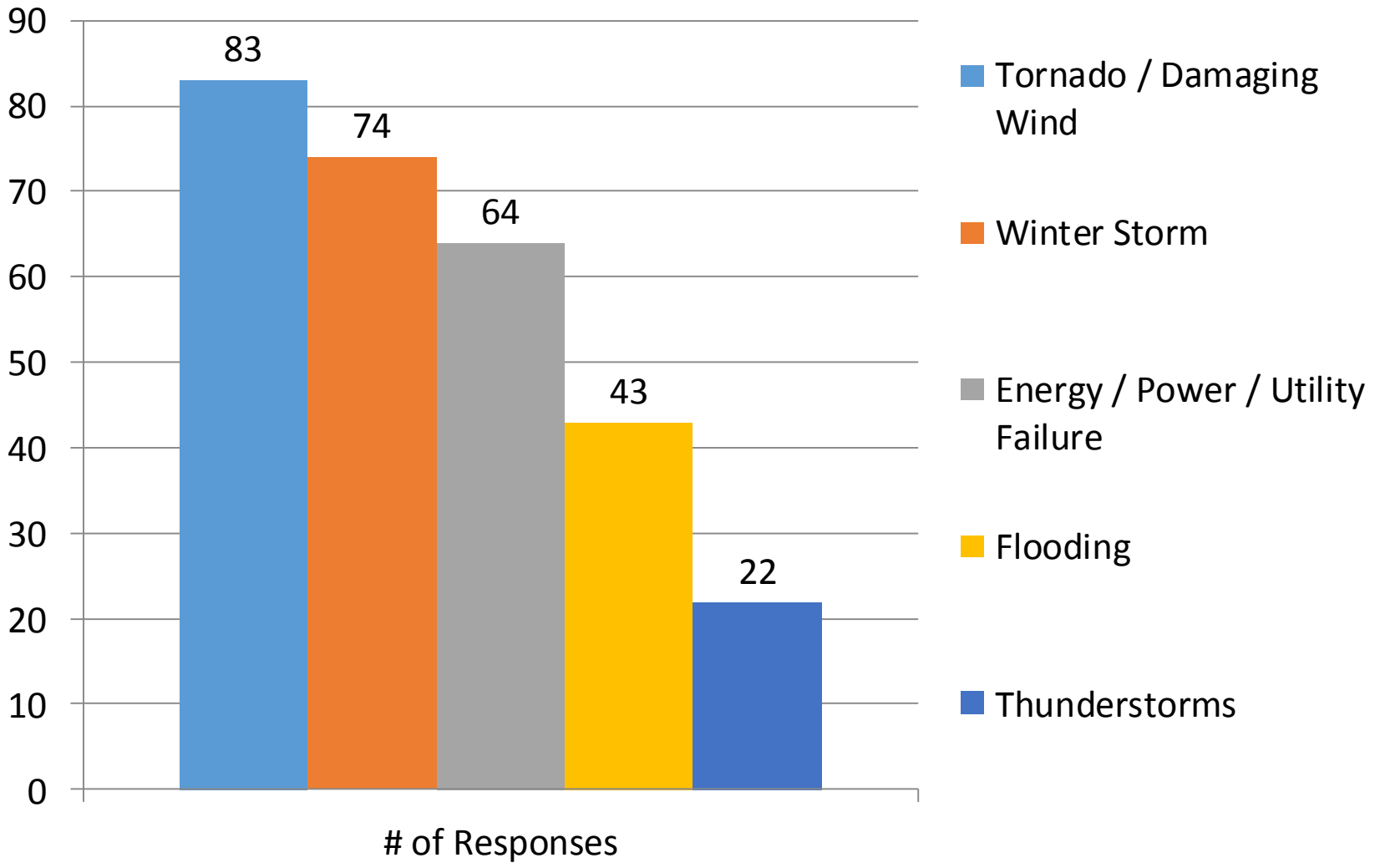
4. Highest hazard threat?



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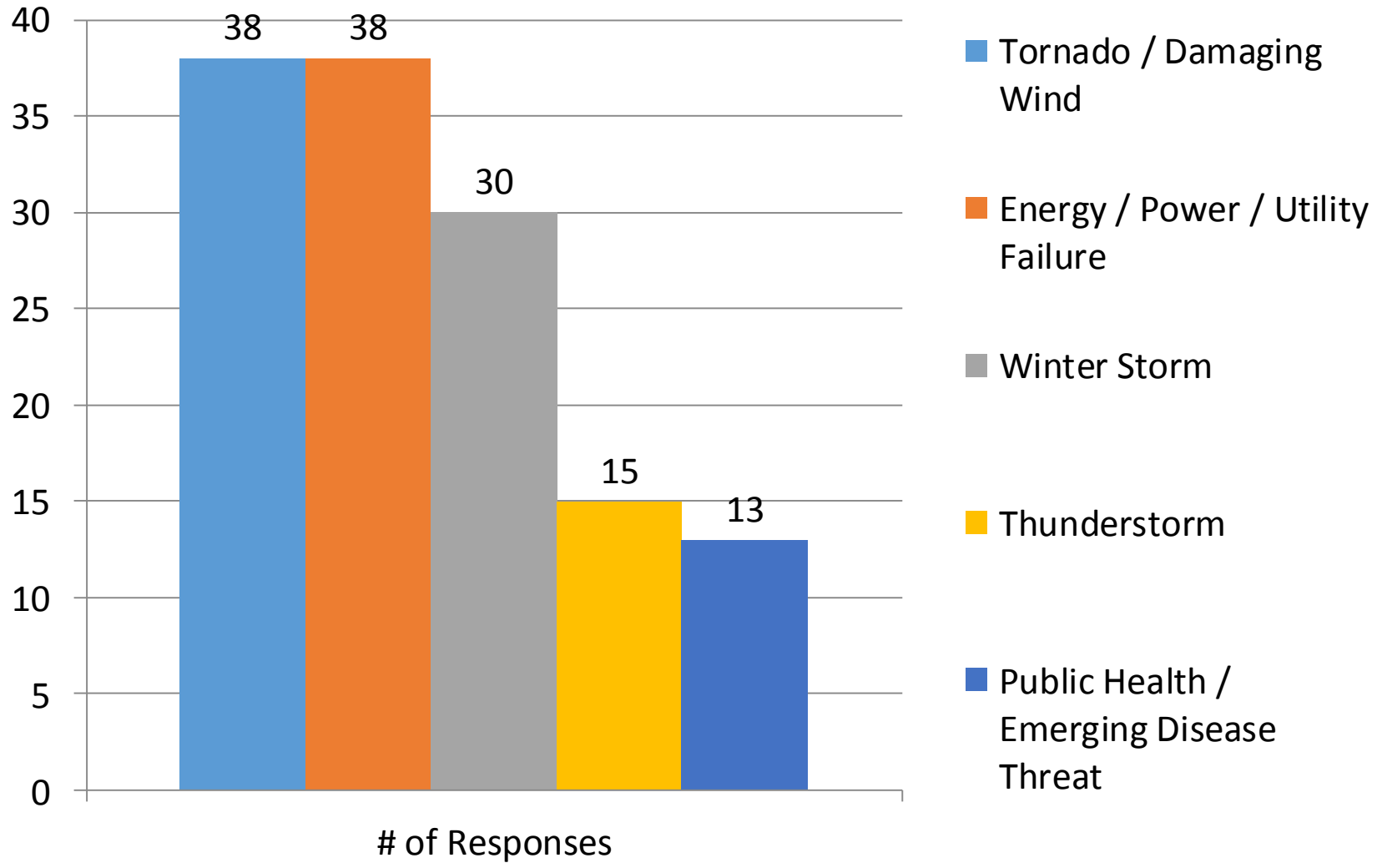
5. Second highest hazard threat?



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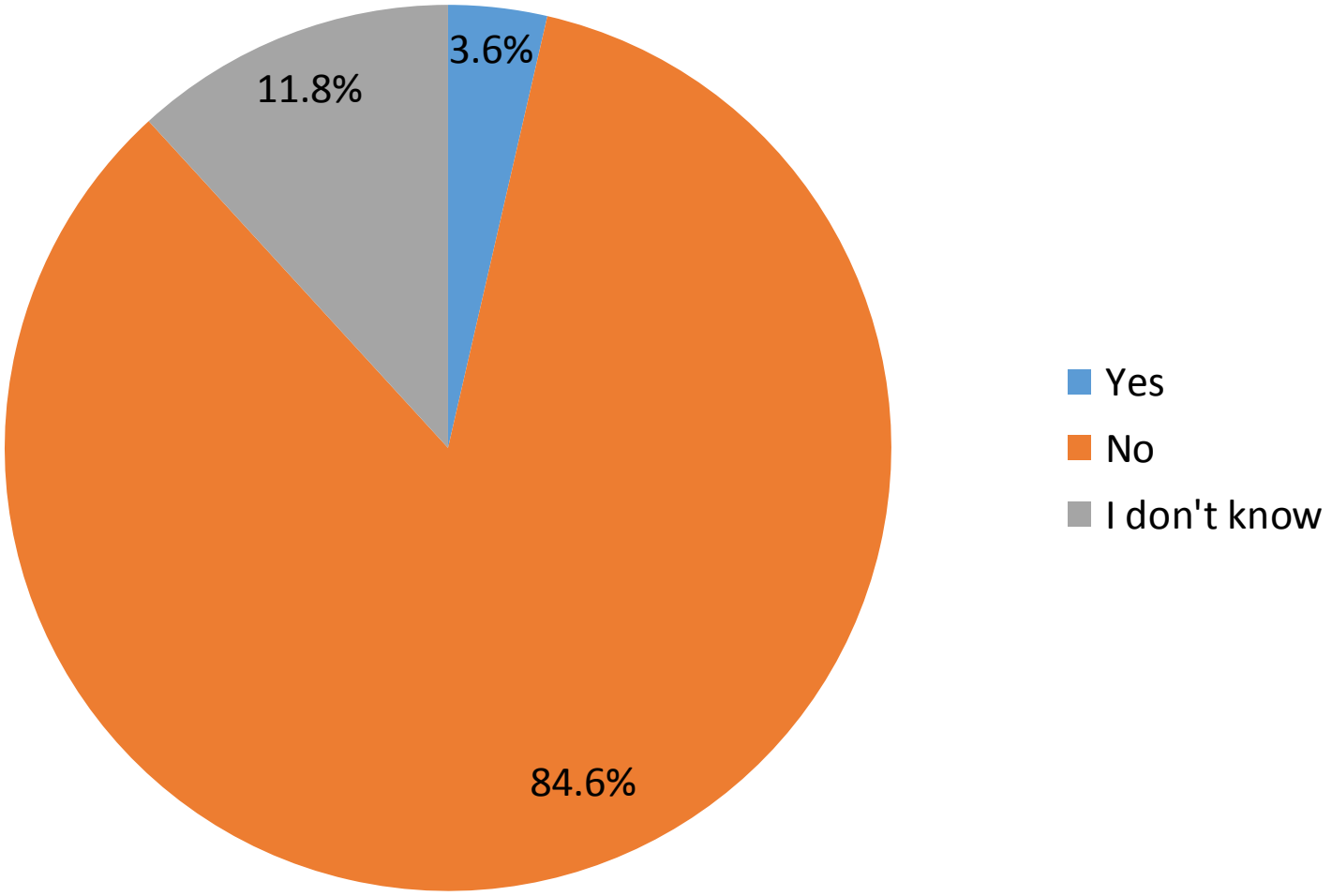
6. Other hazards not listed?

- Noise pollution
- Train derailment
- Sewer / stormwater drainage failure
- Traffic congestion
- Well water / groundwater contamination
- Aging infrastructure
- Pollution / contaminated wildlife
- Crime
- Sinkholes
- Erosion

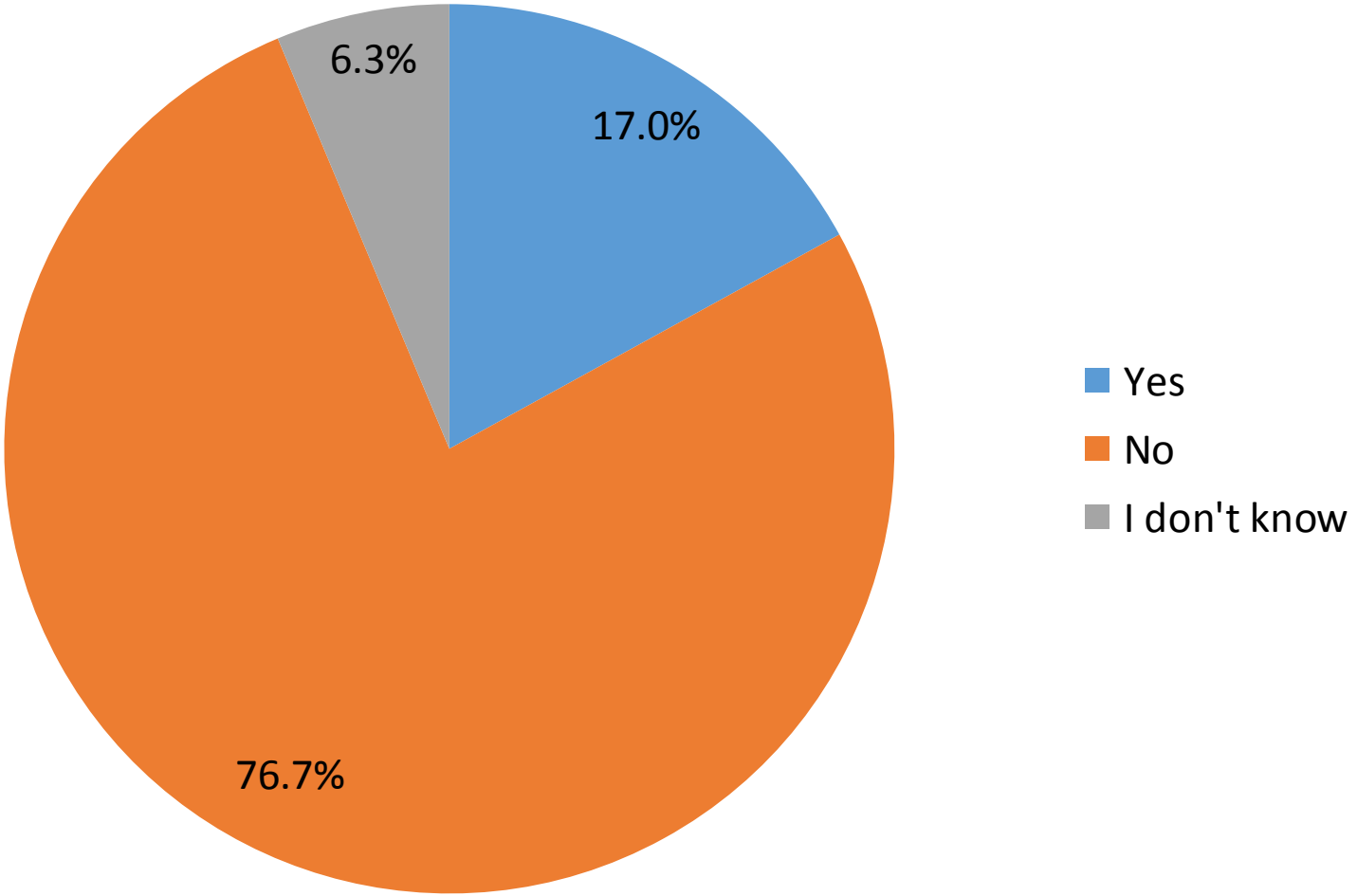
ATKINS

7. Is your home in a floodplain?



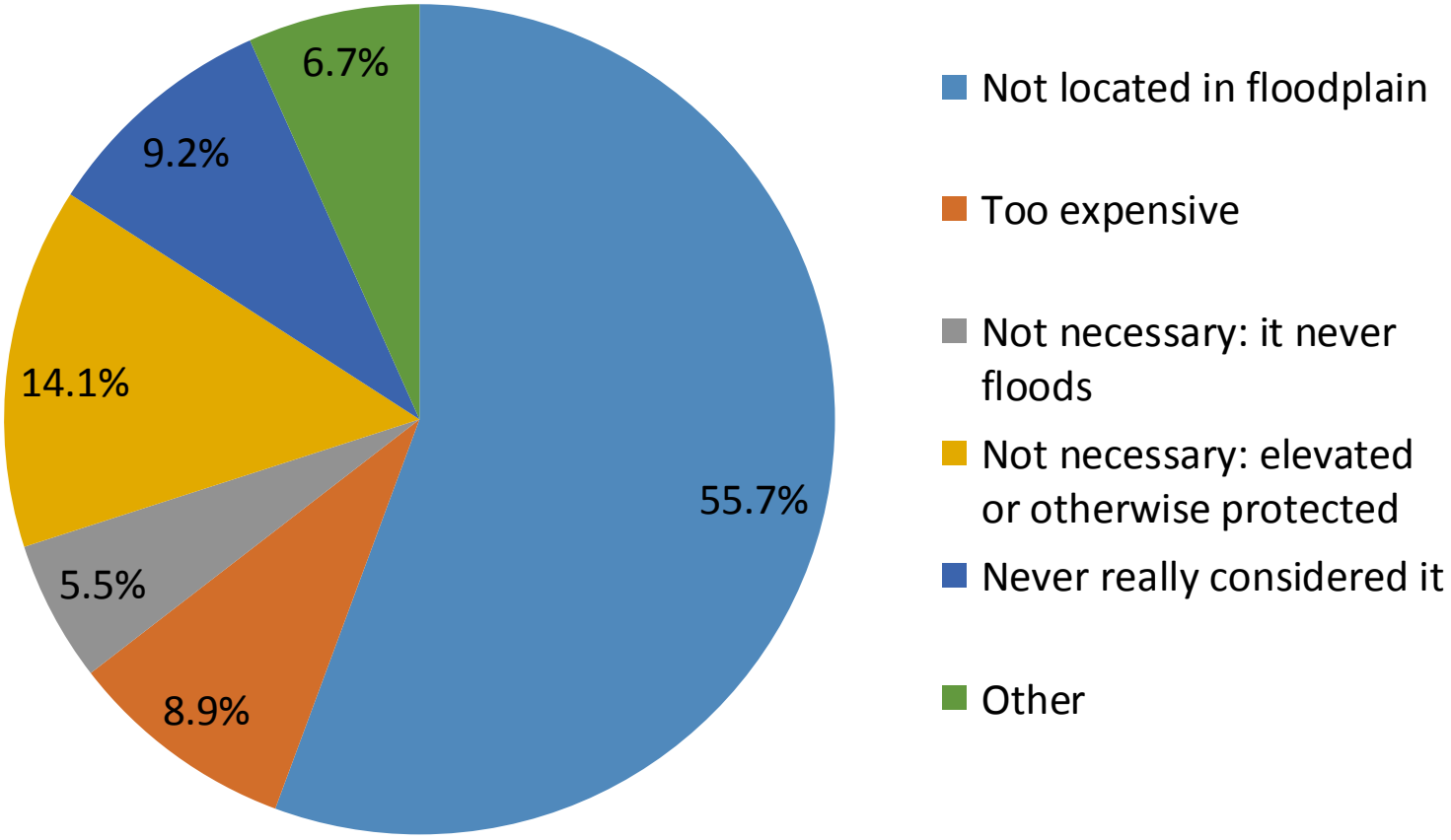
ATKINS

8. Do you have flood insurance?



ATKINS

8. Why no flood insurance?



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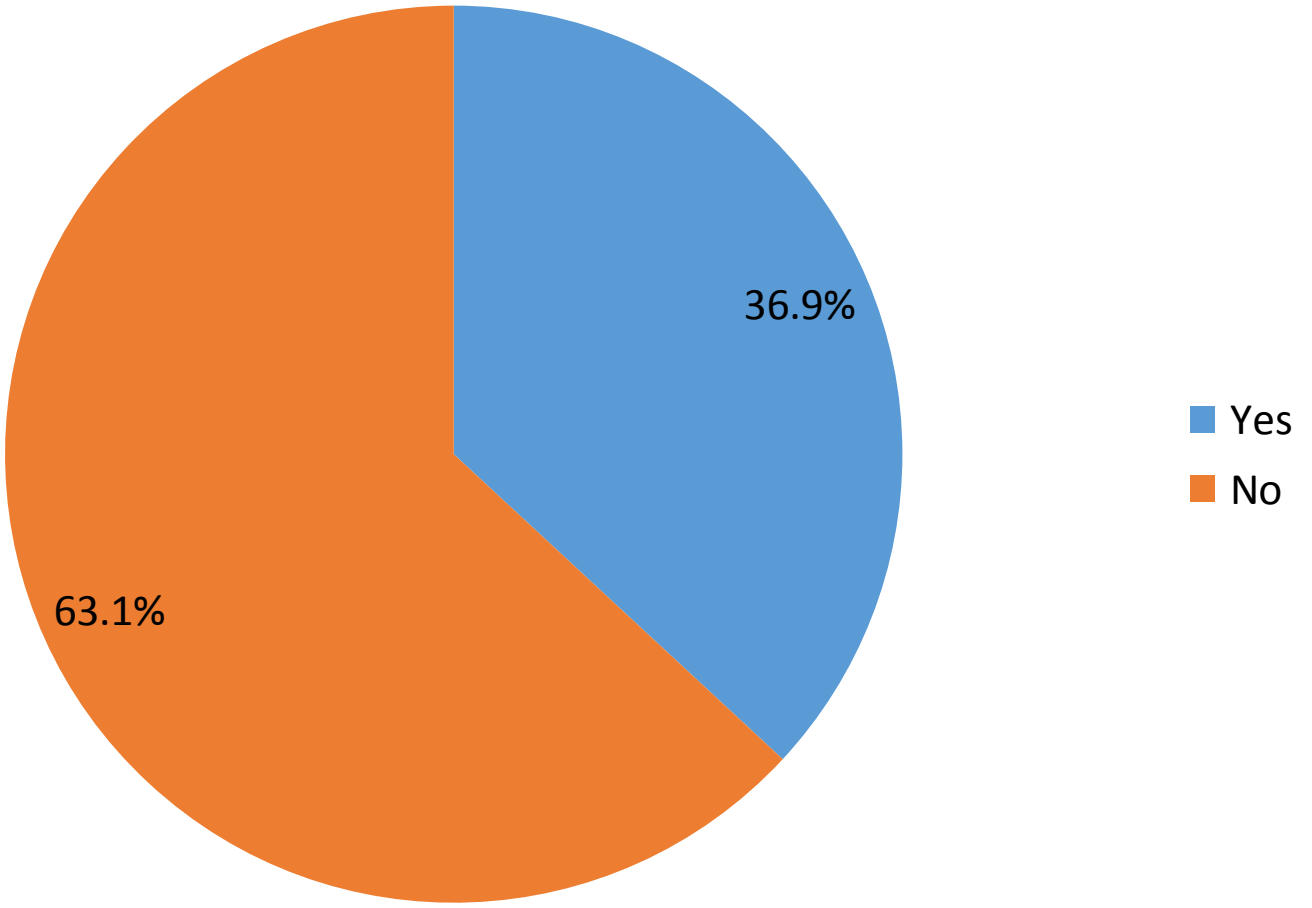
9. Taken action to be more hazard resistant?



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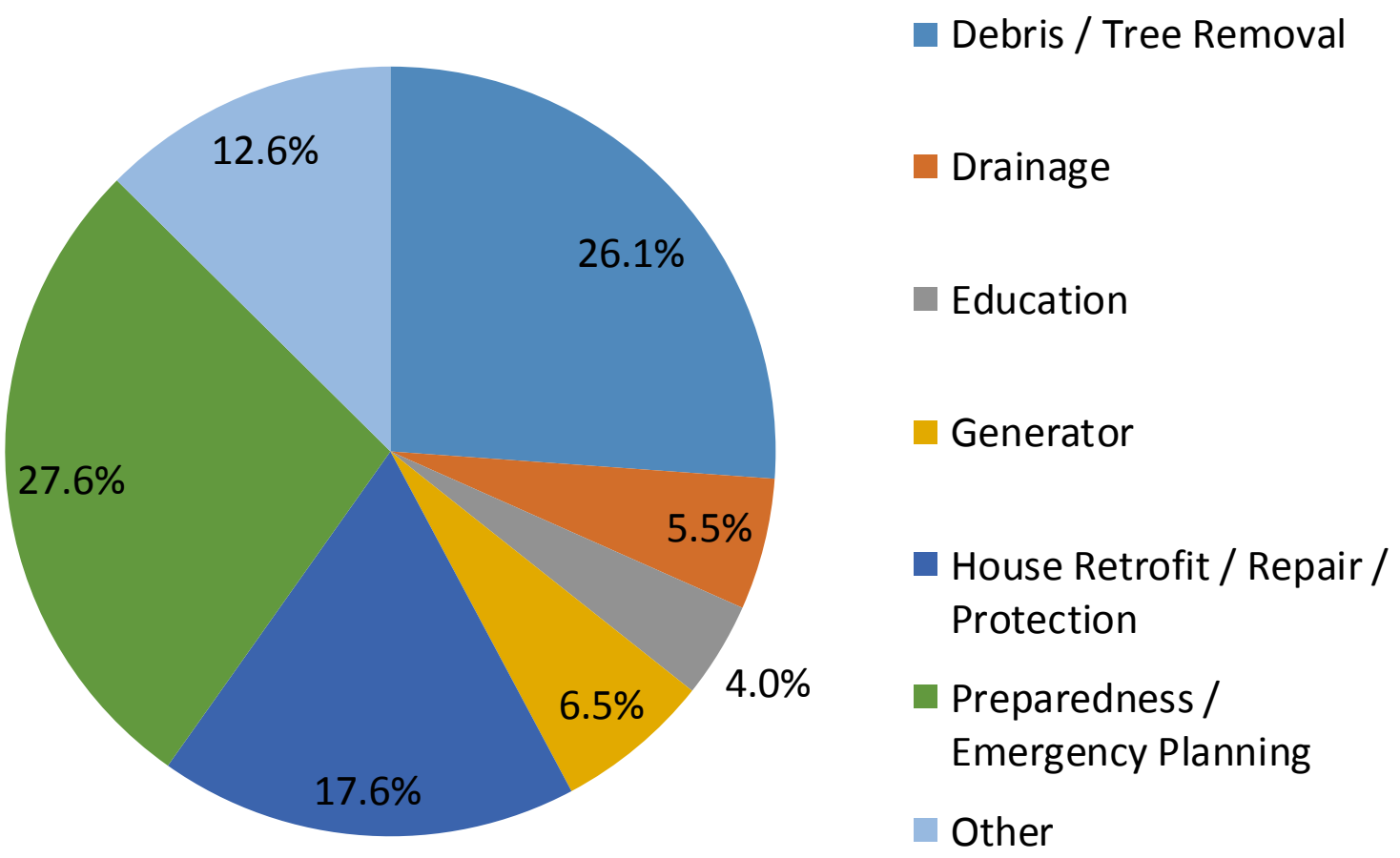
9. Examples of actions taken



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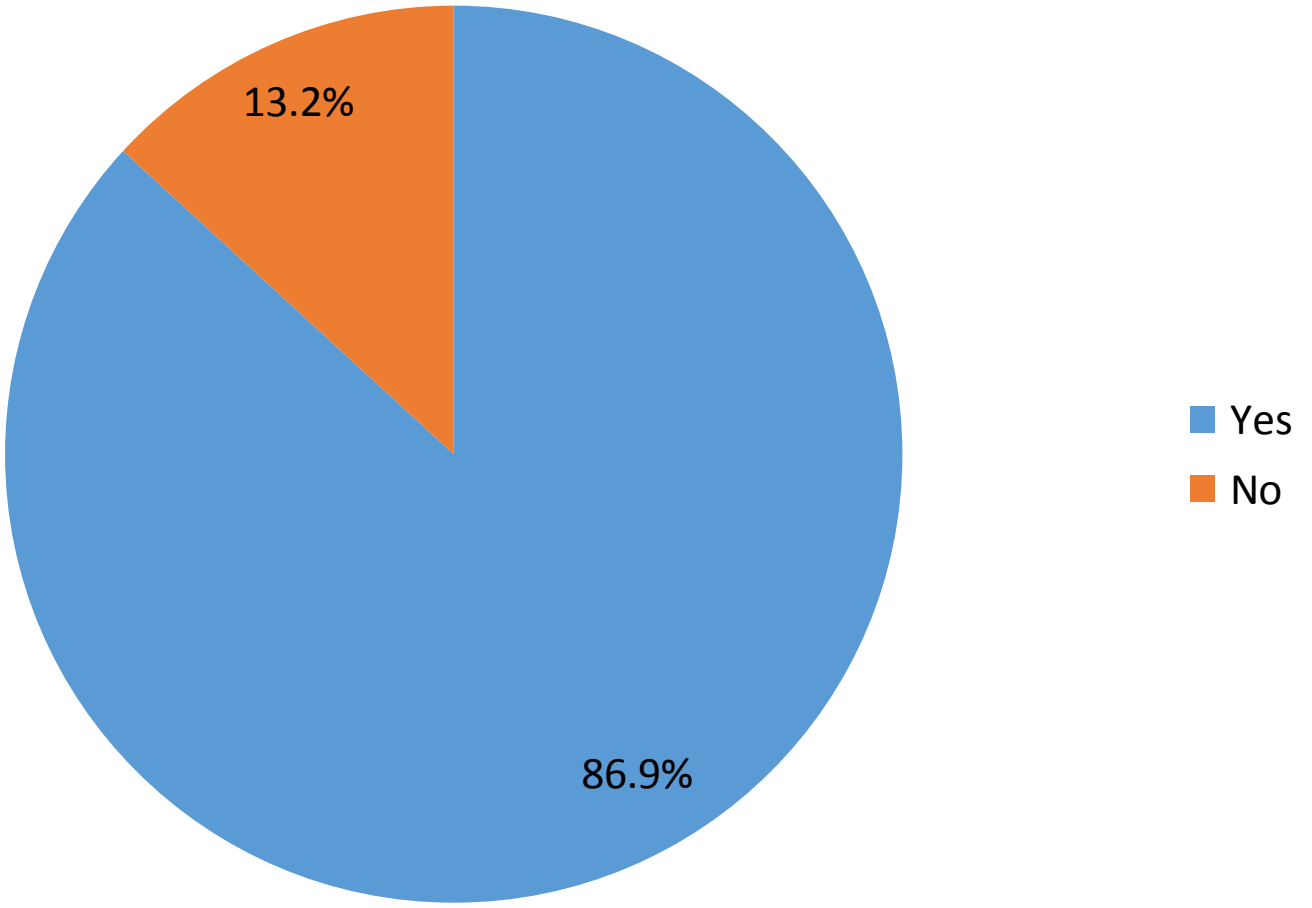
10. Interested in being more hazard resistant?



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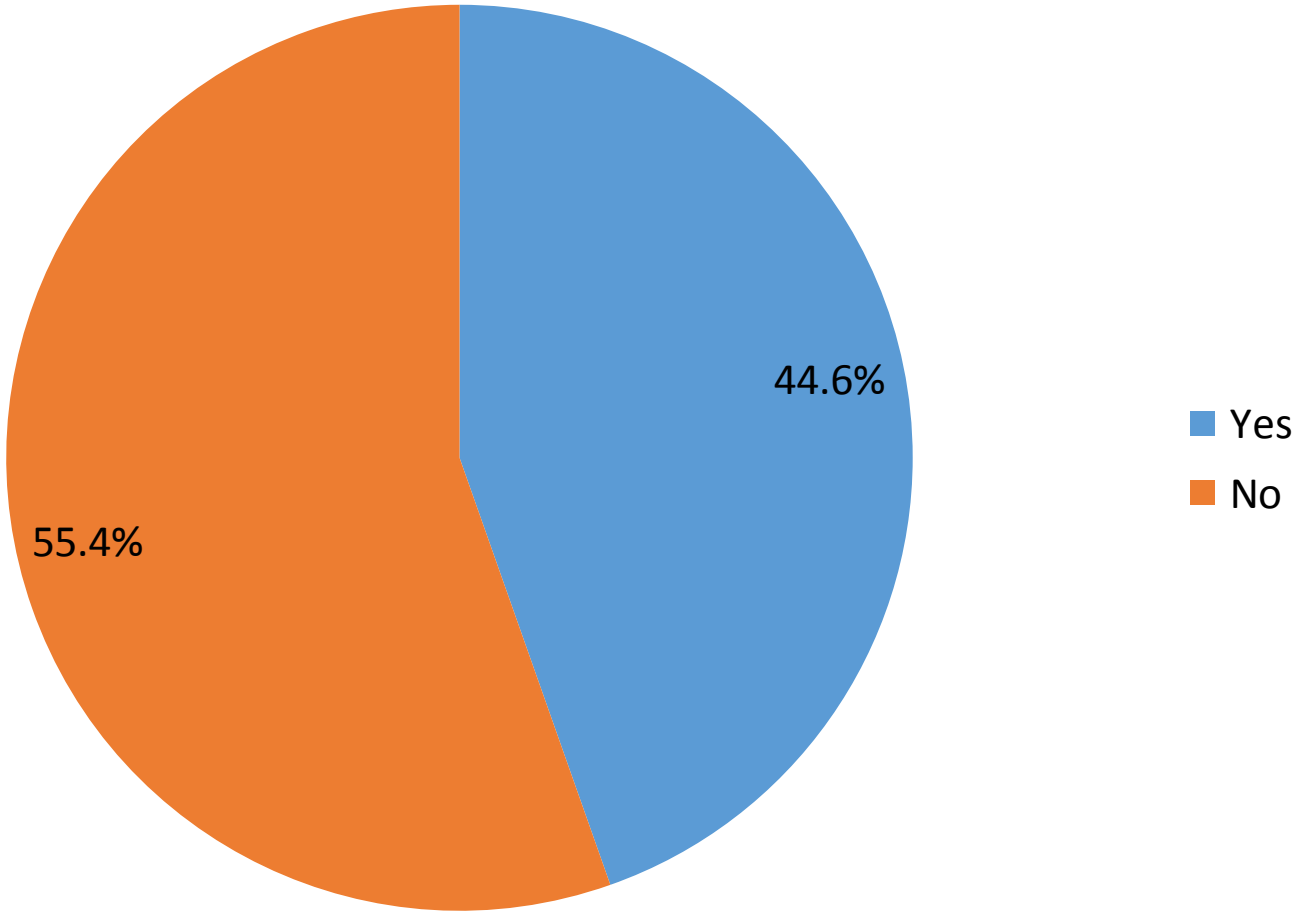
11. Know who to contact for reducing risks?



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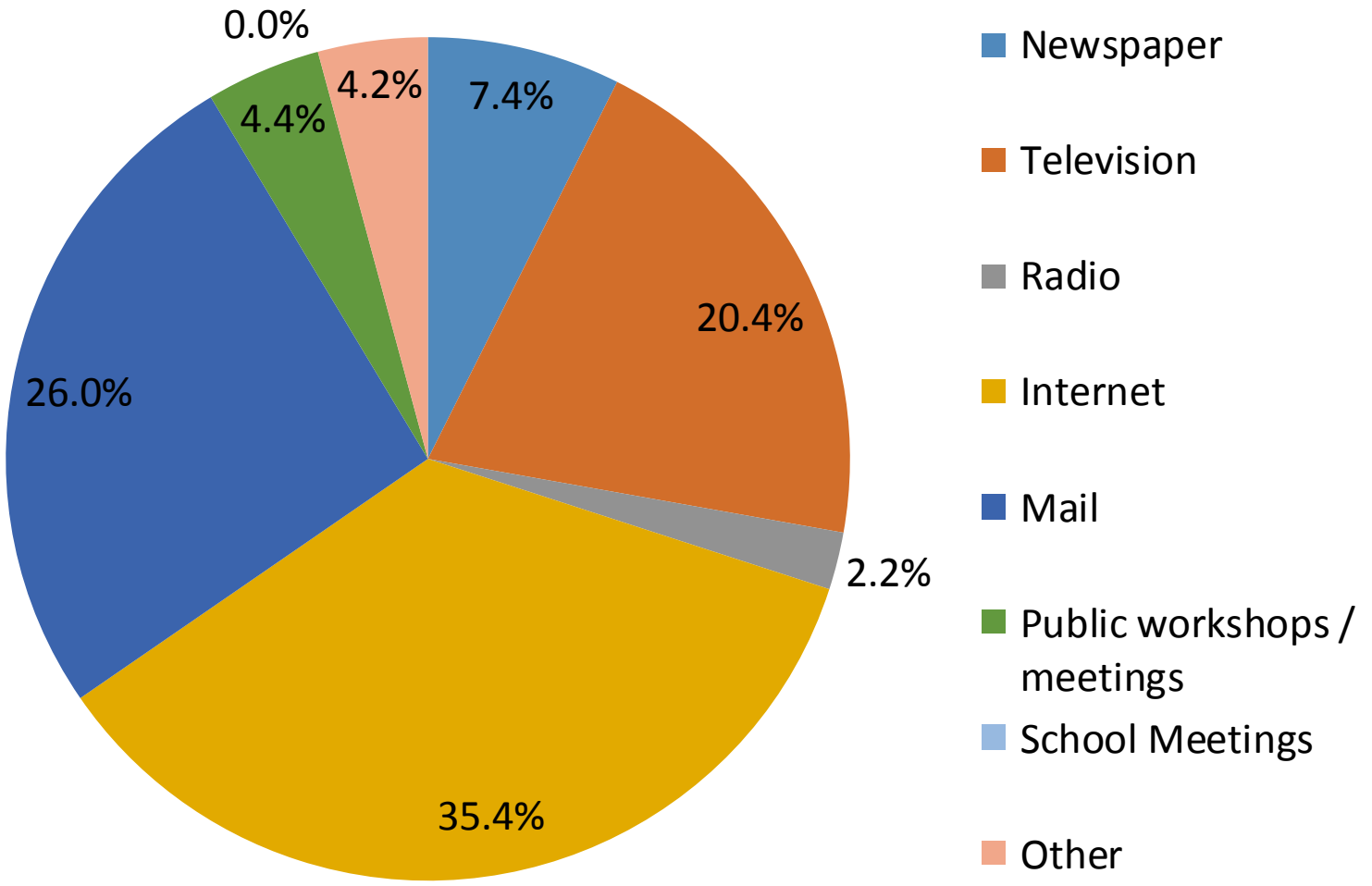
12. Most effective way to receive information?



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12. Other ways to receive information

- Email
- Text Message
- Social Media
- Flyers
- Billboard

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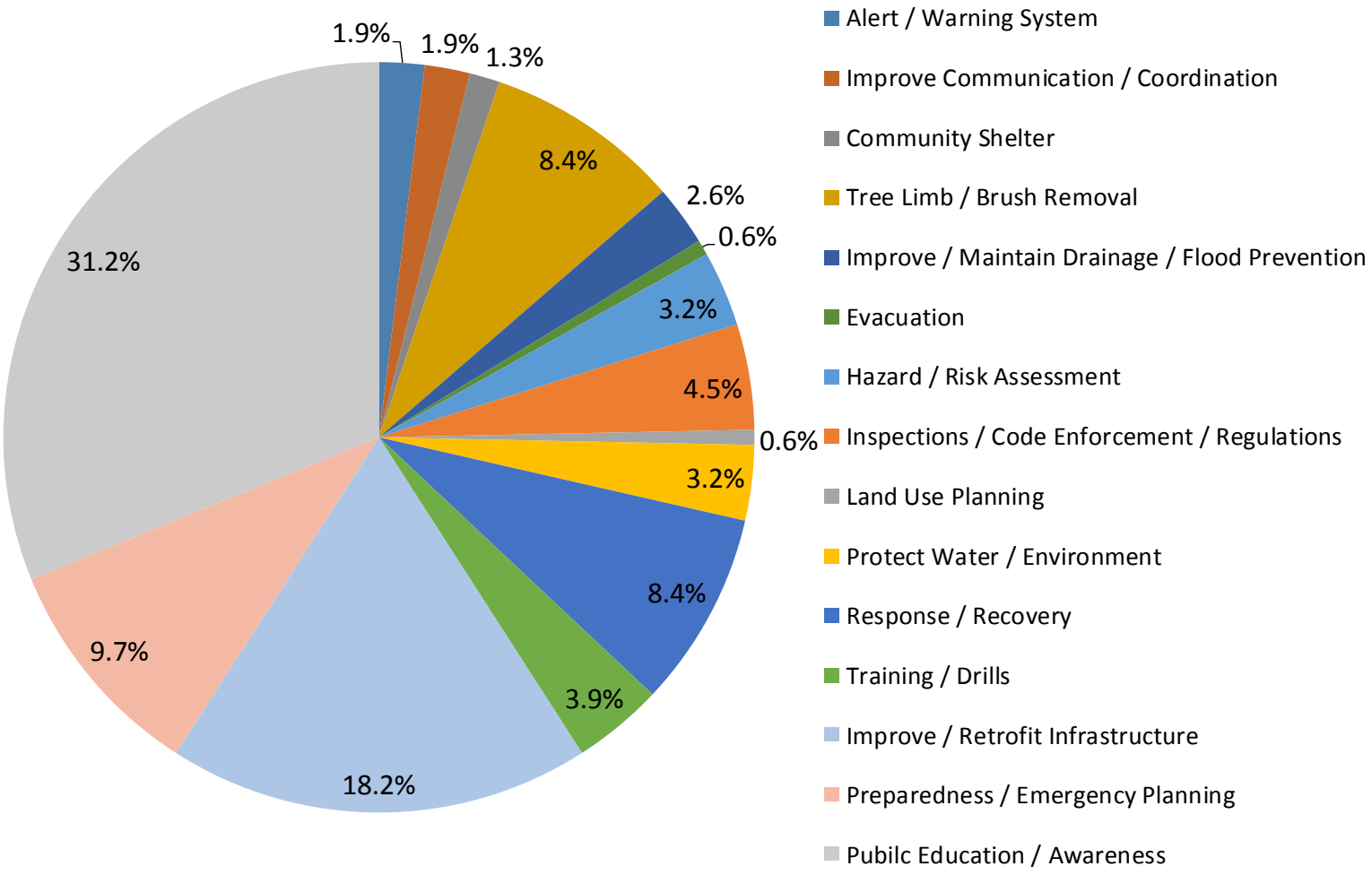
13. Steps local gov't could take to reduce risk



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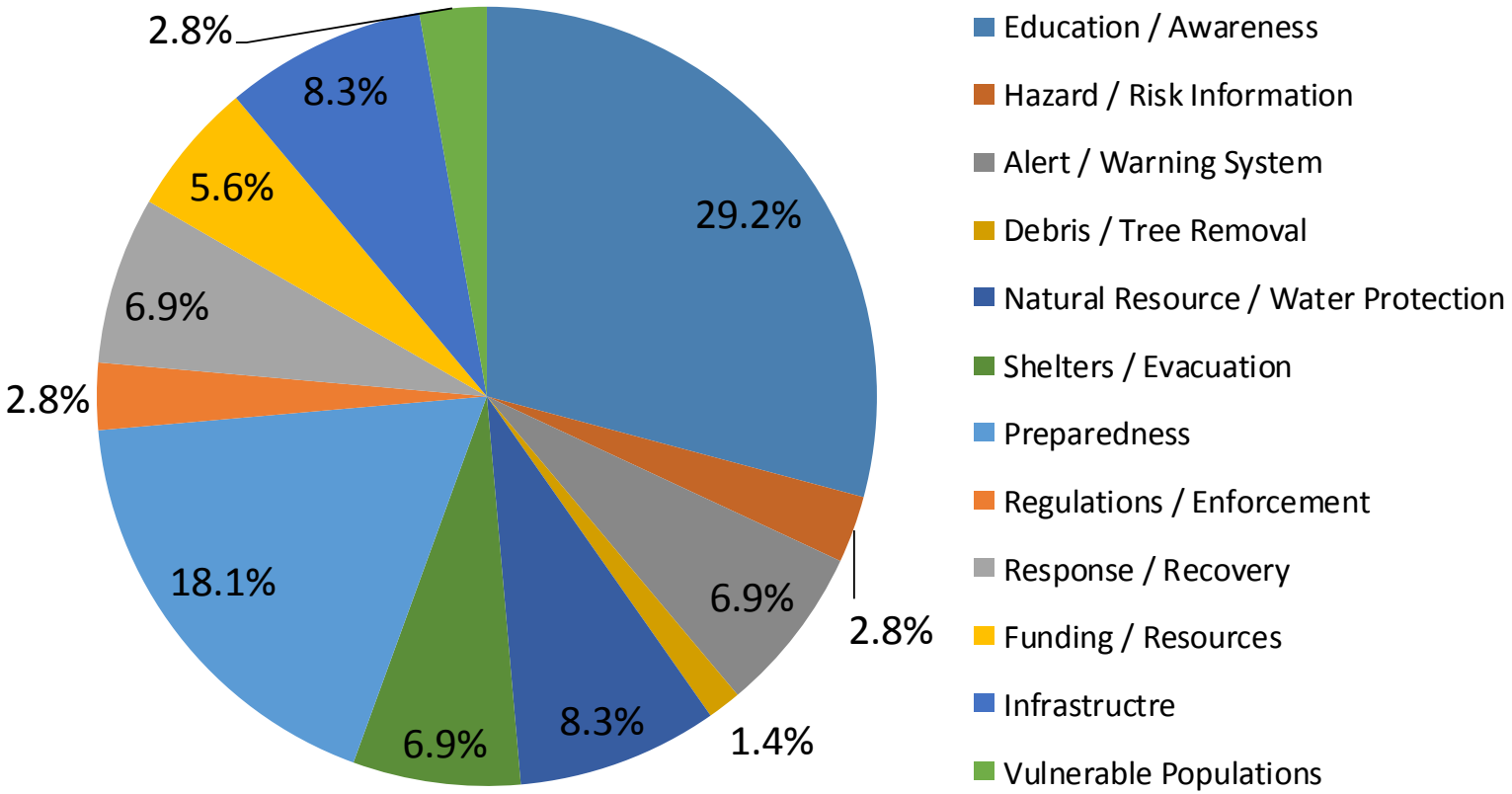
14. Other issues regarding risk and loss



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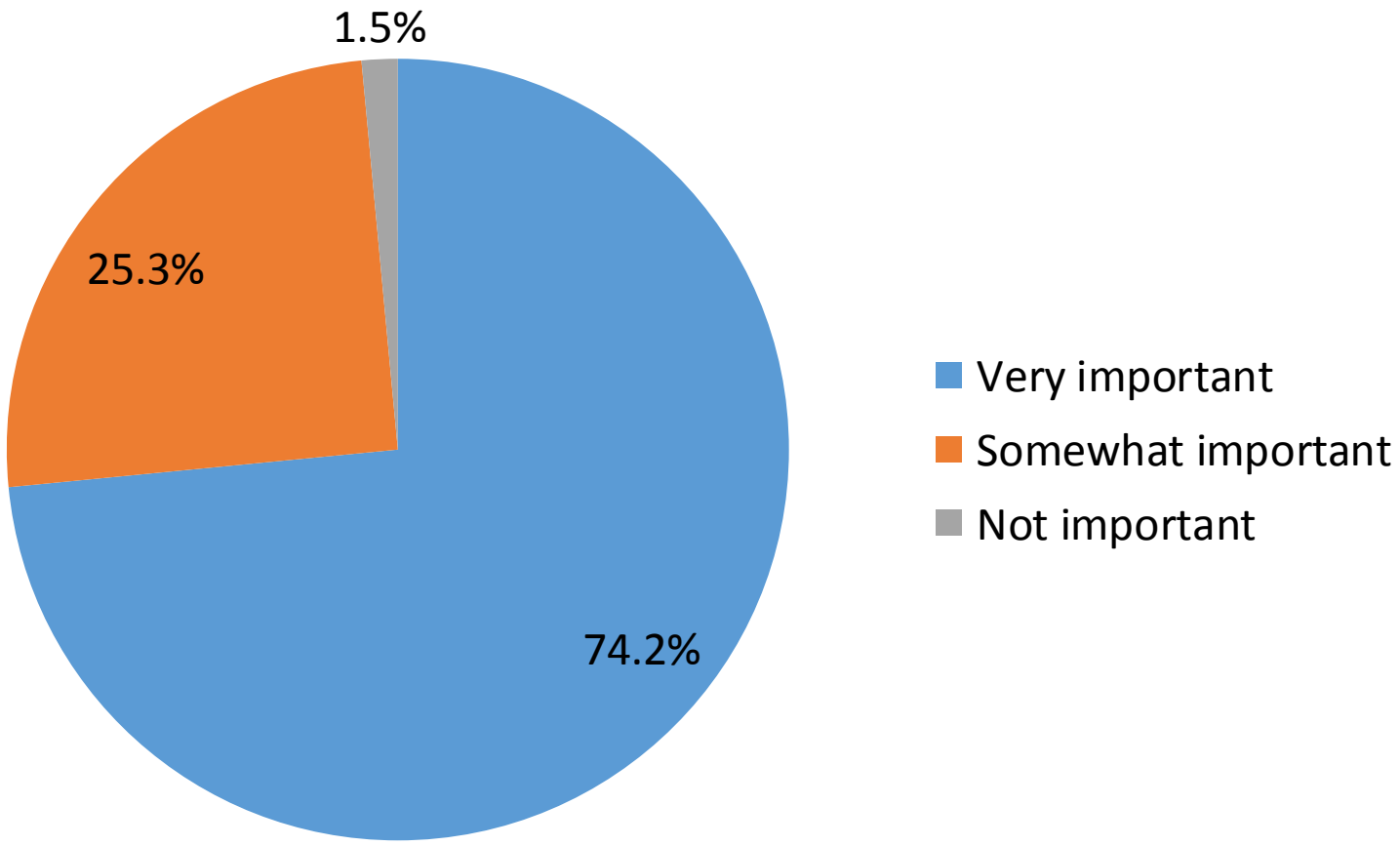
15. Mitigation Actions: Prevention



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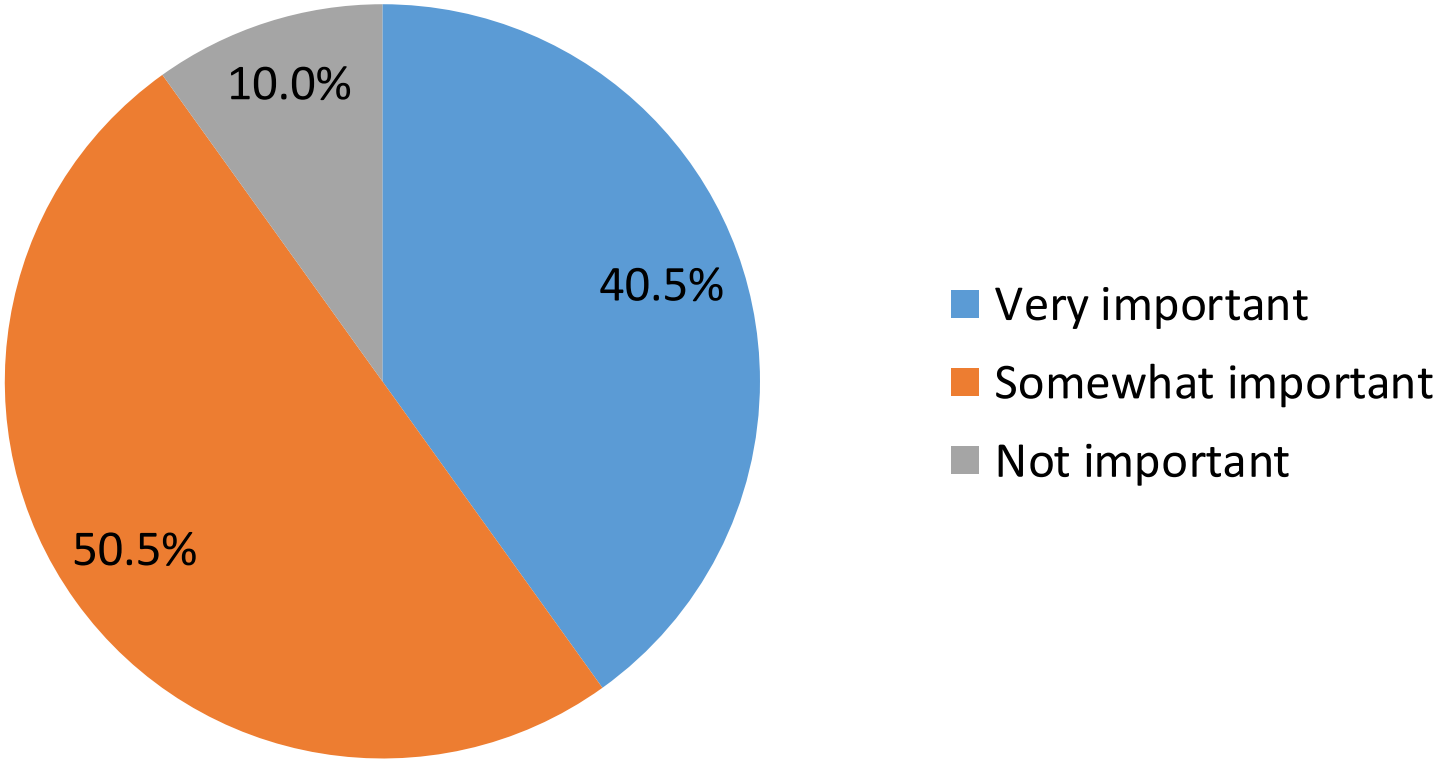
15. Mitigation Actions: Property Protection



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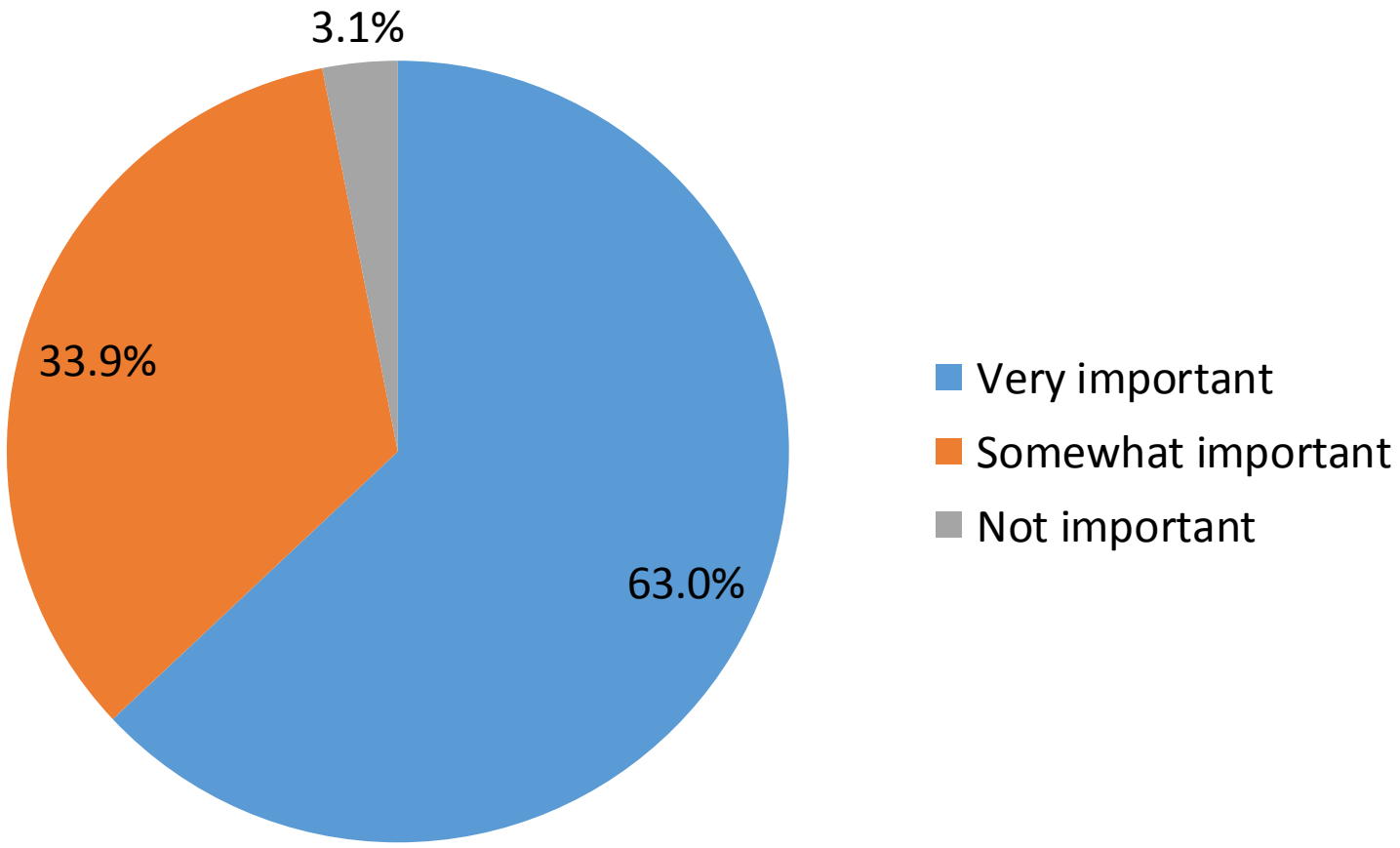
15. Mitigation Actions: Natural Resource Protection



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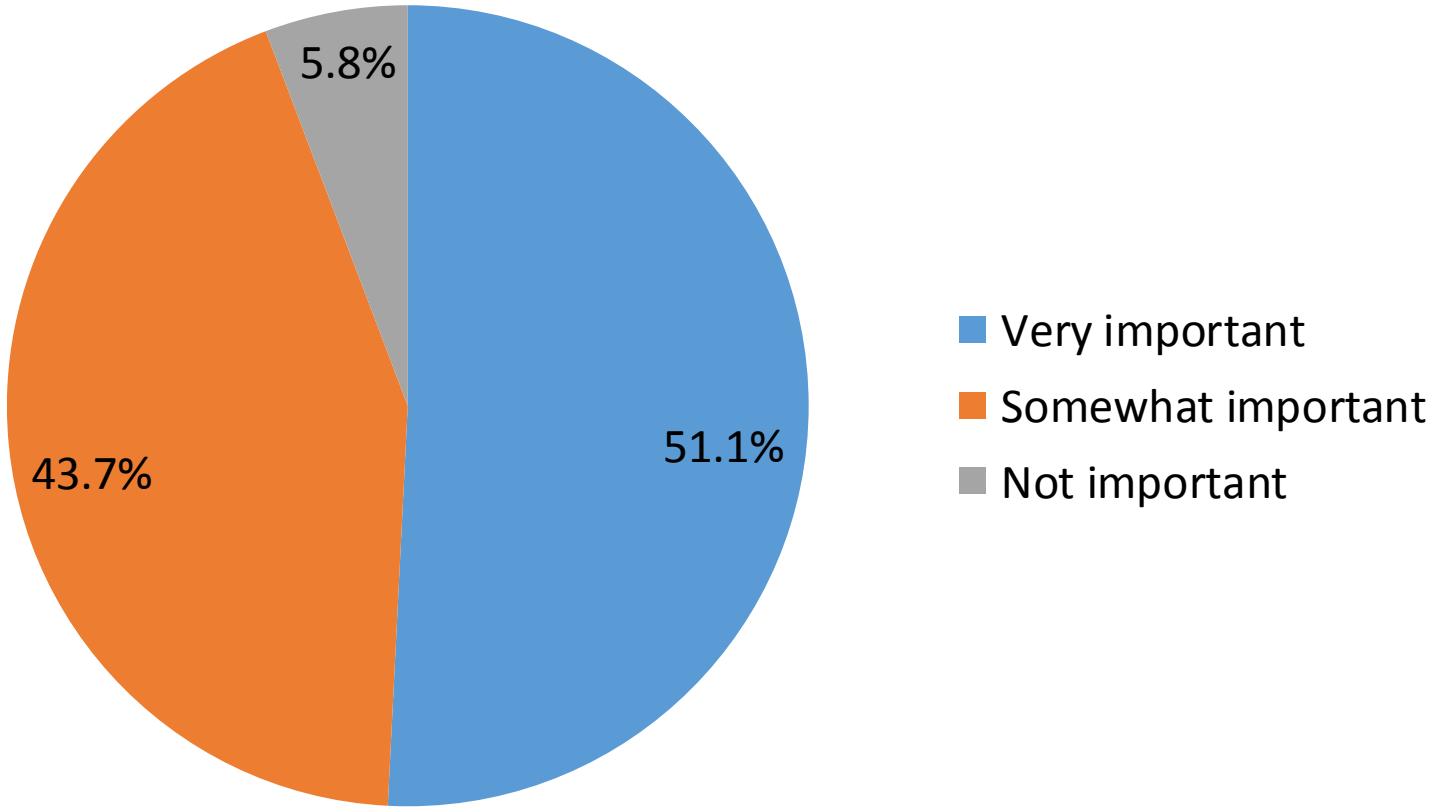
15. Mitigation Actions: Structural Projects



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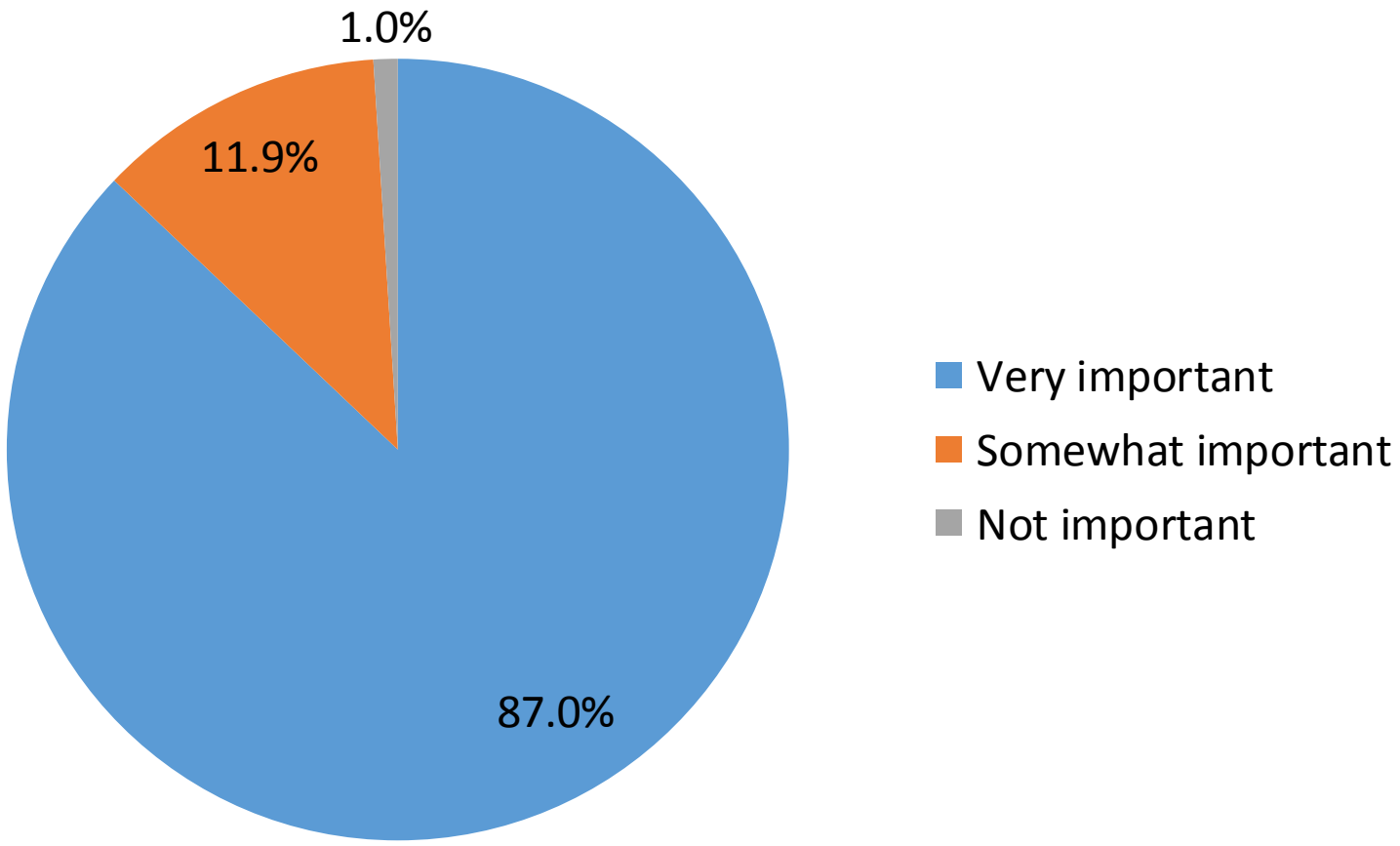
15. Mitigation Actions: Emergency Services



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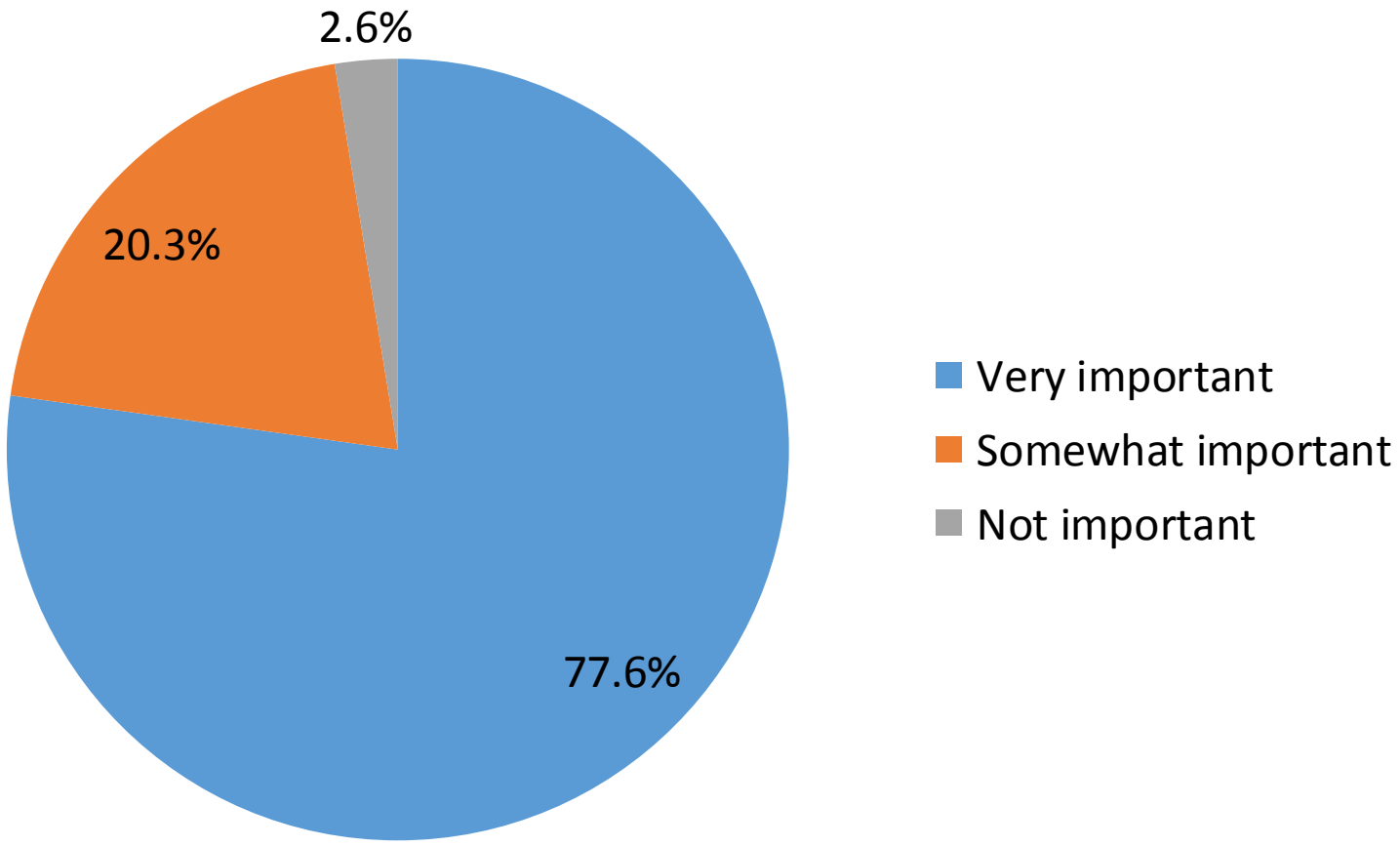
15. Mitigation Actions: Public Education & Awareness



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15. Mitigation Actions – Summary

- Highest importance
  - Emergency Services
  - Public Education & Awareness
  - Prevention
- Moderate importance
  - Natural Resource Protection
- Lowest importance
  - Structural Projects
  - Property Protection

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Flooding along Wendover Avenue in Greensboro
Photo Source: Fox 8

Guilford County
Hazard Mitigation Plan

Public Participation Survey Results

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