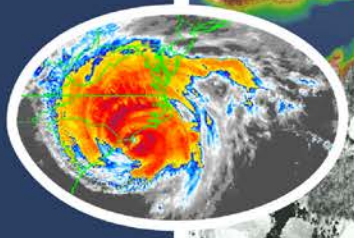
Multi-Jurisdictional Hazard Mitigation Plan
Mecklenburg County, North Carolina

June 2015



Prepared by:

AECOM

MECKLENBURG COUNTY HAZARD MITIGATION PLAN

2015 Plan Update

Adopted By:

Mecklenburg County

City of Charlotte

Town of Cornelius

Town of Davidson

Town of Huntersville

Town of Matthews

Town of Mint Hill

Town of Pineville

Planning Assistance Provided By:

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1 INTRODUCTION

This section provides a general introduction to the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan and consists of the following five subsections:

- BACKGROUND
- PURPOSE
- SCOPE
- AUTHORITY
- PLAN OUTLINE

BACKGROUND

Natural hazards, such as floods, tornadoes and severe winter storms are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity.

Mecklenburg County and the municipalities participating in this planning process are vulnerable to a wide range of natural hazards that threaten the safety of county residents, and have the potential to damage or destroy both public and private property and disrupt the local economy and overall quality of life.

FEMA Definition of Hazard Mitigation

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from [natural] hazards."

While the threat from hazards may never be fully eliminated, there is much we can do to lessen their potential impact. The concept and practice of reducing risks associated with known hazards is referred to as *hazard mitigation*.

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 or floodplain management policies and the creation of public awareness programs. Effective mitigation measures are often implemented at the county or municipal level, where decisions on the regulation and control of development are 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 hazard vulnerability over time.

As a community formulates a comprehensive approach to reduce the impacts of hazards, a key means to accomplish this task is through the development, adoption, and regular update of a local hazard mitigation plan. A hazard mitigation plan establishes the community vision, guiding principles and the specific actions designed to reduce current and future hazard vulnerabilities.

The Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan (hereinafter referred to as "Hazard Mitigation Plan" or "Plan") is an effective means to incorporate hazard mitigation principles and practices into the day-to-day activities of county and municipal governments. The Plan recommends specific actions designed to protect Mecklenburg County's residents as well as the built environment from those hazards that pose the greatest risk. Identified mitigation actions go beyond recommending structural solutions to reduce existing vulnerability, such as elevation, retrofitting and acquisition projects. Local policies on community growth and development, incentives tied to natural resource protection, and public awareness

and outreach activities are examples of other actions intended to reduce Mecklenburg County's future vulnerability to identified hazards.

DISASTER MITIGATION ACT OF 2000

In an effort to reduce the Nation's mounting natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 322 of the Act requires that state and local governments develop and routinely update a hazard mitigation plan in order to remain eligible for pre- and post-disaster mitigation funding. These funds include the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, and Flood Mitigation Assistance (FMA) program, all of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security as part of FEMA's Hazard Mitigation Assistance (HMA) program. 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.

This Plan was prepared using current FEMA planning guidance and in coordination with the North Carolina Division of Emergency Management in order to ensure that it meets all applicable state and federal mitigation planning requirements. This includes conformance with FEMA's latest *Local Mitigation Planning Handbook* (dated March 2013). A *Local Plan Review Tool*, found in *Appendix B*, provides a summary of FEMA and NCEM's current minimum standards of acceptability and notes the location within the Plan where each planning requirement is met.

PURPOSE

The general purpose of this Hazard Mitigation Plan is to:

- protect life and property by reducing the potential for future damages and economic losses that result from natural hazards;
- qualify for additional grant funding, in both the pre-disaster and post-disaster environment;
- speed recovery and redevelopment following future disasters;
- integrate existing flood mitigation documents;
- sustain and enhance existing governmental coordination in Mecklenburg County and demonstrate a firm local commitment to hazard mitigation principles; and
- comply with state and federal requirements tied to local hazard mitigation planning.

SCOPE

This Hazard Mitigation Plan will be updated and maintained to continually address those natural hazards determined to be of high and moderate risk as defined by the results of the risk assessment (see "Conclusions on Hazard Risk" in Section 6: *Vulnerability Assessment*). Other natural hazards that pose a low or negligible risk will continue to be evaluated during future updates to the Plan in order to determine if they warrant additional attention, including the development of specific mitigation measures intended to reduce their impact.

The planning area[1] includes unincorporated areas of **Mecklenburg County**, the City of **Charlotte** and the towns of **Cornelius**, **Davidson**, **Huntersville**, **Matthews**, **Mint Hill** and **Pineville**. The planning area has not changed with either the 2010 plan update or the 2015 plan update.

AUTHORITY

This Hazard Mitigation Plan has been adopted by Mecklenburg County in accordance with the authority and police powers granted to counties as defined by the State of North Carolina (N.C.G.S., Chapter 153A). This Hazard Mitigation Plan has also been adopted by the City of Charlotte, Town of Cornelius, Town of Davidson, Town of Huntersville, Town of Matthews, Town of Mint Hill and the Town of Pineville under the authority granted to cities and towns as defined by the State of North Carolina (N.C.G.S., Chapter 160A). Copies of all local resolutions to adopt the Plan are included in Appendix A.

This Plan was developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans. The Plan shall be monitored and updated on a routine basis to maintain compliance with the following 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) and by FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201.
- North Carolina General Statutes, Chapter 166A: North Carolina Emergency Management Act, as amended by Senate Bill 300: An Act to Amend the Laws Regarding Emergency Management as Recommended by the Legislative Disaster Response and Recovery Commission (2001).

PLAN OUTLINE

This Hazard Mitigation Plan is divided into ten major sections, each of which is briefly introduced and described below. It also includes several appendices for additional or supplemental items not included in the main body of the plan, including copies of local adoption resolutions and a completed *Local Plan Review Tool*.

This ***Introduction*** (Section 1) provides some background on hazard mitigation planning and the Disaster Mitigation Act of 2000, and then defines the purpose, scope and authority of the plan as adopted by Mecklenburg County and its incorporated municipalities. It also provides the following outline of each section making up the plan.

The ***Planning Process***, found in Section 2, fully documents the process by which Mecklenburg County and its participating municipal jurisdictions have prepared and updated this plan. This includes describing the key steps involved in the processes followed, who was involved (the planning team) and full descriptions of community meetings and workshops, how the public and other stakeholders were notified and involved, and how each of the municipal jurisdictions participated in the process.

The ***Community Profile***, located in Section 3, describes the general makeup of Mecklenburg County and participating municipalities, including prevalent geographic, demographic and economic characteristics. In

[1] Refer to Section 3: *Community Profile* for an overview map of Mecklenburg County and other specific details of the planning area.

addition, building characteristics and land use patterns are discussed along with some general historical disaster data. This baseline information provides a snapshot of the countywide planning area and thereby assists participating officials recognize those social, environmental and economic factors that ultimately play a role in determining community vulnerability to natural hazards.

The Risk Assessment is presented in three separate sections: Section 4: ***Hazard Identification***; Section 5: ***Hazard Analysis***; and Section 6: ***Vulnerability Assessment***. Together, these sections serve to identify, analyze and assess Mecklenburg County's overall risk to natural hazards. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect localized areas within the participating jurisdictions. The risk assessment builds on available historical data from past hazard occurrences, establishes hazard-by-hazard profiles, and culminates in a hazard risk ranking based on conclusions about the frequency of occurrence, potential impact, spatial extent, warning time and duration of each hazard. FEMA's HAZUS$^{®MH}$ loss estimation methodology was also used in evaluating known hazard risks according to their relative long-term cost, measured in expected damages. The risk assessment is designed to assist communities seek the most appropriate mitigation actions to pursue and implement—focusing their efforts on those hazards of greatest concern and those assets, structures or planning areas facing the greatest risk.

The ***Capability Assessment***, found in Section 7, provides a comprehensive examination of Mecklenburg County and participating jurisdictions' capacity to implement meaningful mitigation strategies and identifies existing 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, education and outreach, and political capability. Information was obtained through the use of detailed survey questionnaires 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 hazard mitigation program.

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

The ***Mitigation Strategy***, found in Section 8, consists of broad goal statements as well as the identification and evaluation of mitigation techniques for each jurisdiction participating in the planning process to consider in addressing their own unique hazard risks. The strategy provides the foundation for detailed ***Mitigation Action Plans***, found in Section 9, that link jurisdictionally specific mitigation actions to locally assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic and functional through the identification of long-term goals and near-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 Mecklenburg County and participating municipalities less vulnerable to the damaging forces of nature while improving the economic, social and environmental health of the community. The concept of multi-objective planning was emphasized throughout the plan development and update process, with local representatives from each jurisdiction being encouraged to seek ways to link hazard mitigation policies and programs with other complimentary community goals that may be related to housing, economic development, downtown revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety. Specific examples already proven effective in Mecklenburg County include the acquisition of flood-prone properties, the creation of urban greenways and open space in the floodplain, improving water quality through the reduction in non-point source pollution, and the delineation of floodplain boundaries that

account for the impact of future development. Each of these proactive and interconnected measures represents a concerted effort to make Mecklenburg Country and participating jurisdictions more livable communities.

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

There are several appendices to the Plan, including Appendix A (*Plan Adoption*) which includes copies of the local adoption resolutions passed by the governing bodies for each of Mecklenburg County's local jurisdictions requesting approval of the Plan. Appendix B (*Public Participation Survey*) includes a general summary of the results and findings of the public participation survey along with a copy of the survey instrument used to collect the data during the 2015 plan update process. Appendix C (*Key Federal Mitigation Funding Sources*) includes a listing of some of the key, well-established federal hazard mitigation funding programs available to implement future mitigation projects. Appendix D (*Local Hazard Mitigation Plan Update Checklist*) includes a completed copy of the Local Hazard Mitigation Plan Update Checklist as provided by the North Carolina Division of Emergency Management.

2 PLANNING PROCESS

This section of the Plan describes the mitigation planning process undertaken by Mecklenburg County and participating municipalities in the preparation of this Hazard Mitigation Plan. This section consists of the following five subsections:

- OVERVIEW OF HAZARD MITIGATION PLANNING
- PREPARING THE 2005 PLAN
- PREPARING THE 2010 PLAN UPDATE
- PREPARING THE 2015 PLAN UPDATE
- MULTI-JURISDICTIONAL PARTICIPATION
- SUMMARY OF 2010 PLAN UPDATES
- SUMMARY OF 2015 PLAN UPDATES

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 results 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 each mitigation action, responsibility is assigned to a specific individual, department or agency along with a schedule for its implementation. Plan maintenance procedures are established to implement, as well as evaluate and enhance the plan as necessary. Developing clear plan maintenance procedures ensures that Mecklenburg County's Hazard Mitigation Plan remains a current, dynamic and effective planning document over time.

Mitigation planning offers 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;
- enhancing coordination within and across participating jurisdictions;
- expediting the receipt of pre-disaster and post-disaster grant funding; and
- demonstrating a firm commitment to improving community health and safety.

Typically, mitigation planning is 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 pre-disaster investments 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 reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such

as preserving open space, improving water quality, 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. Mecklenburg County and participating jurisdictions have embraced this approach, identifying multiple opportunities to link the Plan with preexisting programs, policies, plans and initiatives.

PREPARING THE 2005 PLAN

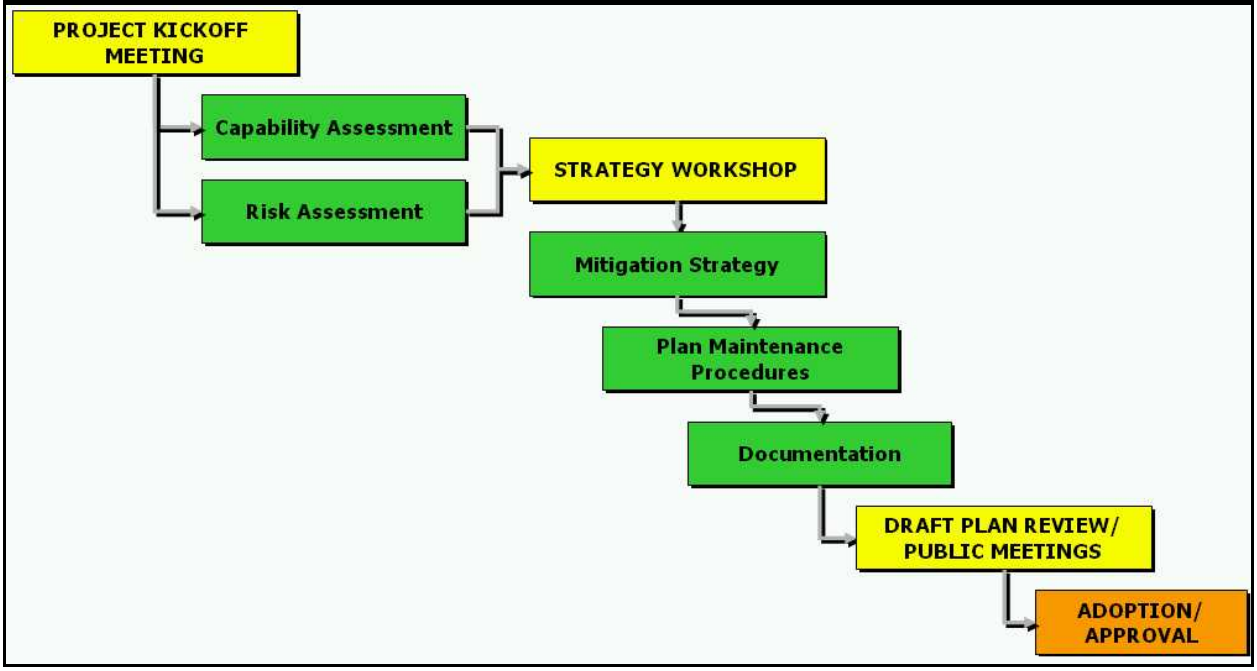
44 CFR Requirement

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.

Mecklenburg County utilized the multi-jurisdictional planning process recommended by the Federal Emergency Management Agency (FEMA Publication Series 386) to develop the initial version of this Plan. A *Local Mitigation Plan Review Tool*, found in Appendix B, provides a detailed summary of FEMA's current minimum standards of acceptability for compliance with the Disaster Mitigation Act of 2000 and notes the location of where each requirement is met within the Plan. These standards are based upon FEMA's Interim Final Rule as published in the Federal Register on February 26, 2002, in Part 201 of the Code of Federal Regulations (CFR).

The planning process included nine (9) major steps that were completed over the course of approximately seven months. These steps are illustrated in **Figure 2.1**.

Figure 2.1: Mecklenburg County Hazard Mitigation Planning Process



Each of the planning steps illustrated in Figure 2.1 resulted in critical products and outcomes that collectively make up the Hazard Mitigation Plan. These work elements have been included as separate sections of the Plan, each of which is introduced in Section 1: *Introduction* (see Plan Outline).

MECKLENBURG COUNTY MITIGATION PLANNING COMMITTEE

A well-rounded community-based planning team contributed heavily to the development of this Plan. Mecklenburg County engaged local government officials in local meetings and planning workshops to discuss and complete tasks associated with preparing the Plan. This working group coordinated all aspects of the Plan's development and became formally recognized as the Mecklenburg County Mitigation Planning Committee. In addition to regular meetings, committee members routinely communicated and were kept informed through a dedicated e-mail distribution group maintained by Mecklenburg County Stormwater Services. Additional participation and input from county residents and other identified stakeholders was sought through the distribution of survey questionnaires and the facilitation of public meetings that described the planning process, the findings of the risk assessment, and proposed mitigation actions.

The participants listed in **Table 2.1** represent the members of the Mitigation Planning Committee who were responsible for participating in the initial development of the Plan. Committee members are listed in alphabetical order by last name.

Table 2.1: Mitigation Planning Committee Members (2005)

NAME	AGENCY, JURISDICTION AND/OR ROLE
David Barley	Town of Pineville
Leamon Brice	Town of Davidson
Melonee Brock	Mecklenburg County
Wayne Broome	Charlotte-Mecklenburg Emergency Management Office
Roger Buell	City of Charlotte Department of Transportation
Dave Christopher	City of Charlotte Department of Transportation
Mitch Combs	Charlotte-Mecklenburg County Stormwater Services
Rodney Crisco	N. Mecklenburg County 911 Communications Center
Tom Drake	Charlotte-Mecklenburg Plus Comm
Bill Garrison	Town of Mint Hill
Jennifer Glotfelty	Charlotte Storm Water Services
Pam Holbrook	Town of Huntersville
Kevin Icard	Town of Pineville
Todd Lamb	Town of Mint Hill
Ken Martin	City of Charlotte Department of Transportation
Ralph Messera	Town of Matthews Public Works
Douglas Morris	City of Charlotte Department of Transportation
Ricky Overcash	Town of Cornelius
Rick Prosser	Watershed Concepts
Bill Pruitt	City of Charlotte Storm Water Services
Darrin Punchard	PBS&J
Brian Richards	Town of Huntersville
Tim Rogers	City of Charlotte Fire Department
Gavin Smith	PBS&J
Bill Tingle	Mecklenburg County Storm Water Services
Tim Trautman	Mecklenburg County Storm Water Services

COMMUNITY MEETINGS AND WORKSHOPS

The preparation of the Plan required a series of meetings and workshops intended to facilitate discussion and initiate data collection efforts with local community officials. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the drafting of the Plan.

Below is a summary of the key meetings and workshops conducted by the multi-jurisdictional Mitigation Planning Committee.[1] In some cases, additional meetings were held to accomplish specific planning tasks, such as the completion of the *Capability Assessment Survey* and the

Members of Mecklenburg County's Mitigation Planning Committee gathered early in the planning process to discuss necessary tasks and individual roles and responsibilities for preparing the multi-jurisdictional plan.

[1] Copies of the agendas, sign-in sheets and handout materials for all meetings and workshops are available through Mecklenburg County upon request.

approval of locally-specific mitigation actions for inclusion in their Mitigation Action Plan. Individual meetings were also held by each participating jurisdiction and their designated staff in order to identify additional mitigation actions beyond those created during the second mitigation planning committee meeting.

First Mitigation Planning Committee Meeting

The first meeting of the Mitigation Planning Committee meeting was held on September 20, 2004 during which the mitigation planning project was introduced to representatives of participating jurisdictions and other invited stakeholders. The intent of this meeting was to educate officials on the mitigation planning process being sponsored by Mecklenburg County, as well as to explain the DMA 2000 multi-jurisdictional planning requirements and the individual roles being required and assigned to each of the committee members. The meeting also served to initiate the preliminary data collection efforts for the risk and capability assessment tasks associated with the development of the Plan.

The meeting began with a detailed presentation on the mitigation planning process led by the project team from PBS&J.[2] During the presentation, the concept of hazard mitigation was introduced, followed by a more detailed discussion of the local mitigation planning process. Ideas on how to improve and/or expedite the process were solicited from committee members, along with potential strategies for overcoming known barriers to accomplishing project tasks in a timely fashion. Specific data collection needs were thoroughly explained, including the need for accurate GIS data as well as any unique local hazard risk data available for specific areas of concern. A preliminary draft of the proposed outline for the Plan was also shared with the committee for review and comment.

During the presentation, the Mitigation Planning Committee reached consensus on those natural hazards that should be addressed in the risk assessment, and subsequently those that participating jurisdictions would possibly focus their mitigation efforts. **Table 2.2** documents the decision-making process as it relates to those hazards that were to be identified, analyzed and assessed through the preparation of the countywide risk assessment. Some of the hazards included in this table are only referenced here along with an explanation as to why they were ruled out for local, State, and/or regional consideration.

[2] Copies of all Microsoft® PowerPoint® presentation slides are available through Mecklenburg County upon request.

Table 2.2 Selection of Natural Hazards for Inclusion in Risk Assessment

HAZARD	PLAN SECTION(S) IN WHICH HAZARD IS ADDRESSED		
	HAZARD IDENTIFICATION	HAZARD ANALYSIS	VULNERABILITY ASSESSMENT
Avalanche	No. This hazard is only relevant to the western United States.[3]		
Coastal Erosion	No. Mecklenburg County lies more than 200 miles inland.		
Dam/Levee Failure	Yes	Yes	Yes
Drought	Yes	Yes	Yes
Earthquake	Yes	Yes	Yes
Extreme Heat	Included in the discussion of drought, where applicable.		
Erosion	Yes	No. Although soil and streambank erosion is a known localized hazard, it rarely threatens property or causes life/safety issues of concern to this planning effort.	
Flood	Yes	Yes	Yes
Hail	Yes. Hail is addressed as part of the Severe Thunderstorm hazard.		
Hurricanes and Tropical Storms	Yes	Yes	Yes
Landslide	Yes	Yes	Yes
Lightning	Yes. Lightning is addressed as part of the Severe Thunderstorm hazard.		
Severe Thunderstorm	Yes	Yes	Yes
Sinkhole	Yes	Yes	Yes
Storm Surge	No. Mecklenburg County lies more than 200 miles inland.		
Tornado	Yes	Yes	Yes
Tsunami	No. Mecklenburg County lies more than 200 miles inland.		
Volcano	No. There are no active volcanoes present in the eastern United States.		
Wildfire	Yes	Yes	Yes
Winter Storm	Yes	Yes	Yes

Following the presentation on the mitigation planning process, the project team from PBS&J addressed any questions and concerns raised by the committee. These were primarily related to the hazards to be addressed in the planning process and the methods and data requirements for completing the risk and capability assessments, and the types of mitigation actions each jurisdiction should consider for inclusion in their Mitigation Action Plans. The committee also briefly discussed the need to expand committee membership or at least invite additional stakeholders to the next committee meeting, which was scheduled for February 9, 2005.

Data collection efforts were launched through the distribution and explanation of the *Capability Assessment Survey* to each member of the committee. Each committee member was assigned the task of returning to their respective agency or jurisdiction and meeting with appropriate officials to complete the survey questionnaire. The committee determined that the surveys would be completed and returned to PBS&J through Mecklenburg County by October 8, 2004 (approximately three weeks from the date of the initial meeting to allow sufficient time to complete each survey completely and accurately).

Second Mitigation Planning Committee Meeting: "Mitigation Strategy Workshop"

The second Mitigation Planning Committee meeting was held on February 9, 2005 in the form of a four hour "Mitigation Strategy Workshop." The workshop began with a detailed presentation by PBS&J on the findings of the risk assessment and capability assessment. This provided county and municipal officials with a more thorough understanding of the hazard risks in their communities, along with the varied levels of

[3] According to FEMA's *Multi-hazard Identification and Risk Assessment*.

local capabilities available to address them. This information was to be used by participants in creating meaningful mitigation planning goals and specific, achievable mitigation actions that are designed to reduce the impacts of the identified hazards.

The following findings were presented and discussed during the workshop.[4]

Risk Assessment Findings

- Total dollar exposure for property within Mecklenburg County is estimated to be approximately $99.3 billion. This figure is based on an estimated 298,426 residential, commercial, industrial and other buildings located throughout the county.
- Mecklenburg County has experienced five presidential disaster declarations since 1965, in addition to numerous state-declared disasters and local emergency events.
- The top five natural hazards based upon the qualitative assessment are: (1) flood; (2) hurricanes and tropical storms; (3) winter storms; (4) severe thunderstorms; and (5) tornadoes.
- The top five natural hazards based upon the quantitative assessment (ranked by estimated annualized loss) are: (1) hurricanes and tropical storms; (2) flood; (3) earthquakes; (4) drought; and (5) winter storms.
- Based upon a combination of findings for the qualitative and quantitative assessments and the general consensus of the Mitigation Planning Committee, the five "high" risk hazards for Mecklenburg County are flood, hurricanes and tropical storms, winter storms, severe thunderstorms and tornadoes. The three "moderate" risk hazards are earthquakes, drought and wildfire.

Following the presentation of the risk assessment findings, an interactive session was held to address questions and discuss potential concerns. In addition, each workshop attendee was issued a survey form titled, *Unique Hazard Risks to Local Jurisdictions,* designed to capture data on hazards not identified in the risk assessment presentation. Most of the questions raised at this point of the meeting were related to the qualitative and quantitative assessments of Mecklenburg County's identified natural hazards. In particular, it was determined that more information needed to be collected for the dam/levee failure hazard (such as historical dam breach information and potential inundation maps from Duke Power, if available).

Capability Assessment Findings

- Mecklenburg County and all participating municipalities have joined the National Flood Insurance Program (NFIP).
- Mecklenburg County, Charlotte and Pineville are actively participating in the NFIP's Community Rating System (CRS).
- All jurisdictions have a Building Code Effectiveness Grading schedule of 4.
- Most participating jurisdictions have already adopted and implement/enforce a comprehensive plan, building codes and zoning ordinances.
- Most of the jurisdictions have already adopted a floodplain management plan.
- Few communities have prepared a continuity of operations plan, evacuation plan or disaster recovery plan.

[4] For more detailed information on the findings presented at the Mitigation Strategy Workshop, please refer to the PowerPoint slides available through Mecklenburg County upon request.

- Mecklenburg County, the City of Charlotte and the Town of Huntersville have relatively higher administrative and technical capability than the other participating jurisdictions.
- Mecklenburg County, the City of Charlotte, and the towns of Huntersville, Cornelius and Davidson have a "high" overall capability rating. Jurisdictions receiving a "moderate" overall capability rating include the towns of Matthews, Pineville and Mint Hill.

Following the presentation of the capability assessment findings, the Mitigation Planning Committee reviewed the quantitative scoring system applied to the capability assessment survey results. This was followed by one-on-one meetings with PBS&J representatives to address gaps or conflicts in initial survey responses, and to verify that all data submitted as part of the capability assessment was as accurate as possible. It was agreed that officials from each jurisdiction will closely review the capability assessment narrative when included and distributed as part of the draft Plan to ensure that all information is up-to-date and accurately reflects their existing local capabilities.

The Mitigation Planning Committee proposed a variety of possible mitigation actions to consider during the cardstorming exercise.

Cardstorming Exercise

Upon completing the presentation and discussions on the findings of the risk and capability assessments, PBS&J facilitated a "cardstorming" exercise—an interactive brainstorming session for workshop attendees to begin building general countywide consensus on the mitigation goals for the Hazard Mitigation Plan. Participants were asked to identify specific mitigation actions that their community could undertake to become less vulnerable to the hazards identified through the risk assessment. Each participant was encouraged to keep their own jurisdiction's existing capabilities in mind, to not only ensure that the mitigation actions they recommend are achievable but to also capitalize on existing gaps, weaknesses or opportunities for program enhancement.

As part of the exercise, workshop participants were asked to discuss potential mitigation policies or projects with official representatives from their community and instructed to record their proposed mitigation actions on cards that would then be posted along the wall of the meeting room. This exercise resulted in a variety of potential mitigation strategies, goals or actions being submitted and posted on the wall for further review, discussion and consideration by the committee. Community officials used this time to elaborate upon each of their proposed mitigation action items, and to share concerns and thoughts related to each one as a group.

The cardstorming technique required input from every workshop participant and resulted in both broad and very specific types of proposed mitigation actions for inclusion in the *Mitigation Strategy*. Following the open discussion, the exercise continued with the categorization of each mitigation action according to the general consensus of the group. Using the cards placed along the wall, workshop participants began to arrange the mitigation actions into agreed upon columns that represented separate mitigation categories.

The intended purpose of this categorization was the identification of common themes that could then translate into goal statements for the Plan.

Upon completion of the exercise, six (6) different categories were identified and labeled with separate column headings generated by consensus of the group. Workshop participants were informed that these categories would later serve as the basis for goal statements for the Plan. Categories consist of the following:

- Planning and Policy
- Education and Outreach
- Warning
- Training
- Traffic Control
- Special Projects

Another outcome of the cardstorming exercise was the preliminary identification of potential mitigation actions for Mecklenburg County and participating jurisdictions to consider for incorporation into their own individual Mitigation Action Plans. These actions are summarized in **Table 2.3**.[5]

Table 2.3: Potential Mitigation Actions for Mecklenburg County

PROPOSED ACTION	CATEGORY	HAZARD	JURISDICTION
How to deal with future development in flood zones	Planning & Policy	Flood	Pineville
Develop recovery plan dealing with sewer treatment plant (flooding)	Planning & Policy	Flood	Pineville
Formulate disaster recovery plan	Planning & Policy	All	Pineville
Consider hazards in growth policies	Planning & Policy	All	Davidson
Identify and develop plan to address cleaning of "recurring problem" of street drainage issues	Planning & Policy	Flood	Charlotte/ Stormwater
Form an ERT to clear storm drains of debris during and after the event	Planning & Policy	Flood	Charlotte/DOT
Develop a stormwater management plan	Planning & Policy	Flood	Davidson
Join the Community Rating System (CRS)	Planning & Policy	Flood	Cornelius
Join the Community Rating System (CRS)	Planning & Policy	Flood	Huntersville
Improve awareness and education of the NFIP	Education & Outreach	Flood	Huntersville
NFIP education for citizens near lake areas	Education & Outreach	Flood	Cornelius
Develop/enhance multi-hazard awareness programs	Education & Outreach	All	Cornelius

[5] As the cardstorming exercise results relate to the final *Mitigation Action Plans* presented in Section 9, some *potential* actions were identified by the Mitigation Planning Committee (as shown in Table 2.3) but were determined to be not appropriate for implementation due to various factors such as cost effectiveness, community priorities, environmental objectives, etc.

Table 2.3: Potential Mitigation Actions for Mecklenburg County

PROPOSED ACTION	CATEGORY	HAZARD	JURISDICTION
Enhance public education of the NFIP, and benefits in "minor system" areas	Education & Outreach	Flood	Charlotte
Gain additional support for tree pruning from Duke Power	Education & Outreach	Winter Storm (ice)	Matthews
Information dissemination (planning maps, broadcasts, website, list servers)	Education & Outreach	All	Charlotte
Sustain / fund FACT program for citizens	Education & Outreach	Flood	Charlotte/Fire
Acquire more information on lake levels and storage capacity	Warning	Hurricanes/ Storms	Mecklenburg County
Enhance Automated flood warning system to include forecasting and inundation mapping	Warning	Flood	Mecklenburg County
Consolidate map and/or computer-driven GIS with real-time flood inundation zones	Warning	All	Charlotte/Fire
Train and equip emergency responders and managers for flood emergencies	Training	Flood	Charlotte/Fire
Provide training and technology for 911 dispatchers during natural disasters	Training	All	Charlotte/Fire
Provide / conduct disaster drills for division managers	Training	All	Charlotte/Fire
Develop and provide safety training for city/county employees during floods/storms	Training	All	Charlotte/Fire
Provide and maintain NIIMS training for all KBE's, division heads and key government officials	Training	All	Charlotte/Fire
Train staff and educate the community on its vulnerability to hazards	Training	All	Pineville
Detours during reconstruction (road closures, utility restoration)	Traffic Control	All	Charlotte
How to deal with traffic during a natural disaster (flooding or ice) in a high traffic commercial area	Traffic Control	All	Pineville
Coordinate efforts in city ROW to minimize closure time	Traffic Control	All	Charlotte/DOT
Traffic control (barricades, barriers, cones, signs)	Traffic Control	All	Charlotte/DOT
Develop evacuation routes (can't be affected by local flooding)	Traffic Control	All	Charlotte
Acquire / elevate flood prone structures for willing property owners	Special Projects	Flood	Mecklenburg County
Floodproofing for non-residential structures for willing property owners	Special Projects	Flood	Mecklenburg County
Provide information (encroachments, abandonments, construction, leases)	Special Projects	All	Charlotte
Mitigate localized flooding caused by road and railroad structures	Special Projects	Flood	Matthews
Develop functioning EOC	Special Projects	All	Davidson
Equip emergency responders with swift water rescue resources	Special Projects	Flood	Charlotte/Fire

Before the meeting concluded, PBS&J distributed and explained several handouts for workshop participants to use in identifying specific mitigation actions for incorporation into their own respective Mitigation Action Plans. This included *Mitigation Action Worksheets* (forms for proposing individual mitigation actions), along with a variety of planning tools and reference guides for considering and evaluating possible mitigation action alternatives.[6] Workshop participants were instructed to take these materials back to their individual jurisdictions to identify and prioritize additional mitigation actions as appropriate.[7]

Third Mitigation Planning Committee Meeting

The third meeting of the Mitigation Planning Committee meeting was held on March 24, 2005 during which the draft Hazard Mitigation Plan was reviewed, discussed and prepared for final submission to NCEM and FEMA. After going through each section of the draft Plan, emphasis was placed on addressing missing information in each jurisdiction's Mitigation Action Plan. The meeting also provided an opportunity for the County and participating municipalities to add new mitigation actions.

Following the meeting, Mecklenburg County distributed specific instructions to officials to provide final review comments on the draft Plan no later than March 29, 2005. They were strongly encouraged to meet with their appropriate agency executive and elected officials to gain additional support for the draft Plan prior to its submission for state and federal approval. Three public meetings were held on March 24, 2005 to solicit feedback on the draft Plan and discuss specific hazard concerns as described in the Public Participation Survey.

INVOLVING THE PUBLIC

44 CFR Requirement

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 Mecklenburg County's community-based mitigation planning process involves public participation. Individual citizen involvement provides the Mitigation Planning Committee with a greater understanding of local concerns and ensures a higher degree of mitigation success by developing community "buy-in" from those directly affected by the planning decisions of public officials. As citizens become more involved in decisions that affect their life and safety, they are more likely to gain a greater appreciation of the natural hazards present in their community and take personal steps to reduce their potential impact. Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business or city safer from the potential effects of natural hazards.

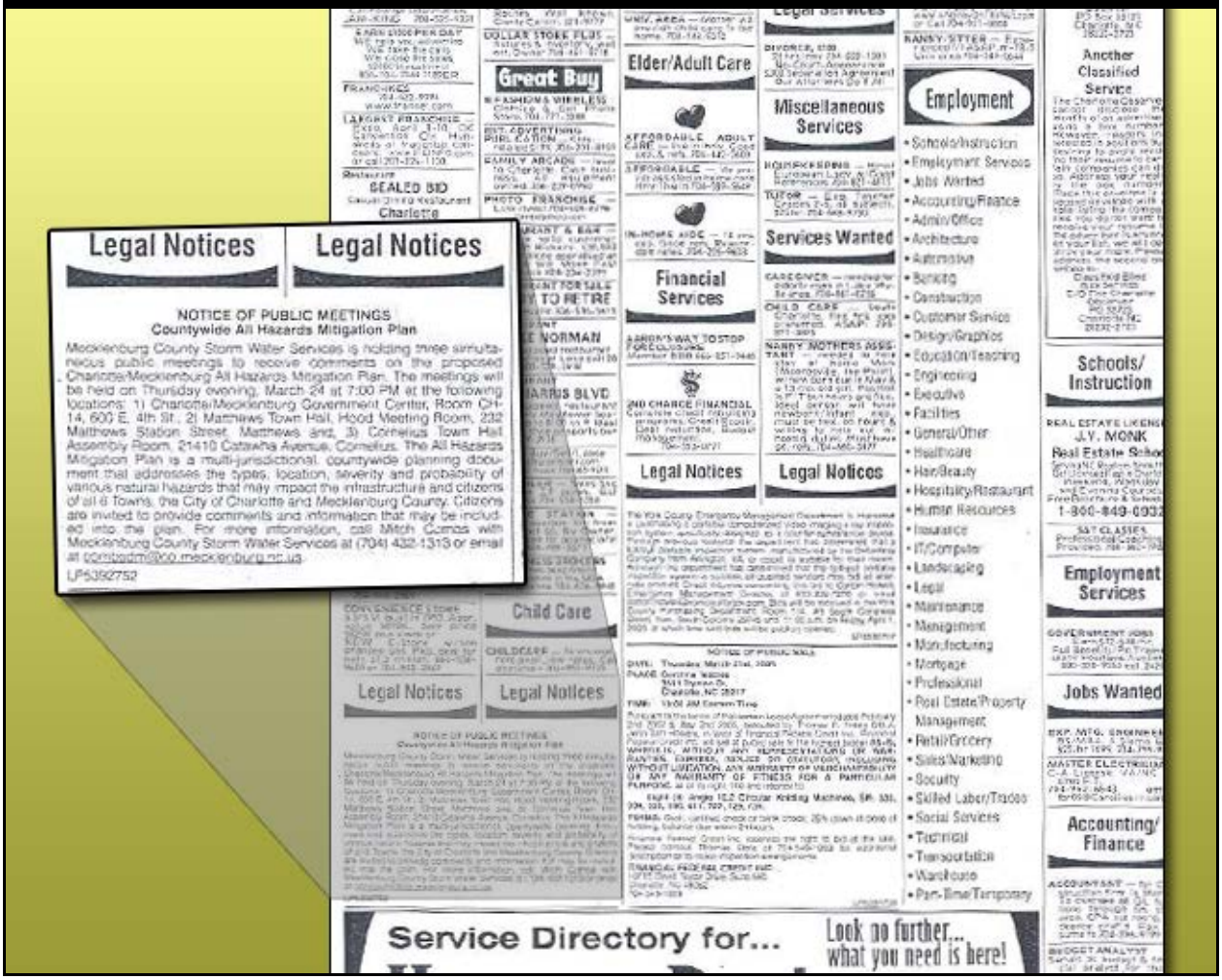
Public input was sought using three methods: (1) open public meetings; (2) the creation of a public participation survey instrument; and (3) the posting of the draft Hazard Mitigation Plan on Internet Web sites and at government offices. County-level public meetings were held at two stages of the planning process; following the completion of the draft Plan and prior to adoption by each participating jurisdiction.

[6] Copies of all planning tools and reference guides distributed at the meeting are available through Mecklenburg County upon request.

[7] It was agreed by the Mitigation Planning Committee that prioritizing mitigation actions was to be based on the following five (5) factors: (1) effect on overall risk to life and property; (2); ease of implementation; (3) political and community support; (4) a general economic cost/benefit review; and (5) funding availability.

Three public meetings were held on the evening of March 24, 2005 at the City of Charlotte, the Town of Matthews, and the Town of Cornelius, respectively. The meetings were advertised through the posting of a public meeting notice at county and municipal offices, along with a newspaper advertisement posted in the Charlotte Observer on the week of March 21, 2005 (**Figure 2.2**). The intent of the meetings was to inform citizens about the importance of hazard mitigation, describe the mitigation planning process and discuss the findings of the risk assessment. A *Public Participation Survey* was created in order to collect additional information from citizens about local hazard concerns and was available at each public meeting.

Figure 2.2: Public Meeting Notice as Published in The Charlotte Observer



Source: The Charlotte Observer

Upon completion of the final draft Plan, the document was posted on the Mecklenburg County public Web site for citizen review and comment. In order to make the draft Plan available to those without Internet access, the Plan was also made available for review at county and municipal offices. On May 17, 2005, a second series of eight public meetings was held by Mecklenburg County and each participating jurisdiction prior to the execution of plan adoption procedures. The meetings provided citizens with the opportunity to review the content of each of the Plan's sections, to ask questions and suggest possible final revisions.

INVOLVING STAKEHOLDERS

44 CFR Requirement

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 authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.

A range of stakeholders, including neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties were invited and encouraged to participate in the development of the Hazard Mitigation Plan. Stakeholder involvement was encouraged through Mecklenburg County's notifications and invitations to agencies or individuals to participate in Mitigation Planning Committee meetings and the Mitigation Strategy Workshop. The invitation and attendance of these stakeholders at the Mitigation Strategy Workshop are documented in **Table 2.4**.

In addition to the Mitigation Planning Committee meetings, Mecklenburg County encouraged more open and widespread participation in the mitigation planning process through the design and publication of newspaper advertisements that promoted the open public meetings. These media advertisements and survey instruments provided local officials, residents and businesses with an opportunity to be involved and offer input throughout the local mitigation planning process.

Table 2.4: Stakeholder Involvement in the Planning Process[8]

STAKEHOLDER GROUP	INVITED TO MITIGATION STRATEGY WORKSHOP	ATTENDED MITIGATION STRATEGY WORKSHOP
Leamon Brice, Town of Davidson, Town Manager	✓	✓
Wayne Broome, Charlotte-Mecklenburg EM	✓	✓
Mitch Combs, Mecklenburg Storm Water Services	✓	✓
Dave Christopher, Charlotte DOT	✓	✓
Rodney Crisco, N. Mecklenburg 911 Comm.	✓	✓
Kevin Icard, Town of Pineville	✓	✓
Ralph Messera, Town of Matthews	✓	✓
Douglas Morris, Charlotte DOT	✓	✓
Ricky Overcash, Town of Cornelius	✓	✓
Bill Pruitt, City of Charlotte Storm Water Services	✓	✓
Brian Richards, Town of Huntersville	✓	✓
Tim Rogers, Charlotte Fire Department	✓	✓
Bill Tingle, Mecklenburg Storm Water Services	✓	✓
Tim Trautman, Mecklenburg Storm Water Services	✓	✓

[8] These individuals were contacted by written letter followed up with e-mail and telephone calls.

PREPARING THE 2010 PLAN UPDATE

In preparing the 2010 plan update, Mecklenburg County continued to follow the multi-jurisdictional planning process recommended by FEMA as most recently published in its *Local Multi-Hazard Mitigation Planning Guidance* (July 1, 2008) in addition to plan update guidance materials made available through NCEM. To assist in this process the County contracted with the consulting firm of AECOM in October 2009. The plan update process was scheduled to be completed over the course of nine (9) months, though it truly began earlier 2009 with a series of preliminary meetings and discussions between representatives from AECOM, Charlotte-Mecklenburg Emergency Management Office (CMEMO), Charlotte-Mecklenburg Storm Water Services (CMSWS) and representatives from each of the participating municipal jurisdictions. This included meetings on **May 1, 2009** and again on **July 29, 2009** in which the working group discussed the need to update the 2005 plan, the scope of work and fee options provided by AECOM, the proposed project schedule and project funding. This also included a meeting between the AECOM project manager and Mecklenburg County's Floodplain Administrator and CRS Coordinator on **October 29, 2009** to review and discuss the incorporation, if appropriate, of any existing new plans, studies, reports, and technical information that has become available since the completion of the initial 2005 Plan. Following completion of these scoping meetings and the execution of a contractual agreement, Mecklenburg County moved forward with notifications for reconvening the Mitigation Planning Committee and beginning the plan update process as described below.

RECONVENING THE MITIGATION PLANNING COMMITTEE

One of the first steps in preparing the 2010 plan update was to reconvene the County's Mitigation Planning Committee for a "plan update kickoff" meeting. The following participants represent the members of the Mecklenburg County Mitigation Planning Committee who were responsible for participating in the plan update process, some of who served as committee members during the initial preparation of the initial Plan in 2005. Committee members are listed in alphabetical order according to their last name.

Table 2.5: Mitigation Planning Committee Members (2010 Plan Update)

NAME	AGENCY, JURISDICTION AND/OR ROLE
David Baucom	Lieutenant, Town of Cornelius Police Department
Kevin Black	Captain, Town of Cornelius Police Department
Leamon B. Brice	Town Manager, Town of Davidson
Wayne Broome	Director, Charlotte-Mecklenburg Emergency Management Office
Eric D. Campbell	Assistant City Manager, City of Charlotte
Joe Chapman	Vice President, AECOM
Sharon Foote	Public Information Specialist, Charlotte-Mecklenburg Storm Water Services
Tim Garner	Assistant Director, Town of Mint Hill Public Works Department
Douglas Huss	Land Development Inspector, Charlotte-Mecklenburg Storm Water Services
Kevin Icard	Planning Director, Town of Pineville
Stephen Jackson	Fire Captain, Town of Mint Hill Fire & Rescue Department
Garet Johnson	Assistant Director, City of Charlotte Planning Department
Doug Lozner	City of Charlotte Engineering & Property Management
Dan Martin	Sergeant, Town of Pineville Police Department
Lisa McCarter	Planner, Town of Huntersville Planning Department

Table 2.5: Mitigation Planning Committee Members (2010 Plan Update)

NAME	AGENCY, JURISDICTION AND/OR ROLE
Kim McMillan	Corporate Communications Director, City of Charlotte
Ron McMillan	Operations Supervisor, Town of Davidson
Ralph Messera	Public Works Director, Town of Matthews
Ricky Overcash	Public Works Director, Town of Cornelius
Darrin Punchard	Senior Project Manager, AECOM
John Rowell	Patrol Lieutenant, Town of Mint Hill Police Department
Trim Sawtelle	Chief, Town of Matthews Fire & Rescue Department
James Scanlon	GIS Analyst, AECOM
Jennifer Smith	Storm Water Division Manager, City of Charlotte
Kelly Smith	Corporate Communications, City of Charlotte
Bryan Tarlton	Construction Manager, City of Charlotte Engineering & Property Management
Bill Tingle	Floodplain Administrator, Charlotte-Mecklenburg Storm Water Services
Tim Trautman	Program Manager, Charlotte-Mecklenburg Storm Water Services
Hal Wishon	Administrative Officer, Charlotte-Mecklenburg Emergency Management Office
Bobby Williams	Town Manager's Office, Town of Huntersville
Doug Wright	Public Works Director, Town of Davidson

COMMUNITY MEETINGS AND WORKSHOPS

The preparation of the 2010 plan update required a series of meetings and workshops for facilitating discussion and data collection efforts with local community officials. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the drafting stages of the plan update. Below is a summary of the key meetings and community workshops for the multi-jurisdictional Mitigation Planning Committee. In many cases, additional meetings were held by the individual participating jurisdictions to accomplish planning tasks specific to their community, such as the approval of locally specific mitigation actions for inclusion in their Mitigation Action Plan.

Members of the Mitigation Planning Committee reconvene to discuss the 2009/2010 plan update process.

October 30, 2009
Mitigation Planning Committee Meeting – "Plan Update Kickoff"

Mr. Wayne Broome opened the meeting by providing an update on the status on the contract and describing the funding procedures for each of the participating municipal jurisdictions. It was noted that the contract with AECOM will be executed within two weeks and that the City of Charlotte would be seeking financial commitments from each municipal jurisdiction to assist with project fees, in addition to larger funding contributions by the Charlotte-Mecklenburg Emergency Management Office and Storm Water Services.

Mr. Broome continued by explaining the critical role that committee members will play throughout the process. He then asked each of the attendees to introduce themselves and reminded them to complete

the sign-in sheet circulating around the room. Following introductions, Mr. Broome turned the meeting over to Mr. Darrin Punchard, the lead consultant from AECOM who would be assisting the County in its plan update process.

Mr. Punchard began his presentation by providing some background on the importance of maintaining and updating an approved local hazard mitigation plan and how it relates to State and Federal grant funding eligibility, a description of new plan update requirements per NCEM and FEMA, and the key objectives for the update process as outlined by the City of Charlotte and Mecklenburg County. These objectives include: (1) to evaluate and update each section to reflect current information and best available data; (2) to provide opportunities for the public and identified stakeholders to provide input to the plan update process; (3) to maintain state and federal compliance for all participating jurisdictions; and (4) to maximize Community Rating System (CRS) credit points for floodplain management planning (Activity 510).

Mr. Punchard continued to provide information on each of the specific plan update tasks and the overall project schedule, along with some of the specific methods to be used for data collection and coordination among each of the eight jurisdictions throughout the process. He also presented an overview of current NFIP statistics for each jurisdiction (number of policies, total coverage, number and amount of claims) in order to illustrate how the information has changed a five-year period. The data prompted representatives from the Town of Davidson to inquire as to the location of the 21 historical insured losses identified for their jurisdiction. Bill Tingle indicated that this data is as readily available, but is something that could hopefully be addressed with the risk assessment update (including through the use of a GIS database on NFIP-insured structures that had recently been geo-coded by address, and would be made available to the AECOM project team). Mr. Punchard also used this information to further discuss the incentives for joining and advancing through the CRS as a recommended component of the plan update, while giving the committee members an opportunity to ask questions, raise concerns or suggest ideas on how CRS planning steps would be integrated at the immediate outset of the update process.

After describing the overall approach, schedule and objectives for the plan update process, Mr. Punchard then facilitated a general discussion among committee members focused on the current (2005) multi-jurisdictional hazard mitigation plan. This included going through each of the five-year plan review questions that had been established in the plan maintenance procedures of the current plan, including the following:

- Do the goals and actions address current and expected conditions?
    - Mr. Punchard went through each of the six goals of the current plan and committee members agreed that they were still applicable, but should be revisited again following the completion of updates to the risk and capability assessments.

- Has the nature or magnitude of risks changed?
    - In order to gain some initial feedback from the committee in response to this question, Mr. Punchard facilitated an interactive gaming exercise to capture current perceptions on Mecklenburg County's existing hazard risks and priorities for mitigation planning. After handing out $20 in mock currency to each committee member (including a $10 bill, a $5 bill and five $1 bills), he asked them all to come to the front of the room and spend their "mitigation money" on the hazards needing the most attention in terms of risk reduction strategies. As each committee member ventured to the front of the room, they found an assortment of labeled cups – one for each natural hazard that had been identified in the initial 2005 plan. Each committee member then deposited their allotted mitigation money into the cups of their choosing (and through the denominations provided, each was forced to deposit at least 50% of their money to one particular hazard). Following completion of the exercise, it was determined that most committee members agreed that the nature

and/or magnitude of most hazard risks haven't changed in the past five years with two notable exceptions: (1) the drought hazard was likely perceived to be a greater hazard threat relative to other hazards; and (2) the hurricane and tropical storm was perceived to be a lesser hazard threat than five years earlier. Committee members also raised several questions regarding the dam/levee failure hazard, which Mr. Punchard explained would again be addressed through the updated risk assessment even though it was deemed a low risk hazard in 2005.

Results of Icebreaker Exercise on Hazard Risks:

HAZARD	TOTAL $	PERCENT
Flood	$86	33.1%
Severe Thunderstorms / Tornadoes	$60	23.1%
Winter Storms	$59	22.7%
Drought	$25	9.6%
Hurricanes & Tropical Storms	$15	5.8%
Dam/Levee Failure	$6	2.3%
Wildfire	$5	1.9%
Sinkholes / Landslides	$2	0.8%
Earthquake	$2	0.8%

- Are current resources adequate to implement the Plan? Should additional local resources be committed to address identified hazard threats?
    - The committee was in general agreement that current resources are appropriate, with the potential exception being limited fiscal capabilities. Mr. Punchard explained that the issue of current resources for implementing the plan will be addressed more specifically in the updated local capability assessment for each participating jurisdiction.

- Are there any issues that have limited the current implementation schedule?
    - No specific issues or problems with regard to plan implementation were raised by the committee.

- Have the implementation of identified mitigation actions resulted in expected outcomes?
    - Minimal comments were provided by the committee. Mr. Trautman asked whether or not the group was going to be responsible for documenting what has been done since the 2005 plan was completed. Mr. Punchard explained that yes, each jurisdiction will have to provide an update to each of their proposed actions (was it completed, deferred or in need of deletion) as part of the plan update process, in addition to identifying newly proposed mitigation action items.
    - Bill Tingle (Mecklenburg County Storm Water Services) indicated that he's maintained status update reports on proposed mitigation actions for some local jurisdictions as part of his annual CRS reporting requirements and would make these available to the AECOM project team.
    - Mr. Punchard explained that this issue will be addressed more specifically in the updated local status reports on mitigation actions for each participating jurisdiction.

- Has the Mitigation Planning Committee measured the effectiveness of completed hazard mitigation projects in terms of specific dollar losses avoided?
    - While there has not been a lot of effort aimed and documenting losses avoided due to completed mitigation projects, it is believed that some of this information has been or can

be quantified for Mecklenburg County's floodplain acquisitions (for example, the recent flooding of Cavalier Apartments). The County has also recently completed a HAZUS study to demonstrate potential losses avoided due to the enforcement of higher regulatory standards for floodplain management based on projected build-out conditions and would make this report available to the AECOM project team.

- Did the jurisdictions, agencies and other partners participate in the plan implementation process as proposed?
    - Most committee members were in agreement that the jurisdictions, agencies and other partners participated in the plan implementation process as expected. It was noted however that the plan maintenance procedures as adopted in the current plan should be significantly revised as part of the plan update process to make monitoring, evaluating and amending the plan more straightforward.

Following discussion on the five-year plan review questions, some additional questions and comments were shared in an open discussion, including:

- Who else needs to be involved on the Mitigation Planning Committee?
    - It was suggested that representatives from the City of Charlotte's Department of Transportation be invited to participate (might need more than one person); someone from the City's Fire Department and/or Swift Water Rescue Team; someone from Charlotte Area Transit System (CATS) and possibly Charlotte Douglas International Airport; along with representatives from the local chapter of the American Red Cross. It was noted that further consideration would be made on their direct involvement with the committee, but at a minimum each of these agencies would be included as targeted stakeholders to review and provide input on the draft plan update.

- What is the greatest need for improvement in the existing plan?
    Some suggested improvements included more realistic and achievable mitigation actions for each jurisdiction (i.e. eliminate those that are not specific enough or aren't practical or measurable); better integration of land use planning and policy alternatives in local mitigation action plans; updating repetitive loss inventory data; revising plan maintenance procedures.

- What is the best strategy for generating public interest, soliciting citizen input and enlisting additional partners in the plan update process?
    - Kim McMillan described a variety of potential means for public outreach efforts including utility bill inserts, newspaper ads, local public access television (including concurrent with open public meetings) and website forums. In order for January meetings to be properly advertised through utility bill inserts, documents would need to be submitted by December 8th.
    - It was agreed that Darrin Punchard would coordinate with Kim on determining the methods and costs associated with potential public outreach strategies, and would report back to Wayne Broome with recommended options to further consider.
    - It was determined that the existing Storm Water Advisory Committee (SWAC) could serve as the means for organized citizen input to the plan update process. Mr. Punchard explained that having such a separate planning advisory committee made up of more than 50 percent representing members of the general public would help maximize CRS credit points.
    - It was asked whether or not someone from an insurance company would want to be a

partner in this effort. It was determined that while such a representative wouldn't be invited for formal participation on the planning committee, the insurance industry should be one of the targeted stakeholders for later review and input on plan update products as part of the broader community outreach activities.

- Are there any new plans, policies, programs, studies, reports, data or technical information that should be reviewed and incorporated into the plan update process?
    - New DFIRM data will be integrated into the risk assessment, along with any other relevant GIS data that has been updated or developed since 2005. The AECOM team has already identified primary GIS points of contact for the project and initiated data collection and cataloging efforts.
    - The County recently completed a debris management plan, a copy of which would be made available to the AECOM team for review.

Upon completion of the general open discussion, committee members were reminded about their forthcoming task assignments, which were to (1) confirm the designation of their jurisdiction's primary point of contact; and (2) ensure the timely completion of plan update surveys that would be sent directly to them to assist the AECOM project team with updating information for each jurisdiction.

Lastly, the next Mitigation Planning Committee meeting was scheduled for January 20, 2010 and the first open public meeting was scheduled for the evening of January 21, 2010.

January 20, 2010
Mitigation Planning Committee Meeting (Second Plan Update Meeting)

Mr. Wayne Broome opened the meeting by welcoming all attendees, having them introduce themselves, and thanking them for their continued support of the 2010 plan update process. He circulated the sign-in sheet and reminded everyone to be certain to document their attendance and provide any updated contact information, if necessary. Mr. Tingle then asked Mr. Punchard, AECOM's lead consultant and project manager for the plan update, to provide a brief description of the plan update process for those committee members who were unable to attend the kickoff meeting.

Following the overview and a brief project update by Mr. Punchard, Mr. Broome provided an update on the contract and payment process and issued further clarification on any financial issues as requested by committee members. It was stated that AECOM will provide three milestone invoices at various stages in the project (50%, 40% and 10%) and that the City would send copies of each invoice to the participating jurisdictions once received. Mr. Broome indicated that he will be making a presentation on the project to the Town of Mint Hill's governing body and would be available to do the same for other jurisdictions upon request. Upon receipt of invoices and payment requests, checks from each of the towns should be sent to Charlotte-Mecklenburg Emergency Management. Mr. Broome also indicated that he would be making paper and electronic copies of the draft plan documents available for each participating jurisdiction at the appropriate time.

The next item on the agenda included approval of meeting minutes. Mr. Broome and Mr. Punchard circulated copies of the meeting minutes from the October 30th Mitigation Planning Committee Meeting which served as the official plan update kickoff. A motion was made to approve the minutes by Mr. Broome, and the motion was seconded by Mr. Tarlton.

Mr. Punchard then launched an overview presentation to provide all committee members with an update on project tasks completed to date, with the major focus of discussion on the risk assessment and capability assessment updates. He reminded everyone that while he had a lot of slides and material to

cover, the presentation should remain interactive and encouraged the active input and feedback from committee members throughout his review of the assessments to date.

In covering the risk assessment update, Mr. Punchard started off by providing an overview of the key differences between the year 2004 (when the current plan was completed) and 2010 for Mecklenburg County as it relates to hazard vulnerability. This included a briefing of some notable hazard occurrences, ranging from severe to extreme drought conditions in 2007-2008 to a major flood event in August 2008, in addition to numerous smaller scale hazard events. This also included a summary of population growth, development trends, the updated inventory of total property exposure (data on buildings and critical facilities), a description of some new GIS hazard layers for the flood and wildfire hazards, and some discussion on mitigation actions completed to date including some large scale acquisition projects as implemented through the County's Floodplain Buyout Program. Mr. Punchard then went through a summary of each natural hazard identified in the plan, covering updated statistics and location data for historical occurrences and documented damages for hazard events (particularly those that have occurred since 2004), updated GIS analyses for determining exposure and potential loss estimates, and updated hazard maps for those hazards that may be spatially defined through GIS technology. Mr. Punchard used PowerPoint slides to showcase many of these enhancements that were being made to the risk assessment as part of the plan update process and reminded committee members that much more information would be available through the draft risk assessment deliverables submitted for their review and comment. In certain cases throughout the presentation Mr. Punchard asked for confirmation of the data or illustrations being shown on the map (such as the identification critical facilities potentially at-risk to hazards), in order to help gain consensus on the preliminary risk assessment findings.

Several questions were raised by committee members during Mr. Punchard's presentation. Mr. Messera asked what the baseline standard or threshold was for including the listing of historical flood hazard occurrences in the plan. Mr. Punchard explained that most of the data came from the County, but is supplemented through the National Climatic Data Center which lists hundreds of events. Mr. Punchard acknowledged that this includes a lengthy listing and noted that one improvement AECOM is making to the tables for historical hazard occurrences is to limit them to only those events that caused documented property damages (though the statistics on the overall number of recorded events would remain in the plan). Committee members were reminded that there are a number of events that go unrecorded, so they are encouraged to review and provide additional historical or anecdotal information for each hazard profile as necessary.

Another question was raised by Bill Tingle regarding the flood exposure analysis completed for each jurisdiction using GIS. He asked if the analysis made any distinction in terms of separating out and excluding accessory structures from the building footprint study. Mr. Punchard explained that no structures were eliminated from the study and agreed that the exposure analysis likely overstates the true monetary exposure for at-risk residential buildings. It was agreed that the analysis would be recalculated to update these figures through the exclusion of structures less than 400 square feet, and a separate analysis would be conducted to exclude structures less than 600 square feet. It is recommended that the exposure analysis be reviewed and possible revised once the results of these new analyses are compared.

Ms. McMillan asked whether distinct housing types associated with NFIP policies can be distinguished (i.e., single family versus multi-family, apartments, etc.). She and Ms. Foote suggested that the media often assumes apartments are the most flood prone housing types and it would be good to clarify whether this is true or not. Mr. Punchard and Mr. Scanlon responded by saying that yes, there are ways to distinguish between housing types through further analysis of the NFIP policy records as provided by FEMA but caution must be used in doing so, as all of the information is protected by the federal Privacy Act.

Mr. Messera asked what the purpose was for differentiating between building types for the annualized hazard loss estimates generated by HAZUS-MH. Mr. Punchard and Mr. Broome explained that it should provide some indication on perhaps where mitigation strategies should be focused (building types at most risk), including the transfer of risk through adequate insurance coverage. Mr. Punchard also explained that FEMA requires information on the types and numbers of buildings, infrastructure, and critical facilities located in the identified hazard areas to be included in the risk assessment portion of the plan.

Mr. Icard inquired as to what the standard was for a dam to be state-regulated (by the North Carolina Division of Land Resources, Dam Safety Office). Mr. Tingle suggested that it is likely tied to a specific height of the dam structure, and Ms. Smith said also likely tied to the size of the drainage area or potential inundation areas, but no firm answer was known. Mr. Punchard indicated that this standard definition would be looked into further. Another issue regarding private dams was raised by Mr. Messera (such as those owned by homeowners associations and possibly not regulated by the State).

Mr. Broome asked Mr. Punchard whether many local hazard mitigation plans also addressed manmade hazards. Mr. Punchard explained that while current legislation (44 CFR Part 201), FEMA and the State only require local mitigation plans to address natural hazards, they do encourage the incorporation of all hazards when it makes sense to do so to the community. Mr. Punchard explained that FEMA has published a specific "How to" guidance document for integrating human-caused hazards such as hazardous materials incidents and terrorism into local plans, but in his experience a relatively small percentage of local communities choose to do so (with a notable exception in Texas where such planning if more routine).

Upon completion of Mr. Punchard's presentation on preliminary risk assessment findings and the subsequent Q&A session, he briefly provided an overview of the preliminary findings of the capability assessment. He thanked all committee members for their timely feedback and responses to the Capability Assessment Survey and asked if anyone had any questions on the updated changes in capability scores from 2004/2005. No questions were raised by the committee, and Mr. Punchard explained that more information would soon be made available in the form of a Section 7 (Capability Assessment) deliverable for people to review. He also indicated that he's going to need some more information that would be collected from each jurisdiction on an individual basis, including some updated information for Section 3 (Community Profile), and would also be encouraging each to consider conducting a "safe growth audit" as recommended and outlined by David Godschalk from UNC.

The agenda item on "Public Involvement" was moved up so that Ms. McMillan could provide an update to some of the City's public outreach efforts. She indicated that the evening public meeting scheduled for January 21 will be broadcast on Cable Channel 16 (Time Warner) and streamed over the Internet on charmeck.org, and that viewers would be able to submit questions via e-mail to publicinput@charlottenc.gov that can be addressed in live form during the broadcast. Ms. McMillan also informed the committee that the online public participation survey was already posted, and along with the public meeting, was being heavily advertised through mass e-mails, advertisements in local publications (including the Charlotte Observer and independent weeklies) and general word of mouth. It was requested that committee members inform Sharon Foote if they knew of any elected officials or other community representatives were planning to attend the public meeting so that they could be recognized accordingly.

Next, Mr. Punchard walked the committee members again through the currently established mitigation goals for the plan as currently written. He explained that these were reviewed at the kickoff meeting, and were now to be evaluated for relevance again following the presentation of the risk assessment and capability assessment findings. After subsequent discussion (including a focus on how hazard mitigation is integrated into local planning activities and Planning Commission decisions), and some additional

questions and answers, the general consensus of the committee was to keep the established mitigation goals for the plan as they are currently written.

Following the discussion on mitigation goals, Mr. Punchard led the committee members through some more presentation slides that focused the various mitigation categories included for the plan and some general examples and evaluations of specific strategies or actions for each. He then walked through the "Decision Tree" interactive PDF document made available through the North Carolina Division of Emergency Management, and noted that it was already posted to the project FTP site that each committee member had access to along with other helpful resources for mitigation action planning (including the CRS Coordinator's Manual and other hazard-specific mitigation documents). Subsequent discussion focused on the differences between traditional mitigation and preparedness/response activities, and Mr. Punchard encouraged committee members to focus their own mitigation planning activities on true risk reduction actions versus those focused on emergency services and first response – though both are acceptable activities to be included in the plan, each jurisdiction must have identifiable mitigation actions included in the plan in order to receive FEMA and State plan approval.

Mr. Tarlton asked whether outreach activities may include schools, and Mr. Broome indicated that such outreach programs are available but not implemented regularly unless requested by the schools themselves. Mr. Punchard indicated that the American Red Cross is often engaged in such activities and encouraged committee members to get information on their "Masters of Disaster" curriculum for children. Mr. Tingle mentioned the FACT program, and Mr. Broome highlighted the Transportation Evacuation Plan, Debris Management Plan and CERT program as other additional examples of ongoing activities that are in support of the established mitigation goals.

Finally, Mr. Punchard indicated that he would make himself available to work with local community officials in preparing and updating their individual mitigation action plans in addition to providing the aforementioned "helpful resource" documents.

Before adjourning the meeting, Mr. Punchard facilitated another interactive mitigation strategy exercise for committee members as a follow-up to the one conducted during the plan update kickoff meeting, and in order to gain some initial feedback from the committee in terms of preferred mitigation techniques. After handing out $20 in mock currency to each committee member (including a $10 bill, a $5 bill and five $1 bills), he asked them all to come to the front of the room and spend their "mitigation money" on the general categories of available mitigation techniques as outlined and described in the mitigation plan and earlier in the meeting (including Prevention, Property Protection, Natural Resource Protection, Structural/Engineered Projects, Public Education & Awareness and Emergency Services).

As each committee member ventured to the front of the room, they found an assortment of labeled cups – one for each mitigation category. Each committee member then deposited their allotted mitigation money into the cups of their choosing (and through the denominations provided, each was forced to deposit at least 50% of their money to one particular mitigation category). While this gaming exercise was being completed, Mr. Punchard explained that the online public participation survey was asking citizens of Mecklenburg County to do much the same thing, in terms of asking them to prioritize the types of mitigation activities they believe their local jurisdiction should be pursuing as part of the local mitigation planning process. Following completion of the exercise, it was determined that preventative activities ranked first in order of importance to committee members, followed closely by emergency services, structural/engineered projects and property protection measures.

Results of Mitigation Strategy Exercise:

MITIGATION TECHNIQUE	TOTAL $	PERCENT
Prevention	$88	27.5%
Emergency Services	$61	19.1%
Structural/Engineered Projects	$59	18.4%
Property Protection	$54	16.9%
Public Education & Awareness	$37	11.6%
Natural Resource Protection	$21	6.6%

Following completion of the exercise, Mr. Punchard reminded everyone of the instructions for accessing and downloading project information from AECOM's dedicated project FTP site and indicated that he would be back in touch with everyone regarding the status reports and updating of mitigation actions for each jurisdiction in the near future. He stated that this will be a critical next step for the mitigation plan update, and similar to other data collection efforts to date, would rely heavily on local participation and involvement in the process. He explained that he will be sending the primary points of contact for each jurisdiction another survey-type instrument to help begin this next step, and will be asking for status reports and initially identified mitigation actions for the plan update to be submitted by everyone no later than February 12, 2010.

Prior to adjourning, the next Mitigation Planning Committee meeting was scheduled for March 17, 2010. It was also noted that the plan would again be presented to the Charlotte-Mecklenburg Stormwater Advisory Committee (SWAC) on March 18, 2010.

March 17, 2010
Mitigation Planning Committee Meeting (Third Plan Update Meeting)

Mr. Wayne Broome opened the meeting by thanking all the committee members for attending and for their efforts in supporting the process to update the countywide mitigation plan to date. Following a few updates on invoicing and billing procedures between the City of Charlotte and the towns, Mr. Broome turned the meeting over to Darrin Punchard, lead consultant from AECOM who is assisting with the plan update process. Mr. Punchard circulated the sign-in sheet and reminded everyone to be certain to document their attendance and provide any updated contact information, if necessary. He then distributed copies of the meeting agenda and minutes from the last Mitigation Planning Committee meeting held on January 20, 2010. Mr. Punchard provided an update on some of the action items noted from the last meeting and then asked for a motion to approve the minutes. A motion was made to approve the minutes by Mr. Messera, and the motion was seconded by Mr. Icard. Mr. Punchard noted that the minutes from all committee meetings will be included in the final plan documents, and then began a PowerPoint presentation for the committee to.

The presentation started with a brief overview of the plan update process and schedule, along with a summary of the findings and conclusions from the last meeting which focused on the risk and capability assessments. Mr. Punchard reminded everyone that updated draft plan deliverables have been posted to the project FTP site, and thanks everyone for their review comments to date. He indicated that everyone will have the opportunity to again review the final plan submitted to NCEM and FEMA for approval and request any further changes to the document prior to proceeding with local adoption procedures. Mr. Tingle asked about the specific timeline for finalizing and submitting the plan update to FEMA. Mr. Punchard indicated that the target submittal date for the final plan to NCEM was April 8, 2010 following the completion of updating mitigation action plans for all participating jurisdictions. Mr. Punchard went on to state that while he didn't expect any major issues or delays to prevent a timely turnaround by NCEM or

FEMA on the updated plan, technically FEMA has up to 45 days to review and approve submitted local hazard mitigation plans and it would be important to stress the importance of a quick turnaround to NCEM staff in order to keep things moving forward due to the forthcoming plan expiration date of June 2, 2010. In order to help facilitate local plan adoption procedures, Mr. Punchard recommended to the committee that they consider presenting the final plan to their local governing bodies in advance of receiving the "Approval Pending Adoption" letter from FEMA due to the fact that there would very likely be no fundamental changes to the document beyond that point.

Mr. Punchard continued his presentation by stating that the goal of today's meeting was to review the results of the public input process (including the online survey) and to finalize the elements required for updating sections 8-10 of the plan, with particular emphasis on identifying and prioritizing new mitigation actions for each jurisdiction. However, he first provided a brief progress report on the project tasks completed to date along with some information on those tasks still pending completion. This included a description of the recent updates to each of the sections of the draft plan per the input or comments from committee members or outside plan reviewers to date, and an explanation of any changes in the results or findings as a result of any new information provided (which were minimal). The discussion generated few questions or comments, and ended with Mr. Punchard encouraging each of the committee members to review the updated plan deliverables as posted to the project FTP site prior to the submittal of a final plan to NCEM and FEMA in April 2010.

Next, Ms. McMillan provided an update on the public input process to date including a description of the open public meeting held on January 21, 2010, as well as all the advertising and media coverage that made the City's outreach efforts a success. Mr. Punchard then went through a series of slides that summarized the results of the online public survey to date. This interactive session generated some discussion as it relates to the preferred method for providing the public its next opportunity for providing input into the process. The survey results suggested, and Ms. McMillan confirmed, that open public meetings are not the most effective means for gaining public participation into the plan update process. It was generally agreed among committee members that most members of the general public are not that interested in the subject of planning for natural hazards unless they are imminently threatening them or their property, but may become more engaged through electronic means such as Web sites (for posting of plan materials), the use of social media, online surveys, Internet blogs and video streaming, as well as any advertised open public hearings held prior to local plan adoption.

Following the presentation and discussion on public participation, Mr. Punchard described the use of a "Safe Growth Survey" for enhancing the recently completed Capability Assessment. He noted that it was based on a technique proposed by David Godschalk at the University of North Carolina at Chapel Hill and is designed to provide a concise evaluation of the extent to which each of Mecklenburg County's local jurisdictions are positioned to grow safely relative to natural hazards, with the ultimate goal of identifying possible safety issues, policy gaps or conflicts, and hazard mitigation opportunities associated with future development and resilience to natural disasters. He encouraged each of the committee members to work with their jurisdiction's local planning department staff to complete and return the surveys as soon as possible, and to contact him should they require any additional information.

Following the break for lunch, Mr. Punchard reviewed each of the six mitigation goals in preparation of a more focused discussion on the unique Mitigation Action Plans under development for each participating jurisdiction. He reminded committee members that their new Mitigation Action Plans should reflect and be based on the following: (1) updated mitigation goals; (2) updated risk assessment and capability assessment; (3) lessons learned since 2005; and (4) some focus on the NFIP and CRS activities. He reminded everyone that the draft plan deliverables and a number of helpful planning resources remained available to them on AECOM's dedicated project FTP site and that he himself was available to discuss specific mitigation alternatives as committee members finalized the updating of their mitigation strategies.

He also suggested that committee members coordinate with other representatives of their own jurisdictions (such as planning and public works staff) on the development of the final Mitigation Action Plans, particularly those designed to meet mitigation Goal #5 which is focused on planning and policy measures.

After distributing a copy of each jurisdiction's draft Mitigation Action Plan to date (including status updates for 2005 actions), along with jurisdictional-level flood and wildfire hazard maps for each, Mr. Punchard continued his presentation with a description of some additional mitigation measures specifically recommended for each jurisdiction to further consider for their action plans. This included a range of various mitigation measures cutting across all established categories for mitigation techniques, and for a range of the high and moderate risk hazards facing Mecklenburg County. Mr. Punchard also shared some examples of best practices to consider for how local jurisdictions may consider addressing the implications of global climate change through local planning or policy measures focused on mitigation of greenhouse gases, in addition to adaptation strategies for the anticipated long-term consequences of climate change on natural hazards. The subsequent discussion focused mostly on some general questions and answers with regard to the specific mitigation actions being recommended for jurisdictions to consider, along with the sharing of some ideas or examples from committee members on how best to approach their own action plans from here out.

Prior to adjourning the meeting, committee members were asked by Mr. Punchard to submit their updated, final Mitigation Action Plans as soon as possible in addition to completing and submitting their Safe Growth Surveys. They were again encouraged to consult the helpful resources made available through the project FTP site, in addition to reviewing and providing comments on the final plan deliverables that were also posted to the site. Mr. Punchard also indicated that he'd make himself available to meet with any local staff to provide further assistance in completing action plans, on request. A deadline of March 31, 2010 was established for all committee members to complete these actions and submit their information to Darrin Punchard for incorporating into the final updated plan documents.

It was noted that the next formal Mitigation Planning Committee meeting would be held following the receipt of comments from NCEM and FEMA on the final plan and prior to completing local adoption procedures.

INVOLVING THE PUBLIC

Public involvement in the 2010 plan update was sought using multiple methods including: (1) an open public meeting during the drafting stage that was broadcast live on local television and streamed online; (2) an online public participation survey instrument; (3) a dedicated citizen advisory committee; (4) the advertising and posting of the final plan update on Internet Web sites; and (5) open public hearings held by each participating jurisdiction's governing body prior to formal adoption of the plan update.

Open Public Meetings

The first open public meeting on the 2010 plan update was held at the Charlotte-Mecklenburg Government Center in downtown Charlotte on **January 21, 2010** from 6:30pm to 8:00pm. For those interested citizens who could not attend in person, the meeting was simultaneously broadcast live on local television (Time Warner Cable Channel 16) and streamed live online at charmeck.org, and viewers were provided with the opportunity to provide input or ask questions via email at publicinput@charlottenc.gov. The meeting was facilitated by Kim McMillan, City Corporate Communications Director and included three speakers. Wayne Broome, Director of Charlotte-Mecklenburg Emergency Management, led the meeting off by providing a summary of the plan update process and describing why it's important to keep the multi-jurisdictional plan current and in good standing with NCEM and FEMA. Darrin Punchard, Senior Project Manager with AECOM, provided a description of the current mitigation plan and the process being followed to complete a

comprehensive five-year update. Mr. Punchard's presentation also include a description of the natural hazards faced by Mecklenburg County, the conclusions of the risk assessment update, the mitigation goals established for the plan update, and a description of the available mitigation techniques or strategies being considered by the Mitigation Planning Committee for the 2010 update. Bill Tingle with Charlotte-Mecklenburg Storm Water Services then walked through a detailed presentation on the flood hazards facing the area and the mitigation strategies and projects previously implemented or ongoing to help minimize eliminate future flood risks and associated losses. After each of the three speakers had spoken, Kim McMillan facilitated an open discussion and Q&A session, and called upon each of the speakers to help provide responses or further clarifications as necessary. Prior to ending the meeting, attendees were reminded to go online and complete the public participation survey.

In addition to the open public meeting held during the drafting stage of the plan update, a series of eight separate public hearings were held by the local governing bodies of each jurisdiction prior to formal adoption. This provided the public with a final opportunity to comment on the plan update that had already been posted for public review and comment.

Online Public Participation Survey

The online public participation survey was designed to capture data and information from citizens across Mecklenburg County that might not be able to attend open public meetings or participate through other means in the plan update process. The survey, which served the dual purpose for citizen input as well as education and awareness, focused on questions related to natural hazards, known problem areas and possible solutions through various mitigation techniques. The survey was posted to charmeck.org from January 11th through March 1st, and hard copies were distributed at the open public meeting on January 21st. A total of 28 responses to the public participation survey were received which provided valuable input for the Mitigation Planning Committee to further consider in the development of their Mitigation Action Plans. A summary of the survey findings is provided in *Appendix B*, and additional information gained through the use of the survey instrument is available through Mecklenburg County upon request.

Citizens Advisory Committee

In order to gain additional citizen input to the plan update process, the Mitigation Planning Committee determined that it would call upon the pre-existing *Charlotte-Mecklenburg Stormwater Advisory Committee* (SWAC) to serve as a separate committee in which to present plan update findings and seek feedback for changes or updates to the current plan. The Storm Water Advisory Committee is made up entirely of citizen (non-governmental) volunteers and was established to review policies; hear appeals and decide on violations, fee credits, service charges and adjustments; evaluate capital and operational programs and budgets; and make recommendations or comments to elected officials regarding the storm water programs of the City of Charlotte and Mecklenburg County. SWAC membership is by nomination and subsequent appointment by the Mecklenburg Board of County Commissioners, Charlotte City Council, Charlotte Mayor, Town Boards, or SWAC members themselves.

Members of the Charlotte-Mecklenburg Storm Water Advisory Committee provided additional input for the 2010 plan update.

The 2010 hazard mitigation plan update was presented to the SWAC for additional input and feedback on three separate occasions. An overview of the plan update process was shared with the committee on **January 21, 2010** with the discussion focused on the key objectives for the plan update and some preliminary conclusions of the updated risk assessment. A second presentation on the plan update was delivered on **March 18, 2010** with the focus of discussion being on the updated mitigation goals and mitigation action plans from each of the County's participating jurisdictions.

Posting of Final Plan Update

Upon completion of a final plan update, each of the plan sections was posted online at the Charlotte-Mecklenburg Emergency Management's Web site at charmeckem.net on **April 30, 2010**, and then hyperlinks to this dedicated Web site were posted on the local Web sites of participating local jurisdictions. In addition to making all final plan sections available for review, the dedicated Web site provided visitors with the opportunity to submit written comments or questions on the plan to CharMeckEM@charlottenc.gov or by calling Wayne Broome, Emergency Management Director (contact information provided). Review and feedback on these draft plan deliverables were encouraged by means of verbal and written communication (including press releases and targeted e-mail messages as described below) by the Charlotte Emergency Management Office and City of Charlotte Corporate Communications office.

PUBLIC OUTREACH AND NOTIFYING STAKEHOLDERS

Notifications on the open public meetings, online public participation survey and posting of the final plan update were sent to a variety of targeted distribution lists maintained by the City of Charlotte, Mecklenburg County and participating towns. This included extensive outreach to local media outlets in the entire Charlotte regional market such as the *Charlotte-Observer*, *WBTV* (local *CBS* affiliate in Charlotte) and *Carolina News 14* which prepared and delivered stories to help promote widespread public and stakeholder involvement in the plan update process. This also included the design and widespread distribution of catchy meeting advertisements for local publication (**Figure 2.3**) as well as postings to the City, County and town Internet Web sites.

Through the City of Charlotte Corporation Communication Office, "e-blasts" promoting input on the plan as well as public meeting attendance were shared with distribution lists across multiple agencies including the local Council of Governments (Centralina), the Centralina Area Agency on Aging, the Red Cross, Salvation Army, National Weather Service, and various neighborhood groups and homeowners' associations. In addition, public meeting information was sent to all City and County employees (approximately 11,500 total), posted to the City of Charlotte's public event calendar on charmeck.org, the Government Channel bulletin, and CMail (bi-weekly e-newsletter containing City of Charlotte news and events, shared with over 1,100 subscribers). Mecklenburg County also contributed to outreach efforts by sending the e-blast to their town distribution lists of elected officials.

Through these means, in addition to presentations at SWAC committee meetings (described above) and through open public hearings held by each local jurisdiction's governing body prior to adopting the final 2010 plan update, written and oral comments and recommendations on the plan update process and the posting of draft and final plan updates were solicited from the general public and a wide range of targeted stakeholders.

Figure 2.3: Advertisement for Open Public Meeting Held January 21, 2010

PREPARING THE 2015 PLAN UPDATE

In preparing the 2015 plan update, Mecklenburg County continued to follow the multi-jurisdictional planning process recommended by FEMA as most recently published in its *Local Mitigation Planning Handbook* (March 2013) in addition to plan update guidance materials made available through NCEM. To assist in this process the County contracted with the consulting firm of AECOM in October 2014. The plan update process was scheduled to be completed over the course of six (6) months, however the process truly began with a series of conference calls and meetings between the AECOM project manager, Charlotte-Mecklenburg Emergency Management, and members of the Hazard Mitigation Planning Team on **June 4, 2014, June 26, 2014,** and **September 3, 2014** to discuss the upcoming plan update and to review and discuss the incorporation, if appropriate, of any existing new plans, studies, reports, and technical information that had become available since the 2010 plan update. Discussions also included ways to secure public involvement and stakeholder participation throughout the process, as well as ways to maximize CRS credit points in an effort to move Mecklenburg County from a Class 5 to a Class 4. Following completion of these scoping meetings and the execution of a Notice to Proceed, Mecklenburg County moved forward with notifications for reconvening the Hazard Mitigation Planning Team and officially beginning the plan update process as described below.

RECONVENING THE HAZARD MITIGATION PLANNING TEAM

One of the first steps in preparing the 2015 plan update was to reconvene the County's Hazard Mitigation Planning Team for a "plan update kickoff" meeting, including relevant stakeholders and citizens, as was done for the 2005 development of the plan as well as the 2010 plan update. The following participants represent the members of the Mecklenburg County Hazard Mitigation Planning Team who were responsible for participating in the plan update process, some of whom served as committee members during the initial preparation of the initial Plan in 2005. Committee members are listed in alphabetical order according to their last name and represent a wide range of community representatives and stakeholders..

Table 2.6: Hazard Mitigation Planning Team Members (2015 Plan Update)	
NAME	**AGENCY, JURISDICTION AND/OR ROLE**
Sam Ascunce	Graduate Research Assistance, UNC-Chapel Hill
Jesse Bouk	Operations Supervisor for Public Works, Town of Davidson
Corey Copley	Lieutenant, Pineville Police Department
Sandy D'Elosha	Corporate Communications and Marketing Director, City of Charlotte
Jeffrey Dulin	Mecklenburg County Emergency Management Director
Sharon Foote	Public Information Specialist, Charlotte-Mecklenburg Storm Water Services
Matthew Gustis	Engineering Program Manager, Charlotte-Mecklenburg Storm Water Services
Christina Hallingse	Public Information Officer, Charlotte-Mecklenburg Emergency Management
David Leath	Chief, Mint Hill Fire Department
David Love	Project Manager, Charlotte-Mecklenburg Storm Water Services
Chris Matthews	Natural Resources Manager, Mecklenburg County Park & Recreation
Ralph Messera	Public Works Director, Town of Matthews
Stacie Neal	Planner, Charlotte-Mecklenburg Emergency Management
Becky Partin	Communications Specialist, Town of Cornelius
Nicole Ramsey	Strategic Communications Manager, City of Charlotte
Mike Robinson	Senior Planner, AECOM
Jennifer Smith	Storm Water Division Manager, City of Charlotte
Bill Tingle	Floodplain Administrator, Charlotte-Mecklenburg Storm Water Services
Michael Tobin	Planner, Charlotte-Mecklenburg Emergency Management
Tim Trautman	Program Manager, Charlotte-Mecklenburg Storm Water Services
Mandy Vari	Long Range Planning, Charlotte-Mecklenburg Planning Department
Bobby Williams	Town Manager's Office, Town of Huntersville
Julia Zweifel	Town Planner, Town of Pineville

COMMUNITY MEETINGS AND WORKSHOPS

The preparation of the 2015 plan update required a series of meetings and workshops for facilitating discussion and data collection efforts with local community officials. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the drafting stages of the plan update. Below is a summary of the key meetings and community workshops for the multi-jurisdictional Hazard Mitigation Planning Team. In many cases, additional meetings were held by the individual participating jurisdictions to accomplish planning tasks specific to their community, such as the approval of locally specific mitigation actions for inclusion in their *Mitigation Action Plan*.

October 21, 2014
Hazard Mitigation Planning Team Meeting #1 – "Plan Update Kickoff"

Ms. Stacie Neal opened the meeting by providing an update on the status of the contract with AECOM, the overall process the County would be following to complete the plan update, and the critical role that committee members would play throughout the process. She then asked each of the attendees to introduce themselves and reminded them to complete the sign-in sheet circulating around the room. Following introductions, Ms. Neal turned the meeting over to Mr. Mike Robinson, the lead consultant from AECOM who would be assisting the County in its plan update process.

Mr. Robinson began his presentation by providing background on the importance of maintaining and updating an approved local hazard mitigation plan and how it relates to State and Federal grant funding eligibility, a description of new plan update requirements per NCEM and FEMA, and the key objectives for the update process as outlined by the City of Charlotte and Mecklenburg County. These objectives include: (1) to evaluate and update each section to reflect current information and best available data; (2) to provide opportunities for the public and identified stakeholders to provide input to the plan update process; (3) to maintain state and federal compliance for all participating jurisdictions; and (4) to maximize Community Rating System (CRS) credit points for floodplain management planning (Activity 510).

Mr. Robinson then facilitated an interactive gaming exercise to capture current perceptions on Mecklenburg County's existing hazard risks and priorities for mitigation planning. After handing out $20 in mock currency to each committee member (including a $10 bill, a $5 bill and five $1 bills), he asked them all to line up at the side of the room and spend their "mitigation money" on the hazards needing the most attention in terms of risk reduction strategies. As each committee member moved to the side of the room, they found a line of labeled cups – one for each natural hazard that had been identified in the initial 2005 plan. Each committee member then deposited their allotted mitigation money into the cups of their choosing (and through the denominations provided, each was forced to deposit at least 50% of their money to one particular hazard). Following completion of the exercise, it was determined that most committee members agreed that the nature and/or magnitude of most hazard risks haven't changed in the past five years with two notable exceptions: "severe thunderstorms and tornadoes" and "droughts," both of which advanced a bit on the list as compared with the 2010 exercise.

Results of Icebreaker Exercise on Hazard Risks:

HAZARD	TOTAL $	PERCENT
Flood	$107	53.5%
Winter Storms	$33	16.5%
Severe Thunderstorms / Tornadoes	$28	14%
Sinkholes / Landslides	$15	7.5%
Hurricanes & Tropical Storms	$9	4.5%
Dam/Levee Failure	$5	2.5%
Erosion	$1	0.5%
Other	$1	0.5%
Wildfire	$1	0.5%
Drought	$0	0%
Earthquake	$0	0%

Mr. Robinson continued to provide information on each of the specific plan update tasks and the overall project schedule, along with some of the specific methods to be used for data collection and coordination among each of the eight jurisdictions throughout the process.

After describing the overall purpose, objectives, approach and schedule for the plan update process, Mr. Robinson then facilitated a general discussion among committee members focused on the current (2010) multi-jurisdictional hazard mitigation plan. One of the primary areas focused on during this discussion was the hazard identification section of the plan and one of the specific questions asked of the group was, "Do we have any cause to re-think the existing list of hazards for this plan update?" At this point in time, the answer from the group was predominately "no," although several people asked about a variety of technological hazards such as hazardous materials sites, infectious diseases, etc. The planning team agreed that the plan update would move forward focusing solely on natural hazards. (Following this

meeting, several citizens concerned about the potential effects of geomagnetic storms came forward to encourage the planning team to investigate this hazard for inclusion in the plan. After appropriate discussions the planning team agreed to move forward with identifying geomagnetic storms as a natural hazard that could potentially impact Mecklenburg County and appropriate mitigation actions were subsequently developed.)

Following discussion on the risk assessment portion of the 2010 plan, the mitigation goals from the existing plan were presented and summarized for the group for discussion. Specific questions that were posed to the group as part of this discussion included the following:

- It's been ***five years*** since the last plan update…are these goals still ***applicable/appropriate***?
- Where has there been ***new development***?
- Are there changes to ***local hazard risk***?
- Have there been changes in ***local capability***?
- Have there been changes to local ***funding options***?
- Are there opportunities for new ***grants***?

The planning team agreed that the goals were still current, relevant and effective for addressing future risk to the natural hazards being addressed in the Plan and that forthcoming revisions to the risk and capability assessments would help answer some of these questions. Other questions that were asked during the ongoing discussion covered the following topics:

- Who else needs to be involved on the Hazard Mitigation Planning Team?
    - Ms. Neal proposed to review the current distribution list and to help ensure that the list included all appropriate representation from stakeholders, especially the participating jurisdictions. She also recommended that each person attending the kick-off meeting consider any other invitees that should be included in subsequent meetings. Mr. Robinson pointed out that typically attendance needs to be the largest and broadest in terms of technical experts, academia, and decision makers at Meeting #3 (the Mitigation Strategy Workshop) due to the proposed agenda for that half-day meeting.

- What is the greatest need for improvement in the existing plan?
    - One of the primary goals for the 2015 plan update is to increase CRS credit points where possible.

- What is the best strategy for generating public interest, soliciting citizen input and enlisting additional partners in the plan update process?
    - A variety of potential means for public outreach efforts was discussed, including utility bill inserts, newspaper ads, local public access television, website forums (including a project website), and social media.
    - The group discussed and agreed upon the use of SurveyMonkey for an online public participation survey which would be promoted on County, City, and Town websites and also via email and social media outlets such as Facebook and Twitter. It was decided the survey would be made available through the end of the year.
    - It was determined that the existing Storm Water Advisory Committee (SWAC) could serve as the means for organized citizen input to the plan update process. Mr. Robinson explained that having such a separate planning advisory committee made up of more than 50 percent representing members of the general public would help maximize CRS credit points.

- Are there any new plans, policies, programs, studies, reports, data or technical information that should be reviewed and incorporated into the plan update process?
    - New DFIRM data effective February 2014 will be integrated into the risk assessment, along with any other relevant GIS data that has been updated or developed since 2010.

Mr. Robinson then went over an organizational chart for the plan update process and proposed streamlined communications channels for submitting "homework assignments," fulfilling data collection requests, etc., and emphasized that participation and responsiveness would be key in light of a fairly aggressive project schedule, which included a series of major holidays.

Mr. Robinson also presented a preliminary outline for a Public Outreach Strategy, citing a series of goals, specific opportunities for participation, and various products and resources that would be created for use as part of the planning process. The final Public Outreach Strategy can be found in Appendix E.

A final opportunity was given for planning team members to discuss potential opportunities with this plan update, possible obstacles or barriers, and other local issues, concerns or ideas. There was minimal discussion at this point and upon completion of this general open discussion time, committee members were reminded about their forthcoming task assignments, which were to (1) confirm the designation of their jurisdiction's primary point of contact; and (2) ensure the timely completion of plan update surveys that would be sent directly to them to assist the AECOM project team with updating information for each jurisdiction.

Lastly, the next Hazard Mitigation Planning Team meeting was scheduled for December 3, 2014 from 1:30 p.m. to 3:30 p.m. and the first open public meeting was scheduled for November 20 from 5:30 p.m. to 7:30 p.m.

December 3, 2014
Hazard Mitigation Planning Team Meeting #2

During this meeting, Mr. Ryan Cox (NCEM Mitigation Planning Supervisor) and Ms. Stacie Neal covered a variety of topics, including natural hazards typically addressed in the State of North Carolina, data requirements for the 2015 plan update, instructions for the *Local Capability Assessment Survey*, *National Flood Insurance Program (NFIP) Survey* and *Safe Growth Survey*, planning resources available, and other related topics. In addition, Ms. Nicole Ramsey distributed a marketing plan for review and discussion.

In terms of the marketing plan and public outreach campaign, the following points and discussion topics were covered:

- A public notice was sent out documenting the planning team meeting.
- A series of videos was proposed including one on winter storms. These will be distributed via social media and local government websites.
- An E-Newsletter will be published every two weeks with information regarding the 2015 plan update.
- GovDelivery pushed out a message about the first Hazard Mitigation Planning Team meeting and can do something similar for future meetings.
- A ticker has been added on the GovChannel that runs during public meetings.
- A citywide employee email was sent out with meeting information and copies of the survey instruments.
- Graphics were added to CMGC.
- Flyers were developed for upcoming public meetings including a link to the online public participation survey (w/QR code) for public meeting participants to take home after the meeting.

- Added educational information to the County website and can link to CMEMO web pages.
- An alert will be sent out via CharMeck Alerts.
- Advertising in utility bills will be utilized
- Status update on the number of responses received via the public participation survey (301 at that point)
- Bobby Williams volunteered the use of specific Huntersville channels to promote meeting awareness and also help coordinate with Planning Board Meetings

A discussion also took place regarding the potential addition of the Solar Events hazard, including geomagnetic storms. It was decided that if the group chose to add the hazard as part of the 2015 plan update, the plan should address it on a high level including the hazard's overall potential effect on the planning area. It was explained that if a geomagnetic interference incident were to occur, only the local government entities (i.e., the County, City and Towns) would potentially be eligible for mitigation grant funds (no private companies who would actually be the ones most directly impacted). It was discussed that there was interest in adding the Solar Events hazard based on the input of concerned citizenry. It was explained that the State of North Carolina does not currently address this hazard nor is there established methodologies and approaches for incorporating this hazard into a local hazard mitigation plan. It was decided that the plan would identify the hazard and offer two to three mitigation actions at the county level to begin to address the concern within the planning area.

Dates were then discussed for the next planning team meeting (to be held January 14, 2015), the next public meeting, and other key dates and deadlines.

January 14, 2015
Hazard Mitigation Planning Team Meeting #3 -- "Mitigation Strategy Workshop"

Ms. Stacie Neal opened the meeting by providing a general update on the overall status of the project then asked each of the attendees to introduce themselves and reminded them to complete the sign-in sheet circulating around the room. She then turned the workshop over to Mr. Mike Robinson from AECOM to cover the specific agenda items agreed upon for the meeting. This included an update on public outreach activities and a report on the public participation survey results; an overview of preliminary risk assessment findings; an overview of capability assessment results, a mitigation strategy exercise, an open discussion period and an overview of next steps.

Mr. Robinson presented a series of charts and graphs summarizing the responses from the public participation survey which was live from October 13, 2014 through January 7, 2015. In total, 347 surveys were completed by citizens throughout the planning area. 72% of respondents said they had personally experienced a disaster, lending real-world experience and personal viewpoints to the planning process. Also, 46% of the respondents said they had lived in Mecklenburg County for 20 years or more, lending seniority and awareness of the planning area and its hazards to the planning process as well. A list of all questions asked and a compilation of all responses received can be found in Appendix B.

The risk assessment portion of the presentation began with an overview of the hazards identified for inclusion in the plan update and an explanation that there have been no new Major Presidential Disaster Declarations since 2004. A table was presented showing population change from the 2000 census to the 2010 census for each participating jurisdiction. (Section 3: *Community Profile* and the risk assessment go on to include 2013 and 2014 population estimates as well.) The planning team pointed out that one of the main reasons for some of the more significant increases and decreases in population is recent annexations. (For example, Pineville has seen a 116.8% increase in population between the 2000 and

2010 census counts, Cornelius has seen a 107.8% increase, and Mecklenburg County has seen a 31.2% decrease.)

A status update was provided on the use of the latest version of Hazus-MH loss estimation software (Version 2.2) to update the loss estimates and annualized losses for flood, earthquake and hurricane wind. A detailed overview was then provided for each hazard (flood, hurricanes and tropical storms, severe thunderstorms, tornadoes, winter storms, earthquakes, landslides, sinkholes, drought, wildfire, dam/levee failure, and geomagnetic storms). Each overview included a summary of hazard occurrences since the last plan update, updated maps if appropriate, an explanation of any observed changes in trends or hazard conditions, and other relevant pieces of information. (All of this information is provided in the risk assessment sections of this updated Plan.) As stated earlier in this section, a new hazard (geomagnetic storms) was proposed for this plan update and this hazard was covered in detail at this meeting. Also, Mr. Bill Tingle suggested that a section be added to cover extreme heat separate from drought/extreme heat. Annualized loss estimates and PRI rankings were reviewed and the planning team agreed that the results of the risk assessment were very similar to previous versions of the plan and that no significant changes are inherent in hazard risk across the planning area.

The discussion then shifted to a report on the *Local Capability Assessment Surveys* that were completed as "homework assignments" by each participating jurisdiction. This began with a review of the primary components of local capability (planning and regulatory capability, administrative and technical capability, fiscal capability, education and outreach capability, political capability, and self assessment). At the time of the meeting, all jurisdictions had submitted their surveys (thus 100% participation) and an overall average score of 56.75 – High Capability was presented for the planning area along with a breakout by jurisdiction of each community's individual score. All of this information is included in Section 7: *Capability Assessment*.

As the meeting transitioned to the mitigation strategy development portion of the workshop, a sample vision statement was presented and discussed by the group. This statement was as follows: "Through a coordinated multi-jurisdictional planning effort, create and implement an effective hazard mitigation plan that will identify and reduce risk to natural hazards in order to protect the health, safety, quality of life, environment and economy of Mecklenburg County." The planning team had no initial comments on this draft vision statement and the meeting moved forward with this idea in mind. The next topic covered was the proposed organization of the *Mitigation Strategy* section and the guiding principles for its purpose and update, including the required elements for the updating of the *Mitigation Action Plans* for each jurisdiction. From there the various types of mitigation actions (i.e., mitigation techniques) as defined by FEMA and the CRS program were described to the group.

At that point, the meeting participants were divided into three small groups for discussion and a series of focus questions was displayed on the overhead screen for the group to consider in their small group discussions. The first focus question was, "Broadly speaking, what would have to happen for Mecklenburg County to truly be more resilient to natural hazards?" This was a discussion only question and no work products were produced. The second focus question was, "What specific actions would need to be taken to accomplish this?" While this question was being discussed within the small groups, Mr. Robinson passed out giant Post-It notes for the small groups to use to document one mitigation action per Post-It note. As the groups completed this task and turned their Post-It notes in, Mr. Robinson placed all of them on the wall for the entire planning team to see. The final question in the series was, "How do all of our ideas come together?" As the large group discussed similarities and connections between the various actions, the actions were reorganized on the wall to form patterns in the types of actions that were being proposed, how they associate with the established mitigation goals for the planning area, how they relate to local capabilities, etc. Photographs were taken of the wall so that the thought process could be captured and used to help inform ongoing mitigation strategy development.

The meeting concluded with an explanation of *Mitigation Action Plan* "homework assignments," which primarily consisted of reviewing previously adopted mitigation actions and providing a status update for each, then proposing any new mitigation actions the jurisdictions felt were appropriate for the 2015 plan update.

February 11, 2015
Hazard Mitigation Planning Team Meeting #4

Mr. Ryan Cox, Mitigation Planning Supervisor for NCEM, led this meeting along with Ms. Stacie Neal. The following is a summary of the key points covered during this meeting:

- Mr. David Love offered to answer any NFIP and/or CRS related questions for the jurisdictions in light of Mr. Bill Tingle's retirement.
- Most of the jurisdictions had not gotten to the point of adding new mitigation actions. They agreed to focus on this moving forward.
    - Mr. Cox focused on public outreach and education items that could be considered new mitigation actions.
    - Mr. Cox emphasized that the plan must state "why" previously adopted actions are to be deleted if that is part of the jurisdiction's status update.
- Jurisdictions were encouraged to focus on the prioritization of their actions (if actions should be moved "up" or "down" as part of the 5-year update.
- Potential funding sources should be included with all actions.
- The Town of Pineville indicated that they would be adding flood-related mitigation actions.
- For the *Plan Maintenance* section Mr. Cox stressed that more meetings could lead to more CRS points. Some communities may be better off getting their points another way.
- Mr. Cox encouraged the jurisdictions at this point in the process to begin pushing out emails related to plan amendment and local adoption.
- March 18 was proposed as the ultimate goal for submission to NCEM.
- Goal is to have approval letter out in July.
- The decision was made that a capability assessment did not need to be completed for geomagnetic storms.

March 16, 2015
Hazard Mitigation Planning Team Meeting #5

Mr. Robinson began this meeting by asking all participating planning team members to introduce themselves. He then went over the agenda and handouts for the meeting. The bulk of the meeting focused on an overview of the working draft of the plan, including the updated plan's organization, a brief status update on each section of the plan, an explanation of the upcoming planning team's review/comment window for the draft plan, suggested areas of focus for the internal review, the availability of the files, and instructions for submitting review comments.

A general overview was also provided to describe the types of changes made throughout the plan document, including the addition of the solar events hazard. The meeting also provided an opportunity for additional coordination regarding the final public meeting, including the ongoing public outreach theme and logistics for the meeting. Mr. Robinson also delivered a short series of slides on "Maintaining Momentum and Implementing the Plan," which highlighted numerous recommendations from FEMA's *Local Mitigation Planning Handbook*.

The meeting concluded with a list of next steps, including the planning team's review/comment window for the draft plan, the timeframe for AECOM to make final revisions to the draft plan prior to its submission to the State, a walkthrough of the review and approval process to be expected from the State and FEMA, and the local adoption process.

An additional meeting took place with Gary Thompson, State Geodetic Officer, who provided assistance to Mecklenburg County and AECOM with the Solar Events section of the Plan (see Section 4: *Hazard Identification*). His stakeholder involvement also included setting up and hosting a conference call/WebEx with NOAA for a detailed presentation on solar storms. He also attended a working session with citizen stakeholder Tom Drake to help draft the Solar Events section.

MULTI-JURISDICTIONAL PARTICIPATION

44 CFR Requirement

Part 201.6(a)(3): Multi-jurisdictional plans may be accepted as long as each jurisdiction has participated in the planning process.

The Mecklenburg County Hazard Mitigation Plan is multi-jurisdictional and includes the participation of county officials and the following municipalities:

- City of Charlotte
- Town of Cornelius
- Town of Davidson
- Town of Huntersville
- Town of Matthews
- Town of Mint Hill
- Town of Pineville

To satisfy multi-jurisdictional participation requirements, each of the local jurisdictions performed the following tasks as part of the initial plan development in 2005 and as part of the plan update process for 2010 and 2015:

1. Designate appropriate officials to serve on the Hazard Mitigation Planning Team;
2. Participate in all mitigation planning meetings and workshops;
3. Provide best available data as required for the risk assessment portion of the Plan;
4. Complete the *Local Capability Assessment Survey* and provide copies of any mitigation or hazard-related documents for review and incorporation into the Plan;
5. Support the development of a countywide Mitigation Strategy, including the design and adoption of general goal statements for all jurisdictions to pursue;
6. Develop a local Mitigation Action Plan with specific mitigation actions for their jurisdiction;
7. Review and provide timely comments on all draft components of the Plan;

8. Adopt the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan, including the local *Mitigation Action Plan* specific to their jurisdiction.

Through the completion of these tasks each participating municipality fully participated with Mecklenburg County in the development and update of this Plan. Further, through the preparation, reporting and updating of their own local *Mitigation Action Plans*, each jurisdiction was responsible for addressing their most significant hazard concerns. This separate component of the planning document provides the opportunity for jurisdictions to monitor and update their own specific Plan implementation responsibilities without necessarily having to meet with the countywide Hazard Mitigation Planning Team. It also enables each of the jurisdictions to be solely responsible and accountable for those actions that apply to their jurisdiction. All jurisdictions participated in all mitigation planning meetings and workshops, as well as reviewed and provided timely comments on all draft components of the plan.

SUMMARY OF PLAN UPDATES (2010)

As part of the 2010 plan update, Mecklenburg County's planning consultant and members of the Mitigation Planning Committee reviewed and analyzed each section of the Plan and made recommendations for necessary updates or revisions. Many of these changes to the initial 2005 Plan were made based on updated data and technical information, as well as necessary changes to the current status for mitigation actions assigned to each participating jurisdiction. **Table 2.6** briefly describes how each section of the Plan was updated through the 2010 plan update process. All revisions made to the 2005 Plan were made using Microsoft Word "track changes" in documents that remain available through Mecklenburg County upon request.

Table 2.6: Summary of Plan Updates (2010)

SECTION	DESCRIPTION OF PLAN UPDATES
Section 1: Introduction	• Revisions made to narrative text describing Disaster Mitigation Act of 2000 • Minor revisions to statements of "Purpose" • Detailed outline of each Plan section was moved to Section 1 from Section 2, and revised where necessary.
Section 2: Planning Process	• Detailed outline of each Plan section was moved to from Section 2 to Section 1, and revised where necessary. • Detailed synopsis of the 2010 plan update process was added, including a description of the process used, who served on the Mitigation Planning Committee, how the public was involved, summaries/minutes of all meetings, photos from meetings and how the general public and targeted stakeholders were invited and encouraged to participate.
Section 3: Community Profile	• Updated all maps, tables, charts and narrative text with updated information. This includes a new base map. the addition of "*Community Quickfacts*" and new or improved data on population, housing, and demographics as well as growth trends and land use for each of Mecklenburg County's jurisdictions as well as new economic data (employment and industry). Members of the Mitigation Planning Committee and representatives from each jurisdiction provided new information for their community along with recommendations for any changes to their community's profile as described in the 2005 Plan.
Section 4: Hazard Identification	• It was determined early on in the project that the identification and descriptions of hazards as written in the 2005 Plan were adequate and did not necessitate significant changes, and that the planning team's time would be better spent updating other sections of the Plan. • Some of the minor updates to Section 4 included the elimination of any outdated or irrelevant data (i.e. national flood damages statistics table). The outdated Fujita Scale was updated to include the new "Enhanced Fujita Scale" for tornadoes.

Table 2.6: Summary of Plan Updates (2010)

SECTION	DESCRIPTION OF PLAN UPDATES
Section 5: Hazard Analysis	• A comprehensive review and update was made to Section 5. For each hazard identified, all historical data was updated to include descriptions of any events taking place since the 2005 risk assessment, but also updated to revise any changes to the documented historical event data from prior years. • Disaster declaration data was reviewed for any changes according to FEMA databases, but no revisions were determined necessary. • All narrative text, tables and figures were revised according to the updated data and subsequent GIS analysis. This included updated DFIRM data for flood hazards (current and future), new hazard probability data for wildfire (SWRA), updated NFIP statistics and new information as recorded in the NCDC's storm events database. • Some tables were simplified to list descriptions of only those hazard events that caused recorded damages and/or casualties. • New, more locally-relevant photos were added courtesy of Mecklenburg County. • All of the maps were graphically enhanced using a new underlying data (i.e., hillshade) and symbology design for map layouts. • Data on the probability of future hazard occurrences was updated as necessary.
Section 6: Vulnerability Assessment	• Similar to Section 5, a comprehensive update was completed for Section 6 using best available data that had changed since the 2005 risk assessment. This includes new historical data and new GIS data for hazard layers (particularly flood and wildfire) as well as local data on parcels, structures, critical facilities and land use. The new data was utilized to completely re-run the vulnerability assessment for Mecklenburg County. This included the generation of new exposure and loss estimates for each hazard through GIS-based and HAZUS-driven assessments using the latest versions of ArcGIS (9.3) and HAZUS (MR4). • All narrative text, tables, figures and maps were updated to reflect the new data and subsequent vulnerability assessments for each hazard. This includes the addition of new building exposure and hazard maps. One particular improvement to the 2005 plan is the addition of local jurisdictional hazard maps for flood and wildfire using best available data. • Improved data on repetitive loss properties was provided following a detailed GIS-based review of data made available through FEMA, as required per their latest national planning guidance (July 2008). • All conclusions were redrawn and described at the end of Section 6 based on the completion of the vulnerability assessment for each hazard and discussion among the Mitigation Planning Committee.
Section 7: Capability Assessment	• Section 7 was updated to include the results of a newly completed capability assessment for Mecklenburg County and its participating jurisdictions, which included the completion of another capability assessment survey for each. The capability assessment also incorporated any new information as taken from any new hazard-related plans, policies, programs, studies, reports, and technical documentation that became available since the completion of the 2005 Plan. Particular attention was focused on updating information for each jurisdiction on their current administration of the NFIP as required by FEMA per their latest national planning guidance (July 2008). • A "Safe Growth Survey" was incorporated into assessment in order to better identify opportunities to better integrate hazard mitigation principles into existing planning mechanisms at the local jurisdictional level, including comprehensive plans, zoning ordinances, subdivision regulations and capital improvements programs. • All results and conclusion in Section 7 were updated based on the completion of the 2009-2010 capability assessment.
Section 8: Mitigation Strategy	• During the 2010 plan update, each of the Mitigation Goals listed in Section 8 (established in 2005) were reviewed and discussed with the Mitigation Planning Committee, as well as members of the general public as well as targeted stakeholders. The goal statements were all reaffirmed for 2010, with no substantive revisions required. • Additional documentation was added to Section 8 to describe how the Mitigation Planning Committee reviewed and discussed the identification, analysis and selection of mitigation techniques to consider including in the 2010 plan update – including the use of NCEM's "Decision Tree," FEMA's "Mitigation Ideas" publication, CRS-related guidance and other sources.

Table 2.6: Summary of Plan Updates (2010)	
SECTION	**DESCRIPTION OF PLAN UPDATES**
Section 9: Mitigation Action Plans	• The comprehensive update to Section 10 included the detailed review and update of every single mitigation action listed for each participating jurisdiction in Mecklenburg County. The status report for each action included whether the action was completed, deferred or deleted as well as an explanation for reaching that determination. The 2010 update also included the identification and assignment of newly proposed mitigation actions for each jurisdiction according to the same format adopted in the 2005 Plan. This resulted in the identification of many new actions for all jurisdictions in Mecklenburg County, including actions specifically focused on continued NFIP compliance as required by FEMA and NCEM. • A table of contents was added to the introductory page of this section to include the page number along with active hyperlinks for each jurisdiction's individual Mitigation Action Plan, making it easier for users of electronic plan files to jump to the specific action plan they're interested in viewing.
Section 10: Plan Maintenance Procedures	• Section 10 was updated with the goal of simplifying the procedures required for Mecklenburg County to follow in implementing, monitoring, evaluating and enhancing the Plan.
Appendix A: Plan Adoption	• Appendix A has been updated with copies of the new (2010) local resolutions passed by each of Mecklenburg County's local jurisdictions requesting approval of the Plan.
Appendix B: Public Participation Survey Results	• Appendix B has been added to include the results of the 2010 Public Participation Survey, which included a total of 28 responses.
Appendix C: Key Federal Mitigation Funding Sources	• Appendix C has been added to provide some general information on some of the key federal mitigation funding sources as administered by FEMA and other agencies.
Appendix D: Local Hazard Mitigation Plan Update Checklist	• Appendix D has been updated to include a copy of NCEM's *Local Hazard Mitigation Plan Update Checklist*, as completed following the 2010 plan update process.

SUMMARY OF PLAN UPDATES (2015)

As part of the 2015 plan update, Mecklenburg County's planning consultant and members of the Hazard Mitigation Planning Team reviewed and analyzed each section of the Plan and made recommendations for necessary updates or revisions. Many of these changes to the initial 2005 plan and 2015 plan update were made based on updated data and technical information, as well as necessary changes to the current status for mitigation actions assigned to each participating jurisdiction. **Table 2.7** briefly describes how each section of the Plan was updated through the 2015 plan update process. All revisions made to the 2015 Plan were made using Microsoft Word "track changes" in documents that remain available through Mecklenburg County upon request.

Table 2.7: Summary of Plan Updates (2015)	
SECTION	**DESCRIPTION OF PLAN UPDATES**
Section 1: Introduction	• Minor revisions related to updated terminology, programmatic changes, etc.
Section 2: Planning Process	• Detailed synopsis of the 2015 plan update process was added, including a description of the process used, who served on the Hazard Mitigation Planning Team, how the public was involved, summaries/minutes of all meetings and how the general public and targeted stakeholders were invited and encouraged to participate.
Section 3: Community Profile	• Updated all maps, tables, charts and narrative text with updated information. This includes a new base map and new or improved data on population, housing, and demographics.

Table 2.7: Summary of Plan Updates (2015)

SECTION	DESCRIPTION OF PLAN UPDATES
Section 4: Hazard Identification	• It was determined early on in the project that the identification and descriptions of hazards as written in the 2005 Plan were adequate and did not necessitate significant changes, and that the planning team's time would be better spent updating other sections of the Plan. • A section was added to introduce Solar Events as a new hazard. • The Data Sources section was updated to reflect the source of the information added for Solar Events.
Section 5: Hazard Analysis	• A comprehensive review and update was made to Section 5. For each hazard identified, all historical data was updated to include descriptions of any events taking place since the 2010 plan update, but also updated to revise any changes to the documented historical event data from prior years. • Disaster declaration data was reviewed for any changes according to FEMA databases, but no revisions were determined necessary. • All narrative text, tables and figures were revised according to the updated data and subsequent GIS analysis. This included updated DFIRM data for flood hazards (current and future), new hazard probability data for wildfire (SWRA), updated NFIP statistics and new information as recorded in the NCDC's storm events database. • Maps were updated where appropriate.
Section 6: Vulnerability Assessment	• Similar to Section 5, a comprehensive update was completed for Section 6 using best available data that had changed since the 2010 plan update. This includes new historical data and new GIS data for hazard layers (particularly flood) as well as local data on parcels, structures, critical facilities and land use. The new data was utilized to partially re-run the vulnerability assessment for Mecklenburg County. This included the generation of new exposure and loss estimates for each hazard through GIS-based and Hazus-driven assessments using the latest versions of ArcGIS and Hazus-MH. • All narrative text, tables, figures and maps were updated to reflect the new data and subsequent vulnerability assessments for each hazard where appropriate.
Section 7: Capability Assessment	• Section 7 was updated to include the results of a newly completed capability assessment survey for Mecklenburg County and its participating jurisdictions. Particular attention was placed on updating information for each jurisdiction on their current administration of the NFIP as required by FEMA per their latest national planning guidance.
Section 8: Mitigation Strategy	• During the 2015 plan update, each of the Mitigation Goals listed in Section 8 (established in 2005) were reviewed and discussed with the Hazard Mitigation Planning Team, as well as members of the general public and targeted stakeholders. The goal statements were all reaffirmed for 2015, with no substantive revisions required.
Section 9: Mitigation Action Plans	• The comprehensive update to Section 9 included the detailed review and update of every single mitigation action listed for each participating jurisdiction in Mecklenburg County. The status report for each action included whether the action was completed, in progress, deferred or deleted as well as an explanation for reaching that determination. The 2015 update also included the identification and assignment of newly proposed mitigation actions for each jurisdiction according to the same format adopted in the 2005 Plan. This resulted in the identification of some new actions for jurisdictions in Mecklenburg County.
Section 10: Plan Maintenance Procedures	• Minor updates were made to Section 10 to clarify the procedures required for Mecklenburg County to follow in implementing, monitoring, evaluating and enhancing the Plan.
Appendix A: Plan Adoption	• Appendix A has been updated with copies of the new (2015) local resolutions passed by each of Mecklenburg County's local jurisdictions requesting approval of the Plan.
Appendix B: Public Participation Survey Results	• Appendix B has been updated to include the results of the 2015 Public Participation Survey, which included a total of 347 responses.
Appendix C: Key Federal Mitigation Funding Sources	• Appendix C has been updated to reflect changes in information regarding the key federal mitigation funding sources identified during the 2010 plan update.
Appendix D: Local Mitigation Plan Review Tool	• Appendix D has been updated to include a copy of NCEM's *Local Mitigation Plan Review Tool*, as completed following the 2015 plan update process.

3 COMMUNITY PROFILE

This section of the Plan provides a general overview of Mecklenburg County and its incorporated municipal jurisdictions. This section consists of the following five subsections:

- GEOGRAPHY AND THE ENVIRONMENT
- COMMUNITY QUICKFACTS
- POPULATION, HOUSING AND DEMOGRAPHICS
- GROWTH TRENDS AND LAND USE
- DATA SOURCES

Mecklenburg County was formed in 1762 from the western part of Anson County. The county was named for Princess Charlotte of Mecklenburg-Strelitz (1744-1818), who had become queen consort of King George III the previous year. Princess Charlotte is also the source of the Mecklenburg County seat's name. In 1768 the part of Mecklenburg County west of the Catawba River became Tryon County. In 1792 the northeastern part of Mecklenburg County became Cabarrus County. Finally, in 1842 the southeastern part of Mecklenburg County was combined with the western part of Anson County to become Union County.

GEOGRAPHY AND THE ENVIRONMENT

Mecklenburg County is located in the south central portion of North Carolina and is bordered on the west by the Catawba River, on the north by Iredell County, on the east by Cabarrus and Union counties, and on the south by the State of South Carolina.

North Carolina consists of 48,711 square miles of land and over 5,000 square miles of inland water including large areas of Lake Norman. The total area of nearly 54,000 square miles ranks North Carolina 29th in area among the states. According to the U.S. Census Bureau, Mecklenburg County contains a total area of 546 square miles, of which 526 square miles is comprised of land and the remaining 20 square miles is water. **Table 3.1** provides a summary of land area within Mecklenburg County, the City of Charlotte and the towns of Cornelius, Davidson, Huntersville, Matthews, Mint Hill and Pineville.

Table 3.1: Summary of Land Area

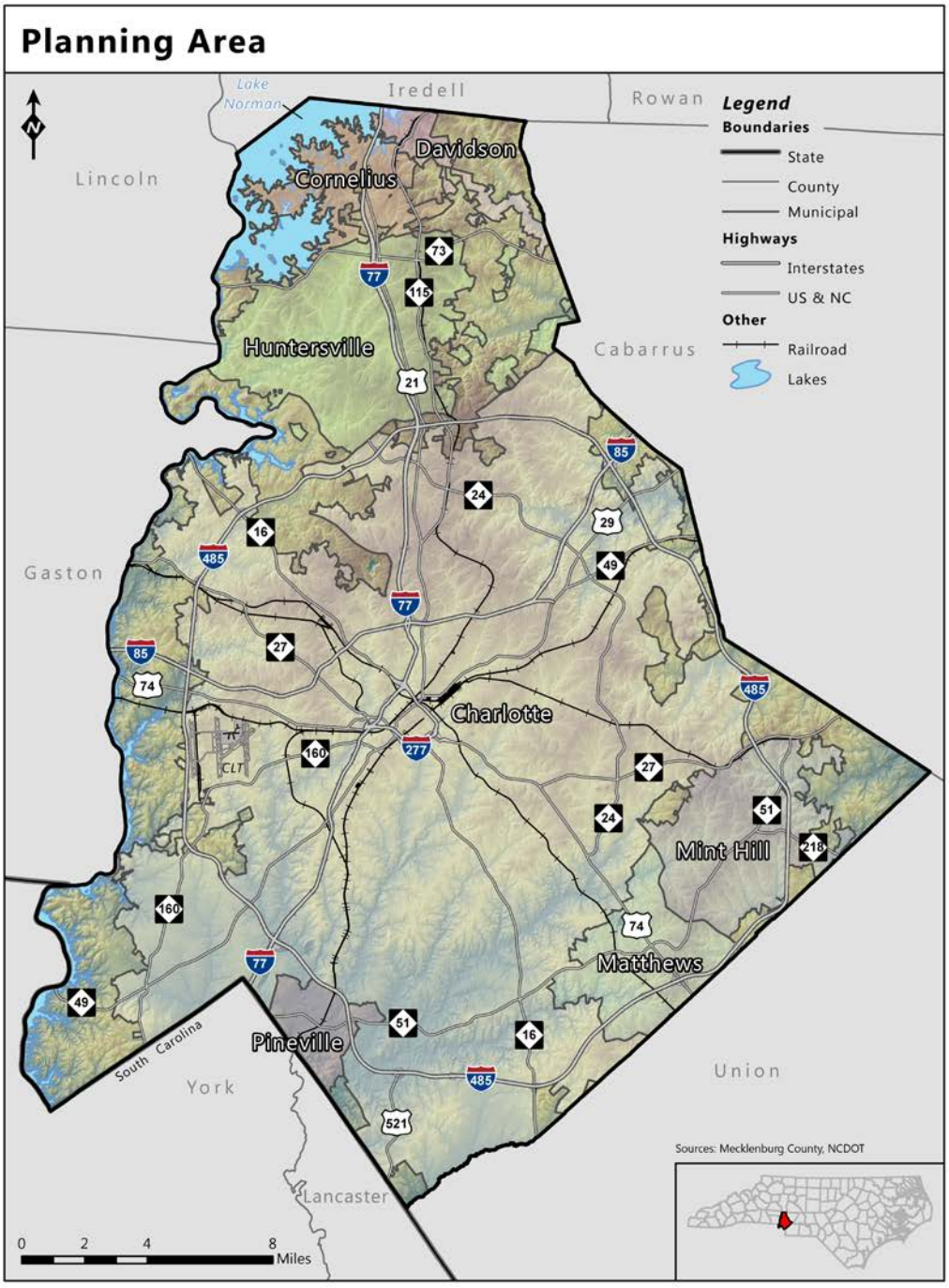
JURISDICTION	AREA IN SQUARE MILES		
	TOTAL AREA	WATER AREA	LAND AREA
Mecklenburg County	547.91	22.07	525.84
City of Charlotte	299.67	1.99	297.68
Town of Cornelius	12.38	0.3	12.08
Town of Davidson	6	0.25	5.75
Town of Huntersville[1]	39.77	0.16	39.61
Town of Matthews	17.19	0.08	17.11
Town of Mint Hill	24.15	0.23	23.92
Town of Pineville	6.66	0.04	6.62
NORTH CAROLINA	**53,818.51**	**5,107.63**	**48,617.91**

Source: U.S. Census Bureau, 2010

Figure 3.1 provides an overview of the geographic location of each municipal jurisdiction with the county.

[1] Huntersville's current town limits is technically 40.52 square miles, though the Town's sphere of influence is 63.46 (the Town has zoning throughout the entire sphere of influence, which could impact potential hazard situations).

Figure 3.1: Overview Map of Mecklenburg County



COMMUNITY QUICKFACTS

There a seven incorporated municipalities within Mecklenburg County, each of which are very briefly introduced below (with 2013 population estimate counts) and then further described in sections that follow.

City of Charlotte (Pop. 792,862)
Charlotte was incorporated in 1768 (as a town, later as a city) and today is the largest city in North Carolina. Nicknamed the *Queen City* in honor of Princess Charlotte, the city has become one of the nation's largest financial centers serving as the home city for Bank of America and numerous other regional banking and financial services companies. The city remains a major employment hub for North Carolina including more Fortune 500 companies than anywhere else in the state, several institutions of higher learning including the University of North Carolina at Charlotte, one of the busiest airports in the world and largest hub for US Airways and a major center for the U.S. motorsports industry, all of which has led to tremendous population growth and urban development in the past several decades. While much of this development has occurred outward from the central business district, the center city/uptown area of Charlotte has experienced remarkable growth and revitalization over the last decade. Numerous residential units continue to be built uptown, including over 20 skyscrapers either under construction, recently completed, or in the planning stage. Many new restaurants, bars and clubs now operate in the uptown area and several projects are continuing to transform the Midtown Charlotte/Elizabeth area of this modern city.

Town of Cornelius (Pop. 26,898)
Established in 1905, the Town of Cornelius originated as a mill and farm community. With the closing of the mills, the damming of the Catawba River, the development of I-77 and the growth of the Town as a result of its close proximity to Charlotte and Lake Norman, the Town has experienced dramatic population growth and significant development in recent years. Since only 2000, the reported population for Cornelius has doubled in size with one of the fastest growth rates in the state during that period.

Town of Davidson (Pop. 11,750)
Founded by a Presbyterian Church in 1835, the Town of Davidson was incorporated as Davidson College in 1879 but the name was changed to Davidson in 1907. Traditionally a small, Southern college town (home to Davidson College) with engaged and active citizens, Davidson's development patterns follow principles of new urbanism and include significant attention to open space (acquiring nearly 500 acres in the past ten years), greenways and transportation systems built for pedestrians and cyclists. In recent years the town has experienced a change in demographics with more retirees and fewer people directly connected to the college.

Town of Huntersville (Pop. 50,458)
The Town of Huntersville was incorporated in 1873, with fertile land and a rail line promoting quick growth. Cotton mill Virgin Manufacturing Company and a brickyard that supplied bricks for many homes in older sections of town were thriving businesses, and in later years textile mills brought jobs and residents to the area. Proximity to Charlotte and Lake Norman have made Huntersville an attractive residential and commercial destination for residents and new and/or relocating companies alike. Available land and a focus on providing high quality of life amenities like parks and recreation have fueled the town's increase in population from 3,024 people in 1990 to over 52,000 residents per the most recent state estimates. Today, Huntersville is the second largest municipality in Mecklenburg County and the 17th largest in North Carolina. Huntersville is fully committed to careful growth and development based upon the principles of traditional town planning, transit-oriented development, and quality urban design, and the Town has received regional and national attention due to its progressive and innovative growth management policies.

Town of Matthews (Pop. 29,384)
The Town of Matthews began as a small farming community in the early 1800s but was not incorporated until 1879, shortly after the town's first railroad stop. Matthews continued to grow and the railroad remained an important and integral part of the community into the early 20th century in which cotton ginning was big business. Keeping pace with population growth and continued development, Matthews is now largely 100% built-out and encompasses approximately 14 square miles between Charlotte and Mint Hill. Recent planning efforts have been focused on downtown development and redevelopment opportunities.

Town of Mint Hill (Pop. 24,543)
Although the Mint Hill community was first settled as early as 1750, the Town was not incorporated until 1971. Primarily a suburban community adjacent to Charlotte, Mint Hill has seen an influx of luxury residential communities and the business district has shown intensified development in recent years with approximately 285 businesses and professional services available. In 2003 the Town established its own Police Department to keep pace with the needs of a growing population and increased development (the Town had formerly been contracting with the City of Charlotte for police services). The Town's Planning and Zoning Department continues to provide long range planning, downtown revitalization and development review services to maintain Mint Hill's quality of life.

Town of Pineville (Pop. 8,061)
Located just south of the City of Charlotte, the Town of Pineville was incorporated in 1973 and today is well known for its antique shops lining Main Street in its historic downtown. Primarily a suburban residential community, it continues to grow rapidly with the recent addition of many shopping centers, malls, businesses and churches. Pineville now also has its own medical park with one of the finest hospitals in the area, and is located in close proximity to Paramount Carowinds amusement park which brings many visitors through the area on a regular basis.

POPULATION, HOUSING AND DEMOGRAPHICS

According to the latest Census estimates (2014), North Carolina is the 10th most populous state in the United States with a resident population of 9,943,964. Over three decades (2000-2029) North Carolina's total population is projected to grow by approximately 4.5 million people (North Carolina Office of State Budget and Management). Although not the fastest growing, Mecklenburg County remains the state's most populated county. According to census records, Mecklenburg County has a 2013 estimated population of 990,977 people – an increase of 7.8 percent from the 2010 census count of 919,568, compared with the statewide growth rate of 3.3 percent. Today, Mecklenburg County remains North Carolina's most densely populated county with 1,755.5 people per square mile, and there are an estimated 410,575 housing units. **Table 3.2** shows population and densities per square mile for population and housing units in Mecklenburg County as well as for each municipal jurisdiction and the entire state of North Carolina.

Table 3.2: Summary of Population, Population Density and Housing Unit Density

JURISDICTION	POPULATION (2013)	DENSITY PER SQUARE MILE OF LAND AREA	
		POPULATION (2010)	HOUSING UNITS (2008)
Mecklenburg County (total)	990,977	1,755.5	766
City of Charlotte	792,862	2,457.1	1,221
Town of Cornelius	26,898	2,058.4	1,900
Town of Davidson	11,750	1,903.0	699*
Town of Huntersville	50,458	1,180.8	533
Town of Matthews	29,384	1,589.6	774
Town of Mint Hill	24,543	949.8	370*
Town of Pineville	8,061	1,129.4	971*
NORTH CAROLINA	**9,848,917**	**196.1**	**78**

Source: U.S. Census Bureau, 2010,2013 Estimates
** No Census data on housing units available for 2008, so these estimates we're generated using 2008 population data in combination with average household size according the most recent Census data (2000).*

According to the official 2013 estimates, the racial makeup of Mecklenburg County is 59.7 percent White, 32.1 percent Black or African American, 5.2 percent Asian, 0.8 percent American Indian or Alaskan Native, 0.1 percent Native Hawaiian and other Pacific Islander, and 2.1 percent from two or more races. Hispanic or Latino of any race makes up 12.6 percent of the county population. Of the total population in Mecklenburg County, 7.1 percent are under 5 years old and 24.8 percent are under 18 years old. A total of 9.7 percent are 65 years old and over.

Note: The remainder of this section on *Population, Housing and Demographics* summarizes the most up-to-date information for Mecklenburg County according to the 2009-2013 American Community Survey (ACS) performed by the U.S. Census Bureau. The ACS is an on-going, nationwide survey that is sent to a sample of the population to help communities determine where to locate services and allocate resources. It is a critical element in the Census Bureau's reengineered decennial census program. The ACS collects and produces population and housing information every year instead of every ten years.

Households and Families

There are approximately 366,689 households in Mecklenburg County with an average household size of 2.4 persons. Families make up 62.2 percent of the households. This figure includes both married-couple families (43.2 percent) and other families (19.1 percent). Nonfamily households make up 37.8 percent of all households in Mecklenburg County. Most of the nonfamily households were people living alone, but some were composed of people living in households in which no one was related to the householder.

Housing Characteristics

Of the approximately 402,401 housing units in Mecklenburg County, it is estimated that 8.9 percent are vacant. Of the total housing units, 67.1 percent are in single-unit structures, 31.3 percent are in multi-unit structures, and 1.6 percent are mobile homes. 49.8 percent of the housing units were built since 1990. In 2009-2013, Mecklenburg County had 366,689 occupied housing units - 218240 (59.5 percent) owner occupied and 148,449 (40.5 percent) renter occupied. 2.1 percent of the households did not have telephone service and 7 percent of the households did not have access to a car, truck, or van for private use. 39.7 percent had two vehicles and another 15.4 percent had three or more.

Housing Costs

The median monthly housing costs were $1,084.

Income
The median income of households in Mecklenburg County is $55,444. 85.1 percent of the households received earnings and 12.6 percent received retirement income other than Social Security. 19.7 percent of the households received Social Security, with the average income amount being $17,767. These income sources are not mutually exclusive; that is, some households received income from more than one source.

Nativity and Language
14.8 percent of the people living in Mecklenburg County are foreign born. 85.2 percent are native, including 42 percent who were born in North Carolina. Among people at least five years old living in Mecklenburg County, 18.2 percent speak a language other than English at home. Of those speaking a language other than English at home, 48 percent speak Spanish and 52 percent speak some other language; 52 percent reported that they did not speak English "very well."

Geographic Mobility
Seventy-seven percent of the people at least one year old living in Mecklenburg County were living in the same residence one year earlier; 13 percent had moved during the past year from another residence in the same county, 3 percent from another county in the same state, 6 percent from another state, and 1 percent from abroad.

Education
88.8 percent of people 25 years and over in Mecklenburg County have at least graduated from high school and 40.7 percent had a bachelor's degree or higher. Eleven percent are dropouts; they were not enrolled in school and had not graduated from high school. The total school enrollment in Mecklenburg County was 260,915 in 2009-2013. Nursery school and kindergarten enrollment was 33,122 and elementary or high school enrollment was 154,598 children. College or graduate school enrollment was 73,195.

Industries
For the employed population 16 years and older, the leading types of industries in Mecklenburg County are educational services, health care and social assistance (19 percent), and finance and insurance, real estate and rental and leasing (13 percent).

Occupations and Type of Employer
The most common occupations in Mecklenburg County are: management, business, science and arts occupations (41 percent); sales and office occupations (26 percent); service occupations (16 percent); production, transportation, and material moving occupations (10 percent); and natural resources, construction and maintenance occupations (10 percent).[2] Eighty-five percent of the people employed are private wage and salary workers; 9 percent are federal, state, or local government workers; and 5 percent are self-employed in their own unincorporated businesses.

Travel to Work
77.3 percent of Mecklenburg County workers drive to work alone, 10.2 percent carpool, 3.4 percent take public transportation, and 3.2 percent use other means. The remaining 6 percent work at home. Among those who commuted to work, it took them on average 24.7 minutes to get to work.

Poverty and Participation in Government Programs
15.4 percent of people in Mecklenburg County are below poverty level. Fourteen percent of related children under 20.8 are below the poverty level, compared with 8.2 percent of people 65 years old and over. 11.9 percent of all families and 29.5 percent of families with a female householder and no husband present have incomes below the poverty level.

[2] This totals 103% due to rounding.

GROWTH TRENDS AND LAND USE

U.S. Census 2010 figures show that Mecklenburg County experienced a 24 percent population growth rate from 2000 to 2010, making it one of the fastest-growing areas in the country. Since 2010 that growth rate remains high with an increase of another 7.8 percent, as estimated in 2013, adding an additional 71,349 people to the county in a three-year period. This rate of growth nearly doubles the statewide percent change of 3.3 percent from 2010 to 2013. **Table 3.3** provides a summary of the growth rates for each jurisdiction in Mecklenburg County between 2010 and 2013 according to the U.S. Census Bureau.

Table 3.3: Population Growth in Mecklenburg County, 2000-2013

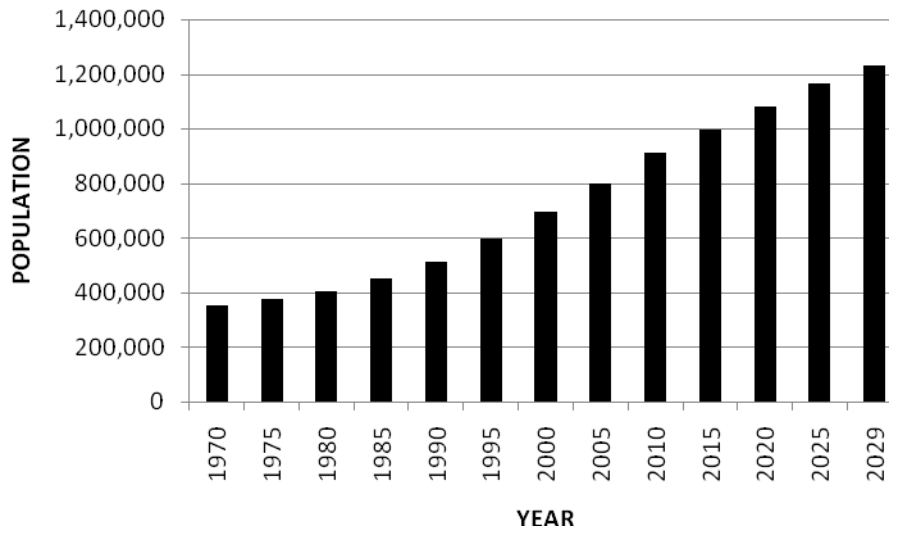
JURISDICTION	2013 POPULATION	POPULATION GROWTH	
		CHANGE SINCE 2010	GROWTH RATE
Mecklenburg County (total)	990,977	71,349	7.8%
City of Charlotte	792,862	61,438	7.8%
Town of Cornelius	26,898	2,032	8.1%
Town of Davidson	11,750	806	7.5%
Town of Huntersville	50,458	3,685	7.9%
Town of Matthews	29,384	2,186	8.0%
Town of Mint Hill	24,543	1,821	7.8%
Town of Pineville	8,061	582	7.8%

Source: U.S. Census Bureau

The rapid growth in population is reflected in the county's pace of development. Nearly every part of Mecklenburg County boasts some level of new development that has continued at a steady pace, seemingly immune to recent economic downturns. Mecklenburg County is becoming more urban in character, and is projected to be fully developed or built out by 2020. The U.S. Forest Service reports an approximate 14 percent loss of forestland in Mecklenburg County between 1990 and 2002, and according to the North Carolina Division of Forest Resources the county lost an additional 47,000 acres in forestland between 2004 and 2009 (35 percent change). A study commissioned by the Charlotte Tree Advisory Commission indicated a 22 percent loss of tree cover and a 22 percent loss of open space between 1984 and 2001.

According to the North Carolina Office of State Budget and Management (OSBM), the county is projected to have a total population of more than 1.2 million by 2029. **Figure 3.2** illustrates this projected growth in comparison to historical population growth for Mecklenburg County according to OSBM data.

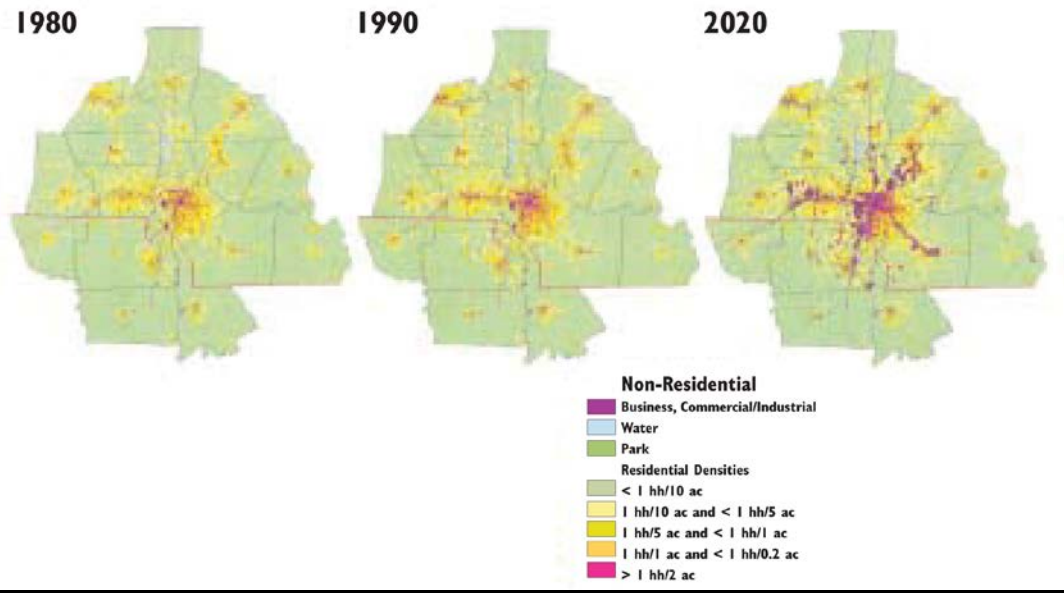
Figure 3.2: Historical and Projected Population Growth in Mecklenburg County, 1970–2029



Source: North Carolina Office of State Management and Budget, 2009.

Figure 3.3 shows the change in land use from 1980 to 2020 as predicted by a model developed by the Open Space Institute of the Carolinas, a non-profit land conservation research and education organization. Nicknamed the "Piedmont Green Plan," it identifies open space as it existed in 1980 and 1990 based on satellite imagery, and uses population projections and adopted land use plans to project conversion of open space to developed uses by 2020. For Mecklenburg County, the model reports a decline in open space, for the years 1980 to 1990, from 41 percent of total land area to 36 percent, with a projected further drop to 17 percent by 2020. This is the equivalent of five acres a day throughout the 40-year period of 1980 to 2020.

Figure 3.3: Land Use Change (1980-2020) for Charlotte Metropolitan Area



Source: 2004 State of the Environment Report for Mecklenburg County, North Carolina by the Mecklenburg County Land Use & Environmental Services Agency.

The County, in coordination with its municipal jurisdictions, has undertaken various efforts to preserve open space and maintain livability. The public land acquisition effort has attempted to put three types of preserved land in place: large park sites geographically dispersed around the county, floodplains along major creeks, and watershed protection land around Mountain Island Lake. By the end of 2003, Mecklenburg County had acquired 833 acres of open space with the 1999 land purchase and parks bond funds to protect the Mountain Island Lake watershed, the main source of the county's drinking water. A number of additional County land acquisitions for open space have since been completed, including several large-scale acquisition and demolitions through Mecklenburg County's *Floodplain Buyout Program* further described in Section 7: *Capability Assessment*.

The City of Charlotte and Mecklenburg County have adopted and continue to implement a "corridors and wedges" land use plan that envisions denser development along five key transportation corridors and less dense development in the wedges between corridors. Integrating urban green space into plans for transit station areas in the corridors has emerged as a key ingredient in making density livable. Each of the small towns within Mecklenburg County is attempting to manage their growth and maintain their individual character. In so doing they have engaged in a number of cooperative long-range projects with the County and each other designed to combat suburban sprawl, encourage commuter rail connections to surrounding communities, and preserve rural lands.

More information on current land use and future development trends in Mecklenburg County and how they relate to natural hazard vulnerability is provided in Section 6: *Vulnerability Assessment*, and Section 7: *Capability Assessment*.

DATA SOURCES

The following primary data sources were among those used to collect the information presented in this section.

- *Welcome to NC* (www.welcometonc.com/countydirectories/Mecklenburg/index.cfm)
- *North Carolina Office of State Budget and Management* http://www.osbm.state.nc.us/index.shtm
- *Town of Cornelius* (www.cornelius.org/)
- *Town of Davidson* (www.ci.davidson.nc.us/)
- *Town of Huntersville* (www.huntersville.org/)
- *Town of Matthews* (www.matthewsnc.com)
- *Town of Mint Hill* (www.minthill.com/)
- *Town of Pineville* (www.pinevillenc.net/)
- *NCGen Web Project* (www.rootsweb.com/~ncmeckle/)
- *Charlotte-Mecklenburg* (www.charmeck.org)
- *Mecklenburg County Land Use and Environmental Services Agency* (www.groundwater.org/pe/actt/MH_NC1202.pdf)
- *Federal Emergency Management Agency* (www.fema.gov/)
- *U.S. Census Bureau* (http://www.census.gov/)

4 HAZARD IDENTIFICATION

INTRODUCTION

North Carolina and its inland communities are vulnerable to a wide range of natural hazards that threaten life and property. The hazards identified by the Mecklenburg County Hazard Mitigation Planning Team for inclusion in this risk assessment are those determined to be of actual potential threat to Mecklenburg County and its incorporated jurisdictions and are consistent with the potential natural hazards identified by the State of North Carolina and the Federal Emergency Management Agency for this part of the State and this region of the country.[1] These hazards consist of the following:

- FLOOD
- HURRICANES AND TROPICAL STORMS
- SEVERE THUNDERSTORMS
- TORNADOES
- WINTER STORMS
- EARTHQUAKES
- LANDSLIDES
- SINKHOLES
- DROUGHT
- WILDFIRE
- DAM/LEVEE FAILURE
- SOLAR EVENTS

Some of these hazards can be interrelated (for example, hurricane events can cause flooding and tornado activity), and thus discussion of these hazards may overlap where necessary throughout the risk assessment. Also, some hazards consist of hazardous elements that are not listed separately above (for example, discussion of severe thunderstorms includes lightning and hail activity; discussion of hurricanes and tropical storms includes nor'easters and coastal erosion).

This section provides a general description for each of the hazards listed above, including their damage-causing characteristics, written largely from a national perspective.[2]

44 CFR Requirement

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.

This CFR requirement is met in the Hazard Identification *and* Hazard Analysis *sections of this risk assessment.*

[1] The process used to arrive at this list of hazards is documented in the *Planning Process* section. Refer to Table 2.2 for details.

[2] As stated, the *Hazard Identification* section of the risk assessment provides general descriptions from a national perspective whereas the *Hazard Analysis* and *Vulnerability Assessment* sections contain information specific to Mecklenburg County, the City of Charlotte, and the towns of Pineville, Mint Hill, Huntersville, Cornelius, Matthews and Davidson.

FLOOD

Flooding is the most frequent and costly of all natural hazards in the United States, and has caused more than 10,000 deaths since 1900. Approximately 90 percent of presidentially declared disasters result from flood-related natural hazard events. Taken as a whole, more frequent, localized flooding problems that do not meet federal disaster declaration thresholds ultimately cause the majority of damages across the United States.

Floods are generally the result of excessive precipitation, and can be characterized as follows: general floods, in which precipitation occurs over a given river basin for a long period of time; and flash floods, which are the product of heavy localized precipitation falling in a short time period over a given location. The severity of a flood event is determined by the following factors: a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, recent soil moisture conditions, and the degree of vegetative clearing in and around flood-prone areas.

Flooding remains one of Charlotte-Mecklenburg's most frequent and problematic natural hazards – often causing severe, repetitive property damages and posing significant threats to people unable to evacuate flood hazard areas as well as drivers of vehicles entering flooded roadways. (Photo courtesy of Robert Lahser, Charlotte Observer)

General floods may last for several days or even weeks. 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 a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters and other large coastal storms. Urban flooding occurs where man-made 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 localized area or by heavy rains associated with hurricanes and tropical storms. Flash flooding can also occur due to accelerated snow melt, a dam or levee failure, or from a sudden release of water held by an ice jam. Although flash flooding occurs often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces. Flash flood waters can move at very high speeds and "walls" of water have been known to reach heights of 10 to 20 feet. Flash flood waters and the accompanying debris can uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads.

The periodic flooding of lands including and adjacent to rivers, streams, and shorelines, referred to as the 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. As the magnitude of a hypothetical flood scenario increases the recurrence interval increases. That is, the greater the magnitude of a given event, the less likely it will occur over time.

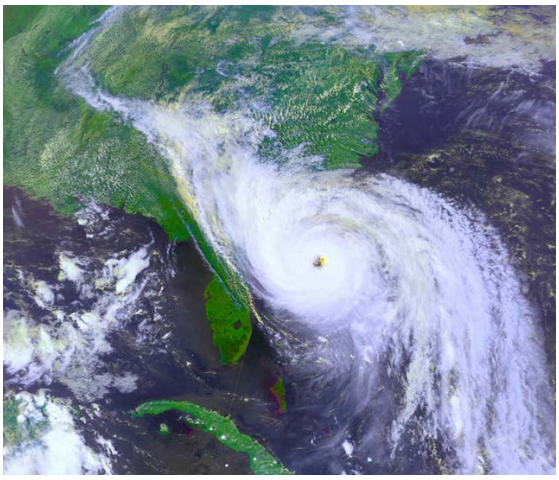
Floodplains are delineated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by a 10-year flood (should it occur) and the 100-year floodplain by the 100-year flood. Flood frequencies such as the 100-year flood are determined by plotting 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 (expressed as a percent) in a given year of a flood event of a given magnitude. For example, the 100-year flood has a 1 percent chance of occurring in any given year.

HURRICANES AND TROPICAL STORMS

Hurricanes and tropical storms, along with nor'easters and typhoons, are classified as cyclones and are 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. Coastal areas are particularly vulnerable to storm surge, wind-driven waves, and tidal flooding which can prove more destructive than cyclone wind.

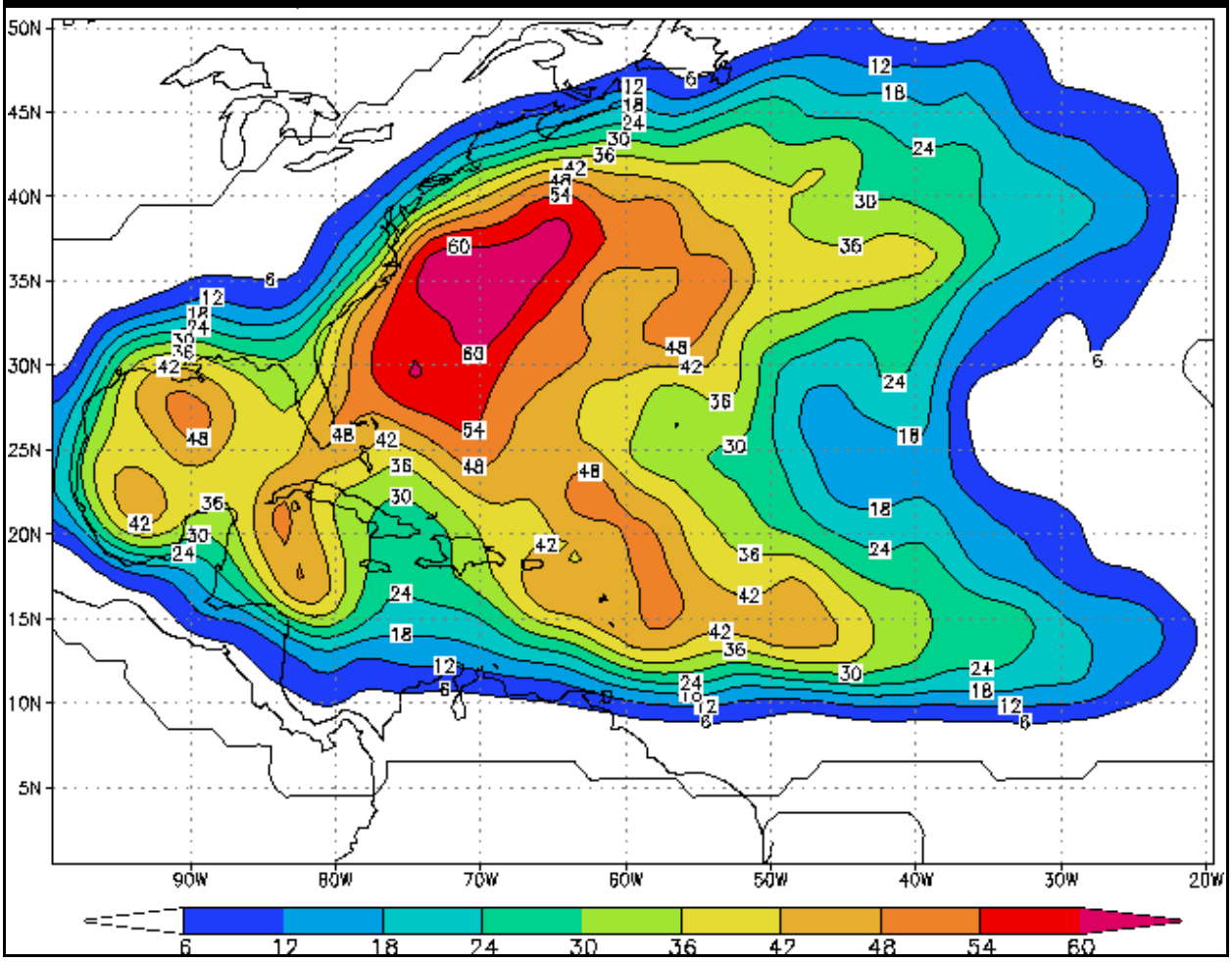
The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of 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. Based on a long-term average, approximately six storms reach hurricane intensity per year.



Although Hurricane Hugo made landfall nearly 200 miles away in Charleston, South Carolina, the storm crossed Mecklenburg County as a Category 2 hurricane causing significant wind-related damages across the area in September 1989. (Photo courtesy of NOAA)

Figure 4.1 shows, for any particular location, the chance of a hurricane or tropical storm affecting the area sometime during the Atlantic hurricane season. The figure was created by the National Oceanic and Atmospheric Administration's (NOAA) Hurricane Research Division, using data from 1944 to 1999. The figure shows the number of times a storm or hurricane was located within approximately 100 miles (165 kilometers) of a given spot in the Atlantic basin.

Figure 4.1: Empirical Probability of a Named Hurricane or Tropical Storm



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

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 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 which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense. The Saffir-Simpson Scale is shown in **Table 4.1**.

Table 4.1: Saffir-Simpson Scale

CATEGORY	MAXIMUM SUSTAINED WIND SPEED (MPH)	MINIMUM SURFACE PRESSURE (MILLIBARS)	STORM SURGE (FEET)
1	74–95	Greater than 980	3–5
2	96–110	979–965	6–8
3	111–130	964–945	9–12
4	131–155	944–920	13–18
5	155 +	Less than 920	19+

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential, 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 cyclones making landfall, they account for over 70 percent of the damage in the United States. **Table 4.2** describes the damage that could be expected for each hurricane category.

Table 4.2: 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.	

Sources: National Hurricane Center and the Federal Emergency Management Agency

While not directly relevant to the planning area, storm surge is another common element of hurricane activity. 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 20 feet in a Category 5 storm. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. A storm surge is a wave that has outrun its generating source and become a long period swell. The surge is always highest in the right-front quadrant of the direction in which the hurricane is moving. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast.

Storm surge heights and associated waves are dependent upon the shape of the 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.

Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms. Hurricane Floyd, for example, was at one time a Category 4 hurricane racing towards the North Carolina coast. As far inland as Raleigh, the state capital located more than 100 miles from the coast, communities were preparing for winds exceeding 100 miles per hour. While Floyd made landfall as a Category 2 hurricane it caused the worst inland flooding disaster in North Carolina's history. Rainfall amounts exceeded 20 inches in certain locales and 67 counties sustained damages.

Hurricane Floyd brought a devastating 15 feet of storm surge that damaged or destroyed hundreds of houses along the ocean front of Long Beach on Oak Island, North Carolina in September 1999. A prime example of successful hazard mitigation, the elevated home (right) survived while the older, ground-level block foundation of the home on the left was undermined and crushed. (Photo by Dave Gatley/FEMA News Photo)

Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their 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. There are two main components to a nor'easter: (1) a Gulf Stream low-pressure system (counter-clockwise winds) generated off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic, and pulled up the East Coast by strong northeasterly winds at the leading edge of the storm; and (2) an Arctic high-pressure system (clockwise winds) which meets the low-pressure system with cold, arctic air blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation and have the potential for creating dangerously high winds and heavy seas. As the low-pressure system deepens, the intensity of the winds and waves increase and can cause serious damage to coastal areas as the storm moves northeast.[3]

[3] Due to the inland nature of Mecklenburg County and its communities, nor'easters are viewed primarily as winter storm-type events, as the coastal storm characteristics and coastal impacts of nor'easters would not likely be observed within the county. The Dolan-Davis Nor'easter Intensity Scale, which shows levels of coastal degradation based on beach and dune erosion, overwash and coastal property damage is not relevant to Mecklenburg County and therefore is not discussed here.

SEVERE THUNDERSTORMS

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." Although thunderstorms generally affect a small area when they occur, they are very dangerous because of their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in those regions are most ideal for generating these powerful storms.

Thunderstorms are caused when air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for thunderstorms. These storms can occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours.

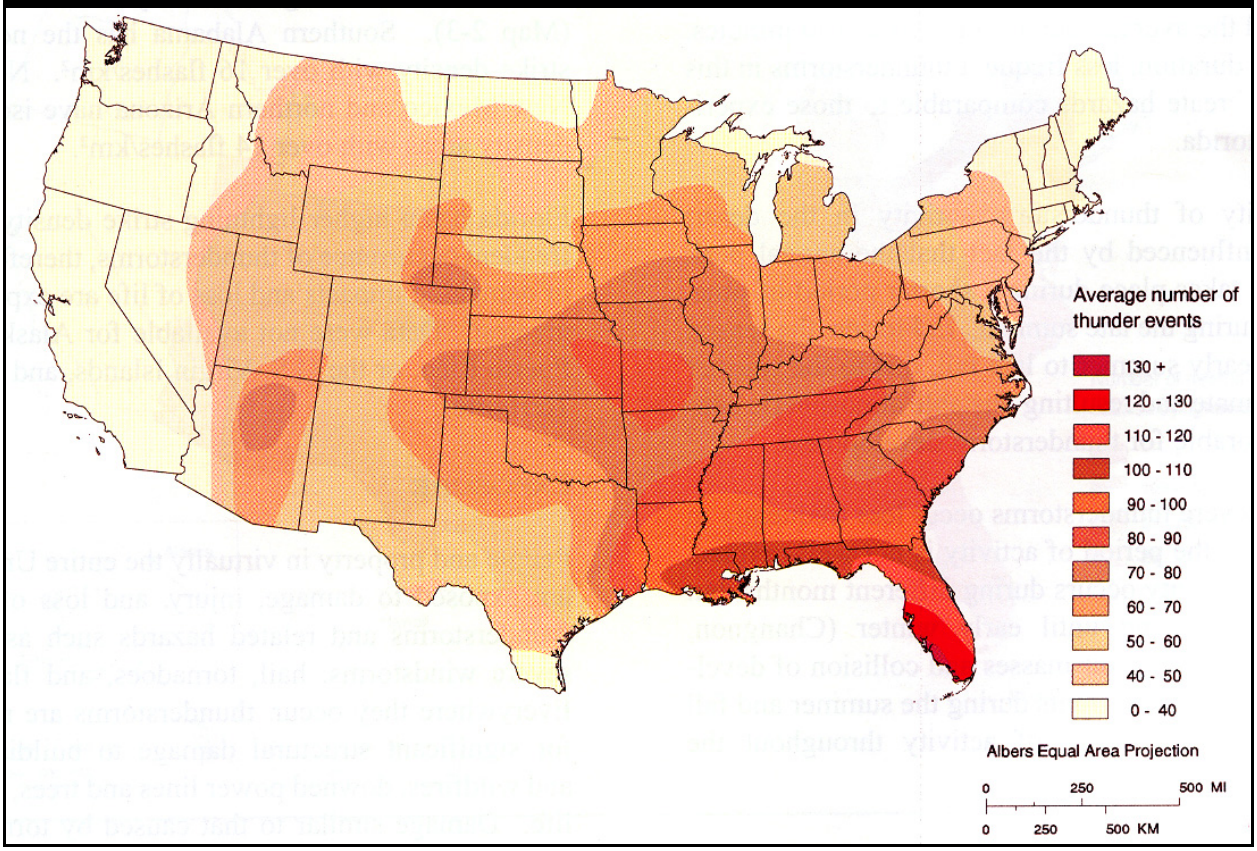
Multiple cloud-to-ground and cloud-to-cloud lightning strokes observed during a nighttime thunderstorm. (Photo courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/ National Severe Storms Laboratory)

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, 89 people are killed each year by lightning strikes in the United States.

The National Weather Service collected data for thunder days, number and duration of thunder events, and lightening strike density for the 30-year period from 1948 to 1977. A series of maps was generated showing the annual average thunder event duration, the annual average number of thunder events, and the mean annual density of lightning strikes.

Figure 4.2 illustrates thunderstorm hazard severity based on the annual average number of thunder events from 1948 to 1977.

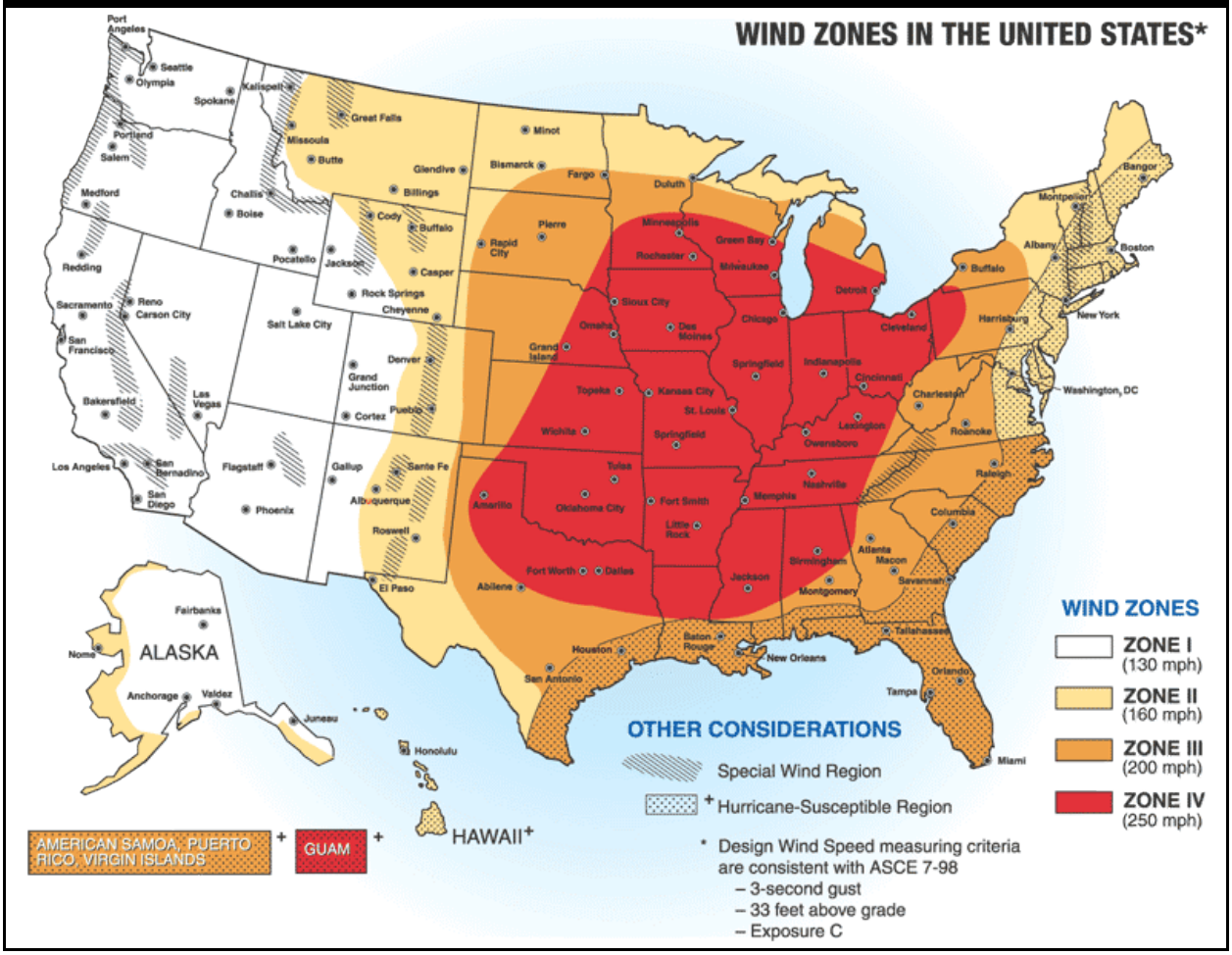
Figure 4.2: Annual Average Number of Thunder Events



Source: Federal Emergency Management Agency

Straight-line winds, which in extreme cases have the potential to cause wind gusts that exceed 100 miles per hour, are responsible for most thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation. **Figure 4.3** shows how the frequency and strength of extreme windstorms vary across the United States. The map was produced by the Federal Emergency Management Agency (FEMA) and is based on 40 years of tornado history and over 100 years of hurricane history. Zone IV, the darkest area on the map, has experienced both the greatest number of tornadoes and the strongest tornadoes. As shown by the map key, wind speeds in Zone IV can be as high as 250 MPH.

Figure 4.3: Wind Zones in the United States

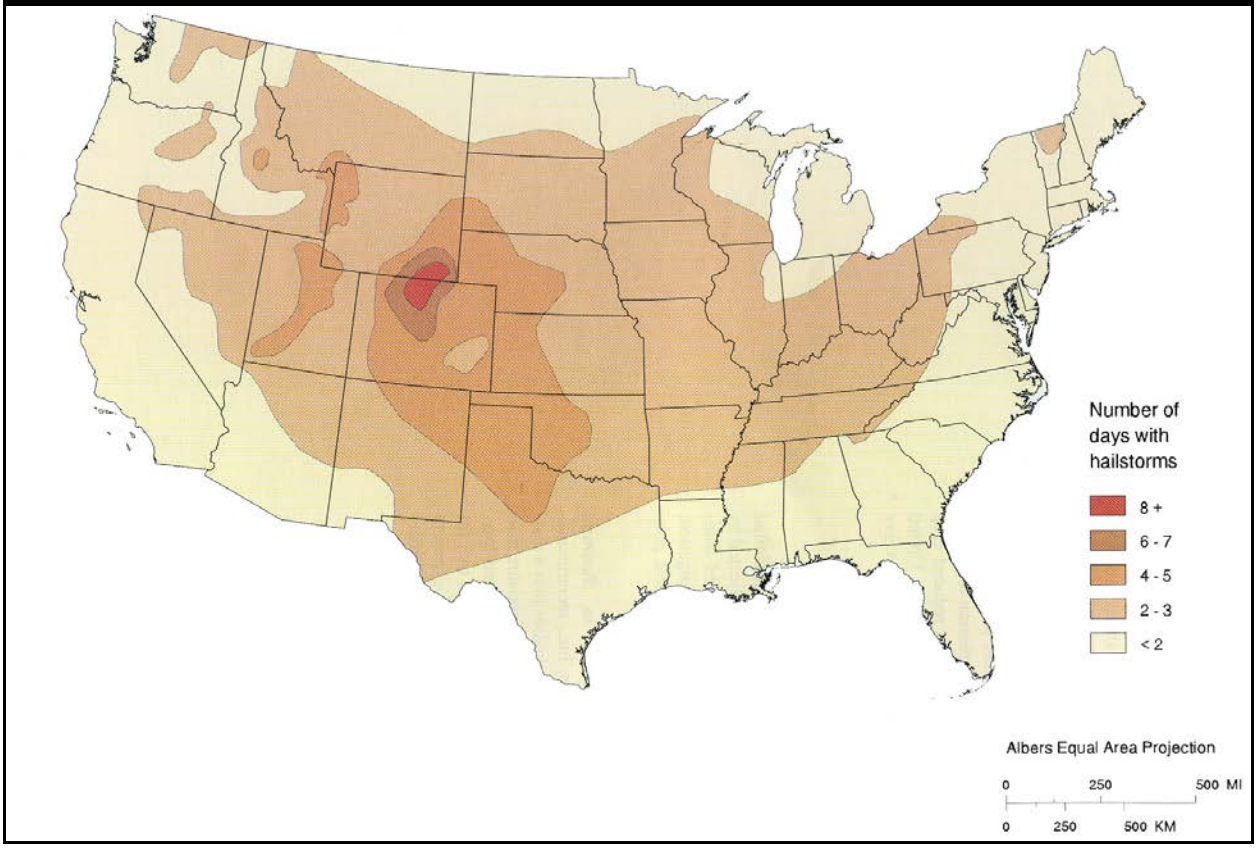


Source: Federal Emergency Management Agency

Hailstorms are another potential damaging outgrowth of severe thunderstorms. 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, having developed sufficient weight, they fall as precipitation—as balls or irregularly shaped masses of ice greater than 0.75 in. (1.91 cm) 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. **Figure 4.4** shows the annual frequency of hailstorms in the United States.

Large hail collects on streets and grass during a severe thunderstorm. Larger stones appear to be nearly two to three inches in diameter. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Figure 4.4: Annual Frequency of Hailstorms in the United States



Source: Federal Emergency Management Agency

TORNADOES

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 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 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 (NOAA, 2002). They are more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are 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 most comprehensively observed tornado in history, this tornado south of Dimmitt, Texas developed June 2, 1995 curving northward across Texas Highway 86 where it entirely removed 300 feet of asphalt from the road tossing it more than 600 feet into an adjacent field. It also caused F4 damage at an isolated rural residence just north of the road. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states. Waterspouts occasionally move inland, becoming tornadoes that cause damage and injury. However, most waterspouts dissipate over the open water causing threats only to marine and boating interests. Typically a waterspout is weak and short-lived, and because they are so common, most go unreported unless they cause damage.

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 damages to structures of light construction such as residential homes (particularly mobile homes), and tend to remain localized in impact. **Table 4.3** shows the Enhanced Fujita Scale for Tornadoes which was developed to measure tornado strength and associated damages.

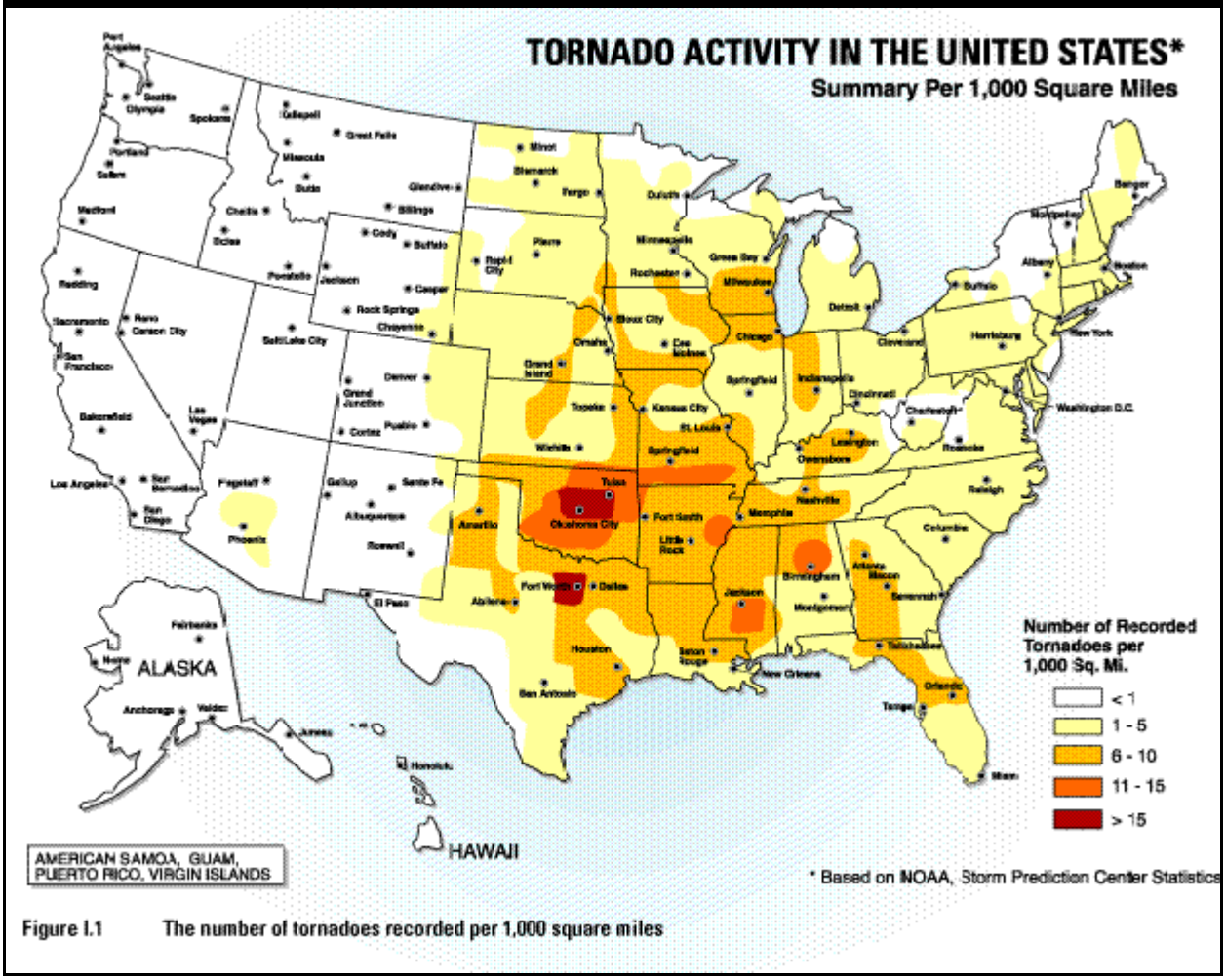
Table 4.3: Enhanced Fujita Scale for Tornadoes

Storm Category	Damage Level	3 Second Gust (mph)	Description of Damages	Photo Example
F0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.	
F1	WEAK	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 might be destroyed.	
F2	STRONG	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	
F3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.	
F4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	
F5	INCREDIBLE	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: NOAA, FEMA

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 4.5** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles.

Figure 4.5: Tornado Activity in the United States



Source: American Society of Civil Engineers

The tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest. This type of tornado usually occurs around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction.

WINTER STORMS

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. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility.

Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Sleet—raindrops that freeze into ice pellets before reaching the ground—usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard, especially on power lines and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

A heavy layer of ice was more weight than this tree in Kansas City, Missouri could withstand during a January 2002 ice storm that swept through the region bringing down trees, power lines and telephone lines. (Photo by Heather Oliver/FEMA News Photo)

A freeze is weather marked by low temperatures, especially when below the freezing point (zero degrees Celsius or thirty-two degrees Fahrenheit). Agricultural production is seriously affected when temperatures remain below the freezing point.

EARTHQUAKES

An earthquake is the motion 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.

Many roads, including bridges and elevated highways, were damaged by the 6.7 magnitude earthquake that impacted the Northridge, California area January 17, 1994. Approximately 114,000 structures were damaged and 72 deaths were attributed to the event. Damage costs were estimated at $25 billion. (FEMA News Photo)

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 borders of the Earth's 10 tectonic plates. These plate borders generally follow the outlines of the continents, with the North American plate following the continental border with the Pacific Ocean in the west, but following the mid-Atlantic trench in the east. As earthquakes occurring in the mid-Atlantic trench usually pose little danger to humans, the greatest earthquake threat in North America is along the Pacific Coast.

The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Earthquakes 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 (see **Table 4.4**). 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, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), 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 4.5**.

Table 4.4: Richter Scale

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
Less than 3.5	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 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 greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: North Carolina Division of Emergency Management

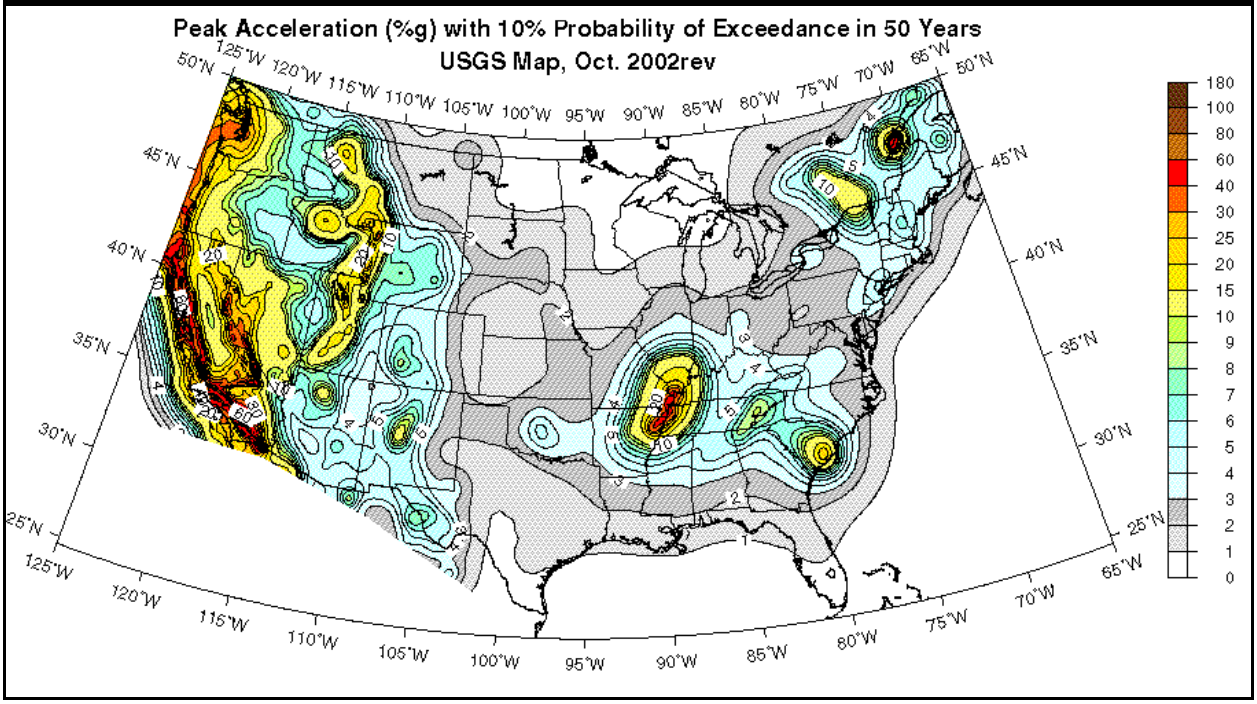
Table 4.5: Modified Mercalli Intensity Scale for Earthquakes

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: North Carolina Division of Emergency Management

Figure 4.6 shows 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.

Figure 4.6: Peak Acceleration with 10 Percent Probability of Exceedance in 50 Years



Source: United States Geological Survey

LANDSLIDES

A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation, which is driven by gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, volcanic eruptions, and changes in groundwater levels.

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

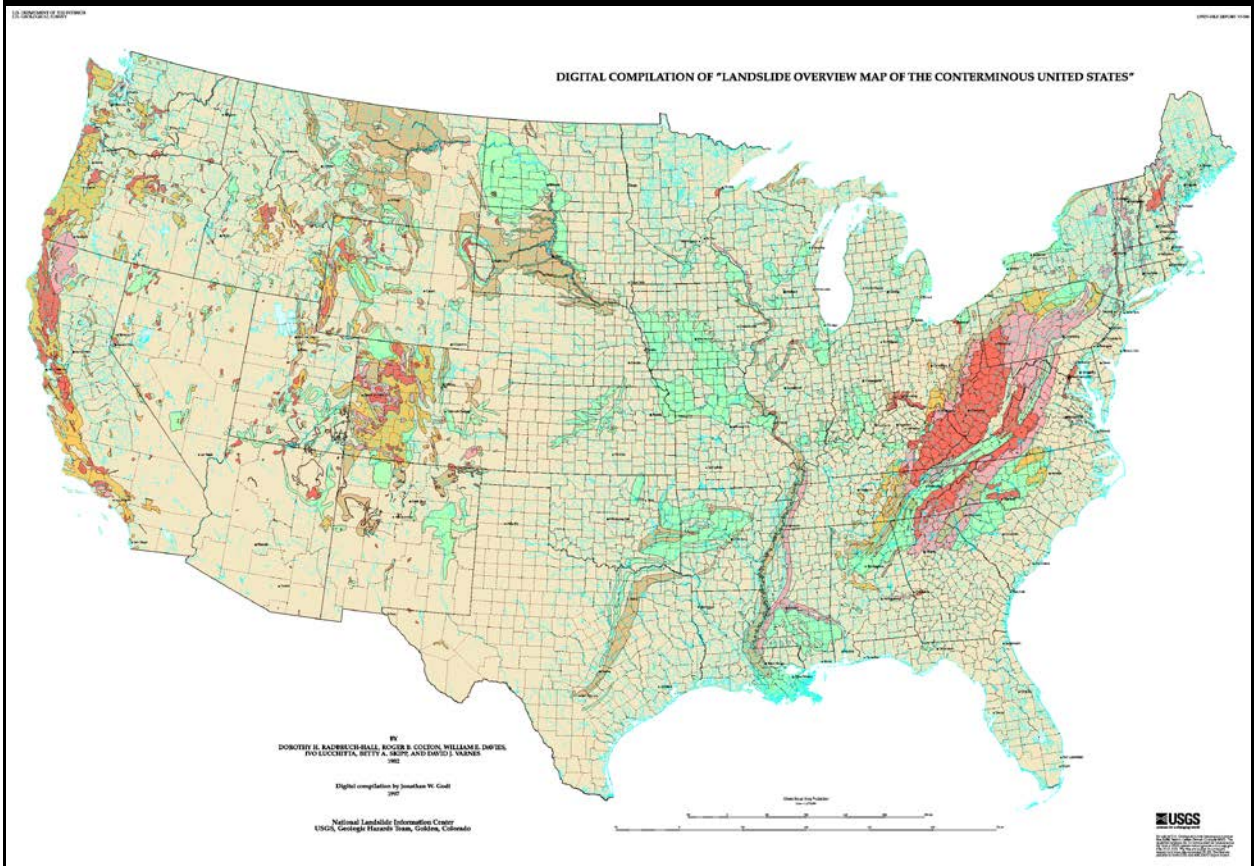
Landslides can damage or destroy roads, railroads, pipelines, electrical and telephone lines, mines, oil wells, buildings, canals, sewers, bridges, dams, seaports, airports, forests, parks, and farms. (Photo by Lynn Forman)

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Among the most destructive types of debris flows are those that accompany volcanic eruptions. A spectacular example in the United States was a massive debris flow resulting from the 1980 eruptions of Mount St. Helens, Washington. Areas near the bases of many volcanoes in the Cascade Mountain Range of California, Oregon and Washington are at risk from the same types of flows during future volcanic eruptions.

Areas that are generally prone to landslide hazards include previous landslide areas; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas that have not moved in the past; relatively flat-lying areas away from sudden changes in slope; and areas at the top or along ridges, set back from the tops of slopes.

In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year. **Figure 4.7** delineates areas where large numbers of landslides have occurred and areas which are susceptible to landsliding in the conterminous United States. This map layer is provided in the U.S. Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States, available online at http://landslides.usgs.gov/html_files/landslides/nationalmap/national.html.

Figure 4.7: Landslide Overview Map of the Conterminous United States



EXPLANATION

LANDSLIDE INCIDENCE

- Low (less than 1.5% of area involved)
- Moderate (1.5%-15% of area involved)
- High (greater than 15% of area involved)

LANDSLIDE SUSCEPTIBILITY/INCIDENCE

- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

Susceptibility not indicated where same or lower than incidence. Susceptibility to landsliding was defined as the probable degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated.

Source: United States Geological Survey

SINKHOLES

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

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

Collapses, such as the sudden formation of sinkholes, may destroy buildings, roads, and utilities. (Photo: Bettmann)

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

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

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

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

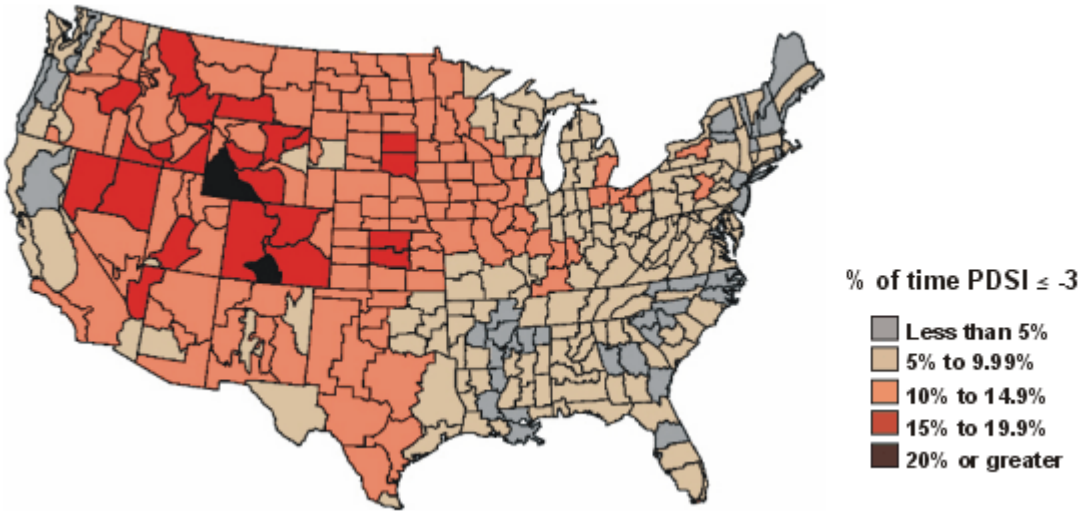
DROUGHT

Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds and low humidity can worsen drought conditions, and can make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July 2000 illustrates the drought conditions that can severely affect water supplies, agriculture, stream water quality, recreation, navigation and forest resources. (Photo courtesy of the United States Geological Survey)

Droughts are frequently classified as one of four types: meteorological, agricultural, hydrological or socio-economic. Meteorological droughts are typically defined by the level of "dryness" when compared to an average or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace. **Figure 4.8** shows the Palmer Drought Severity Index (PDSI) summary map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). As can be seen, the Eastern United States has historically not seen as many significant long-term droughts as the Central and Western regions of the country.

Figure 4.8: Palmer Drought Severity Index, 1895-1995 Percent of Time in Severe and Extreme Drought



Source: National Drought Mitigation Center

WILDFIRE

A wildfire is any fire occurring in a wildland area (i.e., grassland, forest, brush land) except for fire under prescription.[4] Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or 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.

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. Wildland fires are usually signaled by dense smoke that fills the area for miles around.

On Sunday, August 6, 2000, several forest fires converged near Sula, Montana, forming a firestorm that overran 100,000 acres and destroyed 10 homes. Temperatures in the flame front were estimated at more than 800 degrees. (Photo by John McColgan/U.S. Forest Service Firefighter)

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

Fire 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 disasters (hurricanes, tornadoes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities.

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high fire hazard areas. 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 the inferno that can sweep through the brush and timber and destroy property in minutes.

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

DAM/LEVEE FAILURE

Worldwide interest in dam and levee safety has risen significantly in recent years. Aging infrastructure, new hydrologic information, and population growth in floodplain areas downstream from dams and near levees have resulted in an increased emphasis on safety, operation and maintenance.

There are approximately 80,000 dams in the United States today, the majority of which are privately owned. Other owners include state and local authorities, public utilities and federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods.

Dam failure can result from natural events, human-induced events, or a combination of the two. Failures due to natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning.

Though dams have many benefits, they also can pose a risk to communities if not designed, operated and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. If a levee breaks, scores of properties are quickly submerged in floodwaters and residents may become trapped by this rapidly rising water. The failure of dams and levees has the potential to place large numbers of people and great amounts of property in harm's way.

SOLAR EVENTS

There are many different types of space weather that can result in what is referred to as a "solar event." Although these naturally occurring hazards are relatively new to the sphere of hazard mitigation planning, there are concerns raised by geomagnetic storms, solar radiation storms, and radio blackouts that are very real and relevant to local hazard mitigation planning teams. NOAA, DHS, and NASA are among the Federal agencies that are publishing information on solar events and providing warnings and alerts to interested parties.

Significant geomagnetic storms—one type of solar event—happen less frequently than other natural hazards, but have the potential to cause considerable damage across the globe with a single event. In the past, geomagnetic storms have disrupted space-based assets as well as terrestrial assets such as electric power transmission networks. Extra-high-voltage transformers and transmission lines may be particularly vulnerable to geomagnetically induced currents caused by the disturbance of Earth's geomagnetic field. The simultaneous loss of large numbers of these assets could cause a voltage collapse and lead to cascading power outages, resulting in significant economic costs to the Nation. An extreme geomagnetic storm is a low-probability, high-consequence event that could pose a systemic risk to the Nation.[5]

The three main types of solar events are geomagnetic storms (described above), solar radiation storms (defined as elevated levels of radiation that occur when the numbers of energetic particles decrease), and radio blackouts (defined as disturbances of the ionosphere caused by X-ray emissions from the Sun).[6]

The NOAA Space Weather Prediction Center has developed a set of intensity scales for each of these types of solar events as shown in **Tables 4.6** through **4.8**. These tables provide further explanation of the nature of each type of solar hazard and the potential effects of each. There are some notification procedures in place based on these scales to notify stakeholders of potential solar events. These are tracked by FEMA and are based on the severity of the anticipated event (i.e., G3 and above for geomagnetic storms, S3 and above for solar radiation storms, R2 and above for radio blackouts, etc.).

[5] Risk Management Issue Brief, May 2011, *Geomagnetic Storms: An Evaluation of Risks and Risk Assessments By the Office of Risk Management and Analysis*.
[6] NOAA Space Weather Prediction Center.

Table 4.6: NOAA Space Weather Scale for Geomagnetic Storms

CATEGORY		EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
Scale	**Descriptor**	**Duration of event will influence severity of effects**		
G5	Extreme	**Power systems:** Widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. **Spacecraft operations:** May experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. **Other systems:** Pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).	Kp = 9	4 per cycle (4 days per cycle)
G4	Severe	**Power systems:** Possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. **Spacecraft operations:** May experience surface charging and tracking problems, corrections may be needed for orientation problems. **Other systems:** Induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).	Kp = 8, including a 9-	100 per cycle (60 days per cycle)
G3	Strong	**Power systems:** Voltage corrections may be required, false alarms triggered on some protection devices. **Spacecraft operations:** Surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. **Other systems:** Intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).	Kp = 7	200 per cycle (130 days per cycle)
G2	Moderate	**Power systems:** High-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. **Spacecraft operations:** Corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. **Other systems:** HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).	Kp = 6	00 per cycle (360 days per cycle)
G1	Minor	**Power systems:** Weak power grid fluctuations can occur. **Spacecraft operations:** Minor impact on satellite operations possible. **Other systems:** Migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).	Kp = 5	1700 per cycle (900 days per cycle)

Source: NOAA Space Weather Prediction Center

Table 4.7: NOAA Space Weather Scale for Solar Radiation Storms

CATEGORY		EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
Scale	**Descriptor**	**Duration of event will influence severity of effects**	**Flux level of > = 10 MeV particles (ions)**	**Number of events when flux level was not met (number of storm days)**
S5	Extreme	**Biological:** Unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** Satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. **Other systems:** Complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle
S4	Severe	**Biological:** Unavoidable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** May experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. **Other systems:** Blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S3	Strong	**Biological:** Radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. **Satellite operations:** Single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. **Other systems:** Degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S2	Moderate	**Biological:** Passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk. **Satellite operations:** Infrequent single-event upsets possible. **Other systems:** Small effects on HF propagation through the polar regions and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S1	Minor	**Biological:** None. **Satellite operations:** None. **Other systems:** Minor impacts on HF radio in the polar regions.	10	50 per cycle

Source: NOAA Space Weather Prediction Center

Table 4.8: NOAA Space Weather Scale for Radio Blackouts

CATEGORY		EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
Scale	Descriptor	Duration of event will influence severity of effects	GOES X-ray peak brightness by class and by flux	Number of events when flux level was met; (number of storm days)
R5	Extreme	**HF Radio:** Complete HF (high frequency) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. **Navigation:** Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20 (2×10^{-3})	Less than 1 per cycle
R4	Severe	**HF Radio:** HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. **Navigation:** Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10 (10^{-3})	8 per cycle (8 days per cycle)
R3	Strong	**HF Radio:** Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. **Navigation:** Low-frequency navigation signals degraded for about an hour.	X1 (10^{-4})	175 per cycle (140 days per cycle)
R2	Moderate	**HF Radio:** Limited blackout of HF radio communication on sunlit side, loss of radio contact for tens of minutes. **Navigation:** Degradation of low-frequency navigation signals for tens of minutes.	M5 (5×10^{-5})	350 per cycle (300 days per cycle)
R1	Minor	**HF Radio:** Weak or minor degradation of HF radio communication on sunlit side, occasional loss of radio contact. **Navigation:** Low-frequency navigation signals degraded for brief intervals.	M1 (10^{-5})	2000 per cycle (950 days per cycle)

Source: NOAA Space Weather Prediction Center

Historical Examples

To illustrate the vulnerability of various types of infrastructure to geomagnetic storms, it is worth presenting three historical examples: the October-November 2003 "Halloween" event; the Quebec Power Outage of 1989; and the Carrington Event of 1859.[7]

From late October to early November 2003, large geomagnetic storms, which peaked at a severity of -410nanoTeslas, affected the power system infrastructure, the aviation industry, and satellite communications in Europe and North America. In Sweden, a large power utility experienced transformer problems, which led to a system failure and a subsequent power outage. During the 2003 Halloween event, the international airline industry experienced communication problems on a daily basis, with significantly degraded communications at high-latitudes. The Federal Aviation Administration (FAA) could not provide GPS navigational guidance for approximately 30 hours.

[7] Risk Management Issue Brief, May 2011, *Geomagnetic Storms: An Evaluation of Risks and Risk Assessments By the Office of Risk Management and Analysis.*

On March 13, 1989, a geomagnetic storm that registered -640 nanoTeslas affected Canadian and U.S. power systems, resulting in a major power outage for nine hours for the majority of the Quebec region and for parts of the northeastern United States. Geomagnetically induced currents flowing through the power system severely damaged seven static compensators in the Hydro-Quebec grid, causing them to trip or shut down automatically before preventive measures were possible. The unavailability of new equipment to replace damaged equipment prevented power restoration to the transmission network. After nine hours, 83 percent of full power was restored, but one million customers were still without electrical power.

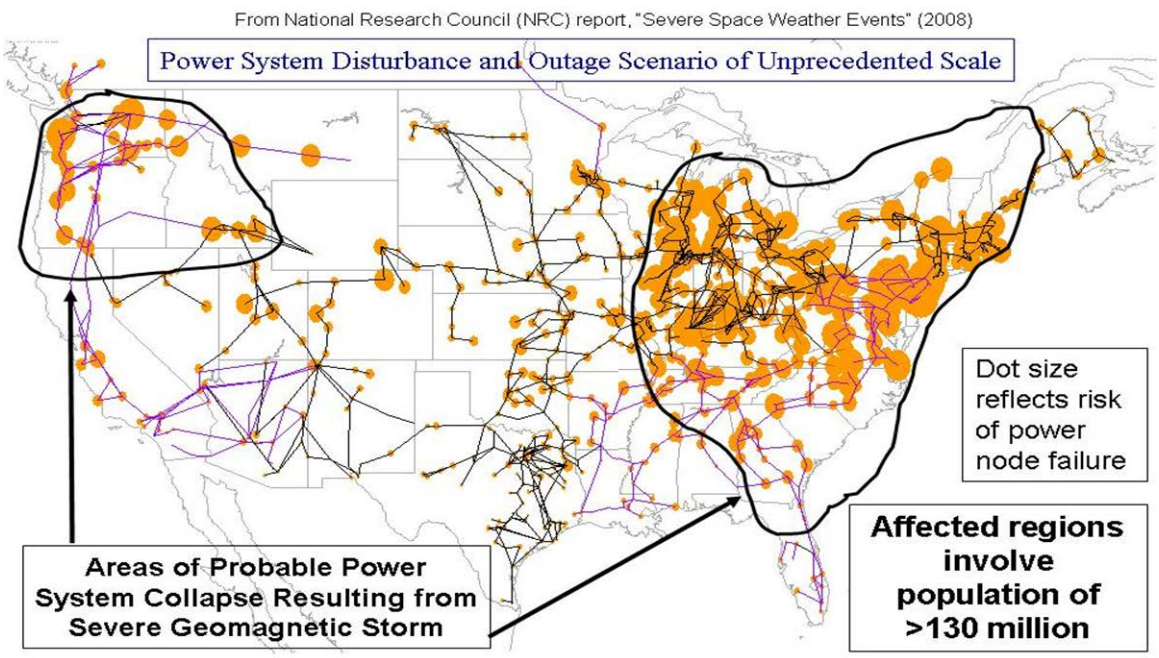
The most severe space weather event recorded in history is the Carrington Event of 1859, measured at -850 nanoTeslas. From August 28 to September 4, 1859, auroral displays, often called the northern or southern lights, spanned several continents and were observed around the world. According to modern experts, the auroras witnessed were actually two intense geomagnetic storms. Across the world, telegraph networks experienced disruptions and outages as a result of the currents generated by the geomagnetic storms. The economic costs associated with a catastrophic geomagnetic storm similar to that of the Carrington Event could measure in the range of several trillion dollars.

Impacts

Large, violent eruptions of plasma and magnetic fields from the Sun's corona, known as coronal mass ejections, form the origin of geomagnetic storms. Coronal mass ejections shock waves create solar energetic particles—consisting of electrons and coronal and solar wind ions—that when they approach Earth, create disturbances that affect the planet's magnetic field. It takes approximately one to three days after a coronal mass ejections launches from the Sun for a geomagnetic storm to reach Earth and to affect the planet's geomagnetic field. Countries located in northern latitudes, such as Canada, the United States, and Scandinavia, are particularly vulnerable to geomagnetic storms. Power systems in these countries are more likely to experience significant geomagnetically induced currents because of their location in the northern latitudes, the soil type (igneous rock) surrounding electrical infrastructure, and the fact that transmission networks in these countries cover longer distances to the load center. Power systems located in the northern regions of the North American continent are also particularly vulnerable because of their proximity to the Earth's magnetic north pole.

Figure 4.9 shows the potential widespread power outages that may occur during a severe geomagnetic storm.

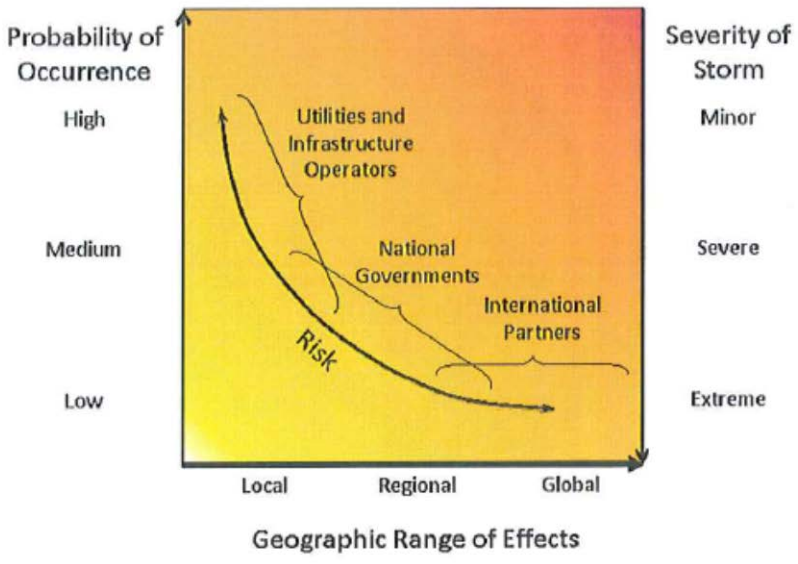
Figure 4.9: Power System Disturbance and Outage Scenario



Source: National Research Council

Figure 4.10 shows the correlation between the probability of occurrence, severity, and geographic extent relative to geomagnetic storms.

Figure 4.10: Geomagnetic Storm Risk Management



Source: CENTRA Technology, Inc.

Legislation

Despite the potentially serious consequences of a severe geomagnetic storm, a literature review indicates that the state of the art for assessing the security risk from geomagnetic storms is still in development. There are examples of analyses that describe threat, vulnerability, and consequence, but they are not integrated, primarily because of the weakness in the threat analysis. Without a sense of the likelihood of such events or at least a mechanism for relative comparisons, cost-benefit analyses have been unable to demonstrate the utility of investing either in hardening or in testing and maintaining operational procedures. The Federal government lacks comprehensive national-level geomagnetic storm risk management assessments and strategies, and no standing entity exists to coordinate cross-Federal government geomagnetic storm risk analysis.[8]

Despite these limitations, several states have developed legislation that seeks to address this hazard. This includes the State of Maine which recently passed "An Act To Secure the Safety of Electrical Power Transmission Lines" in the event of a geomagnetic storm (LD 131).

Other recent state-level legislation activities related to solar events include, but are not limited to, the following:

- The Florida Senate HM 1251: Electromagnetic Pulse Threats, Cyber-Attacks, and Geomagnetic Storms
- The Florida Senate HB 1342: Relating to Electromagnetic Pulses and Geomagnetic Storms
- Georgia General Assembly HB 1148: Public utilities; evaluation of electromagnetic field levels and protection of the transmission and distribution systems against damage from an electromagnetic pulse or a geomagnetic storm
- The State of New Jersey: An Act Establishing the "New Jersey Electromagnetic Infrastructure Advisory Commission" (A275)

[8] Risk Management Issue Brief, May 2011, *Geomagnetic Storms: An Evaluation of Risks and Risk Assessments By the Office of Risk Management and Analysis.*

DATA SOURCES

The following primary data sources were among those used to collect the information presented in this section.

- *American Society of Civil Engineers (ASCE), "Facts About Windstorms"* (www.windhazards.org/facts.cfm)
- *Bureau of Reclamation, U.S. Department of the Interior* (www.usbr.gov/)
- *CENTRA Technology, Inc.* (www.centratechnology.com)
- *Federal Emergency Management Agency (FEMA)* (www.fema.gov)
- *National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (http://lwf.ncdc.noaa.gov/oa/ncdc.html)
- *National Drought Mitigation Center, University of Nebraska-Lincoln* (www.drought.unl.edu/index.htm)
- *National Research Council, The National Academies* (www.nationalacademies.org/nrc)
- *National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (www.nssl.noaa.gov)
- *National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (www.nws.noaa.gov)
- *Space Weather Prediction Center, U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (www.swpc.noaa.gov)
- *Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service* (www.spc.noaa.gov)
- *The Tornado Project, St. Johnsbury, Vermont* (www.tornadoproject.com)
- *United States Geological Survey (USGS), U.S. Department of the Interior* (www.usgs.gov)

5 HAZARD ANALYSIS

INTRODUCTION

The *Hazard Analysis* section continues to focus on those hazards identified in the *Hazard Identification* section. The *Hazard Analysis* provides a summary of best available information on significant historical hazard events[1] that have occurred in Mecklenburg County, including the seven incorporated jurisdictions participating in this Plan, and also describes the future potential for a hazard event to occur. When possible, this includes an assessment of the location and spatial extent of potential hazards as well as best available data regarding notable historical damages[2] within the county. The outline for the *Hazard Analysis* is the same as that for the *Hazard Identification* section, and consists of the following hazards:

- FLOOD
- HURRICANES AND TROPICAL STORMS
- SEVERE THUNDERSTORMS
- TORNADOES
- WINTER STORMS
- EARTHQUAKES
- LANDSLIDES
- SINKHOLES
- DROUGHT
- WILDFIRE
- DAM/LEVEE FAILURE

To a large extent, historical records are used to identify the level of risk within the planning area—with the methodological assumption that the data sources cited are reliable and accurate. This section also provides a series of maps that illustrate the location and spatial extent for those hazards within Mecklenburg County that have a recognizable geographic boundary (i.e., hazards that are known to occur in particular areas of the county such as the 100-year floodplain). For those hazards with potential risk not confined to a particular geographic area (such as thunderstorms and tornadoes), historical event locations and/or general information on the applicable intensity of these events across the entire planning area is provided.

44 CFR Requirement

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.

This CFR requirement is met in the Hazard Identification *and* Hazard Analysis *sections of this risk assessment.*

[1] Significant historical events are based on information made available through the National Oceanic and Atmospheric Administration (NOAA) unless otherwise cited. In most cases, NOAA information is obtained directly from NOAA's National Climatic Data Center (NCDC), the world's largest archive of weather data.

[2] Historical damage information is based on best available data and should only be considered approximate figures for general analysis and planning purposes. Dollar figures have not been adjusted for inflation in Section 5 but were adjusted in the calculation of annualized loss estimates for Section 6: *Vulnerability Assessment*.

It is important to note that for most hazards analyzed in this section, some level of property damage was possible during any or all of the hazard events cataloged. However, for events reaching deeper into Mecklenburg County's past, historical records in some instances may show no report of property damage. Therefore, totals of past property damages derived from historical records are considered to be estimates and should not be used as a stand-alone indicator of hazard risk.

The next section included in this Plan, the *Vulnerability Assessment*, further expands upon the foundation established in the *Hazard Identification* and *Hazard Analysis* sections.

SUMMARY OF PRESIDENTIAL DISASTER DECLARATIONS

Before beginning the hazard-by-hazard analysis, it is important to note and document past presidential disaster declarations that have included Mecklenburg County. A presidential disaster declaration is issued when a disaster event has been determined to be beyond the capabilities of state and local governments to respond. Since 1953—the first year presidential disaster declarations were issued in the United States—Mecklenburg County has been named in five such declarations (**Table 5.1**).

Table 5.1: Presidential Disaster Declarations Issued for Mecklenburg County

EVENT	DECLARATION DATE	DECLARATION NUMBER
Hurricane Hugo	09/25/1989	844
Blizzard of '96	02/02/1996	1087
Severe Winter Storm	01/31/2000	1312
Severe Ice Storm	12/13/2002	1448
Tropical Storm Frances	09/10/2004	1546

Source: Federal Emergency Management Agency

Under a presidential disaster declaration, the state and affected local governments are eligible to apply for federal funding to pay 75 percent of the approved costs for debris removal, emergency services related to the storm, and the repair or replacement of damaged public facilities.

The county has also experienced additional emergencies and disasters that were not severe enough to require federal disaster relief through a presidential declaration.

The probability of occurrence for each hazard is based on the following values: "Unlikely" equals less than a 1 percent annual probability. "Possible" equals between a 1 and 10 percent annual probability. "Likely" equals between a 10 and 100% annual probability. "Highly Likely" equals a 100% annual probability.

FLOOD

Mecklenburg County is estimated to have more than 3,000 miles of streams varying in size and depth within its boundaries, the western two-thirds of which drain to the Catawba River System while the eastern one-third drains to the Yadkin River System. Both of these river systems drain south into South Carolina and eventually flow into the Atlantic Ocean. When heavy or prolonged rainfall events occur, these rivers and streams are susceptible to some degree of riverine flooding. There have been a number of past riverine flood events, ranging widely in terms of location, magnitude and impact. The most frequent flood events have been localized in nature, resulting from heavy rains occurring in a short period of time over urbanized areas that are not able to adequately handle stormwater runoff. These events typically do not threaten lives or property and do not result in emergency or disaster declarations.[3]

Figure 5.1 shows the major water bodies in Mecklenburg County according its 33 unique watersheds. Watershed boundaries highlighted in yellow indicate those for which detailed studies and flood mitigation plans were completed in 2004. These studies and plans cover approximately 50 percent of the total land area of the county and 80 percent of Charlotte, and provide estimates of flood damages and recommend mitigation alternatives. These studies include the following and are essentially adopted by reference as detailed extensions to this Plan:

- Mecklenburg County Floodplain Management Guidance Document
- Determination of Financial Impacts from Flood Studies
- Watershed-specific Flood Hazard Mitigation Plans
    - Briar Creek, Four Mile Creek, Irwin Creek, Little Sugar Creek (Lower), Little Sugar Creek (Upper), Mallard Creek, McAlpine Creek, McDowell Creek, McMullen Creek, and Sugar Creek

New countywide floodplain maps for Mecklenburg County were made effective in March 2009. Central and southeastern basins have been remapped with an effective date of February 19, 2014. Remapping for western basins is expected to become effective in fall of 2015 while north eastern basin remapping is expected to become effective in calendar year 2016. **Figure 5.2** shows the *existing* potential flood hazard areas throughout the county based on the best available GIS data for the FEMA-identified 100-year and 500-year floodplains. **Figure 5.3** shows a combination of the existing and *future* potential flood hazard areas throughout the county based on the FEMA and Community-identified 100-year floodplains. In 2000, Charlotte-Mecklenburg became the first community in the nation to show both current and future floodplains on its official maps. The “Community Floodplain” illustrates where flooding is likely to occur in the future based on expected development upstream, and extends the existing FEMA 100-year floodplain by approximately 4.18 square miles at the predicted future build-out conditions. While flood insurance is typically required for properties in a FEMA Floodplain, it is not required in the Community Floodplain but is strongly recommended. However, local development regulations apply to both the FEMA Floodplain and the Community Floodplain. Where available, more detailed flood hazard data for each participating jurisdiction within the county is provided in Section 6: *Vulnerability Assessment*.

[3] The vast majority of flood events in the United States do not meet the per capita damage thresholds required to trigger a presidential disaster declaration and the release of large sums of federal aid. This fact dramatizes the need for local governments to establish a comprehensive mitigation strategy that includes achievable actions that do not rely entirely on assistance from the state and federal government.

Figure 5.1: Major Water Bodies in Mecklenburg County, by Watershed

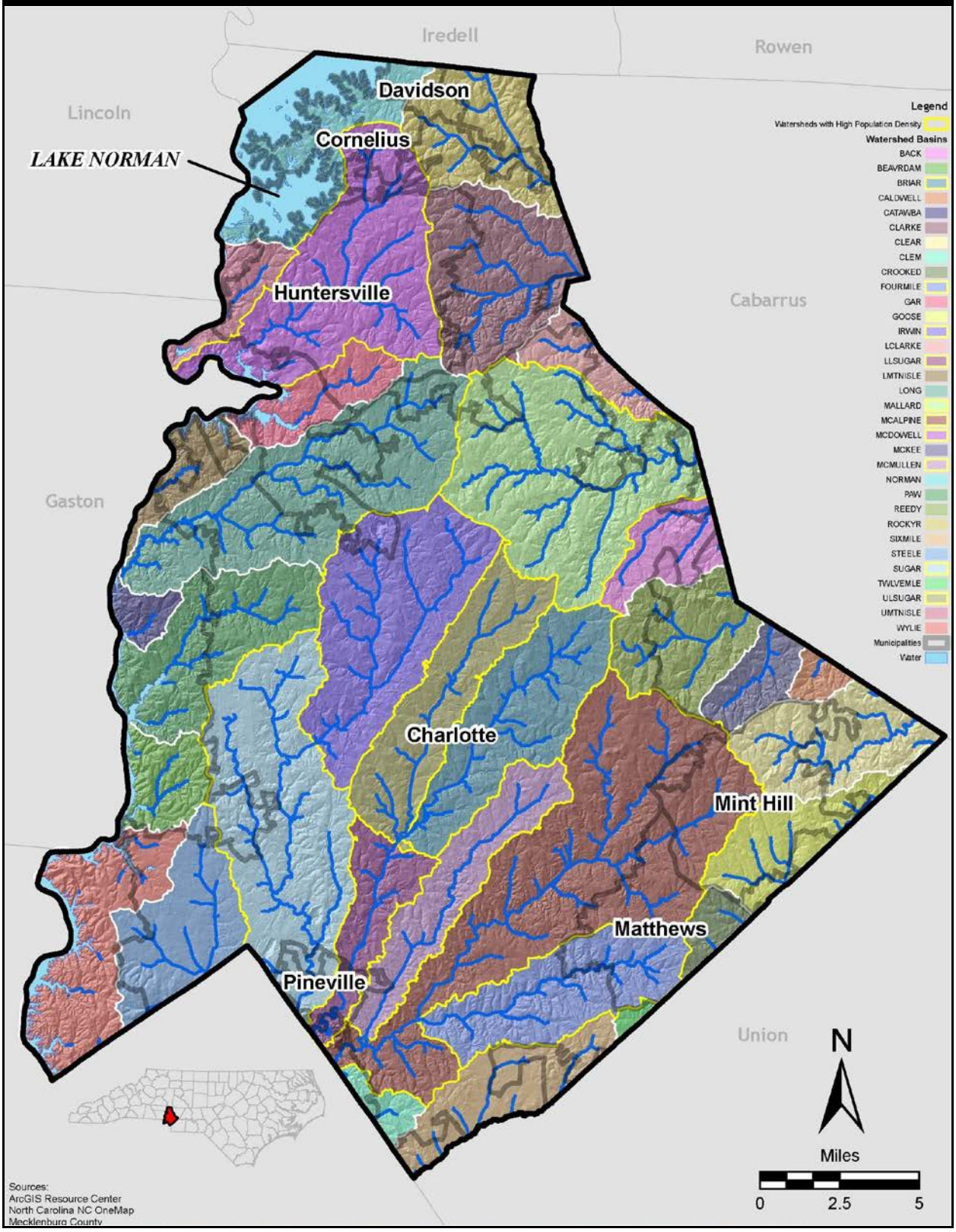


Figure 5.2: Existing Potential Flood Hazard Areas (FEMA Floodplains)

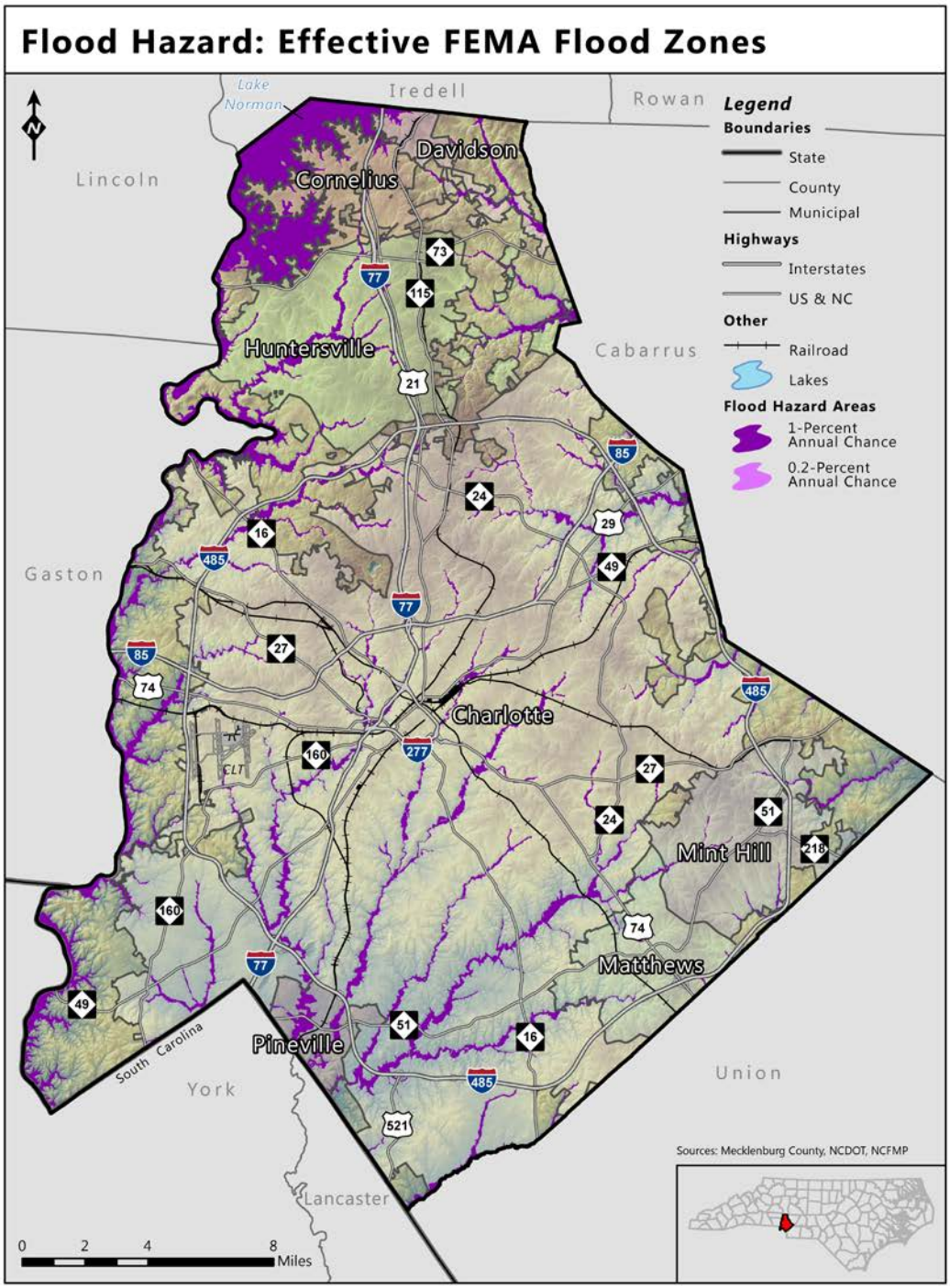
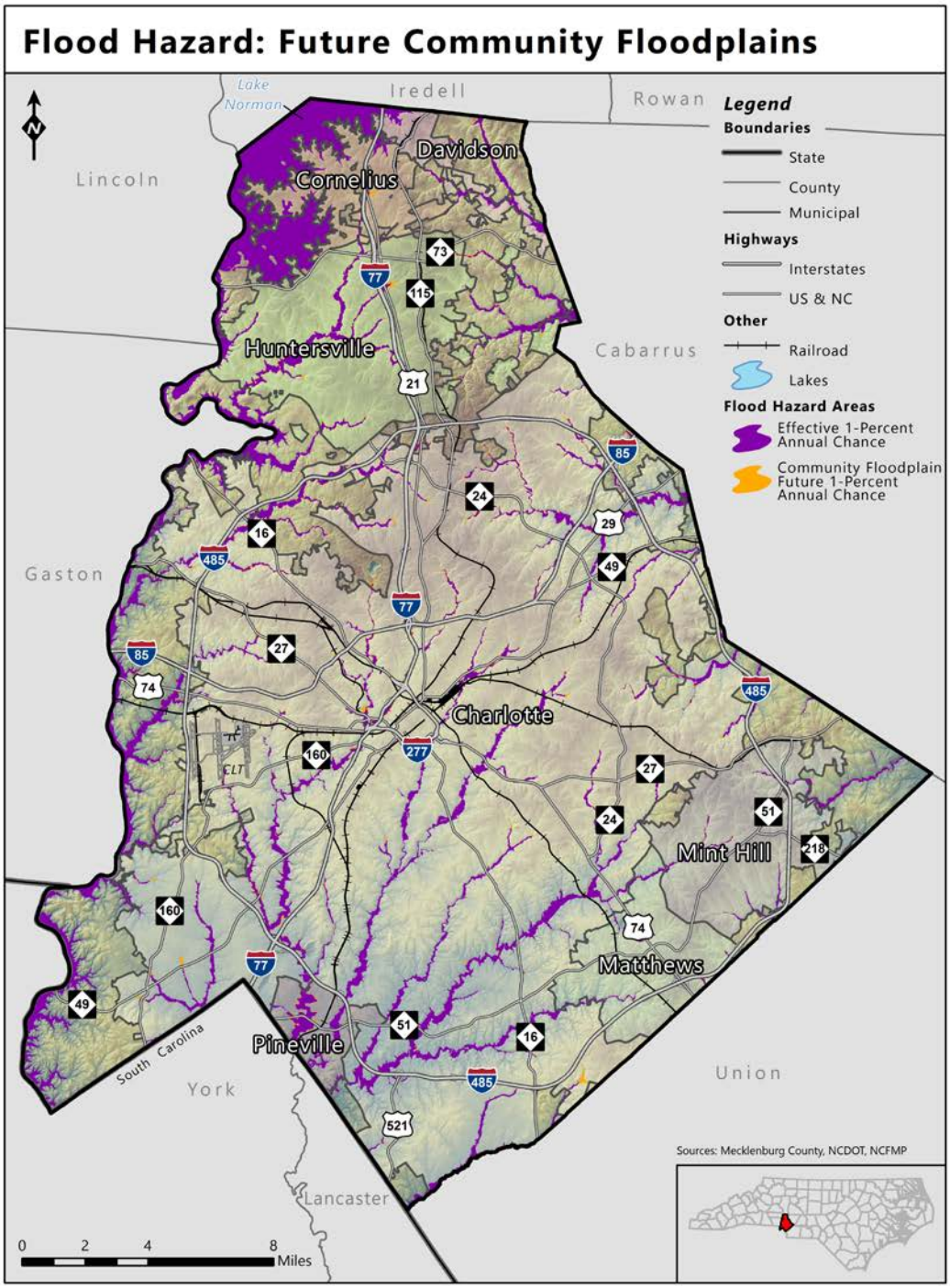


Figure 5.3: Future Potential Flood Hazard Areas (FEMA and Community Floodplains)



SIGNIFICANT HISTORICAL EVENTS

The most recent, significant flash flood event for Mecklenburg County occurred on August 5, 2011 when heavy rains (over six inches in four hours) caused flooding that affected more than 100 buildings, with 68 reported instances of floodwater within the structure. The area along Brookshire Boulevard and Beatties Ford Road was especially hard-hit with the worst flooding in the Irwin and Stewart Creek basins. Firefighters and police performed 86 responses to assist people in flooded vehicles and buildings. Two deaths were reported in southeast Charlotte where a mother and daughter attempted to wade across rain swollen Irvins Creek.

The most recent major and damaging flood event occurred in **August 2008** when the remnants of Tropical Storm Fay stalled just west of the Appalachian Mountains, resulting in a prolonged, moist south to southeasterly flow over western North Carolina. Storm total rainfall in this area averaged 8 to 10 inches, with locally higher amounts, resulting in significant urban and stream flooding – particularly along Briar Creek in east Charlotte. Numerous evacuations were required of homes and apartments along the creek as water entered dozens of structures, and numerous cars were submerged on Independence Boulevard, with some rescues required. Other affected roads included Dunlavin Way, Harbinger Court, Chantilly Lane, Cavalier Court, and Dolphin Lane. Uninsured losses included major damage to 147 homes and 1 business but would have been significantly higher if not for many of the County's ongoing flood hazard mitigation efforts including its highly successful Floodplain Buyout Program (further discussed in Section 7: *Capability Assessment*).

Flooding caused by the remnants of Tropical Storm Fay created the need for swift water rescues across the Charlotte area in August 2008 . (Photo courtesy of Mecklenburg County)

In total, downpours from the remnants of Tropical Storm Fay flooded more than 600 structures and required the evacuation of dozens of people, including 20 swift-water rescues made by the Charlotte Fire Department. Total estimated damages from the event are $8.5 million, and approximately 90% of the flooding was in the Briar Creek Watershed. Rainfall in a 24-hour period in northeastern Mecklenburg County exceeded 11 inches. Stream gauges measuring how deep the water is in local creeks set 19 new records, exceeding the 100-year flood level in some areas.

A CSX derailment due to a bridge washout during the July 1997 flood event. (Photo courtesy of Mecklenburg County)

Other devastating flood events occurred in Mecklenburg County occurred in **August 1995** and **July 1997**. The flooding in 1995 was caused by excessive rainfall from the remnants of Tropical Storm Jerry, with rainfall ranging from 3.87 to 9.37 inches throughout the county. The highest rainfall amounts were concentrated in the southeastern part of the City of Charlotte between Providence Road and East Independence Boulevard, primarily in the Little Sugar Creek and McAlpine Creek drainage basins. The recurrence interval for a 24-hour storm exceeded 100 years in this part of the city. Due to the flooding, approximately $4 million in flood insurance claims were paid and $1 million in loans were issued for the repair of properties. Two years later in July 1997, the remnants of Hurricane Danny caused an estimated total of $8.5 million in property damage in Mecklenburg County and the loss of three lives in floodwaters, including a child in Charlotte who drowned when floodwater swept her into a creek. Rainfall amounts during the July 1997 storm were far greater than those of the August 1995 storm. The maximum total rainfall during the 1997 storm was 13.11 inches and the maximum rainfall amount measured in a continuous 24-hour period was 11.40 inches, which exceeds the 100-year storm total by 4.3 inches. The 24-hour rainfall recurrence interval exceeded 100 years for much of the central part of Mecklenburg County, including a large percentage of the Irwin Creek and Little Sugar Creek Basins (USGS, 1998). More than 100 flood-prone homes were bought and removed from the floodplain using Hazard Mitigation Grant Program (HMGP) and Flood Mitigation Assistance (FMA) program funds. Residents participating in these voluntary programs were relocated to higher ground out of harm's way.

Table 5.2 lists the number of insured losses and total claims payments for historical flood damages in each jurisdiction as recorded under the National Flood Insurance Program (NFIP).[4]

Table 5.2: NFIP Statistics on Historical Losses and Claims Payments

JURISDICTION	NFIP ENTRY DATE	TOTAL LOSSES	TOTAL PAYMENTS
Mecklenburg County	06/01/1981	188	$2,808,438
Charlotte	08/15/1978	2,139	$38,000,582
Cornelius	09/30/1997	3	$46,001
Davidson	10/16/1997	0	$0
Huntersville	02/04/2004	6	$269,245
Matthews	02/04/2004	4	$41,250
Mint Hill	12/21/07	0	$0
Pineville	03/18/1987	3	$18,800
TOTAL		**2,343**	**$41,184,316**

Source: Federal Emergency Management Agency (as of 01/13/2015)

Table 5.3 provides more descriptive information on 104 significant flood events that are known to have occurred between 1900 and 2014 in Mecklenburg County. The flood events documented here resulted in a total within the county of 19 known deaths and four known injuries, and approximately $41.4 million in

[4] NFIP claims statistics provided by the Federal Emergency Management Agency (as of 1/13/2015).

total reported property damages.[5] Based on historical and anecdotal evidence, it is clear that there is a relatively high frequency of flooding in the county.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg County	1916	Flood	13/0	NR[6]	"Great Flood" on the Catawba River. Two hurricanes converged over western North Carolina causing more than three days of downpours. West of Charlotte, the Catawba River crested at more than 47 feet. The flood water was nearly twice as deep as that of any previously recorded flood. At least 13 people died when a double-track railroad bridge over the river between Charlotte and Gastonia gave way. The crews had been trying to secure the bridge when it washed out. A few survivors were rescued from treetops the following morning.
Mecklenburg County	1928	Flood	0/0	NR	A 10-year flood caused minor property damage.
Mecklenburg County	1936	Flood	0/0	NR	A 20-year flood washed out two bridges on Stewart Creek; several streams were dredged throughout the city and county.
Mecklenburg County	1942	Flood	0/0	NR	A 10-year flood damaged several homes.
Mecklenburg County	1958	Flood	0/0	NR	A 5-year flood damaged several homes; families were evacuated in Myers Park and along Westfield Road.
Mecklenburg County	1962	Flood	0/0	NR	A 5-year flood caused minor flood damage.
Mecklenburg County	1973	Flood	0/0	NR	A 50-year flood along Little Sugar Creek damaged several homes and closed several roads.
Mecklenburg County	1975	Flood	0/0	**$12,000,000**	A series of three consecutive floods caused an estimated $12 million in damages.
Mecklenburg County	1976	Flood	0/0	NR	A 25-year flood on Irwin and Sugar Creeks severely damaged many homes in Pineville. It's the second time in two years that Irwin Creek had at least a 25-year flood.
Charlotte	1979	Flood	0/0	NR	25-year flood damaged some homes along McAlpine Creek near Sardis Road.
Charlotte	1982	Flood	0/0	NR	30-year flood in McMullen Creek and 25-year flood on Irwin Creek.
Mecklenburg County	1985	Flood	0/0	NR	Property damage was caused by 25-year floods on Little Sugar Creek and Little Hope Creek.
Charlotte	07/03/1995	Flash Flood	0/0	NR	Flooding on Sam Newell Road between East Independence and Highway 51.
Charlotte	08/27/1995	Flash Flood	0/0	**$5,000,000**	The remnants of Hurricane Jerry dropped 8 to 9 inches of rain producing serious flooding. Three hundred families were evacuated from their homes, some by boat. Many roads and bridges were flooded or washed away. Several roads were covered with 3 to 5 feet of water. Flooding in the Briar, McMullen and McAlpine watersheds resulted in $4 million in flood insurance claims and an additional $1 million in loans to repair property damage.

[5] Property damage data reflects general estimates only, and include insured and uninsured losses. The majority of this information is documented by Mecklenburg County and/or the National Climatic Data Center and covers a period from 1994 to 2014. Additional historical information was provided by Mecklenburg County for the period 1900 to 1994 and includes an estimated total of $12 million in recorded damages, though actual figures are likely much higher.

[6] "NR" means "None Reported" indicating that no records exist of reported property damage figures. This does not exclude the possibility or probability that unreported damages did in fact occur.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	10/04/1995	Flash Flood	0/0	NR	Flash flooding was reported in several parts of Charlotte. The areas included Providence Road between Wendover and Sharon Amity and Carmel Road between Fairview and Quail Hollow Road.
Charlotte	10/04/1995	Flash Flood	0/0	NR	Rainfall amounts of two to four inches produced widespread flooding of major roads in the county.
Charlotte	10/04/1995	Flash Flood	0/0	NR	Briar Creek came out of its banks at the intersection of Providence Road and Randolph Road.
Charlotte	08/02/1996	Flash Flood	0/0	NR	No details available.
Southern Portion of Mecklenburg County	08/02/1996	Flash Flood	0/0	NR	Slow moving thunderstorms dumped heavy rain across southern Mecklenburg County causing several roads to flood.
Charlotte	08/05/1996	Flash Flood	0/0	NR	Slow moving thunderstorms caused severe urban flooding in northeast sections of Charlotte.
Charlotte	08/24/1996	Flash Flood	0/0	**$200,000**	No details available.
Charlotte	06/13/1997	Flash Flood	0/0	NR	Thunderstorms swept over areas of Charlotte causing some severe urban flooding. Roads were closed around the area because of flooding.
Countywide	07/23/1997	Flash Flood	**3**/0	**$8,500,000**	100-year flood in July from the remnants of Hurricane Danny caused $60 million in property damage. The maximum total rainfall recorded at USGS gauging stations was 13.11" inches over a 36-hour period. Flood stage record set for Little Sugar Creek at Archdale Drive at 15.06 feet. A railroad trestle collapsed, sending a CSX locomotive into Little Sugar Creek. Three people died in the floodwater: a man died in a car accident related to the storm, a woman drowned in her car on a flooded Charlotte street, and a child was swept away while playing near a flooded creek.
Charlotte	07/24/1997	Flash Flood	0/0	NR	The remnants of Hurricane Danny continued to move across the flood-ravaged Charlotte metro area during the early morning hours of the 24th. Additional rainfall of 2 to 3 inches aggravated the flooding problems mainly south and east of downtown Charlotte. This round of rain prompted the evacuation of some apartments near Pineville. Area roads were covered in 2 to 3 feet of water.
South Portion of Mecklenburg County	01/06/1998	Flood	0/0	NR	Heavy rain during the day caused area streams to rise out of their banks, flooding many roads. One road was washed out between Monroe and Wingate in neighboring Union County and other roads in the far southern part of Mecklenburg County, near the Union County line, were washed out as well.
Charlotte	04/09/1998	Flood	0/0	**$50,000**	Heavy rain and thunderstorms persisted over the Charlotte metro area during the early morning and resulted in several flooded roads. A park was flooded in Monroe and people were stranded in their van. Bridges were covered by the floodwaters in the southern portion of neighboring Cabarrus County with one vehicle stuck in the water. Apartments and cars in the Briar Creek area of south Charlotte were flooded and some evacuations took place.
Charlotte	06/10/1998	Flash Flood	0/0	NR	Heavy rain in a short period of time resulted in some urban flooding from the Belmont and Mount Holly areas, to the south side of Charlotte. Numerous roads were flooded and several motorists required rescue in different parts of the city.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	07/20/1998	Flash Flood	0/**1**	NR	Flash flooding occurred in south Charlotte late in the evening and continued into the early morning hours. One injured woman had to be rescued from her auto on South Boulevard by a firefighter.
Southern Portion of Mecklenburg County	07/27/1998	Flash Flood	0/0	NR	Up to 4 inches of rain fell in just a few hours during the morning of the 27th, causing flash flooding across southern Mecklenburg County and much of neighboring Union County. McAlpine Creek, McMullen Creek and several other creeks flooded in these areas, flooding numerous streets and roads. A brick wall collapsed, 52 auto accidents occurred and six motorists required rescue in the southern part of Mecklenburg County.
Charlotte	08/09/1998	Urban Flood	0/0	NR	Flood-prone areas of south Charlotte were flooded during heavy rainfall in an afternoon thunderstorm. Four lanes of Archdale Road were also blocked. This area usually does not flood easily.
Charlotte	09/03/1998	Flood	0/0	NR	Duration rain from the remnants of Tropical Storm Earl caused some flooding problems. In the southern part of Charlotte, roads and streets were flooded in the typical areas. High water lingered until at least 9 a.m. the next morning.
Charlotte	01/23/1999	Flash Flood	**1**/0	NR	Thunderstorms in the Charlotte metro area dumped up to 1.5 inches of rain in a half hour during the afternoon. This caused severe urban flooding in low-lying paved areas. A man stepped into a storm drain, then was swept into a creek and drowned. A few roads were flooded and underwater, and a few small streams came out of their banks briefly.
Charlotte	06/10/1999	Urban / Small Stream Flood	0/0	NR	More than one inch of rain fell in a short period of time in Charlotte and caused some urban flooding in which a few cars were involved. However, no serious problems were reported
Charlotte	07/12/2000	Urban / Small Stream Flood	0/3	NR	Slow-moving thunderstorms produced heavy rain during the late afternoon and early evening. Three boys sustained minor injuries while playing in a swollen creek which swept them downstream. Typical urban flooding also occurred in the city.
Charlotte	08/04/2000	Flood	0/0	NR	Four to 6 inches of rain in a three-hour period resulted in several roads becoming impassable due to high water.
Charlotte	08/18/2000	Urban / Small Stream Flood	0/0	NR	Numerous streets were briefly blocked by high water.
Huntersville	09/04/2000	Flood	0/0	NR	Excessive rain from nighttime convection in the area resulted in flooded farm fields and overflowing ditches along Highway 73 about 4 miles west of Huntersville.
Charlotte	05/30/2002	Urban / Small Stream Flood	0/0	NR	Slow moving thunderstorms caused rainfall of 2 to 4 inches to accumulate in a short time across portions of the Charlotte metro area. Some small streams rose to bank full, and there was some flooding of streets and low lying areas around the city. Ponding of water on area roads caused some traffic accidents.
Pineville	07/01/2002	Flash Flood	0/0	NR	Cars were stalled in a shopping center parking lot by high water from severe urban flooding. Two people required rescuing from their cars.
Charlotte	07/14/2002	Urban / Small Stream Flood	0/0	NR	Two to three inches of rain fell in a short time, causing local creeks to rise quickly to near bank full. No creeks reportedly flooded, but usual flood-prone areas in the southern part of the metro area had minor flooding and standing water.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	10/13/2002	Flood	0/0	NR	Flooding was reported at the intersection of Morgan Street and Blackman. Flooding was also reported along an I-85 service road where one car was stranded in water up to its fenders and doors.
Countywide	03/20/2003	Flash Flood	0/0	NR	Heavy rainfall resulted in rapid rises and flooding along numerous creeks and small streams in and near the Charlotte metro area. Severe urban flooding was also reported.
Countywide	03/20/2003	Flood	0/0	**$2,000,000**	After flash flooding during the morning hours, moderating rainfall resulted in additional flooding along creeks and streams into the evening hours. Some of the flooding was described as the worst in the area in over five years. Flooding was especially severe along the Mecklenburg County/Union County line, where some people required rescue from vehicles and homes.
Charlotte	04/10/2003	Flood	0/0	NR	Flooding occurred along many creeks and streams in Charlotte and surrounding areas.
Charlotte	05/22/2003	Flood	0/0	NR	Heavy overnight rainfall resulted in mainly urban flooding in the Charlotte metro area during the morning and early afternoon hours, which resulted in a few road closures. However, by late afternoon area creeks and streams began to overflow their banks. By evening, several roads were closed due to flooded creeks and streams, including a portion of I-485, which were covered with water from Briar Creek. Sugar, Paw and McDowell Creeks also flooded.
Charlotte	06/07/2003	Flash Flood	0/0	**$1,000,000**	Slow-moving thunderstorms producing very heavy rainfall caused severe urban flooding to development in the Charlotte metro area during the evening of the 7th. Water levels on the Briar and Sugar Creek systems rose rapidly and overflowed their banks. Deep water covered portions of Independence Boulevard and several vehicles were submerged. The first floor of a hotel was flooded, causing severe damage that necessitated rebuilding of the hotel. Several large sinkholes also developed. People required rescue from two apartment complexes, as well as from submerged vehicles.
Charlotte	06/16/2003	Flash Flood	0/0	NR	Flooding of roads and a campground was reported in areas near the Charlotte Motor Speedway.
Matthews	06/16/2003	Flash Flood	0/0	**$50,000**	A vehicle traveling along Monroe Road was washed into Briar Creek. Four Mile Creek flooded several yards. Water also covered I-85 near the I-77 exchange.
Charlotte	06/18/2003	Flash Flood	0/0	NR	Several streets were closed on the east side of the city due to high water, including Independence, Randolph, Ballentyne Corporate Road and Sam Newell Road.
Charlotte	07/29/2003	Flash Flood	0/0	NR	Several creeks overflowed their banks and flooded adjacent roads. Sam Newell Road in Matthews was flooded. In southeast Charlotte, Four Mile Creek flooded Tank Town Road and Briar Creek flooded part of Sheffield Drive.
Charlotte	08/14/2003	Flash Flood	0/0	NR	Severe urban flooding developed during the early evening, with several roads flooded and closed, including Freedom, Ashley and Berry Hill Drives. Sam Newell Road in Matthews was covered with 5 feet of water.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	07/17/2004	Flash Flood	0/0	**$25,000**	Severe urban flooding developed across the metro area, as a strong thunderstorm moved across the city, producing rainfall rates of 2 to 3 inches per hour. Several intersections and roads were closed, and numerous vehicles were stranded in high water. Several peopled had to be rescued from their vehicles. In addition, the roof of a business collapsed due to the weight of accumulated water.
Mecklenburg County	09/7/2004	Flood	0/0	**$1,500,000**	Remnants of Hurricane Frances dumped more than 20 inches of rain in the upper reaches of the Catawba River watershed in September. The resulting runoff caused significant flooding along the Catawba River below Mountain Island Lake dam. In Mecklenburg County, more than forty houses were flooded and eight were destroyed, with damages totaling approximately $1.5 million.
Charlotte	09/27/2004	Flash Flood	0/0	$0	Moderate to heavy rain fell through much of the early evening hours, but flooding developed rapidly around midnight, as an intense tropical rain band produced around 2 inches of rain across the area in a 2-to-3 hour span. Overflowing streams caused flooding of numerous roads in areas from Monroe northward to Charlotte and vicinity.
Charlotte	05/10/2005	Flash Flood	0/0	**$10,000**	Severe urban flooding developed, with 2 cars stranded in water on Sugar Creek Road. There was also water over North Tryon Street.
Charlotte	05/12/2005	Flash Flood	0/0	**$4,000**	Severe urban flooding developed, with water deep enough to float a car into the median on Independence Boulevard, and several inches of water covering Queens Road.
Charlotte	06/07/2005	Flash Flood	0/0	**$10,000**	A tributary of Little Sugar Creek flooded Bradbury and Montford drives in south Charlotte. Two vehicles were trapped in flood water, and their drivers had to be rescued. Several homes were threatened for a while, and at least 1 home had water up to the top of the front porch.
Charlotte	06/09/2005	Flash Flood	0/0	$0	A small creek overflowed its banks near Stateville Avenue, with water surrounding a home. At least one road was covered with water.
Charlotte	07/01/2005	Flash Flood	0/0	$0	Severe urban flooding developed in and around Charlotte, with water of 2 to 3 feet reported at some intersections on the southeast side of the city. This required several rescues.
Charlotte	07/22/2006	Flash Flood	0/0	**$100,000**	Significant flooding developed along Stewart Creek on the west side of Charlotte after strong to severe thunderstorms dumped 2 to 4 inches of rain over the city. Water entered several homes on Trade Street near its intersection with Seldon Avenue. Water also entered several units at 2 apartment complexes along the creek. Approximately 150 people were forced from their homes due to flood water, and about 5 apartment units were condemned. In addition to the stream flooding, poor drainage flooding developed in other areas of the city. 25 water rescues were performed, most of them due to motorists driving into deep standing water.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	08/15/2006	Flash Flood	0/0	**$100,000**	Severe urban flooding developed in the Charlotte metro area, when as much as 7.5 inches of rain fell in just a few hours. High water first developed at flood-prone intersections, such as John Belk Freeway and Independence Boulevard and I-85 and Billy Graham Parkway. Cars stalled out in deep water on East 9th Street and North Caldwell Avenue. In all, 12 motorists were rescued from high water across the city. Numerous other roads and highways were flooded with 2-4 feet of water, including portions of I-85. Although most of the flooding was due to drainage problems, Briar Creek and Little Sugar Creek both exceeded established flood stages and likely contributed to the problems. An apartment building on Dolphin Lane was evacuated when water entered one of the units. Another apartment building was evacuated on Monroe Road when a creek flooded the parking lot.
Charlotte	08/31/2006	Flash Flood	0/0	$0	Water from Steele Creek flooded a trailer park on John Price Road, forcing the evacuation of about 100 people. Steele Creek also flooded Choate Circle near the South Carolina border.
Charlotte	07/09/2007	Flash Flood	0/0	**$10,000**	Slow moving thunderstorms developed over the Charlotte metro area during the early evening hours, dropping several inches of rain in short period of time, causing significant urban and stream flooding. Several roads were closed north of Charlotte due to flooding streams, including Mallard Creek Road and Statesville Road near Lakeview Road. A motorist required rescue from his vehicle when it became submerged on Lakeview Road. A spotter reported 2-3 feet of water covering the intersection of Westfield Road and Queens Road West. Additional flooded roads were reported in the vicinity of the I-85 and I-77 exchange.
Charlotte	06/21/2008	Flash Flood	0/0	$0	Heavy rain resulted in an isolated area of flash flooding on the northeast side of Charlotte. A tributary of Little Sugar Creek flooded a business on Atando Road, inundating the building with several feet of water and trapping 5 employees inside. The employees had to be rescued via rafts.
North Charlotte	08/27/2008	Flash Flood	0/0	**$8,500,000**	The remnants of Tropical Storm Fay brought as much as 11 inches of rain to the area in less than 24 hours, flooding more than 600 structures and submerging vehicles on numerous roadways with some rescues required. Numerous evacuations were required of homes and apartments along the Briar Creek, as water entered dozens of structures. Stream gauges measuring how deep the water is in local creeks set 19 new records, exceeding the 100-year flood level in some areas.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
North Charlotte	09/10/2008	Flash Flood	0/0	**$100,000**	A cluster of slow moving thunderstorms produced several inches of rain over the northeast side of Charlotte, resulting in a flash flooding. Significant flash flooding developed along Little Sugar Creek in northeast Charlotte. Sugar Creek Road and Tryon Street were immersed by flood water, with at least one automobile submerged. Several water rescues were required in the area, with some people trapped in their homes. A homeless shelter was damaged by floodwater on North Tryon Street.
Charlotte	05/05/2009	Flash Flood	0/0	**$50,000**	Training thunderstorms caused localized flash flooding across parts of the Charlotte metropolitan area. Flash flooding developed across the southern and eastern sides of the city after thunderstorms dumped 3 to 5 inches of rain across the area in a couple of hours. Although much of the flooding was due to poor drainage, Briar Creek, Little Sugar Creek and other small streams flooded. Numerous motorists were trapped and required rescuing due to flood water, with the most serious situations occurring on Independence Boulevard near Wendover Road, Wellesley Avenue near Freedom Park, and on East Boulevard at Maryland Avenue. Some residents had to be evacuated from an apartment complex on Monroe Road due to flooding along Briar Creek. According to Mecklenburg County, floodwater entered the living space of about 10 homes and businesses. Another 85 buildings had water in crawl spaces or damage to air conditioners, and 80 unoccupied units of the Doral Apartments flooded. Damage was in the McMullen, Briar, and Little Sugar Creek Watersheds.
Charlotte	06/05/2009	Flash Flood	0/0	$0	A mesoscale convective vortex brought heavy rain to the Charlotte metro area, producing flash flooding on the northeast side of town. Later in the day, an area of thunderstorms developed to the southwest of Concord, producing more flooding. Rockland Drive was flooded and closed, as was Mary Alexander Road. Also, the stream gauge on Little Sugar Creek below 36th Street exceeded the established flood stage by more than 2 feet.
Charlotte	07/09/2009	Flash Flood	0/0	$0	A slow moving complex of thunderstorms produced flash flooding in metro Charlotte. Flooding of quite a few roads developed across the north side of the city, mainly due to poor drainage. Most of the flooding was concentrated along Freedom Boulevard, where several intersections were under 2-3 feet of water. Flooding extended northeast along portions of Statesville Road and North Tryon Street as well.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	07/28/2009	Flash Flood	0/0	$0	An old mesoscale convective vortex spawned numerous showers and thunderstorms over western North Carolina. Severe urban flooding developed during the evening hours on the south side of Charlotte. The road was closed at Rodman Street and Sam Drenan Road due to flood water and a sink hole. Also, Carmel Road was closed due to flooding. McMullen Creek overflowed its banks, flooding Addison Drive and Lincrest Place with 6-12 inches of water, and Little Sugar Creek exceeded its established flood stage at Hillside Avenue.
Charlotte	08/16/2009	Flash Flood	0/0	**$50,000**	Slow moving thunderstorms developed over the Charlotte metro area during the afternoon hours, resulting flooding of urban areas and small streams. Flash flooding developed across portions of the Charlotte metro area after as much as 4 inches of rain fell over the city in just a few hours. Most of the problems were within the Little Sugar Creek basin, especially in the Wakefield Drive area, where roads were flooded and some apartment units were evacuated. Water ended the crawl spaces of two homes in this area. The other main problem area was in the Parkwood Road area northeast of Charlotte, where roads were flooded. Flooding of numerous intersections was reported due to poor drainage, including at Tyvola Road and I-77, where two vehicles were reported floating through high water.
Pineville	01/25/2010	Flash Flood	0/0	**$40,000**	A combination of urban flooding and small stream flooding developed across much of the southern and eastern half of Mecklenburg County. The Briar Creek basin was hardest hit, with numerous roads closed along the creek and several rescues required from vehicles. A few of the closed roads included Independence Bvd, Shannonhouse Dr, Dunlavin Way, and Country Club Dr. Other closed roads included Reedy Creek Rd 11 miles east of town, Sharon Rd, Lancaster Highway 13 miles south of town, Woodland Dr at Commonwealth Ave, and Eastway Dr.
Pineville	01/26/2010	Flood	0/0	$0	Although heavy rainfall ended across the area during the early morning hours, high water conditions persisted until after sunrise across the Charlotte metro area.
Charlotte	05/31/2010	Flash Flood	0/0	$0	Little Sugar Creek overflowed its banks, flooding and closing Freedom Park.
Charlotte	06/01/2010	Flash Flood	0/0	$0	Slow moving thunderstorms caused flooding of several roads near the city center, including Tryon St and Independence Bvd. In addition, McMullen Creek flooded Lincrest Place and Little Hope Creek flooded Mockingbird Ln on the south side of the city.
Stonehaven	06/02/2010	Flash Flood	0/0	$0	McMullen Creek overflowed its banks and flooded several roads on the southeast side of Charlotte, including Addison Dr, Nottingham Dr and Willhaven Dr.
Stonehaven	06/30/2010	Flash Flood	0/0	$0	Flooding developed along McMullen Creek on the southeast side of town, with Addison Dr and Lincrest Place covered with about a foot of water.
Oakhurst	07/12/2010	Flash Flood	0/0	$0	Apartments were flooded on Teal Point Dr due to Edwards Branch overflowing its banks. Also, McMullen Creek overflowed and flooded Lincrest Place and Sam Newell Rd was flooded by Irvin Creek.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	07/27/2010	Flash Flood	0/0	$0	Several roads were flooded throughout the city due to poor drainage. A gage along McMullen Creek went about a foot above flood stage at Addison Dr and Lincrest Place, about 5 miles southeast of Uptown, and flooding along Briar Creek was reported in the South Park area.
Haskings Mills	08/06/2010	Flash Flood	0/0	**$20,000**	A stream gauge on Irwin Creek at Statesville Rd exceeded the established flood stage by more than 2 feet, flooding a portion of Dilworth Rd. Flash flooding along Stewart Creek forced evacuations of an apartment complex on Southwest Bvd. Water rescues from automobiles were also reported on the north side of the city during this time.
Thomasboro	08/19/2010	Flash Flood	0/0	**$50,000**	Quite a few roads were closed near the city center, mainly on the east side, primarily due to poor drainage. Affected roads included Tryon St, East 4th St, Hubbard Rd, and Delilah Ln. Several water rescues were required from automobiles in this area. Additionally, a stream gauge on Mallard Creek reached the established flood stage near Harrisburg. Heavy rainfall also caused the roof to collapse at a homeless shelter on N College St.
Thrift	08/05/2011	Flash Flood	0/0	**$1,500,000**	A major flash flood event developed in the Charlotte metro area after 4-7 inches of rain fell in about a three hour period. Most of the streams in the city overflowed their banks at some point, including Sugar Creek, Little Sugar Creek, McMullen Creek, Stewart Creek, Irwin Creek, and Mallard Creek. Locations from near downtown to the north side of the city were particularly hard hit. Automated gauges on some of these streams exceeded established flood stages by five feet or more, including some record crests observed on portions of Irwin, Sugar, and Stewart Creeks. Numerous roads were flooded and closed due to flooding streams or poor drainage, with water accumulating to depth of several feet in some areas. Numerous swift water rescues were required, including twenty people alone from a single apartment complex off Beatties Ford Rd. Approximately 80 homes were damaged across the city.
Matthews	08/05/2011	Flash Flood	0/0	$0	Four Mile Creek flooded Tank Town Rd and Beards Creek flooded Sam Newell Rd. Both locations are near Matthews.
Matthews	08/05/2011	Flash Flood	2/0	$0	A mother and daughter drowned when they attempted to wade through a rain-swollen tributary of Irvins Creek, about 9 miles southeast of Center City Charlotte. The approximate time of death was 1:30 pm EST (or 2:30 pm EDT).
Stonehaven	09/23/2011	Flash Flood	0/0	$0	A webcam and stream gage verified that McMullen Creek overflowed its banks and flooded Addison Dr.
Idlewild	09/23/2011	Flash Flood	0/0	$0	A webcam and stream gage verified that Briar Creek flooded Shamrock Dr.
Stonehaven	07/20/2012	Flash Flood	0/0	$0	Addison Drive was flooded by McMullen Creek.
Stonehaven	07/20/2012	Flash Flood	0/0	**$40,000**	McMullen Creek overflowed it's banks, entering the crawl spaces of 4 houses along Johnny Cake Lane.
Pineville	08/07/2012	Flash Flood	0/0	$0	A few back roads were closed in parks near Pineville due to high water.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Thomasboro	08/07/2012	Flash Flood	0/0	**$20,000**	People in two separate vehicles required rescue at the intersection of Ashley Road and Wilkinson Blvd. Another vehicle was trapped in high water at Camp Greene Street at Freedom Drive. A final water rescue occurred at the intersection of Wesley Village and Freedom Drive. All of these are on the west side of Charlotte where automated gauges reported 2 to 3 inches of rain in a little over an hour.
Stonehaven	09/08/2012	Flash Flood	0/0	$0	Addison Drive and Lincrest Place were flooded and closed by McMullen Creek after 2 to 2.5 inches of rain fell in an hour's time.
Northwest Charlotte/ Mecklenburg	05/2013	Flood	0/0	$0	At 7:30 in the morning CFD responded to the Riverside Drive area of Northwest Charlotte in response to information received from Duke Energy on water release from Mountain Island Dam. At 07:30 the lake level was at 101.2 which is 1.2 feet above the dam level as water was overtopping. At 10:00 the lake level had risen to 102.8 and the anticipated level by 12 noon would be 104.1.
Matthews	06/02/2013	Flash Flood	0/0	**$5,000**	In excess of two inches of rain fell in an hour's time, causing a small stream to flood Tank Town Road. The water was reported to be between 4 and 6 feet deep over the road. One car stalled in the flood waters and had to be pushed to higher ground. Minor flooding was also reported along Sam Newell Rd south of Independence Blvd. Water was about 1 to 2 feet deep over Morningwood Drive near St John Street in this same area. A car stalled in flood waters at this location as well.
Hahn	06/03/2013	Flash Flood	0/0	**$10,000**	Mallard Creek flooded Kirk Farm Fields Park, near the intersection of Mallard Creek Church Road and North Tryon Street. Water was 2 to 3 feet deep in much of the park. A delivery truck was partially submerged by the flood waters.
Hoods	06/07/2013	Flash Flood	0/0	$0	Tank Town road was flooded by a stream.
Cornelius	06/28/2013	Flash Flood	0/0	$0	Several roads were reportedly flooded in Cornelius.
Smithville	06/28/2013	Flash Flood	0/0	**$250,000**	Several inches of rain fell over a period of a couple hours across the northern tip of Mecklenburg County. Two Cocorahs observers reported around 5.50 inches of rain in this area. A bridge was flooded at Cashion Rd and Beatties Ford Rd. Sam Furr Road was flooded by McDowell Creek, just west of Interstate 77. Several cars stalled in the floodwaters at this location, with 4 people pulled from 3 different cars. Four ground floor apartments in Huntersville were flooded with 4 to 5 inches of water. McIlwaine Road was flooded and closed by a stream. Gilead Road was damaged by floodwaters, requiring $168,000 in repairs.
Huntersville	06/28/2013	Flash Flood	0/0	**N/A**	A Town police car was responding to a call and when he crossed the bridge on McIlwaine Road, he did not realize that while the bridge deck looked like it usually does, it was actually under approximately 4 feet of water. We had several officers look at this and they agreed that due to the smoothness of the water (this reflected the bridge rails and created a normal appearance for the bridge) and lack of light on the roadway, it was difficult to see the bridge was under water. The officer was driving approximately 30 mph when he drove into the water. The vehicle began to float and then became submerged. The vehicle was swept away by the rising water and got hung on the guardrail of the bridge. It settled in the water, which eventually reached the top of the trunk.

Table 5.3: Significant Flood Events (1900-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg Co.	07/11/2013	Flash Flood	0/0	**$20,000**	Some homes were flooded along Stewart Creek with evacuations. Flooding was reported along Margaret Turner Road with water reportedly entering one home. Stewart Creek also flooded Southwest Blvd.
Charlotte	07/11/2013	Flash Flood	0/0	$0	West Morehead Street was flooded and closed by Stewart Creek. Spruce, Merriman and Wilmore Streets were flooded in this same area, forcing some residents to evacuate.
Mecklenburg Co.	07/21/2013	Flash Flood	0/0	**$90,000**	Around 2 inches of rain fell in less than an hour, sending a small stream into 9 apartments in the Arcadian Village Apartment complex on Cedars East Court. The Red Cross sheltered 30 people whose apartments were damaged by the knee-deep flood waters. Also, McMullen Creek flooded portions of Addison Drive and Lincrest Place.
Mecklenburg Co.	07/24/2013	Flash Flood	0/0	$0	Several Streets around Southpark Mall were flooded and closed during the late evening hours as a result of severe urban flooding, including the intersection of Fairview Road and Sharon Road.
Douglas Muni Arpt	07/03/2014	Flash Flood	0/0	**$10,000**	FD and public reported flash flooding throughout the west side of Charlotte, primarily as a result of poor drainage, after 2-3 inches of rain fell in just a couple of hours. Multiple roads were closed throughout this area, including Freedom Drive, which was reported to have as much as two feet of water over it just northwest of downtown.
Matthews	07/15/2014	Flash Flood	0/0	**$100,000**	A cluster of slow moving and repeating thunderstorms produced 3.5 to 5 inches of rain in less than two hours near the Mecklenburg/ Union County line. Severe urban and small stream flooding occurred in the Matthews area, with water up to the windows of some vehicles. Stream flooding included a tributary of McAlpine Creek which flooded a part of Sam Newell Rd. Multiple roads were closed throughout the city.
TOTAL			**19/4**	**$41,414,000**	

Sources: Mecklenburg County (1900 to 1993 data); Mecklenburg County and National Climatic Data Center (1993 to 2014 data)

The “Great Flood" of 1916 on the Catawba River is still considered by many to be the largest flood event on record in terms of depth of flooding, when the Catawba River crested at more than 47 feet. Specific stream gauge data is not available for this event, but there were at least 13 deaths attributed to this event.

PROBABILITY OF FUTURE OCCURRENCES

Flooding remains a highly likely occurrence (100% annual probability) throughout the identified flood hazard areas of Mecklenburg County. Smaller floods caused by heavy rains and inadequate drainage capacity will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals. While the potential for flood is always present, Mecklenburg County continues to reduce the likelihood of repetitive flood losses to existing development through its ongoing flood mitigation programs (including its *Floodplain Buyout Program*). Further, the County and each of its municipal jurisdictions do have effective flood damage prevention ordinances and other local regulatory policies for new development in place that should help lessen potential property damage due to future floods. These flood mitigation programs and policies are further discussed and demonstrated in Section 6: *Vulnerability Assessment* and Section 7: *Capability Assessment*.

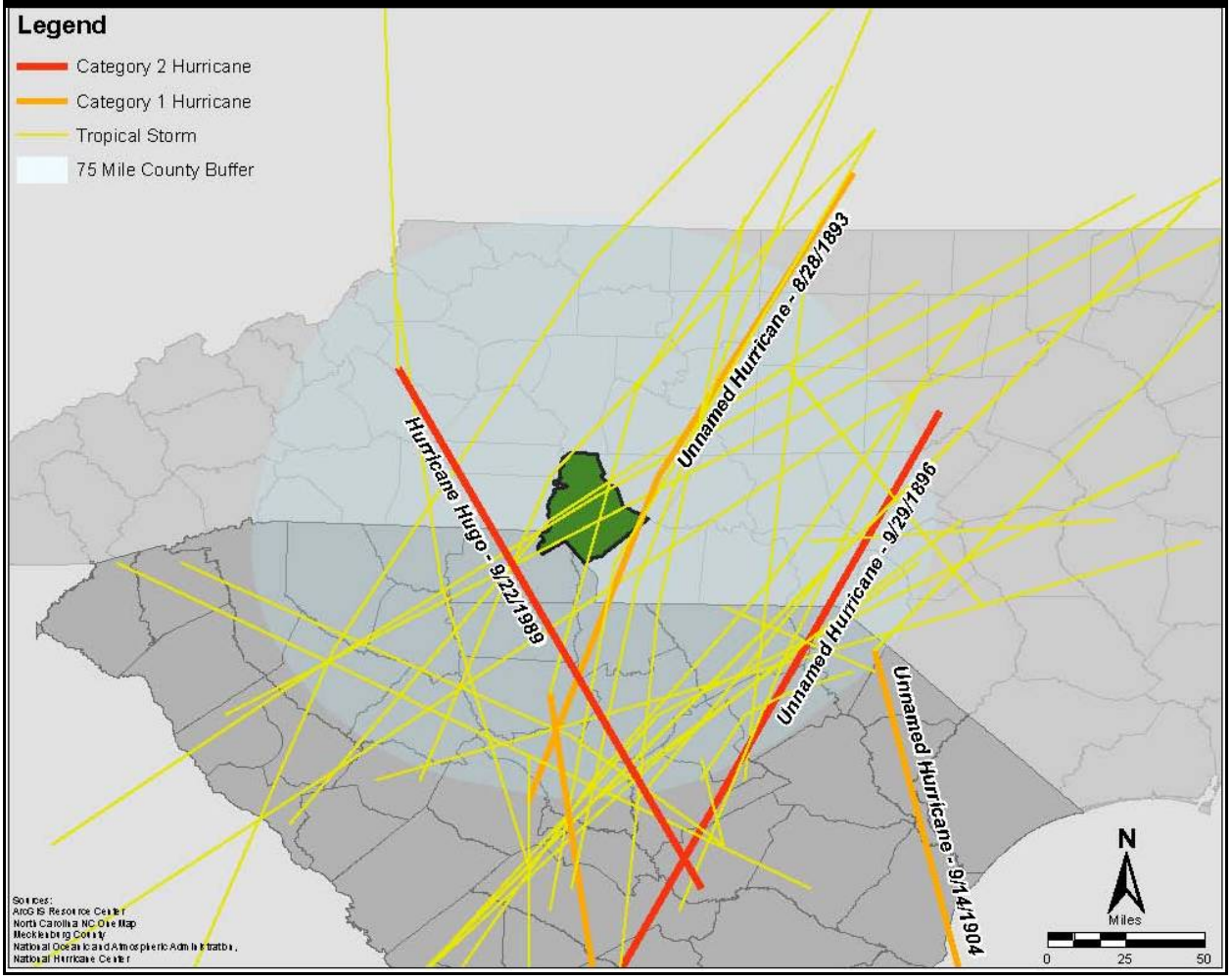
HURRICANES AND TROPICAL STORMS

On average, North Carolina experiences a hurricane approximately once every two years. Substantial hurricane damage is most likely to occur in the easternmost counties of the state; however, hurricane and tropical storm-force winds have significantly impacted areas far inland, including Mecklenburg County. In fact, 32 such storms have passed within 75 miles of Mecklenburg County since 1851 (**Figure 5.4**), seven of which crossed directly through the county. Two of the 32 storms were Category 2 hurricanes (Hurricane Hugo in 1989 and an unnamed hurricane in 1896), three were Category 1 hurricanes (Hurricane Able in 1952 and two unnamed hurricanes in 1893 and 1904), and 27 were tropical storms. Of the seven storms that passed through the county, Able was the most recent (1952).

After passing inland, Hurricane Hugo was not done wreaking havoc. Electric power was interrupted throughout Charlotte with some areas remaining without power for up to three weeks. (Photo courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/ National Severe Storms Laboratory)

No nor'easters are known to have significantly impacted Mecklenburg County in recent history. If a nor'easter had impacted the county, the effects would have been perceived as severe winter weather and not as a coastal cyclone event.

Figure 5.4: Historical Storm Tracks Within 75 Miles of Mecklenburg County (Since 1851)



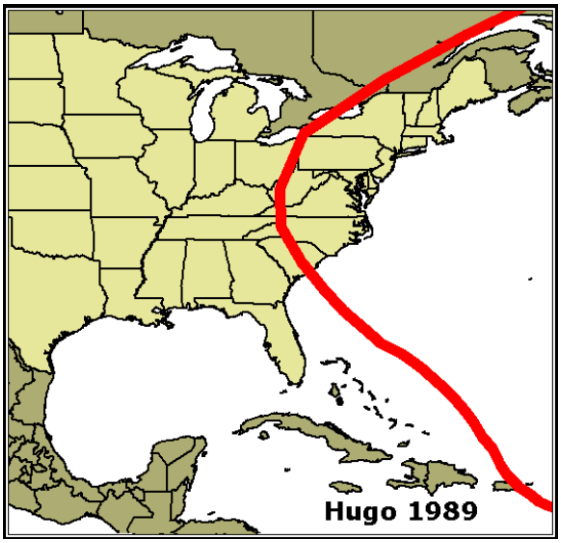
SIGNIFICANT HISTORICAL EVENTS

There is very little detailed information on the historical impacts of past hurricane and tropical storm events in Mecklenburg County. No official historical records or damage statistics specific to the area are available through Mecklenburg County, the North Carolina Division of Emergency Management or the Federal Emergency Management Agency. The county is known to have sustained a significant portion of the estimated statewide total of $1 billion in property damages caused by Hurricane Hugo in 1989, Mecklenburg County's most powerful storm event to date. Brief descriptions of significant known historical events, including Hurricane Hugo, are provided below.

Hurricane Hugo made landfall as a Category 4 storm on September 22, 1989 at Sullivan's Island, South Carolina and tracked northward across the Charlotte metro area (pictured right). As Hugo crossed western North Carolina, the storm dumped 3 to 7 inches of rain and caused wind damage as far north as Caldwell County. In North Carolina, Charlotte recorded the highest sustained wind of 69 miles per hour and wind gusts of 87 miles per hour, and a barometric pressure of 978 millibars. Mecklenburg County reported 3.16 inches of rain from the storm. Twenty-nine counties in North Carolina were presidentially declared disaster areas, with an estimated $1 billion in damages in North Carolina. In Mecklenburg County, the winds downed trees and power lines causing massive disruption for days. The following description of Hurricane Hugo was excerpted from *North Carolina's Hurricane History* by author Jay Barnes.

"As the center of the storm rolled past Charlotte, wind gusts of over 85 mph buffeted the region. Trees crashed into homes, cars, and power lines and utility poles snapped. Charlotte lost more than eighty thousand trees to the storm, many of which were more than seventy years old. Ninety-eight percent of the city's residents lost power, and for some, repairs were not made for more than two weeks. Power outages caused large amounts of raw sewage to bypass treatment plants and flow into streams throughout Mecklenburg County. North Carolina's largest metropolitan area was brought to its knees by the storm...

…The people of Mecklenburg County thought they were immune to hurricanes prior to this storm's arrival. Most had believed that tropical cyclones were strictly a coastal phenomenon, but Hugo proved to be an exception." (Jay Barnes 1998)



The track of Hurricane Hugo takes the powerful storm past Charlotte in 1989. (Photo courtesy of the National Hurricane Center)

An unnamed tropical storm caused winds up to 60 mph in the Charlotte area on July 14, 1916. An unnamed tropical storm impacted Mecklenburg County August 28, 1949 with heavy rains and minimal gale force winds. Hurricane Gracie crossed into North Carolina as a tropical storm and moved rapidly north out of the state, bringing heavy rain to Mecklenburg County on September 30, 1959. Although Hurricane Abby had dissipated by the time it reached North Carolina, remnants of the storm impacted Mecklenburg County on June 7 to June 13, 1968. Charlotte recorded 5.11 inches of rain, a wind gust of 46 mph, and one tornado that was spawned near Charlotte. Damages in the Charlotte area were estimated by the National Weather Service to be $30,000. Hurricane Ginger was a Category 1 storm when it made landfall near Atlantic Beach, North Carolina on September 30/October 1, 1971. The Charlotte area recorded a wind gust of 30 mph and 2.21 inches of rain as a result of this storm.

Table 5.4 shows the historical storm tracks within 75 miles of Mecklenburg County since 1851 that are the basis for Figure 5.4.

Table 5.4: Historical Storm Tracks Within 75 Miles of Mecklenburg County (Since 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (MPH)	STORM CATEGORY
1854	Not Named	70	Tropical Storm
1859	Not Named	45	Tropical Storm
1877	Not Named	45	Tropical Storm
1878	Not Named	70	Tropical Storm
1882	Not Named	45	Tropical Storm
1885	Not Named	45	Tropical Storm
1886	Not Named	45	Tropical Storm
1888	Not Named	40	Tropical Storm
1889	Not Named	50	Tropical Storm
1893	Not Named	45	Tropical Storm
1893	Not Named	85	Category 1 Hurricane
1896	Not Named	100	Category 2 Hurricane
1901	Not Named	40	Tropical Storm

Table 5.4: Historical Storm Tracks Within 75 Miles of Mecklenburg County (Since 1851)

DATE OF OCCURRENCE	STORM NAME	WIND SPEED (MPH)	STORM CATEGORY
1902	Not Named	40	Tropical Storm
1904	Not Named	80	Category 1 Hurricane
1906	Not Named	70	Tropical Storm
1912	Not Named	40	Tropical Storm
1913	Not Named	40	Tropical Storm
1913	Not Named	40	Tropical Storm
1916	Not Named	65	Tropical Storm
1920	Not Named	65	Tropical Storm
1927	Not Named	45	Tropical Storm
1935	Not Named	65	Tropical Storm
1945	Not Named	45	Tropical Storm
1949	Not Named	45	Tropical Storm
1952	Able **(5)**	80	Tropical Storm
1959	Cindy	40	Tropical Storm
1959	Gracie	70	Tropical Storm
1979	David	65	Tropical Storm
1985	Bob	65	Tropical Storm
1988	Chris	40	Tropical Storm
1989	Hugo	100	Category 2 Hurricane

Source: National Hurricane Center

PROBABILITY OF FUTURE OCCURRENCES

Mecklenburg County experiencing the effects of a major (Category 3 or stronger) hurricane is considered unlikely, however the county remains susceptible to the high wind effects from such storms making landfall along the Atlantic coast of the United States. The effects of tropical storms (sustained wind speeds of at least 39 miles per hour and torrential rains) will be more frequent, as storms making landfall along the Atlantic seaboard as well as the Gulf Coast could impact the county in any given year.

SEVERE THUNDERSTORMS

Thunderstorms are common throughout the state of North Carolina, and have been known to occur during all months of the year. In addition to the high winds associated with these events, thunderstorms can also bring dangerous lightning that can cause fires, property damage and may cause death or serious injury. Thunderstorms can also produce hail, which can cause varying degrees of property and crop damage. According to information provided by the National Lightning Safety Institute, the Piedmont Region, which includes Mecklenburg County, experiences an average of 70 thunderstorm days per year. According to the National Climatic Data Center, Mecklenburg County has experienced a recorded 244 *severe* thunderstorm events since 1950 resulting in four deaths, 13 injuries and approximately $2.2 million in property damage. In addition, and described separately herein, Mecklenburg County experienced 160 documented hail events since 1950 resulting in an estimated $1 million in reported property damages, and 32 lightning events resulting in 3 fatalities, seven injuries and an estimated $2.7 million in property damages.

SIGNIFICANT HISTORICAL EVENTS

Table 5.5 provides details of historical severe thunderstorm activity in Mecklenburg County for those events that resulted in casualties or property damage as recorded by the National Climatic Data Center.[7] The most notable thunderstorm damage occurred on July 20, 1998 when a storm moved into southern Mecklenburg County and blew down six trees on the southwest side of Charlotte striking 15 dwellings including apartments, condominiums and houses and causing an estimated $1 million in property damages. Also, flash flooding occurred in the city late in the evening of the 20th and continued into the early morning hours. One injured woman had to be rescued from her car during this storm event. The extent of the thunderstorm hazard is based on wind speed as recorded by the National Weather Service through the National Climatic Data Center (NCDC).

Table 5.5: Significant Severe Thunderstorm Events (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE (KNOTS)	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg	08/20/1990	58	0/**1**	NR	No details available.
Mecklenburg	06/21/1992	0	0/**1**	NR	No details available.
Charlotte	05/19/1993	N/A	0/0	**$5,000**	Thirty trees were blown down and a carport destroyed.
Mecklenburg	01/18/1996	N/A	0/0	**$3,125**	An extremely strong cold front, preceded by heavy rain all day, moved through the Piedmont during the night with the highest winds recorded in 20 years of record.
Charlotte	04/30/1996	0	0/0	**$25,000**	No details available.
Huntersville	05/27/1996	50	0/0	**$5,000**	No details available.
Huntersville	08/03/1996	65	0/0	**$50,000**	No details available.
Charlotte	02/21/1997	50	0/0	**$25,000**	No details available.
Cornelius	08/04/1997	70	0/0	**$25,000**	Two severe thunderstorms moved south-southeast causing significant damage. Around Lake Norman in northern Mecklenburg County several boats were capsized and hundreds of trees were blown down. There was also some damage to homes from both wind and fallen trees.

[7] While the Severe Thunderstorm hazard is understood to include lightning and hail as hazardous elements, tables are provided with lightning and hail activity presented separately with the understanding that some duplication of deaths, injuries and property damage may occur when comparing all three tables.

Table 5.5: Significant Severe Thunderstorm Events (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE (KNOTS)	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg	02/24/1998	50	0/0	**$1,250**	High gradient winds in the wake of an exiting strong storm system combined with saturated soil conditions to blow down some trees and power lines across the Piedmont.
Charlotte	04/19/1998	50	0/0	**$70,000**	Fast low-topped thunderstorms moved rapidly north across the Charlotte metro area during the afternoon hours. A few of the storms became severe and produced a moderate amount of wind damage. A large tree was blown onto two cars, one house and broke a gas line on the south side of Charlotte. Trees and power lines were downed from Matthews to Mint Hill. North of Charlotte, a roof was blown off an old grocery store, a beauty shop was damaged, mobile home windows were blown out, and a car had a piece of wood hurled through its glass.
Charlotte	07/20/1998	50	0/0	**$1,000,000**	A strong thunderstorm struck 15 dwellings including apartments, condominiums and houses in the Charlotte area. Damage was estimated near $1 million.
Charlotte	08/08/1998	52	0/0	**$12,000**	A couple of severe thunderstorms developed late in the afternoon in the Piedmont. In east Charlotte trusses were blown off a house under construction and limbs were knocked down.
Mecklenburg	09/15/1999	45	0/**1**	NR	Near and east of Interstate 77, winds directly associated with Hurricane Floyd caused scattered damage. Winds gusting between 35 and 45 mph downed some trees and power lines.
Mecklenburg	03/28/2000	50	0/**1**	NR	High winds following a cold front caused a number of problems during the afternoon hours. Numerous trees and power lines were downed and some light structural damage occurred. Several thousand people were without power for a short time. Downed trees and power lines in Charlotte blocked streets.
Charlotte	08/18/2000	75	**1/2**	**$250,000**	A large swath of wind damage occurred from Ericsson Stadium to the east side of Charlotte. A trained spotter estimated the wind speed to be 90 mph at Dillworth Square. Other estimates were reported of between 75 and 100 mph. Numerous trees and power lines were downed and a canopy was blown off a gas station. Numerous streets were blocked and Interstate 85 was blocked in both directions. Nearly 90,000 people were left without power. The County 911 center said this event generated the most calls since Hurricane Hugo moved through Charlotte. Falling trees injured two people, and one person drowned when his boat was blown away from where he was swimming.
Mecklenburg	12/17/2000	55	0/0	**$25,000**	No details available.
Mecklenburg	03/20/2001	55	0/0	**$45,455**	No details available.
Mecklenburg	04/17/2001	50	**1**/0	NR	Gusty winds were strong enough to cause scattered damage. In Charlotte, a number of trees and limbs fell. One 60-foot section of a tree fell on a car, resulting in a fatality.
Cornelius	05/13/2002	55	0/0	**$3,000**	Numerous trees and power lines were blown down.
Charlotte	05/13/2002	60	0/0	**$50,000**	A roof was partially blown off of a business, a crane was blown over and numerous power lines were blown down.
Matthews	05/13/2002	52	0/0	**$50,000**	A tractor-trailer truck was toppled, and numerous trees and power lines were blown down.
Pineville	07/01/2002	50	0/0	**$1,000**	Power lines were blown down in Pineville. Trees were blown down along Highway 51 near Pineville.
Mecklenburg	07/02/2002	60	0/0	**$3,000**	Numerous trees and power lines were blown down.
Charlotte	07/03/2002	50	0/0	**$8,000**	A tree was blown onto a car. Several traffic lights and signs were damaged.

Table 5.5: Significant Severe Thunderstorm Events (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE (KNOTS)	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	07/03/2002	50	0/0	**$20,000**	Trees were blown down onto an apartment complex, resulting in evacuation of some units.
Charlotte	07/03/2002	55	0/0	**$3,000**	Numerous trees and power lines were blown down.
Charlotte	08/16/2002	50	0/0	**$1,000**	Some power lines were blown down.
Cornelius	08/24/2002	55	0/0	**$3,000**	Numerous trees and power lines were blown down.
Charlotte	05/02/2003	65	0/**2**	**$100,000**	Tents, booths, and other property were blown down at an arts and food festival in uptown Charlotte. Some structures received damage. Flying debris injured two people. Trees and power lines were blown down in areas south of town.
Huntersville	05/02/2003	60	0/**3**	**$25,000**	Numerous trees and power lines were blown down. A tree fell through a mobile home, resulting in serious injuries to two people, and minor injuries to a third.
Charlotte	07/09/2003	50	0/0	**$1,000**	Trees were blown down.
Huntersville	07/11/2003	50	0/0	**$1,000**	Trees were blown down.
Huntersville	07/12/2003	50	0/0	**$5,000**	Trees were blown down.
Charlotte	08/05/2003	50	0/0	**$5,000**	No details available.
Charlotte	08/22/2003	54	0/0	**$1,000**	Wind equipment at the Charlotte/Douglass International Airport measured a wind gust of 62 mph. Trees and power lines were blown down in the same area.
Huntersville	11/19/2003	50	0/0	**$1,000**	Some power lines were blown down.
Charlotte	11/19/2003	50	0/0	**$1,000**	Large tree limbs and power lines were blown down in scattered locations across the city.
Mecklenburg Huntersville	03/07/2004	65	**1/2**	**$55,000**	Numerous trees and power lines were blown down, while roofs were torn off of some buildings. Some outbuildings and barns were damaged or destroyed. In Mecklenburg County, an 81-year-old man was killed in Huntersville, when a tree fell across the deck on which he was standing.
Charlotte	05/31/2004	50	0/0	**$1,000**	Several power lines were blown down.
Charlotte	01/14/2005	50	0/0	**$4,000**	County reports a tree blown onto a house.
Charlotte	01/14/2005	50	0/0	**$5,000**	A few trees down in the city. One fell on a house, causing damage.
Charlotte	03/08/2005	60	0/0	**$50,000**	Tree fell on a car on Mount Holly Road near NC 27. Several trees fell on homes along Beatties Ford Road near LaSalle Street. Some roofs were torn off buildings in this same area.
Pineville	03/08/2005	60	0/0	**$20,000**	Several 8-inch diameter pine trees blown down near the intersection of highways 51 and 521. A large road sign was blown down on I-485, and some scaffolding was blown down at a construction site. A portion of the roof was torn off Charlotte Catholic High (10 S. City Center) and several large trees were blown down on Windyrush Road near Rea Road. Numerous power outages were reported.
Davidson	07/28/2005	55	0/0	**$10,000**	Quite a few trees, power lines, and power poles down, with at least 2 trees on houses.
Charlotte	02/04/2006	50	0/0	**$10,000**	Two trees blown down on the east side of Charlotte and a privacy fence blown down. One large tree fell on a home, causing significant damage.
Charlotte	06/11/2006	60	0/0	**$100,000**	Numerous trees were blown down in various locations across the southern part of the city due to a series of microbursts. Several trees on homes in the Sardis Road area around Bently Oaks Road and Chevron Road. A private sector meteorologist estimated wind speeds at 65 to 75 mph based on the damage. Also, a spotter reported 3 trees snapped off on Patrick Springs Court. Trees were also blown down on Kings Drive and Hartford Avenue. Trees were also blown down in the Matthews area. There were at least 28,000 power outages in the area.

Table 5.5: Significant Severe Thunderstorm Events (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE (KNOTS)	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg	04/16/2007	60	0/0	**$22,727**	Widespread damaging high wind event, with most damage reports coming from north of Charlotte and throughout the Piedmont. Thousands of trees fell across the region, resulting in widespread power outages. Numerous trees fell on roads, homes, and vehicles but no specific reports of damage in Mecklenburg County. The Blue Ridge mountains and the foothills received the brunt of the strongest winds.
Charlotte	08/26/2007	60	0/0	**$50,000**	Isolated severe storms affected the mountains and Piedmont of North Carolina during the afternoon and early evening hours. The roof of a business was damaged on Statesville Road. Part of the roof of a restaurant was damaged at the intersection of I-485 and Sunset. A canopy at a gas station was lifted and fell on several vehicles near the intersection of Sunset and Reames Road. Trees and power lines were blown down near the intersection of Beatties Ford Road and Trinity Road, and at I-485 and Brookshire.
Mecklenburg	03/09/2008	45	**1/0**	**$0**	Gusty winds toppled a large tree, which fell on a vehicle at the corner of East Boulevard and Asheville Place. The impact killed the 53-year-old woman driving the vehicle.
North Charlotte	04/19/2013	40	0/0	**$5,000**	A large tree was split on Shamrock Dr near Palm Ave, falling on a vehicle and clipping the roof of a house.
Shopton	06/10/2013	50	0/0	**$10,000**	Multiple trees and power lines were blown down across the city. Power lines fell on a vehicle on Park Dr (3 S) and a tree fell on a vehicle on Seneca Place.
TOTAL			**4/13**	**$2,151,727**	

Source: National Climatic Data Center

The worst severe thunderstorm event on record is the 8/18/2000 event based on wind speed.

North Carolina had 29 lightning-related deaths from 1990 to 2003 ranking North Carolina fifth in the United States in such deaths. Forty-four lightning events not directly associated with a thunderstorm event are known to have impacted Mecklenburg County since 1995, resulting in three known deaths, eight known injuries and over $3.7 million in reported property damage, as shown in **Table 5.6.** The University of North Carolina at Charlotte conducted a study to evaluate whether there is geographic correlation of lightning damage with environmental and socio-economic variables in Mecklenburg County. The study found that the majority of lightning damage during a period from 1993 to 1995 occurred in the South Planning District among seven districts in which a significant suburban growth in Mecklenburg County has taken place since 1950. This planning area has been one of the primary locations for new residential developments containing predominantly single family residences over $100,000 (Cao, Xiang and Wilson, *GIS-Based Study of Lightning Damages*).

According to the National Lightning Safety Institute, damage estimates reported by government agencies (such as NCDC) do not accurately represent actual losses due to underestimation or underreporting of actual damages. Nationwide, realistic lightning costs and losses may reach $4 to $5 billion per year including losses associated with forest fires, insurance claims and damages to warehouses, aircraft, electrical infrastructure and nuclear power plants.

Table 5.6: Lightning Activity in Mecklenburg County (1950-2014)

LOCATION	DATE OF OCCURRENCE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Unincorporated Mecklenburg County	07/16/1995	0/0	**$50,000**	Lightning and the ensuing fire damaged a home substantially.
Charlotte	07/23/1997	0/0	**$100,000**	Lightning struck a home in north Charlotte.
Charlotte	06/10/1998	0/0	**$200,000**	Lightning severely damaged a church in Millersville, but no damage estimate was available. Several homes were struck by lightning in the Charlotte area, causing extensive damage.
Countywide	07/20/1998	0/0	**$1,000,000**	Intense cloud to ground lightning struck 15 dwellings ranging from apartments to condominiums to houses in the Charlotte area. Damage was estimated near $1 million as many homes were destroyed.
Charlotte	07/31/1999	0/0	NR[8]	Lightning strikes across the region caused numerous structure fires.
Charlotte	06/14/2000	0/**1**	NR	A woman hanging clothes was shocked and injured by lightning that struck nearby her Charlotte home.
Charlotte	07/07/2000	0/0	**$100,000**	Lightning struck an apartment complex in Charlotte and caused a fire that destroyed the roof of one building. Fourteen people were left homeless.
Charlotte	07/03/2002	0/0	**$20,000**	Lightning struck a house and a condominium, resulting in damage to both.
Charlotte	07/03/2002	0/0	**$10,000**	Lightning ignited two house fires.
Charlotte	07/04/2002	0/0	**$260,000**	Lightning, some at apartments and houses ignited at least three major fires.
Huntersville	05/02/2003	0/**1**	NR	No details available.
Charlotte	06/16/2003	0/0	**$250,000**	Lightning struck the roof of a condominium, resulting in a fire that caused significant damage.
Charlotte	07/19/2003	0/0	**$30,000**	A house was struck by lightning.
Charlotte	07/21/2003	0/**1**	NR	A person was injured after being struck by lightning.
Matthews	07/29/2003	**3/1**	**$30,000**	Three people were killed and another injured when lightning struck a large oak tree, which then fell on and crushed the vehicle they were sitting in. The fallen tree damaged two other vehicles.
Charlotte	07/29/2003	0/**1**	NR	A person was injured when he was struck by lightning.
Charlotte	08/14/2003	0/0	NR	Lightning struck two homes.
Charlotte	05/23/2004	0/0	**$250,000**	Two houses and an apartment complex were damaged due to fires ignited by lightning.
Pineville	06/08/2004	0/0	**$5,000**	Intense lightning caused widespread power outages in Pineville and surrounding areas. Three houses were struck on Lancaster Highway alone.
Charlotte	07/05/2004	0/0	**$20,000**	Lightning ignited several fires at homes and outbuildings.
Charlotte	05/10/2005	0/0	**$50,000**	Report of 8 to 9 homes struck by lightning. A fire was started at one of the homes, resulting in considerable damage.
Charlotte	06/07/2005	0/0	**$25,000**	Lightning ignited fires at 2 homes.
Charlotte	07/1/2005	0/0	**$60,000**	Lightning was responsible for at least 6 house fires across the city.
Matthews	07/18/2005	0/0	**$0**	Lightning knocked out power to about 6,000 customers in the Matthews area.

[8] "NR" means "None Reported" indicating that no records exist of reported property damage. This does not exclude the possibility or probability that unreported damages did in fact occur.

Table 5.6: Lightning Activity in Mecklenburg County (1950-2014)

LOCATION	DATE OF OCCURRENCE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Huntersville	07/28/2005	0/0	**$20,000**	Lightning struck a house, which ignited a fire that destroyed the porch and damaged the main part of the house.
Charlotte	04/03/2006	0/0	**$15,000**	Lightning ignited a house fire in northwest Charlotte.
Charlotte	06/23/2006	0/**1**	**$0**	A utility worker working on a water line was injured when lightning struck the ground nearby.
Charlotte	07/22/2006	0/0	**$150,000**	Lightning started a fire at the Barton Creek Apartment Complex near UNC-Charlotte.
Huntersville	06/24/2007	0/0	**$20,000**	Lightning struck a home, igniting a fire that damaged the roof.
Charlotte	07/07/2007	0/0	**$20,000**	Lightning struck a house, igniting a fire that damaged the roof and attic.
Charlotte	07/22/2008	0/0	**$50,000**	Lightning ignited a fire at a home on Morton Street, causing significant damage.
Charlotte	05/02/2009	0/**1**	**$0**	Lightning ignited a fire at a home on Nevin Road, causing extensive damage and causing minor injuries to a firefighter.
Pineville	06/13/2010	0/0	**$50,000**	Lightning ignited a fire at a home on John Beck Dr, causing significant damage.
Alexanders Store	06/13/2010	0/0	**$150,000**	Lightning ignited a fire at an apartment building on Corktree Ct, damaging the building and forcing evacuation of five families.
Matthews	07/13/2010	0/0	**$100,000**	Lightning struck a home on Saintsbury Place, igniting a fire that caused significant damage.
Matthews	07/27/2010	0/0	**$100,000**	Lightning ignited a fire at a home on Tripper Ln, causing significant damage.
Oakhurst	07/27/2010	0/0	**$100,000**	Lightning ignited a fire at a home on Langhorne Ave, causing significant damage.
Pineville	06/21/2011	0/0	**$200,000**	Lightning struck a home on Polo Ridge Ct, igniting a fire that caused significant damage.
Pineville	08/07/2011	0/0	**$150,000**	Lightning started a fire at a home on James Jack Lane, which heavily damaged the second floor of the home.
Smithville	03/20/2012	0/0	**$50,000**	Lightning struck a single family home on John Connor Rd near Lake Norman. The strike immediately started a fire that spread thorough the upstairs part of the home.
Griffith	05/22/2012	0/0	**$50,000**	Lightning started a fire at an apartment building on Cherrycrest Lane. The blaze damaged two units of the complex, causing about 50 thousand dollars worth of damage.
Croft	07/01/2012	0/0	**$25,000**	Lightning struck a home on Davis Lake Parkway, starting a fire that caused some structural damage.
Griffith	07/16/2012	0/0	**$5,000**	Lightning struck a tree on Starcrest Dr, igniting a fire. The tree then fell against a home, burning a portion of the exterior.
Charlotte	06/25/2014	0/**1**	$0	Media reported a 9-year-old boy received serious injuries from a lightning strike near Johnson C Smith University.
TOTAL		**3/8**	**$3,715,000**	

Source: National Climatic Data Center

Table 5.7 shows a summary of reported hail events for unincorporated areas of Mecklenburg County, Charlotte, Cornelius, Huntersville, Matthews and Mint Hill between 1950 and 2014. A total of 205 hail events are known to have impacted Mecklenburg County since 1950, resulting in a total of approximately $1 million in property damage. The size of the recorded hailstones ranged from 0.75 inches to 3 inches.

No deaths, injuries or crop damages have ever been reported in Mecklenburg County as a result of hailstorm activity.[9]

Table 5.7: Hail Activity in Mecklenburg County (1950-2014)

LOCATION	TOTAL NUMBER OF EVENTS	MAXIMUM HAIL SIZE (INCHES)	MINIMUM HAIL SIZE (INCHES)	AVERAGE SIZE (INCHES)
Mecklenburg	94	3.00	0.75	1.08
Charlotte	56	2.50	0.75	1.01
Cornelius	6	1.75	0.75	1.29
Davidson	2	1.00	0.75	0.88
Huntersville	12	1.00	0.75	0.80
Matthews	13	1.75	0.75	1.02
Mint Hill	12	2.00	0.75	1.24
Pineville	10	1.75	0.75	0.98
TOTAL	**205**	**3.00**	**0.75**	**1.04**

Source: National Climatic Data Center

PROBABILITY OF FUTURE OCCURRENCES

Severe thunderstorms will remain a highly likely occurrence for Mecklenburg County (100% annual probability). Lightning and hail may also be experienced in the area due to such storms.

TORNADOES

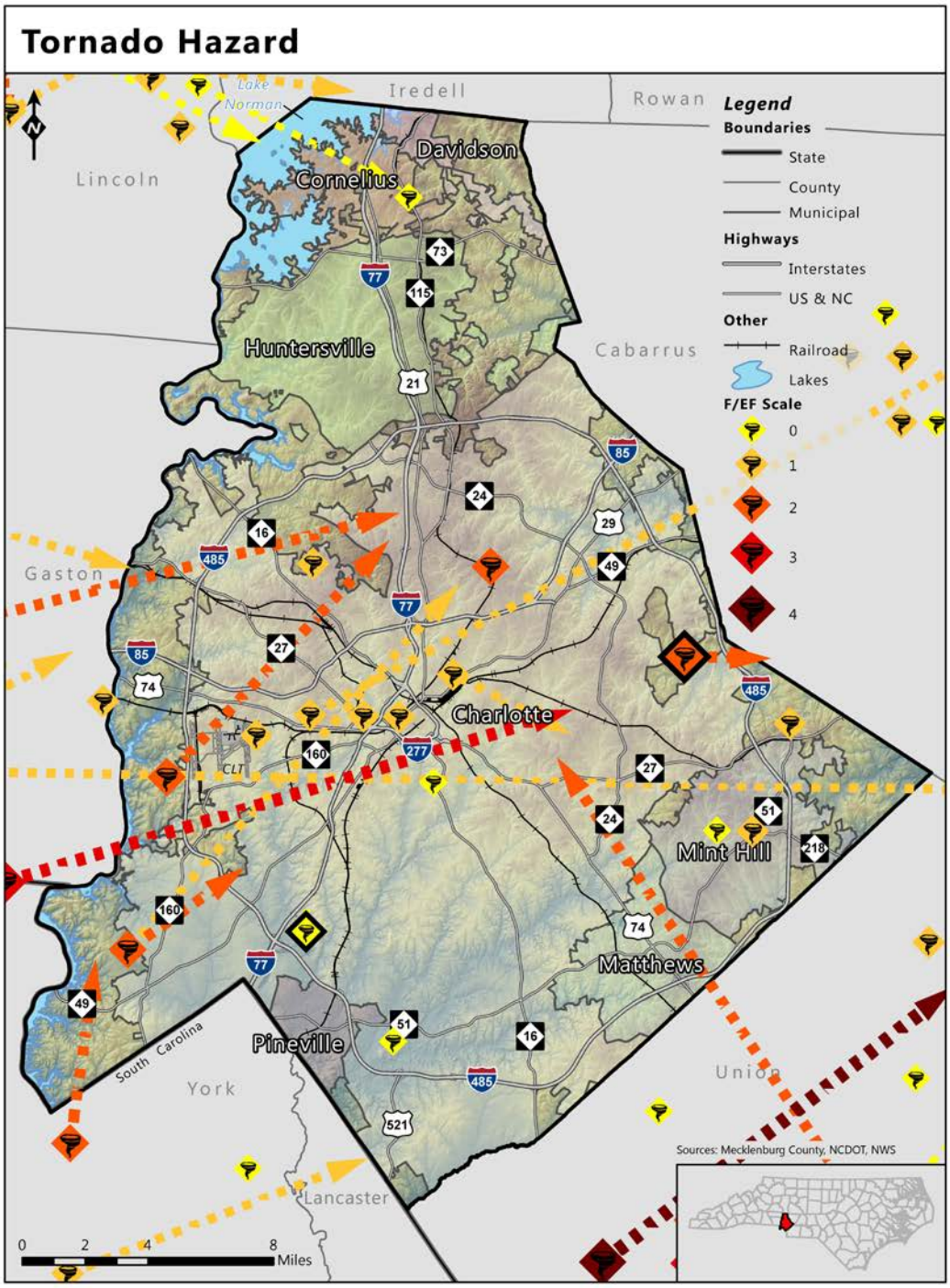
When compared with other states, North Carolina ranks 22nd in number of tornado events, 20th in tornado deaths, 17th in tornado injuries and 21st in damages. These rankings are based upon data collected for all states and territories for tornado events between 1950 and 2003. According to the State Climate Office of North Carolina, most (43 percent) of tornado occurrences in North Carolina are minimal (F0) in intensity, followed F1 (37 percent).[10]

Figure 5.5 illustrates the approximate location where confirmed tornadoes have touched down in Mecklenburg County (and for those with end locations, the approximate tracks) according to historical tornado data collected from the National Oceanic and Atmospheric Administration through 2014, and according to their intensity classification on the Fujita scale. (The two new tornado hazard occurrences since the 2010 plan update are highlighted with black borders around the map symbols.)

[9] While no injuries or crop damages have been reported, this does not necessarily mean that they did not occur. It does, however, reflect the best readily available (reported) data.

[10] For more information on classifying tornado intensity according to the Enhanced Fujita Scale, please see Section 5: *Hazard Analysis*.

Figure 5.5: Tornado Occurrences in Mecklenburg County



SIGNIFICANT HISTORICAL EVENTS

According to National Climatic Data Center records, Mecklenburg County experienced 22 tornado events from 1950 through October of 2014, causing no deaths, 23 injuries and approximately $5.4 million in property damage (**Table 5.8**). The majority (50%) of these events were classified as F1 tornadoes, with the remaining 50% split evenly between F0 and F2. The most significant recorded event occurred on March 10, 1992 when an F2 tornado touched down in the late evening hours, was on the ground for 3.4 miles with a reported width of 180 yards, and caused 18 injuries and $2.5 million in damages. No additional information on this event (outside of NCDC records) was found.

Table 5.8: Tornado Events in Mecklenburg County (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Mecklenburg	02/18/1960	F1	0/0	**$3,000**	No details available.
Mecklenburg	04/12/1961	F1	0/0	**$25,000**	No details available.
Mecklenburg	08/10/1964	F1	0/0	NR[11]	No details available.
Mecklenburg	09/12/1965	F2	0/0	**$25,000**	No details available.
Mecklenburg	06/07/1968	F2	0/0	**$25,000**	No details available.
Mecklenburg	05/28/1973	F2	0/0	**$250,000**	No details available.
Mecklenburg	05/28/1973	F1	0/**1**	**$250,000**	No details available.
Mecklenburg	10/08/1975	F1	0/0	**$25,000**	No details available.
Mecklenburg	09/16/1977	F1	0/0	**$25,000**	No details available.
Mecklenburg	08/14/1978	F0	0/0	**$3,000**	No details available.
Mecklenburg	05/03/1984	F1	0/0	**$250,000**	No details available.
Mecklenburg	06/06/1985	F0	0/0	**$250,000**	No details available.
Mecklenburg	11/28/1990	F1	0/0	**$25,000**	No details available.
Mecklenburg	03/10/1992	F2	0/**18**	**$2,500,000**	No details available.
Mint Hill	03/20/1998	F0	0/0	NR	A weak, short-lived tornado was observed by a woman in Mint Hill to briefly touchdown in front of her stopped car. Tornado damage was confined to trees and power lines.
Cornelius	05/07/1998	F0	0/0	**$50,000**	A waterspout/tornado crossed Lake Norman from neighboring Lincoln County and moved through Cornelius. The roof of a grocery store was damaged and debris from the store damaged cars and other buildings across the street at a dealership.
Pineville	08/01/1999	F0	0/0	NR	A citizen near Pineville reported twin gustnadoes separated by 30 seconds, which spun up along the gust front of one of the severe thunderstorms. The wind from the gustnadoes pinned the man against the outside wall of his home, chewed up tree limbs and downed a few trees, and threw a 40 foot section of a tree over his house. A neighbor measured the wind associated with the first gustnado at 70 mph with a hand held anemometer.
14 Miles Southwest of Charlotte	09/07/2004	F2	0/0	**$150,000**	This tornado produced widespread damage to trees and power lines along its two-mile path across the southwest corner of Mecklenburg County. The roof of a well-constructed home was blown off, and several other homes incurred shingle damage. There was additional damage to automobiles and homes due to fallen trees.

[11] "NR" means "None Reported" indicating that no records exist of reported property damage. This does not exclude the possibility or probability that unreported damages did in fact occur.

Table 5.8: Tornado Events in Mecklenburg County (1950-2014)

LOCATION	DATE OF OCCURRENCE	MAGNITUDE	DEATHS/ INJURIES	PROPERTY DAMAGE	DETAILS
Charlotte	03/08/2005	F1	0/0	**$50,000**	A weak tornado developed within a squall line as it moved over the Charlotte metropolitan area. The tornado developed near the intersection of 36th and North Tryon streets, where the roof of a building was torn off. In the same general area, the roofs of two trailers were partially torn off. Intermittent tree damage occurred along most of the remaining three miles of the track, with some trees falling on vehicles. At the end of the track, the roof was damaged and some windows blown out when a large oak tree fell on Cochrane Middle School. The roof cover was torn off of a business and some large pine trees and limbs were blown down just south of the school.
Mecklenburg	05/09/2008	F1	0/0	NR	A mini-supercell thunderstorm produced a tornado with a nearly 20-mile path through the Gastonia and Charlotte metro areas during the early morning hours. It produced damage to several structures in extreme eastern Gaston County before moving into Mecklenburg County, where the track became more intermittent. The public reporting several large trees blown down in the area around Woodlyn Drive in Northwest Charlotte. The path ended in the Beatties Ford Road area north of Charlotte, where an outbuilding was lifted and blown 20 to 30 feet and two large dumpsters were overturned.
East Charlotte/ Wilgrove	03/03/2012	EF2	**0/4**	**$1,500,000**	An NWS Storm Survey found the path of a strong tornado that developed rapidly over eastern portions of the Charlotte metro area during the early morning hours of March 3rd. The tornado touched down near the intersection of Dulin Creek Rd and Little Whiteoak Rd, moving just south of Plaza Rd extension. The tornado affected two subdivisions in Mecklenburg County. Four homes slid off their foundations and were completely destroyed. Twenty-nine homes were rendered uninhabitable from collapsed exterior walls. A total of 162 homes were damaged in the county. Four people were injured in this area. The tornado crossed I-485, just south of Plaza Rd Extension before moving into Cabarrus County. The total path length in Mecklenburg County was a little over 1.5 miles, while the maximum width was 200 yards.
Charlotte	05/15/2014	EF0	0/0	**$10,000**	Emergency managers' survey indicated a short tornado track on the south side of Charlotte. The tornado touched down at the end of Arrowpoint Blvd , where some siding was peeled off an industrial office building. The tornado tracked north/northeast along Arrowpoint Blvd, blowing down trees, tossing a large awning, and tearing a glass panel from another industrial office building. The tornado then crossed Arrowood Rd within a half mile of I-77, where more than a dozen additional trees were blown down and the tops blown out of other trees. The tornado lifted in a wooded area just north/northeast of this point.
TOTAL			**0/23**	**$5,416,000**	

Source: National Climatic Data Center

PROBABILITY OF FUTURE OCCURRENCES

It is likely that Mecklenburg County will continue to experience weak to moderately intense tornadoes. Based on historical data, the annual probability for tornado events (F0 to F2 intensity) across the county is

estimated to be 41 percent. It is unlikely that very strong tornadoes (F3, F4 or F5) will strike the area, though it does remain possible.

WINTER STORMS

Mecklenburg County has been impacted by varying degrees of snow storms and ice storms over the last century, the extent of which is measured in inches of snow; however, the occurrence of severe winter storms in the county is intermittent. In terms of receiving measurable snowfall, the National Climatic Data Center estimates that there is statistically an 84.9 percent probability that Mecklenburg County (Charlotte Douglas International Airport weather station) will receive measurable snowfall in any given year; an 87 percent probability in winter; and a 29.1 percent probability in spring. The month of January has the highest single probability at 54.5 percent, with February a close second (49.1 percent). December has a 23.6 percent probability of receiving measurable snowfall. Measurable snowfall has typically occurred between December and March. The snowiest winter on record was in 1960, when a cumulative total of approximately 22.9 inches of snow fell (November through April).

The primary concern with severe winter storms in Mecklenburg County is the impacts of widespread power outages (including business interruption and potential life/safety threats associated with the loss of power – most notably home heating during cold weather), as well as the negative impacts to transportation infrastructure that can cause disruptions to mobility and an increased potential for traffic accidents, a leading cause of fatalities reported for winter storm events. Winter storms affect all of Mecklenburg County equally.

SIGNIFICANT HISTORICAL EVENTS

According to the National Climatic Data Center, Mecklenburg County has experienced 51 significant winter storm events including snow and ice storms, extreme cold, and freezing rain since January 1994 (**Table 5.9**). These events account for a recorded estimate of $112 million in property damages for the affected areas, which includes multiple counties including Mecklenburg County in most instances. Mecklenburg County received presidential disaster declarations from major winter storms in 1996, 2000 and 2002. It is also important to consider that recorded property damages understate the true impact and cost to local governments wrought by severe winter storms as these figures do not include the expenses of snow removal, debris clean-up and the loss of electrical power which are often very significant.

The “1996 Blizzard” from January 6 to January 8, 1996 affected much of the eastern seaboard. In North Carolina, the winter storm claimed five deaths and left up to 30 inches of snow in portions of the state. In Mecklenburg County, rain gradually changed to freezing rain and then to snow and sleet. The layer of ice under the 3 to 4 inches of snow caused serious traffic problems. The ice accumulation caused widespread power outages around the Charlotte metro area and numerous traffic accidents were reported.

Five winter storms hit North Carolina from January 18 to January 29, 2000. More than 25 inches of snow and icy conditions were reported across central portions of the state, prompting the governor to declare a state of emergency. One state meteorologist considered the storm to be a 100-year event. Heavy snow and freezing rain were heavy enough across the southern Piedmont, including the Charlotte area, to result in a 1/4 to 1/2-inch glaze and downed trees and power lines. Nearly 127,000 people in North Carolina were without power early January 19th, with more cold weather in the forecast. Shelters were opened in Charlotte where about 40,000 people were without power and heat. Dozens of cars were stranded on a 15-mile stretch of Interstate 85. At the height of the storm, more than 399,000 North Carolina customers were without power and schools were closed across affected areas. A total of 31 counties in North

Carolina including Mecklenburg County received $12 million in federal assistance for snow removal and public infrastructure recovery.

The 2002 December Ice Storm paralyzed central parts of North Carolina with ice, snow and freezing rain, leaving 1.3 million customers without power and blocking streets with snapped tree limbs. Total cleanup and response costs have been estimated at $97 million. Forty-three counties in North Carolina, including Mecklenburg County, were declared for federal assistance. According to Duke Energy, the number of outages exceeded the power loss experienced after Hurricane Hugo hit Mecklenburg County in 1989. Of the 1.3 million customers affected, 285,000 lived in the Charlotte area with some being without power for 10 days or more. Twenty-seven patients were treated and released for carbon monoxide poisoning in the Charlotte area after bringing grills inside for use as heaters. The American Red Cross opened several public shelters, including public schools, the Charlotte Coliseum, and the Convention Center to accommodate more than 600 people in the Charlotte area. More than 100 roads, mostly residential and secondary roads, were closed or blocked because of downed power lines or debris in the roadway.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
Statewide including Mecklenburg County	02/10/1994	Ice Storm	NR[12]	A strong cold front brought a surge of arctic air into North Carolina on the 10th and plunged temperatures 40 to 50 degrees from readings the previous day to below freezing. Low pressure developed along the front causing widespread sleet and freezing rain across northern portions of the state. The greatest ice accumulation of 1 to 2 inches and associated damages to trees and power lines occurred in the northern Piedmont. Elsewhere in northern interior portions of the state, ice accumulations ranged from 1/4 inch to 1 inch. Numerous motor vehicle accidents were also reported.
4 Counties including Mecklenburg County	01/06/1996	Winter Storm	NR	Rain gradually changed to freezing rain and then snow and sleet across the southern Piedmont. The precipitation continued well into the next day. The layer of ice under the 1 to 2 inches of snow (3 to 4 inches in neighboring Gaston County) caused serious traffic problems. The ice accumulation was enough to cause widespread power outages around the Charlotte metro area. Across central North Carolina, numerous traffic accidents were reported. There were numerous indirect injuries and a few fatalities associated with the storm. Most injuries and deaths were traffic related.
25 Counties including Mecklenburg County	01/11/1996	Winter Storm	NR	In the Piedmont, there was more of a mixture of ice with minimal ice storm conditions reported in and around the Charlotte area. There were some power outages and numerous traffic accidents.
8 Counties including Mecklenburg County	02/02/1996	Ice Storm	**$1,250,000**	Frozen rain fell in most of the Piedmont. Bridges and overpasses quickly became icy with numerous problems reported on highways and streets. Rain was falling so heavily that not much was accumulating as ice. However, by about noon ice storm conditions began to develop quickly with numerous power outages reported. Areas west and north of Charlotte were hardest hit. Damage estimates for this major ice storm are a broad estimate and are not reliable. Road repair/cleanup costs in North Carolina exceeded $20 million. Numerous traffic accidents caused many injuries and some indirect fatalities.
14 Counties including Mecklenburg County	02/03/1996	Snow	NR	Light snow accumulated to 1 to 3 inches on top of the ice. Travel problems worsened in some places.
Mecklenburg County	02/04/1996	Extreme Cold	NR	A homeless man on the streets of Charlotte died from exposure/ hypothermia.

[12] "NR" means "None Reported" indicating that no records exist of reported property damage. This does not exclude the possibility or probability that unreported damages did in fact occur.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
14 Counties including Mecklenburg County	02/16/1996	Snow	NR	Snow fell and accumulated to several inches.
11 Counties including Mecklenburg County	02/13/1997	Ice Storm	NR	A winter storm brought a variety of weather woes to central North Carolina. Several inches of snow fell in parts of the Piedmont with up to 3 1/2 inches around Cherryville. In the Piedmont, the snow changed to a sleet storm during the afternoon with several inches of accumulation. Around Charlotte freezing rain during the evening caused scattered power outages.
29 Counties including Mecklenburg County	04/01/1997	Cold	NR	Several cold snaps following the relatively warm late winter caused temperatures to dip well into the 20s at times yielding substantial damage to the apple crop and perhaps to other crops.
7 Counties including Mecklenburg County	12/29/1997	Snow	NR	Snow moved north across the Piedmont during the morning and became heavy north and west of the Charlotte area before ending in the middle of the afternoon. Snowfall ranged between 1 and 4 inches across the southern Piedmont, to 4 to 8 inches across the northwest Piedmont. There were hundreds of traffic accidents.
4 Counties including Mecklenburg County	01/19/1998	Snow	NR	A wet snow fell at a steady rate early in the morning across the southern Piedmont, including the Charlotte metro area. Despite temperatures hovering just above freezing, the snow accumulated to between 1 and 3 inches.
21 Counties including Mecklenburg County	12/23/1998	Freezing Rain/ sleet	NR	Freezing rain and some sleet developed early Wednesday morning and persisted through the morning of Christmas Eve. Some areas later received enough glaze to cause damage.
2 Counties including Mecklenburg County	12/24/1998	Ice Storm	NR	Freezing rain built a glaze to damaging levels by sunrise and many power outages continued to occur until late morning. Power was not restored to some places until the next morning.
16 Counties including Mecklenburg County	02/19/1999	Snow	NR	A surface low moving across central Georgia and South Carolina combined with a strong upper level system to produce light snow across much of North Carolina during the afternoon. Most accumulations were between 1 and 2 inches.
9 Counties including Mecklenburg County	01/18/2000	Snow	NR	Low pressure moved east across Tennessee and weakened as it ran into a surface high pressure ridge along the East Coast. Enough moisture was available to cause heavy snow to fall across the northwest Piedmont. Precipitation began as light rain in the mid-evening hours on the 17th, but quickly turned to snow as the atmosphere cooled to below freezing. Snowfall ranged between 3 and 6 inches across the area by noon on the 18th, with a narrow band of 1 to 3 inches of accumulation of snow and sleet to the immediate south.
28 Counties including Mecklenburg County	01/22/2000	Heavy Snow	NR	Snow became heavy by evening across the Piedmont. Generally, 4 to 6 inches of snow fell across the Piedmont, with a local maximum of 7 inches in neighboring Lincoln County. Freezing rain and sleet mixed with the snow for a short time before the precipitation ended, and for the most part, caused little additional problems.
6 Counties including Mecklenburg County	01/24/2000	Heavy Snow	NR	Low pressure rapidly deepened near the North Carolina coast, wrapping abundant moisture back across the Piedmont. Snow fell all day and into the night, heavy at times south and east of Interstate 85. By the time snow ended, accumulations ranged from a trace to 4 inches to the immediate north and west of Interstate 85, to 4 to 8 inches in Charlotte, and 10 to 14 inches across southeastern Mecklenburg County. This storm followed no more than 36 hours after the area received several inches of snow and ice from a previous storm over the weekend.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
14 Counties including Mecklenburg County	01/29/2000	Ice Storm	NR	Weakening low pressure in the Ohio River Valley, developing low pressure along the Gulf Coast and cold, arctic air in place across the Carolinas resulted in a wintry mess across parts of North Carolina. This was the last in a series of five winter storms that wreaked havoc on North Carolina in an 11-day span. Across the Piedmont, precipitation that briefly began as some light sleet and snow turned quickly to freezing rain. The freezing rain was heavy enough across the southern Piedmont, including the Charlotte area, to result in a 1/4 to 1/2 inch glaze. Scattered power outages resulted. The entire Duke Power system reported 77,000 people without power.
29 Counties including Mecklenburg County	11/19/2000	Snow	NR	Light to moderate snow started in the mountains and spread southeast, lasting through the day. Generally 1 to 3 inches of snow fell.
29 Counties including Mecklenburg County	12/01/2000	Extreme Cold	NR	December 2000 will long be remembered for the brutal hold that cold weather had on the region. Temperatures ran 6 to 8 degrees below normal for the entire month. At Charlotte, it was the coldest month in 83 years.
2 Counties including Mecklenburg County	01/02/2002	Heavy Snow	NR	Heavy snow started falling early in the evening and reached heavy snowfall accumulation status between 8 p.m. and midnight in this part of the Piedmont.
7 Counties including Mecklenburg County	12/04/2002	Ice Storm	**$14,142,857**	Freezing rain began over the extreme southern mountains of North Carolina during the early afternoon on the 4th, and spread into the southwest Piedmont by mid-afternoon. Resultant damage due to ice accumulation began during the mid-to-late afternoon. The intensity of the freezing rain increased after midnight, and by sunrise on the 5th, devastating ice accumulations of 1/2 to 1 1/2 inches were observed. The hardest hit area was the Charlotte metro area. Hundreds of thousands lost power, and the outages lasted for as long as 2 weeks in some areas.
12 Counties including Mecklenburg County	01/16/2003	Winter Weather/mix	NR	Light snow fell during the evening across portions of the Piedmont of North Carolina and accumulated to 1 to 2 inches. Numerous traffic accidents were reported.
4 Counties including Mecklenburg County	01/23/2003	Heavy Snow	NR	Light snow began around midnight in the southwest Piedmont of North Carolina. A burst of heavy snow during the pre-dawn hours resulted in total accumulations of 3 to 8 inches by mid-morning.
18 Counties including Mecklenburg County	02/27/2003	Winter Weather/mix	NR	A light freezing rain developed during the overnight hours in areas from the Blue Ridge Mountains eastward to the I-77 corridor. Light ice accumulations were mainly confined to trees, bushes and automobiles. However, some slick spots did develop on bridges and overpasses, especially in the Piedmont.
12 Counties including Mecklenburg County	12/04/2003	Winter Weather/mix	NR	Light freezing rain and sleet fell for much of the day, resulting in ice accretion on trees and power lines of generally 1/8 inch or less. Some icy spots developed on bridges and overpasses.
7 Counties including Mecklenburg County	01/27/2004	Winter Weather/mix	NR	Light freezing rain developed during the early morning hours of the 27th across the southwest Piedmont. This added an additional layer of glaze to the mixture of sleet and ice that was already present. The layer of ice was as thick as 2 inches in some areas. Hundreds of traffic accidents occurred overnight and into the morning rush hour. Many of the accidents involved injuries and some fatalities. The ice was slow to melt, and traffic accidents continued for another two days.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
16 Counties including Mecklenburg County	02/26/2004	Heavy Snow	**$193,750**	Heavy snow began to fall across the Piedmont of North Carolina during the late morning. Although snowfall intensity decreased dramatically during the early-to-middle portion of the afternoon, heavy snow redeveloped during the late afternoon and continued into the evening and overnight hours. Scattered thunderstorms contributed to intense snowfall rates of 2 to 3 inches per hour from time to time, especially in the Piedmont, where total snowfall of 12 to 22 inches occurred. The heaviest amounts occurred in the southwest Piedmont, particularly in southern portions of the Charlotte metro area. Thousands of people were stranded on I-77 during the early afternoon, and some required rescue. The weight of the snowfall caused damage to numerous roofs, while some roofs completely collapsed.
4 Counties including Mecklenburg County	1/29/2005	Winter Storm	NR	Up to an inch of snow fell across the area during the morning, but sleet and ice made the greatest impact. Most locations received between 1/2 to 1 inch of sleet. In addition, freezing rain deposited a glaze of ice over the sleet during the afternoon and evening, creating extremely dangerous driving conditions, and numerous accidents.
7 Counties including Mecklenburg County	12/15/2005	Ice Storm	**$300,000**	Ice accretion began to cause damage in the northwest piedmont of North Carolina by late morning. Quite a few trees fell and power outages numbered in the tens of thousands. Several trees and large limbs fell on and damaged homes and vehicles. A 58 year-old male was killed when a tree fell through the roof of his home south of Kannapolis. Total ice accumulation ranged from a half inch or more near and west of Interstate 77 to around an eighth of an inch further east toward the Triad. Fortunately, traffic problems were few, as the temperature hovered right around freezing through the event, causing only a few slick spots.
19 Counties including Mecklenburg County	1/18/2007	Winter Weather	NR	Widespread light precipitation, mainly in the form of freezing rain, produced light ice accretion, mainly across the foothills and piedmont during the morning hours. Accretion was mainly confined to elevated surfaces, although some slick spots developed on bridges and overpasses. Quite a few traffic accidents occurred, especially in the Charlotte metro area and in the northern North Carolina foothills. A few sporadic power outages were reported.
8 Counties including Mecklenburg County	1/16/2008	Winter Weather	NR	Light snow developed across the Piedmont during mid-evening, and continued through much of the overnight hours. By mid-morning on the 17th, total accumulations ranged from around an inch south of I-85, to 3 inches or so along the I-40 corridor. Sleet and freezing rain mixed in with the snow before the event ended.
5 Counties including Mecklenburg County	1/22/2008	Winter Weather	NR	Freezing drizzle and light freezing rain developed across the western Piedmont around sunrise. Roads became very slick and hazardous, and there were numerous traffic accidents during the morning commute.
12 Counties including Mecklenburg County	1/20/2009	Winter Weather	NR	Snow developed across the foothills and western Piedmont of North Carolina. The snow continued through the overnight hours before tapering off during the morning. Total snowfall accumulations ranged from trace amounts across the North Carolina foothills, to 3 inches in the Charlotte metro area and surrounding locations.
5 Counties including Mecklenburg County	2/3/2009	Winter Weather	NR	A small area of snow developed across the piedmont during the evening, with some areas picking up a quick 2 inches before the snow tapered off.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
11 Counties including Mecklenburg County	3/1/2009	Heavy Snow	NR	Rain changed to snow during the early evening across portions of the foothills and the western Piedmont of North Carolina. Snow became heavy at times throughout the evening, and up to 4 inches had accumulated across the area by 10 pm. Snow, heavy at times and accompanied by occasional lightning, continued into the late evening and early overnight hours. By the time the snow tapered off, accumulations of 3-6 inches were common across the area. However, localized amounts of up to 9 inches were reported, especially along a corridor extending from Shelby to Hickory. The heavy wet snow caused quite a few trees and power lines to fall, resulting in numerous power outages. Some structures received minor to moderate roof damage due to the weight of the snow. Some customers were without power for several days. Numerous traffic accidents also occurred.
5 Counties including Mecklenburg County	01/29/2010	Winter Storm	NR	Low pressure tracked across southern Georgia during the night of the 29th, and then off the southeast cost on the 30th. Snow became heavy at times during the late evening, resulting in quick accumulation of snow. The snow gradually changed over to sleet overnight, before ending as freezing rain. Where precipitation fell mainly as snow, generally along and north of I-40, snow accumulation of 6-8 inches occurred. More sleet fell south near the I-85 corridor, with accumulations of 2 to 4 inches of sleet and snow being common. Light ice accumulation also occurred near the I-85 corridor. A 45-year-old man died in a single-vehicle accident near Cleveland in Rowan County (indirect). Also, nighttime refreezing of snow and ice resulted in several days of high traffic accident incidents. Another traffic fatality occurred near Cleveland on the morning of February 2, when a 26-year-old man died after hitting a patch of ice and colliding with another vehicle.
9 Counties including Mecklenburg County	02/12/2010	Winter Storm	NR	Light snow developed during the evening rush across portions of the Carolina piedmont and southern foothills. The snow intensified through the evening, and began to quickly accumulate. By mid-evening, 1 to 3 inches of snowfall had occurred across the area. Numerous traffic accidents resulted, particularly in the Charlotte metro area. The snow continued until around midnight, with total accumulations of 2 to 4 inches across the area.
16 Counties including Mecklenburg County	03/02/2010	Winter Weather	NR	Snow, mixed with rain at times, quickly spread north and east across the western Carolinas shortly after sunrise. Despite bursts of moderate to heavy snow, a warm ground and above freezing temperatures caused much of the snow to melt upon impact. As a result, accumulations were light, ranging from trace an inch or so along the I-85 corridor, to 2-3 inches along the I-40 corridor.
31 Counties including Mecklenburg County	12/16/2010	Winter Weather	NR	Light precipitation fell across the mountains during the evening, and continued for much of the overnight. Precipitation mainly fell as freezing rain, although some areas saw a period of light accumulating snow at the onset. By late morning, most areas had received at least a trace of ice accretion, resulting in very slippery roads. Over the piedmont and foothills the majority of the precipitation fell as freezing rain and freezing drizzle. Most areas saw at least trace amounts of ice, with some areas along the I-40 corridor seeing as much as a tenth of an inch. Very hazardous driving conditions existed across the northern foothills and northwest Piedmont. Locations closer to I-85 only saw a light glaze on elevated surfaces and patchy slick spots on roads. Hundreds of traffic accidents were reported across the region. Temperatures warmed above freezing in most areas by late morning.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
7 Counties including Mecklenburg County	12/25/2010	Heavy Snow	NR	A developing coastal storm brought a mix of light rain and snow to portions of the piedmont of western North Carolina during Christmas afternoon. By early evening, precipitation had changed to all snow in most areas northwest of Charlotte, and by late evening, these areas had experienced a rare white Christmas. Shortly after midnight, the precipitation had changed to all snow in the Charlotte metro area. Snow continued to fall steadily overnight, with areas northwest of Charlotte reporting heavy snowfall totals by midnight, with heavy totals not reached until shortly before sunrise along the I-85 corridor. Total accumulations ranged from 2 to 5 inches across the area by the time the snow tapered off to flurries and light snow showers later in the morning.
16 Counties including Mecklenburg County	01/10/2011	Heavy Snow	NR	Moderate to heavy snow associated with a Gulf Coast storm system spread northward across the foothills and western piedmont of North Carolina during the early morning hours. The heavy snow accumulated quickly, and by sunrise parts of the southwest foothills and piedmont had received 4 inches of snow. The snow was lighter across the northern most foothills and piedmont, where only an inch or two of snow had fallen by mid-morning. The snow became lighter during the day, but continued to accumulate. By early afternoon, snowfall totals ranged from around 7 inches over the southern foothill and southwest piedmont locations, to around 3 inches over the northern most parts of the foothills and piedmont. During the afternoon, precipitation changed to light to moderate freezing rain, which continued into the evening hours. This added as much as a tenth to a quarter inch of ice to the heavy snowfall totals, resulting in sporadic power outages, particularly in the Charlotte metro area. Persistent cold air resulted in only gradual improvement in road conditions, with some businesses and schools remaining closed for several days.
27 Counties including Mecklenburg County	01/25/2013	Winter Weather	NR	Light sleet developed across much of the western Carolinas and northeast Georgia during the morning. The intermittent sleet eventually changed to light freezing rain in most areas by late afternoon. Most areas north of the I-85 corridor saw measurable sleet, generally less than a quarter inch. A light glaze then fell on top of that, making for treacherous driving conditions during the afternoon. Most areas south of the I-85 corridor saw only trace accumulations, but that was enough to cause plenty of slick spots. Hundreds of accidents were reported across the area, especially along the I-85 corridor.
6 Counties including Mecklenburg County	02/16/2013	Winter Weather	NR	Snow showers increased in coverage and intensity as they moved out of the foothills into the Piedmont during mid-afternoon. Snowfall rates of 1 to 2 inches per hour were common, especially near the North Carolina/South Carolina border. Occasional thunder and lightning were also observed in these areas. Despite the brief nature of the snowfall, widespread accumulations of 2 to 3 inches were seen across the area.
11 Counties including Mecklenburg County	11/26/2013	Winter Weather	NR	Light to moderate freezing rain developed across the Piedmont and foothills of the Carolinas, mainly north of I-85 and east of I-26, during the pre-dawn hours. Warm roads and temperatures right at freezing prevented much in the way of travel problems. However, many areas saw between 0.1 and 0.2 inch accumulation on trees and other elevated surfaces. Ice accumulation may have approached 1/4 inch across portions of Iredell County, where a few trees were reportedly brought down by ice. Warming temperatures forced a transition to rain by late morning.

Table 5.9: Winter Storm Activity in Mecklenburg County (1998-2014)

LOCATION	DATE OF OCCURRENCE	TYPE OF EVENT	PROPERTY DAMAGE	DETAILS
13 Counties including Mecklenburg County	01/28/2014	Winter Weather	NR	Light snow developed over the Piedmont and foothills of the Western Carolinas and northeast Georgia during the afternoon and continued into the evening before tapering off. The snow initially melted on roads. However, air temperatures rapidly cooling into the 20s caused many roads to subsequently freeze. Although snowfall totals were light, ranging from 1 to 2 inches of less in most areas, the slick roads caused hundreds of traffic accidents.
3 Counties including Mecklenburg County	02/11/2014	Winter Weather	NR	Light to occasionally moderate snow began to overspread the extreme southern Piedmont of North Carolina around mid morning and continued off and on through the day. By mid-evening, total accumulations ranged from 1 to 3 inches across much of the area, although isolated 4 inch amounts were reported. Warm road temperatures yielded little in the way of travel problems.
2 Counties including Mecklenburg County	02/12/2014	Winter Storm	NR	A Miller type-A low pressure system moved up along the South Carolina coast bringing widespread snow, which by late afternoon began to change to sleet and freezing rain. Precipitation eventually changed back to snow before ending during the morning of the 13th. Most areas saw 3-6 inches of snow and sleet. Meanwhile, a band of heavy snowfall that developed during the morning of the 13th produced additional heavy accumulations on the east and north side of Charlotte, where storm total amounts ranged from 10-12 inches.
4 Counties including Mecklenburg County	03/17/2014	Winter Weather	NR	Sub-freezing air that gradually oozed south across the North Carolina Piedmont caused light rain to change to freezing rain during the early afternoon along the I-85 corridor. By late evening, many areas reported around 0.10 inch of ice accretion, with pockets of higher amounts. Most of the ice accretion was on elevated surfaces and warm roads prevented significant travel problems, although a few slick spots and accidents were reported. The freezing rain tapered off to freezing drizzle during the evening of the 17th, but even this continued through the night in some areas.
TOTAL			**$15,629,464**[13]	

Source: National Climatic Data Center

PROBABILITY OF FUTURE OCCURRENCES

Winter storms will remain a likely occurrence for Mecklenburg County. While most storms will be more likely to produce small amounts of snow, sleet or freezing rain with minimal impacts in terms of property damage, larger storms, though less frequent in occurrence, may also occur with more significant impacts to the area.

[13] Damages are for Mecklenburg County only based on the methodological assumption that damages were equally distributed among impacted counties. While this may not produce an exact estimate of property damage within the county, it is deemed sufficient for planning purposes within this context.

EARTHQUAKES

While there are no active fault zones in North Carolina, Mecklenburg County is affected by the New Madrid (Missouri), Eastern Tennessee, Giles County, Virginia and Charleston, South Carolina Seismic Zones. During the last 200 years, major faults in both the New Madrid and Charleston seismic zones have generated earthquakes measuring greater than 8 on the Richter Scale and causing ground shaking events in Mecklenburg County.[14] **Figure 5.6** shows the location of ancient (and inactive) fault lines and the location of historical earthquake epicenters in North Carolina between 1698 and 1997. The state has had its share of earthquakes, but large, damaging seismic events are infrequent – most are relatively small, random and scattered events. Approximately two-thirds of North Carolina is subject to earthquakes, with the western and southeast regions the most vulnerable to a very damaging earthquake.

Figure 5.6: Earthquake Epicenters in North Carolina (1698-1997)

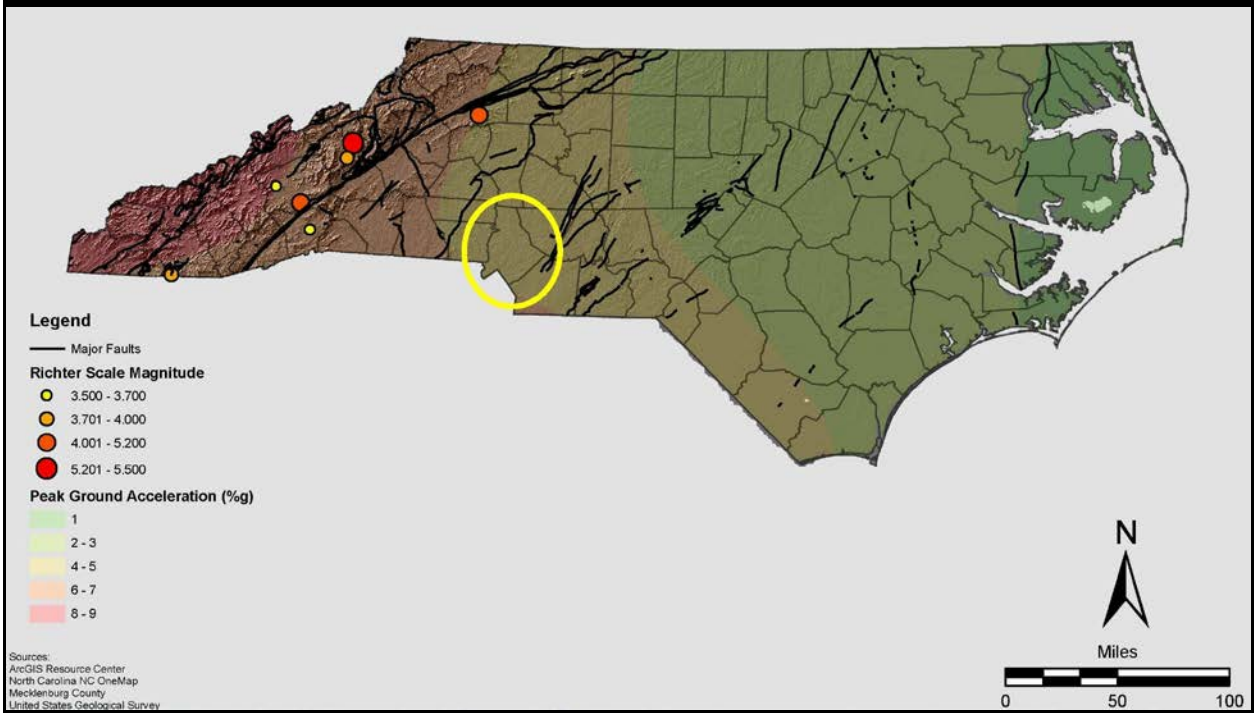
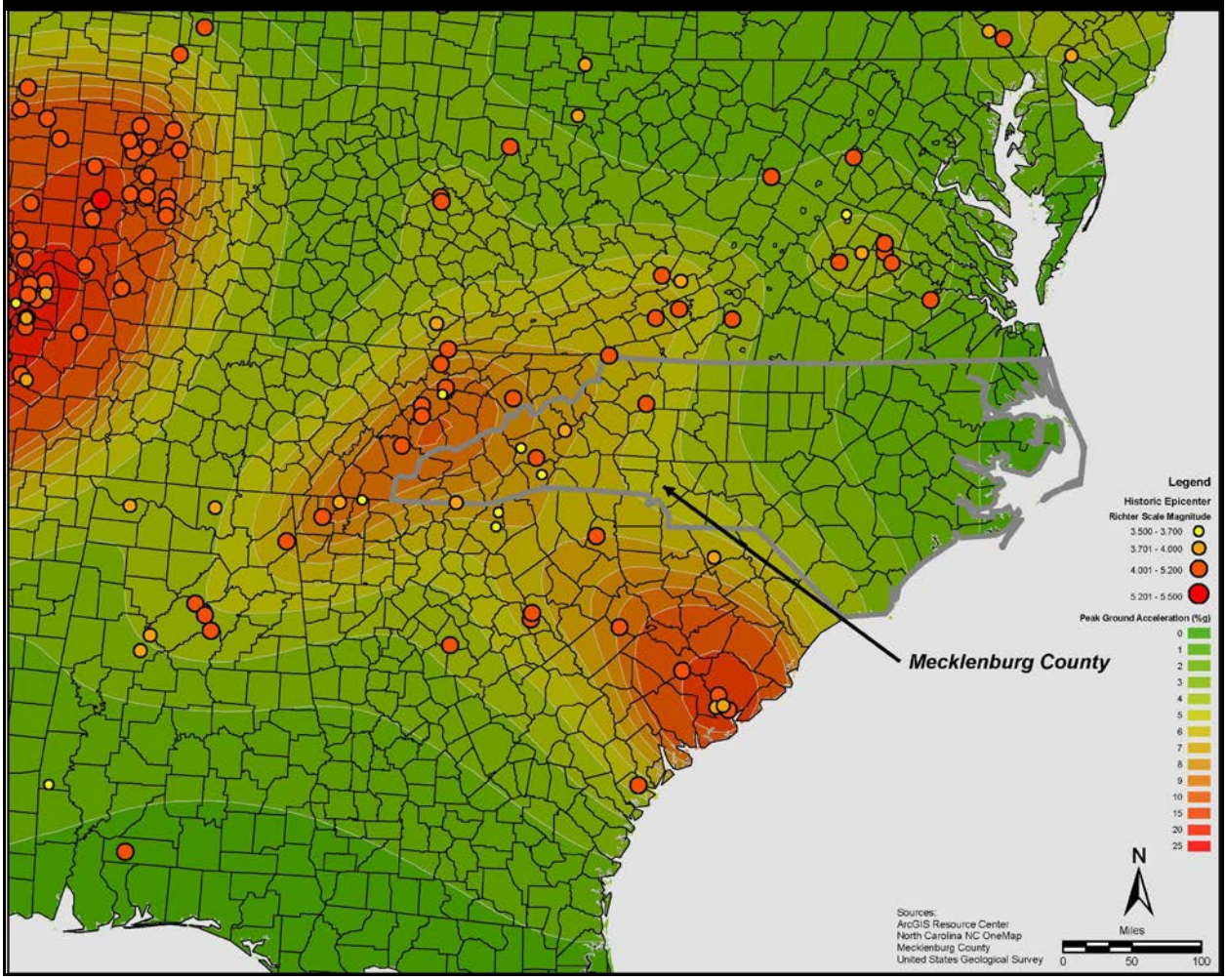


Figure 5.7 shows the earthquake intensity level associated with Mecklenburg County relative to regional hazard susceptibility, based on the national U.S. Geological Survey map of peak acceleration with 10 percent probability of exceedance in 50 years.[15] According to this data, Mecklenburg County is in a moderate risk zone, with a peak ground acceleration value (%g) of 5.

[14] Refer to the *Hazard Identification* in the preceding section for details regarding the Richter Scale and the potential damages associated with varying degrees of seismic events.
[15] This national USGS base map is presented and discussed in the *Hazard Identification* section of this Plan. The zones indicated on the Mecklenburg County map are based on and consistent with the national map.

Figure 5.7: Peak Acceleration with 10 Percent Probability of Exceedance in 50 Years



SIGNIFICANT HISTORICAL EVENTS

Table 5.10 lists the 16 significant earthquake events that have impacted Mecklenburg County as compiled from National Geophysical Data Center records for the period 1638 to 1985 according to database queries for all participating jurisdictions using "city name". This includes data on the intensity of each event as felt locally in Mecklenburg County. Of particular note, on December 13, 1879, a minor earthquake awakened residents in Charlotte, Pineville and surrounding communities, but no property damage or injuries were reported. The most severe property damage in North Carolina ever attributed to an earthquake was caused by the 1886 Charleston earthquake. Severe property damage occurred within a 160-kilometer radius of Charleston including the southeast portion of North Carolina. Several communities, including Charlotte, reportedly had chimneys thrown down, fallen plaster and cracked walls.

While not listed in the table, the great earthquakes of 1811-1812 centered on the Mississippi Valley near New Madrid, Missouri were felt throughout North Carolina. The North Carolina Geological Survey reports that MMI VI effects were observed in the western part of the state. The relatively small amount of damage in North Carolina associated with the event is attributed to the low population density of the area at that time.

Table 5.10: Significant Seismic Events in Mecklenburg County

LOCATION	DATE OF OCCURRENCE	MMI[16]	DISTANCE FROM EPICENTER (MILES)
Charlotte	12/13/1879	5	4
Pineville	12/13/1879	5	14
Charlotte	09/01/1886	8	270
Pineville	09/01/1886	4	256
Charlotte	11/25/1898	4	N/A
Charlotte	02/21/1916	5	153
Charlotte	10/20/1924	2	162
Charlotte	11/3/1928	4	180
Charlotte	12/23/1928	3	N/A
Charlotte	07/26/1945	4	101
Charlotte	11/20/1969	5	241
Cornelius	11/20/1969	3	213
Matthews	11/20/1969	3	254
Pineville	11/20/1969	3	257
Davidson	11/22/1974	4	296
Charlotte	09/13/1976	2	152

Source: National Geophysical Data Center

For the 2015 plan update, the NGDC Global Significant Earthquake Database, 2150 B.C. to present was also consulted to determine if any earthquake events have impacted the planning area since the 1985 study. No records were found for the state of North Carolina, including Mecklenburg County.

PROBABILITY OF FUTURE OCCURRENCES

Earthquakes of significant magnitude are unlikely occurrences for Mecklenburg County, though the proximity of the area to major faults in several active seismic zones could increase the possibility of feeling some impact of a large, regional earthquake if it were to occur within those zones. The potential for ground shaking caused by events in these zones is well documented, and modern building codes do take them into account for today's design and construction standards. Those buildings, infrastructure and assets built long ago and not constructed to these codes are most susceptible to damage during future earthquake events.

[16] Refer to the *Hazard Identification* in the preceding section for details regarding the Modified Mercalli Intensity (MMI) scale for earthquakes.

LANDSLIDES

Figure 5.8 shows general indication of areas that may be susceptible to landslides according to the United States Geological Survey based upon potential incidence and susceptibility, though these geographic delineations are based on national mapping and not recommended for local planning or analysis purposes. More refined and detailed landslide hazard maps are produced for North Carolina communities through the North Carolina Geological Survey (NCGS), however to date Mecklenburg County has not been studied.[17] While better local spatial data on landslide hazards is not currently available for Mecklenburg County, it is assumed that minor landslide events are possible in localized, steep-sloped areas during extremely wet conditions.

According to NCGS, landslides are most common in the mountain region of North Carolina because of steep slopes. The Piedmont and Coastal Plain regions also have landslides that are commonly related to human activity such as making a road cut too steep. Large rainstorms, hurricanes, freeze-thaw processes and human activities all can trigger landslides.

SIGNIFICANT HISTORICAL EVENTS

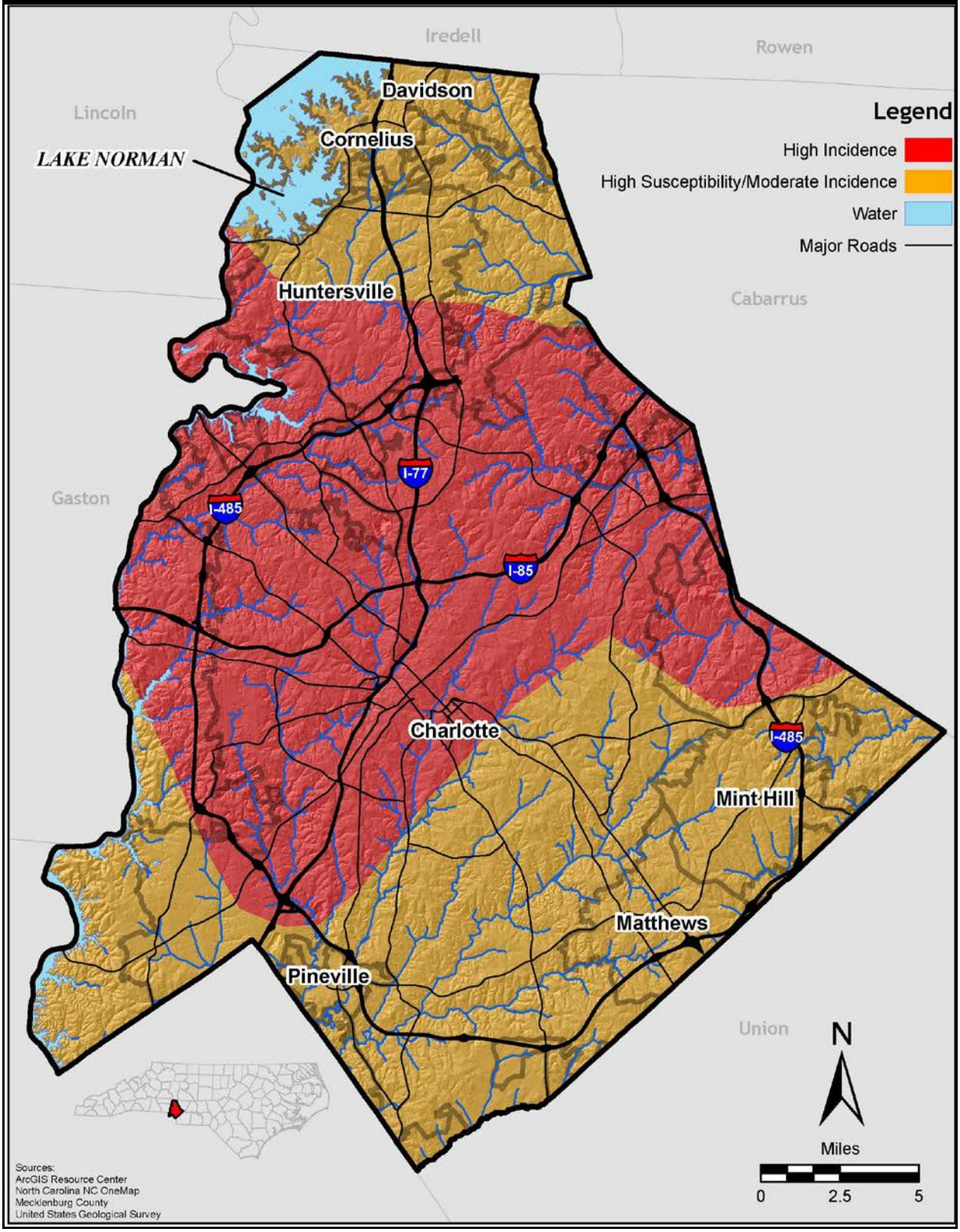
There is no history of significant landslide events in Mecklenburg County. The extent of the landslide hazard would be based upon cubic yards of earth moved or area shifted and how far, however no historical data exists to measure extent based on this criteria.

PROBABILITY OF FUTURE OCCURRENCES

Landslides remain a possible occurrence in localized areas of Mecklenburg County, but impacts from such events would likely cause minimal localized damage.

[17] NCGS has focused their landslide hazard mapping efforts on counties with a more significant risk and history of landslide occurrence including Buncombe, Macon and Watauga.

Figure 5.8: Landslide Incidence and Susceptibility



SINKHOLES

Existing soil types in Mecklenburg County are not conducive to the formation of natural sinkholes. There is a higher potential for soil piping and/or erosion caused by leakage from drainage pipes, collapsed water mains or sewer lines, failed culverts and the effects of other human infrastructure activity. The extent of sinkhole activity is measured in terms of the dimensions of the sinkhole. The largest known sinkhole in the region was 45 feet deep recorded in Catawba County in 2002. This was not a naturally occurring sinkhole however, as it was caused by a drainpipe failure. The historical information that is available for Mecklenburg County is recorded below, however specific diameters of historic sinkholes in Mecklenburg County is unrecorded.

SIGNIFICANT HISTORICAL EVENTS

Mecklenburg County has experienced minor sinkhole activity in the past; however, these events are very uncommon occurrences and very few have caused any reported property damages. The most recent significant incident was reported in June 2009 when heavy rain formed a sinkhole around an existing drainage pipe underneath Sam Drenan Road. The corrugated metal pipe was originally installed in 1961 which corroded and the entire road was washed out. The failure caused Sam Drenan Road to be closed to vehicular and pedestrian access for several months. No private property damages occurred and this resulted in approximately $800,000 in repair costs to replace the roadway crossing. According to the county engineer, sinkholes of that magnitude are very uncommon. However, many pipes underneath the ground could form cracks due to age and over time leaks could erode the dirt and soil around it.

PROBABILITY OF FUTURE OCCURRENCES

Sinkholes remain a possible occurrence in localized areas of Mecklenburg County, though primarily as caused by human activity versus a naturally occurring event. This is particularly the case in areas of the county with older water and sewer lines that are prone to possible leakage or collapse, though Charlotte-Mecklenburg Utility crews continuously examine underground pipes for problems and spend approximately $15 million each year to maintain and repair water and sewer lines. Impacts from such events would likely cause minimal localized damage, though potentially significant service interruptions caused by infrastructure damage and road closures.

DROUGHT

According to the Palmer Drought Severity Index (PDSI) illustrated in Section 4: *Hazard Identification* (Figure 4.4), Mecklenburg County is located in a region that experienced severe drought conditions less than 10 percent of the 100-year period during 1895 to 1995, meaning that severe long-term drought conditions are a relatively low probability event for Mecklenburg County. However, based on historical event data, shorter term droughts of less severity are more common and may occur several times in a decade.

While Mecklenburg County doesn't have nearly the amount of agriculture-based businesses as other counties in North Carolina, the regional impacts of long-term drought conditions are felt locally. In addition to the negative effects on agriculture, lower lake levels, reduced streamflows and decreases in groundwater supply can result in the drying up of wells and often necessitate mandatory water restrictions for all areas of the county, including those urbanized communities.

The *Charlotte Water Comprehensive Emergency Management Plan* (CEMP) is the County's umbrella emergency preparedness document which covers all participating jurisdictions. The CLTWater CEMP includes a section describing the City's planned response including potential mandatory water conservation measures that could become necessary in the event of a drought or other declared water supply shortage. The City of Charlotte is a leading member of the Catawba-Wateree Water Management Group that monitors water supply conditions and operates under one Low Inflow Protocol (LIP) in case of any situation that leads to limited availability of the shared regional water supply. The utility's drought response plan and the regional LIP aligns with municipal water conservation regulations as described in Chapter 23, Article 7 of the City of Charlotte Code of Ordinances.

SIGNIFICANT HISTORICAL EVENTS

In recent years, all of western North Carolina has experienced severe to extreme drought conditions. Since 1998, the National Climatic Data Center has recorded 34 instances of drought in Mecklenburg County (**Table 5.11**).[18] Though instances are recorded on a monthly basis by the National Climatic Data Center, events are usually part of ongoing drought conditions that last several months or years. This was certainly the case for Mecklenburg County which endured what can be classified as multiple drought periods in 1998-2002 (severe to extreme), Spring 2004 (moderate), and 2007-2008 (severe to extreme). None of these events resulted in any deaths or injuries, and no damages to property or crops were recorded for Mecklenburg County.[19] However, according to some NCDC reports, agricultural and other losses attributed to the long-term drought in western North Carolina are estimated to be in the hundreds of millions of dollars. In addition, these droughts resulted in near record lows for stream flows, reservoirs and groundwater levels and the implementation of mandatory water restrictions across the area.

Of particular note, Mecklenburg County received a USDA agricultural disaster declaration in July 2002 along with 72 other counties in North Carolina due to long-term drought conditions. According to the North Carolina Department of Agriculture (NCAGR), agricultural losses exceeded a total of $170 million for the state. The NCAGR estimated that crop losses in some of the affected counties were as high as 75 to 80 percent. This agricultural disaster declaration makes farmers eligible for USDA low interest emergency

[18] Drought occurrences recorded by the National Climatic Data Center are not necessarily unique events, as many instances of drought persist through multiple reporting periods. This is reflected in the details provided for some long-enduring occurrences in Table 5.11.

[19] While no injuries or crop damages have been reported to the NCDC, this does not necessarily mean that they did not occur. For example, the USDA disaster declaration data that follows provides another means to measure the impact of drought-related damages.

farm loans. Lastly, according to the National Climatic Data Center, there have been no occurrences of prolonged extreme heat events in Mecklenburg County that are sometimes a hazardous element of drought conditions.

Table 5.11: Occurrences of Drought in Mecklenburg County (1998-2004)

LOCATION	DATE OF OCCURRENCE	DETAILS
Countywide	07/01/1998	Dry weather continued through much of the month of July, affecting crops during the critical part of the growing season. Corn and other vegetables sustained the most damage, but a dollar amount was not available at the time of this writing.
Countywide	10/01/1998	The drought that began during the summer continued through October. The only significant rainfall during the month occurred on the 7th and 8th. Cities and counties began to restrict water usage and stream flows for several mountain locations were reduced to the lowest seen in 50 years.
Countywide	11/01/1998	Dry weather persisted into the late fall with rainfall deficits between 5 and 10 inches. This affected late season crops and caused water shortages. Water usage restrictions were initiated in many communities.
Countywide	07/01/1999	A long-term dry spell became a drought in July. Without any widespread rain events, the only relief came in the form of rare, widely scattered afternoon and evening thunderstorms. The lack of rainfall lowered water tables significantly and significant damage to crops began to occur. The northwest Piedmont was affected first, followed by the southern Piedmont.
Countywide	08/01/1999	The drought worsened during the month of August as high evaporation rates and little rainfall occurred. The most severe conditions by the end of the month had developed in the Piedmont. Water restrictions began in several communities, and for some, the first time in memory. Hay and late crops dried up in many counties. Ponds and wells began to dry up as well, affecting homeowners, farmers and businesses such as nurseries. In addition, boaters were running aground on recreational lakes due to low water levels.
Countywide	09/01/1999	Rainfall continued to be scarce across portions of North Carolina through the month of September, prolonging the drought conditions that existed all summer. However, some areas in the Piedmont picked up some rain from the remnants of Hurricane Dennis early in the month and from Hurricane Floyd itself two weeks later. Although this rain brought some relief, more wells ran dry and many more areas began mandatory water restrictions.
Countywide	10/01/1999	The return of some rainfall as well as lower evaporation rates due to the change of seasons resulted in the drought easing somewhat. Drought classifications were lowered in some cases, and some jurisdictions lifted water restrictions. However, the drought had not ended by the end of the month.
Countywide	08/01/2000	The two-year drought was reaching a critical stage by late summer. Many 80 to 100-foot wells were going dry. Area lakes were at record low levels causing property damage to docks, boats, etc.
Countywide	09/01/2000	Overall, drought conditions continued across portions of North Carolina despite some locations receiving near their month's average rainfall. Low stream flow and municipal water supply remained the largest issues with many cities and towns enacting water restrictions. Citizens were quoted as saying this is the driest they had ever seen it. Despite the drought conditions, impact on crops seemed to be minimal.
Countywide	10/01/2000	Effects of the drought intensified, as many areas received absolutely no rain during the month setting records for the longest stretch without measurable rainfall in several locations. Wells and some streams continued to dry up and lake levels continued to drop. Many communities were forced to start more stringent water conservation measures.
Countywide	11/01/2000	The long-term drought continued to affect the region. Rainfall during the month was near or slightly above normal, but this had little effect on the ground water levels. Numerous wells dried up during the fall, and well borers and drillers could not keep up with the demand. Large lakes reported record low levels and some communities continued or initiated water control measures.
Countywide	02/01/2001	The long-term drought's impact became more severe, even during the winter, as water levels in lakes dropped and stream flow on rivers reached the lowest in memory. More and more communities began water restrictions and started preparing for a busy fire weather season.

Table 5.11: Occurrences of Drought in Mecklenburg County (1998-2004)

LOCATION	DATE OF OCCURRENCE	DETAILS
Countywide	03/01/2001	Despite beneficial rain during March, the drought continued to grip most of the area. Severe water restrictions were implemented in parts of the Piedmont, where reservoirs had dropped to all-time low levels.
Countywide	04/01/2001	Some relief to the long-term drought occurred at mid-month, but for the most part, the rainfall deficit for the three-year period actually grew larger by the end of April. Mandatory water restrictions continued at some locations, with voluntary water restrictions urged at many others. Numerous wells went dry during April.
Countywide	05/01/2001	Unprecedented drought conditions continued. Some rivers and lakes reached record-low levels. Well-drilling companies in the Piedmont were recording twice as much business as usual.
Countywide	08/01/2001	The effects of the long-term drought became more severe, especially in the Piedmont. Critical water conditions were beginning to concern officials and residents of Charlotte.
Countywide	11/01/2001	Drought was again the major concern during November. An extended short-term dry spell exacerbated the 3.5-year drought, beginning in mid October and persisting through late November. During that stretch of weeks, many areas received no measurable rainfall. Toward the end of the month, wildfires became common, burning many acres especially in the higher terrain. Extremely low lake levels affected boating and water supplies. The Piedmont had received about half the normal rainfall for the calendar year by the end of November. Many additional wells and ponds dried up, tree farms closed and many communities began or expanded water restrictions. Streams were observed with record low flow levels.
Countywide	12/01/2001	Very little active weather during December signaled that the drought was still present—and becoming critically important to more and more people. The Charlotte area recorded an all-time record dry calendar year with just 26.23 inches of rainfall during 2001. Records have been kept in the area since 1878. Many communities initiated either mandatory or voluntary water restrictions.
Countywide	08/01/2002	The water supply situation reached crisis levels in some communities, as the effects of the long-term drought continued to plague North Carolina. Particularly hard hit were several Piedmont communities along the Interstate 77 corridor. Water levels on area lakes were as much as 10 feet below full pond. Most of the larger cities and towns along the I-77 corridor had imposed mandatory water restrictions by the end of the month, including the Charlotte metro area.
Countywide	5/1/2004	A period of dry weather that began in August of 2003 resulted in moderate drought conditions across portions of western North Carolina by late spring of 2004. Streamflow and lake levels began to run below normal, and a few communities instituted water restrictions.
Countywide	5/1/2007	The effects of an extended period of dry weather were exacerbated by an abnormally dry May, with many locations reporting one of the driest Mays in recorded history. By the end of May, many climatological stations were reporting yearly rainfall deficits as high as 10 inches. The result was severe to extreme drought conditions across much of western North Carolina by the end of the month. Water restrictions were implemented in some counties across extreme western North Carolina. The very dry conditions added to agriculture hardships caused by a hard freeze and widespread damaging winds in April.
Countywide	6/1/2007	Despite an increase in thunderstorm activity, drought conditions persisted across much of western North Carolina. The persistent drought continued to cause hardships to agricultural interests that were still recuperating from the April freeze.
Countywide	7/1/2007	Drought conditions persisted across much of western North Carolina during July. By the end of July, voluntary water restrictions were instituted in almost all North Carolina counties along and west of I-77. Agricultural interests continued to be especially hard hit. The absence of rain negatively affected the hay crop, creating concern for the loss of livestock.
Countywide	8/1/2007	Severe to extreme drought conditions persisted across much of western North Carolina during August. Stream flows and groundwater levels approached record low levels. Water levels on some reservoirs decreased by as much as 1 foot every 10 days. Agricultural interests continued to be especially hard hit, and the North Carolina governor requested federal disaster aid by the end of the month.

Table 5.11: Occurrences of Drought in Mecklenburg County (1998-2004)

LOCATION	DATE OF OCCURRENCE	DETAILS
Countywide	9/1/2007	Extreme drought conditions persisted across western North Carolina through September, as the region experienced another month of well-below normal precipitation. By the end of the month, most locations were running a yearly rainfall deficit of 11-17 inches. Stream flows and groundwater levels were near record low levels, with many streams running at 5 percent or less of normal flow. Water levels on area reservoirs were some of the lowest in recorded history. Agricultural interests continued to be especially hard hit. Farmers continued to struggle to feed livestock due to a lack of hay and poor pasture conditions, forcing many cattle to be sold or slaughtered. Agricultural and other losses attributed to the drought are estimated to be in the hundreds of millions of dollars.
Countywide	10/1/2007	Unusually dry weather continued across western North Carolina through October. Although a soaking rain near the end of the month resulted in near-normal monthly precipitation for the mountains, the piedmont saw another month of well-below normal rainfall. Most areas were on pace to break yearly rainfall deficit records. By the end of the month, exceptional drought conditions were reported across the majority of the area. Water flow on area streams continued at 3 to 6 percent of normal, while lake levels remained at near-record lows. Although most cities and towns were requesting voluntary water restrictions be observed, mandatory restrictions were ordered in quite a few communities. Also, private wells were beginning to dry up in many areas. Agriculture continued to be severely impacted by the drought.
Countywide	11/1/2007	November provided no relief from the effects of the long term drought. Many locations remained on pace to set annual records for rainfall deficit. By the end of the month, the vast majority of the region was experiencing exceptional drought conditions. Streamflow on area rivers remained extremely low, generally less than 10 percent of normal. Meanwhile, lakes continued to gradually fall toward record low levels.
Countywide	12/1/2007	The latter half of December saw a transition to a wetter pattern across the southeast. Most observing stations in western North Carolina reported above normal monthly rainfall for the first time since January 2007. However, this was not enough to put much of a dent in the long-term drought as extreme to exceptional drought conditions persisted into the New Year. Although the increase in rainfall did allow for some recharge of area streams, many were still running at less than 25 percent of normal flow at the end of the month.
Countywide	1/1/2008	January saw a return to dry weather across western North Carolina. Most observing stations across the region reported a rainfall deficit of 1 to 2 inches during the month, resulting in another month of exceptional drought conditions across most of the area. Water levels on area lakes remained within a foot or two of record low stages. However, rivers and streams remained somewhat recharged from the December rains, with streamflow on most waterways running 25 to 75 percent of normal.
Countywide	6/1/2008	Although near normal rainfall was observed across much of the area during the late winter and early spring, another period of abnormally dry weather in May and June exacerbated severe to extreme drought conditions over the western Carolinas and northeast Georgia. Much of the area saw less than 2 inches of rain during this period of time. By the end of the month, much of the mountains and foothills of western North Carolina were running 10 inches below normal annual rainfall. Total rainfall deficits since the beginning of 2007 were around 20 inches or more in the hardest hit areas. By the end of the month, flow on almost all major streams was running less than 10 percent of normal. Many area crops suffered.
Countywide	7/1/2008	Unusually dry weather continued through the month of July, with severe to extreme drought conditions persisting across the area. Afternoon and evening thunderstorms provided some degree of relief across portions of the North Carolina piedmont, but locations across Upstate South Carolina and extreme western North Carolina reported annual rainfall deficits of nearly 11 inches by the end of the month. Mandatory water restrictions were instituted across much of the North Carolina foothills. Water well levels began to descend below record low levels, most of which were recorded during the 1999-2002 drought. The vast majority of major streams across the area continued to run 1-10 percent of normal flow. Agriculture continued to be hard hit, with some areas reporting a 100 percent loss of the corn crop.

Table 5.11: Occurrences of Drought in Mecklenburg County (1998-2004)

LOCATION	DATE OF OCCURRENCE	DETAILS
Countywide	8/1/2008	Dry weather persisted across much of the area for most of August, although portions of the North Carolina Piedmont began to see relief from the dry conditions early in the month, due to an increase in daily thunderstorm activity. Elsewhere, exceptional drought conditions persisted and even expanded slightly westward to cover more of far western North Carolina and northeast Georgia. During the early part of the month, flows on most of the major streams across the area were running at record low levels, with the French Broad River setting a minimum flow record that had stood for almost 100 years. Only a handful of streams were running at more than 1 to 7 percent of normal. Groundwater levels were 2-5 feet below normal. Significant agricultural impacts persisted, with losses to summer crops, including hay, estimated at 30%. The dry weather also affected the livestock industry, due to shortages of pasture crops necessary for feeding. By the end of the month, Tropical Storm Fay had dropped up to 11 inches of rainfall across the area, providing some relief from the drought conditions, especially across the North Carolina Piedmont.
Countywide	9/1/2008	The heavy rain brought by Tropical Storm Fay in late August provided some relief to the drought conditions across the area. This was particularly true across the North Carolina piedmont, where improving conditions were aided by normal September rainfall. However, another dry month resulted in a persistence of extreme to exceptional drought conditions across the North Carolina mountains and foothills. Voluntary water restrictions remained widespread during the month. A few communities held onto mandatory restrictions early in the month, but many of these were lifted by the end of the month. Well water remained near record low levels in many areas, while lake levels persisted well below normal stages. Rainfall from Fay resulted in some improvement in streamflows, although most rivers and major streams remained at less than 25 percent of normal, with many still running at less than 10 percent of normal. By the end of the month, government officials had requested a federal disaster declaration for most of the counties in the area due to crop damages.

Source: National Climatic Data Center

In terms of the worst drought event on record, there were continuous negative monthly PDSI values from May 1998 through September 2002, but the lowest value on record was -6.31 in July 2002.

PROBABILITY OF FUTURE OCCURRENCES

Based on current and seasonal outlook drought maps available through the National Weather Service's Climate Prediction Center and the National Drought Mitigation Center[20], there is no concern for imminent or forecasted drought occurrences. However, based on past events, it remains possible over the long-term that Mecklenburg County will experience recurring drought conditions when precipitation falls below normal for extended periods of time. Based on climate data, Mecklenburg County will continue to experience occasional periods of extreme heat, but not nearly as severe as other regions of the country. It is estimated that the annual probability of severe to extreme drought conditions for the area is less than 10 percent.

[20] Current and seasonal drought outlook maps are made available by the National Drought Mitigation Center at www.drought.unl.edu/dm/index.html.

WILDFIRE

According to the North Carolina Division of Forest Resources (NCDFR), Mecklenburg County contains 337,773 acres of land, of which 97,299 acres are classified as forest. This is a notable increase in forestland from the nearly 85,800 acres reported in 2010. Approximately 70 percent (68,036) of the total timberland is privately owned with the remaining 30 percent being owned by Mecklenburg County or its incorporated municipalities.

In an effort to map potential wildfire hazard areas in Mecklenburg County, a GIS-based data layer called the "Wildland Fire Susceptibility Index" (WFSI) was obtained from NCDFR. The WFSI is a component layer derived from the Southern Wildfire Risk Assessment (SWRA), a multi-year project to assess and quantify wildfire risk for the 13 Southern states. The Wildland Fire Susceptibility Index (WFSI) is a value between 0 and 1. It was developed consistent with the mathematical calculation process for determining the probability of an acre burning. The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. But since all areas of the Mecklenburg County have this value determined consistently, it allows for comparison and ordination of areas of the county as to the likelihood of an acre burning. **Figure 5.10** illustrates the level of wildfire potential for Mecklenburg County based on the WFSI data provided by NCDFR.

SIGNIFICANT HISTORICAL EVENTS

According to the most recent wildfire statistics made available through NCDFR, Mecklenburg County experiences an average of 80 wildfire events per year, the majority of which are caused by "miscellaneous" or undetermined reasons and are typically smaller events. The leading cause of wildfires in North Carolina is debris burning, but much less so in Mecklenburg County due to strong local ordinances which severely restrict outdoor burning. Minor property damages generally amounting to less than $10,000 per year have been recorded as resulting from wildfire events, though occasionally, and especially during periods of severe to extreme drought, more severe damages result as was the case in 2008 with an estimated $1.6 million in property damages. **Table 5.12** shows the causes of historical occurrences of wildfire events in Mecklenburg County and a five-year average as updated by NCDFR in 2015. **Table 5.13** provides wildfire statistics for Mecklenburg County for the past ten years as reported by NCDFR, including the number of fires, acreage burned and total property damages. No additional information on these events was made available through NCDFR.

Table 5.12: Causes of Wildfire Occurrences in Mecklenburg County

CAUSE OF FIRE	NUMBER OF OCCURRENCES IN 2014	FIVE-YEAR AVERAGE
Lightning	0	1
Campfire	1	2
Smoking	2	7
Debris Burning	4	6
Incendiary	3	14
Machine Use	4	21
Railroad	0	0
Children	3	11
Miscellaneous	8	18
TOTAL	**25**	**80**

Source: North Carolina Division of Forest Resources, 2015

Table 5.13: Wildfire Statistics for Mecklenburg County (2005-2014)			
YEAR OF EVENT	NUMBER OF FIRES	ACREAGE BURNED	PROPERTY DAMAGE
2005	16	8.7	$11,000
2006	25	14.8	$5,500
2007	59	61.5	$11,000
2008	72	51.8	$1,600,000
2009	49	17	$22,025
2010	49	26.1	$0
2011	62	37.8	$0
2012	51	23.9	$0
2013	27	4.5	$0
2014	26	8.2	$0
TOTAL	**436**	**254.3**	**$1,649,525**

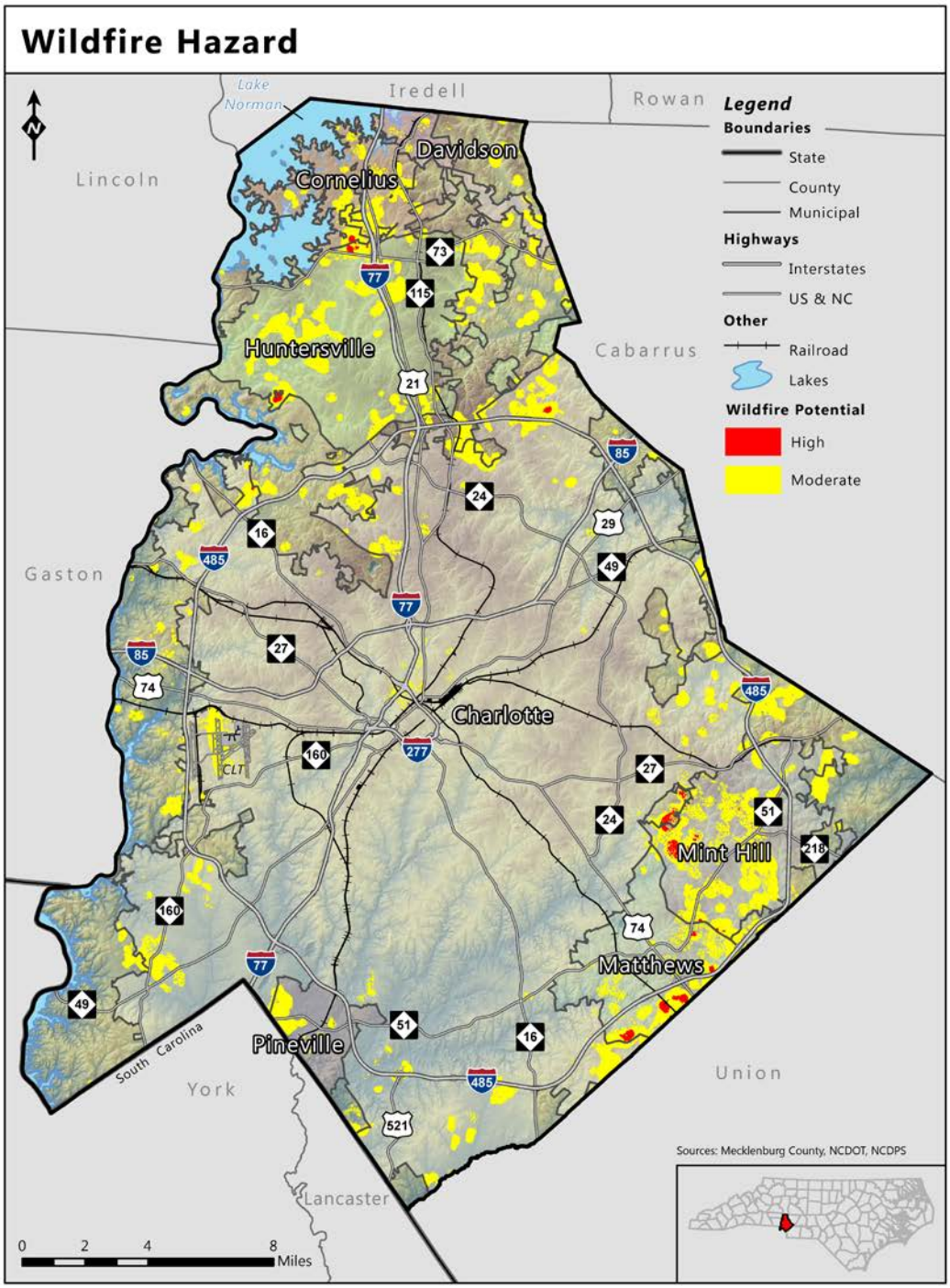
Source: North Carolina Division of Forest Resources, 2015

The largest wildfire on record in Mecklenburg County since 2004 was a 10-acre fire that started on 11/11/2007 and lasted for one day. The cause of the fire was ruled "accidental" and resulted in no reported property damage.

PROBABILITY OF FUTURE OCCURRENCES

Wildfires remain a highly likely occurrence for Mecklenburg County (100% annual probability), though most will likely continue to occur in less urbanized areas and be small in size before being contained and suppressed.

Figure 5.10: Areas of High and Moderate Wildfire Potential



DAM/LEVEE FAILURE

According to the National Inventory of Dams (NID) maintained by the U.S. Army Corps of Engineers[21], there are five major dams located in Mecklenburg County (**Table 5.14**). Major dams are defined as dams being 50 feet or more in height, or with a normal storage capacity of 5,000 acre-feet or more, or with a maximum storage capacity of 25,000 acre-feet or more. Of the five major dams located in the county, four are classified as "high" hazards where failure or mis-operation of the dam will probably cause loss of human life. The NID consists of dams meeting at least one of the following criteria:

1) High hazard classification—loss of one human life is likely if the dam fails
2) Significant hazard classification—possible loss of human life and likely significant property or environmental destruction
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

The Cowans Ford Dam created the largest manmade body of fresh water in North Carolina when it dammed the Catawba River in 1963. (Photo courtesy of Duke Energy)

It is important to note that these hazard classifications are not related to the physical condition or structural integrity of the dam (nor the probability of its failure) but strictly to the potential for adverse downstream effects if the dam were to fail.

The state regulatory agency for dams is the North Carolina Department of Environment and Natural Resources, Division of Land Resources. In addition to the five major dams listed in the National Inventory of Dams, this agency tracks and regulates a number of other smaller dams (such as farm pond impoundments, etc.) that present less severe hazard threats. According to their database there are 195 state-regulated dams[22] located in Mecklenburg County, of which 69 have been classified as "high" hazard dams where in the event of a dam failure there is a probability of at least one death and more than $200,000 in economic damages. According to the Charlotte-Mecklenburg Emergency Management Office and a review of the National Inventory of Dam Performance (NPDP) database, there is no record of failure for any of these state-regulated dams.

[21] The National Inventor of Dams was developed by the U.S. Army Corps of Engineers in cooperation with FEMA's National Dam Safety Program. The full inventory contains over 75,000 dams, of which 7,700 are classified as major, and is used to track information on the country's water control infrastructure.

[22] State-regulated dams include any dam structure greater than 15 feet in height or that has an impoundment capacity of greater than 10 acre-feet, along with any dam in which failure could result in loss of human life or significant damage below the dam. Exempt dams include those constructed by the United States government or licensed by the Federal Energy Regulatory Commission, as well as those in connection with electric generating facilities under the jurisdiction of the North Carolina Utilities Commission.

Table 5.14: Major Dams in Mecklenburg County

NAME OF DAM	HAZARD CLASSIFICATION	YEAR BUILT	NORMAL STORAGE (ACRE FEET)
Cowans Ford	HIGH	1963	1,028,307
Mountain Island	HIGH	1923	45,970
250 MG Raw Water Reservoir	HIGH	1990	0
Hicks Crossroad Dike	HIGH	1963	1,028,307
McGuire Standby Nuclear Service Water	LOW	1981	578

Source: National Inventory of Dams

Figure 5.11 shows the location of all major and state-regulated dams in Mecklenburg County, and notes which of those are classified as high, intermediate and low hazard. The Charlotte-Mecklenburg Emergency Management Office also maintains inundation maps that were prepared based on computer-simulated dam failure scenarios by Duke Energy, the owner and operator for the major hydroelectric dams in Mecklenburg County (Cowans Ford and Mountain Island). These inundation maps are currently not yet digitally referenced and are therefore not included in the GIS-based risk assessment for Mecklenburg County, but it is expected that they may be in future Plan updates – particularly if dam/levee failure is determined to be a high or moderate risk hazard through future updates to this assessment.

SIGNIFICANT HISTORICAL EVENTS

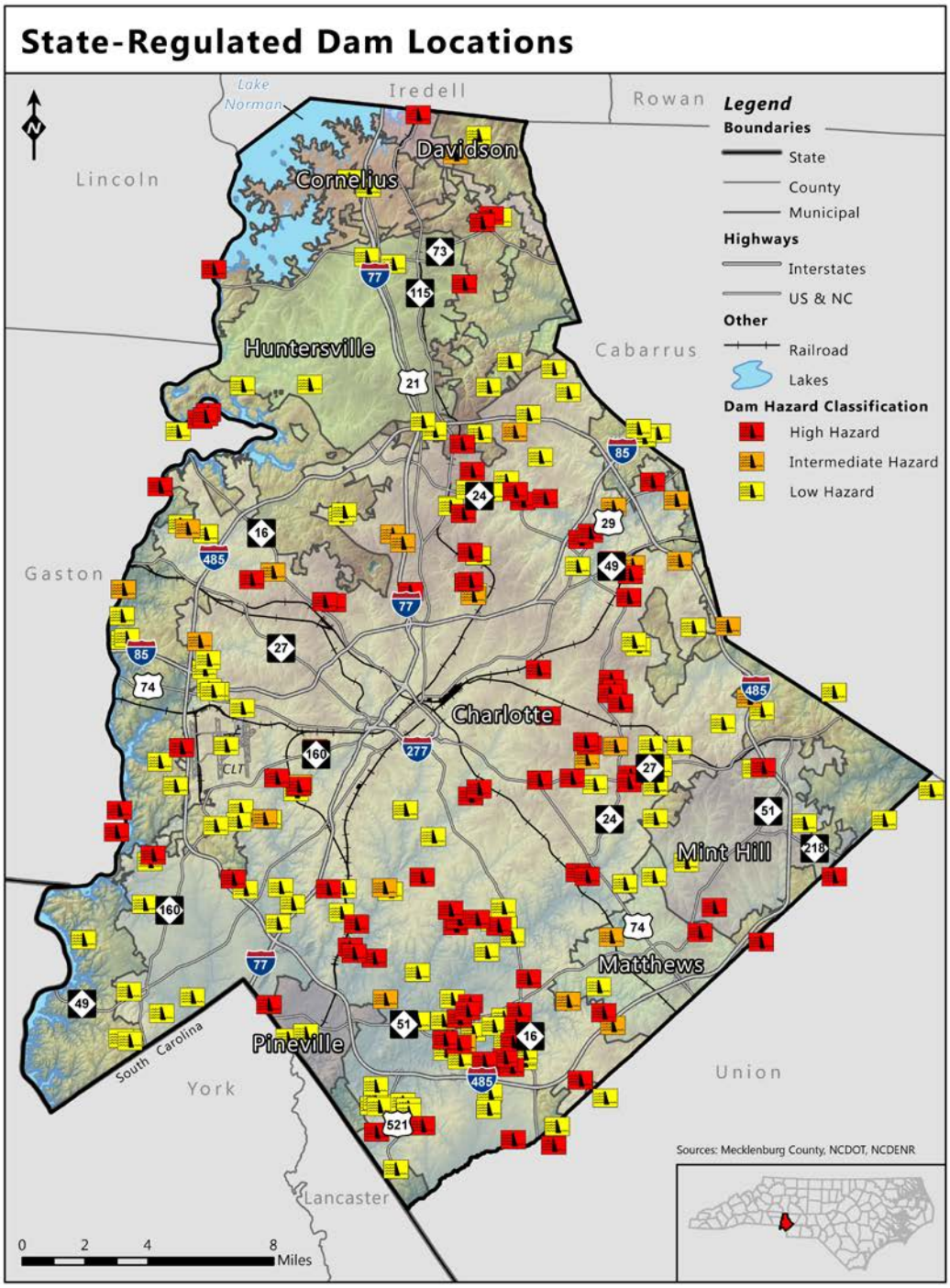
There is no record of any damages, deaths or injuries associated with dam failure in Mecklenburg County. However, in September of 2004 the torrential rains from the combined remnant effects of hurricanes Ivan and Frances forced Duke Energy to release flows through the Cowans Ford dam, resulting in the overtopping of the Mountain Island dam further downstream (there is no controlled spillway for the Mountain Island dam). This overtopping caused moderate flooding of areas immediately below the dam, including an approximately one-mile stretch of residential properties (an estimated 50-70 homes were affected in the vicinity of Riverside and Lake Drives). More recent heavy rain and localized flood events in the area have created the need for Duke Energy and Charlotte-Mecklenburg Emergency Management to update their plans and procedures for issuing notifications and evacuation orders for these same areas, including the use of Charlotte-Mecklenburg's Reverse 911® system.

The Mountain Island Dam. (Photo courtesy of Duke Energy)

PROBABILITY OF FUTURE OCCURRENCES

Dam failure remains an unlikely occurrence for all major and state-regulated dams in Mecklenburg County. The North Carolina Department of Environment and Natural Resources, Division of Land Resources is tasked with monitoring the routine inspection and maintenance of those dams that present the greatest risk or are in need of structural repair. Further, Duke Energy routinely monitors and inspects the major hydroelectric dams located in the county, and maintains the capabilities to control lake levels and the flows running through its dams on a routine basis. These activities are done so in coordination with Charlotte-Mecklenburg County Emergency Management Office.

Figure 5.11: Location of Dams in Mecklenburg County



DATA SOURCES

The following primary data sources were among those used to collect the information presented in this section.

- *American Society of Civil Engineers (ASCE), "Facts About Windstorms"* (www.windhazards.org/facts.cfm)
- *Bureau of Reclamation, U.S. Department of the Interior* (www.usbr.gov/)
- *Charlotte-Mecklenburg, Emergency Management/Homeland Security* (www.charmeck.nc.us)
- *Federal Emergency Management Agency (FEMA)* (www.fema.gov)
- *Jay Barnes, North Carolina's Hurricane History, 1998*
- *Lin Cao, Wei-Ning Xiang, and Joseph C. Wilson, Department of Geography and Earth Sciences University of North Carolina at Charlotte* (www.lightningsafety.com/nlsi_lhm/GIS_study.html)
- *National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (http://lwf.ncdc.noaa.gov/oa/ncdc.html)
- *National Drought Mitigation Center, University of Nebraska-Lincoln* (www.drought.unl.edu/index.htm)
- *National Geophysical Data Center* (www.ngdc.noaa.gov)
- *National Hurricane Center, National Oceanic & Atmospheric Administration (NOAA)* (www.nhc.noaa.gov)
- *National Lightning Safety Institute* (www.lightningsafety.com)
- *National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (www.nssl.noaa.gov)
- *National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration* (www.nws.noaa.gov)
- North Carolina Geological Survey (www.geology.enr.state.nc.us)
- *Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service* (www.spc.noaa.gov)
- *The Tornado Project, St. Johnsbury, Vermont* (www.tornadoproject.com)
- *United States Geological Survey (USGS), U.S. Department of the Interior* (www.usgs.gov)
- *WCNC.com, Belo Interactive, Inc.* (www.wcnc.com)
- *WRAL News, Capitol Broadcasting Company* (www.wral.com)

6 VULNERABILITY ASSESSMENT

INTRODUCTION

The *Vulnerability Assessment* section builds upon the information provided in the *Hazard Analysis* by identifying community assets, potentially at-risk populations and development trends in Mecklenburg County, then assessing the potential impact and amount of damage (loss of life and/or property) that could be caused by each hazard event addressed in this risk assessment.[1] The primary objective of this level of vulnerability assessment is to prioritize hazards of concern to Mecklenburg County and its incorporated municipalities adding to the foundation for mitigation strategy and policy development. Consistent with the preceding sections, the following hazards are addressed in this assessment:

- FLOOD
- HURRICANES AND TROPICAL STORMS
- SEVERE THUNDERSTORMS
- TORNADOES
- WINTER STORMS
- EARTHQUAKES
- LANDSLIDES
- SINKHOLES
- DROUGHT
- WILDFIRE
- DAM/LEVEE FAILURE

To complete the vulnerability assessment, best available data was collected from a variety of sources, including local, state and federal agencies, and multiple analyses were applied through qualitative and quantitative means (further described below). Additional work will be done on an ongoing basis to enhance, expand and further improve the accuracy of the baseline results, and it is expected that this vulnerability assessment will continue to be refined through future plan updates as new data and loss estimation methods become available.

The findings presented in this section were developed using best available data, and the methods applied have resulted in an approximation of risk. These estimates should be used to understand relative hazard risk and the potential losses that may be incurred. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning specific hazards and their effects on the built environment and also from approximations that are necessary in order to provide a comprehensive analysis.

[1] As explained in previous sections and as fully documented in Section 2: *Planning Process*, the Mecklenburg County Hazard Mitigation Planning Team evaluated all primary natural hazards likely to impact the United States and determined which of those hazards would be addressed in the *Hazard Identification*, *Hazard Analysis* and *Vulnerability Assessment* sections. For example, the tsunami and volcano hazards were briefly considered (as documented in Table 2.2), but were ruled out as valid hazards for inclusion in this risk assessment for reasons documented in Table 2.2.

44 CFR Requirement

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 risk assessment must also address the National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of: (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; (B) An estimate of the potential 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.

Part 201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

This CFR requirement is met in the Vulnerability Assessment *section of this risk assessment.*

METHODOLOGIES USED

Two distinct risk assessment methodologies were used in the formation of this vulnerability assessment. The first consists of a *quantitative* analysis that relies upon best available data and technology, while the second approach consists of a *qualitative* analysis that relies more on local knowledge and rational decision making. Upon completion, the methods are combined to create a "hybrid" approach for assessing hazard vulnerability for Mecklenburg County that allows for some degree of quality control and assurance. The methodologies are briefly described and introduced here and are further illustrated throughout this section. For each hazard addressed in this section, vulnerability is summarized in part by an annualized loss estimate specific to that hazard, along with a "PRI" value (described in detail below).

QUANTITATIVE METHODOLOGY

The quantitative assessment consists of utilizing Hazards U.S. Multi-Hazard (Hazus®MH)[2] software, a geographic information system (GIS)-based loss estimation tool available from the Federal Emergency Management Agency (FEMA), along with a statistical risk assessment methodology for hazards outside the scope of Hazus®MH. For some hazards, the quantitative assessment incorporates a detailed GIS-based approach using best available local data from Mecklenburg County. When combined, the results of these vulnerability studies are used to form an assessment of potential hazard losses (in dollars) along with the identification of specific community assets that are deemed potentially at-risk.

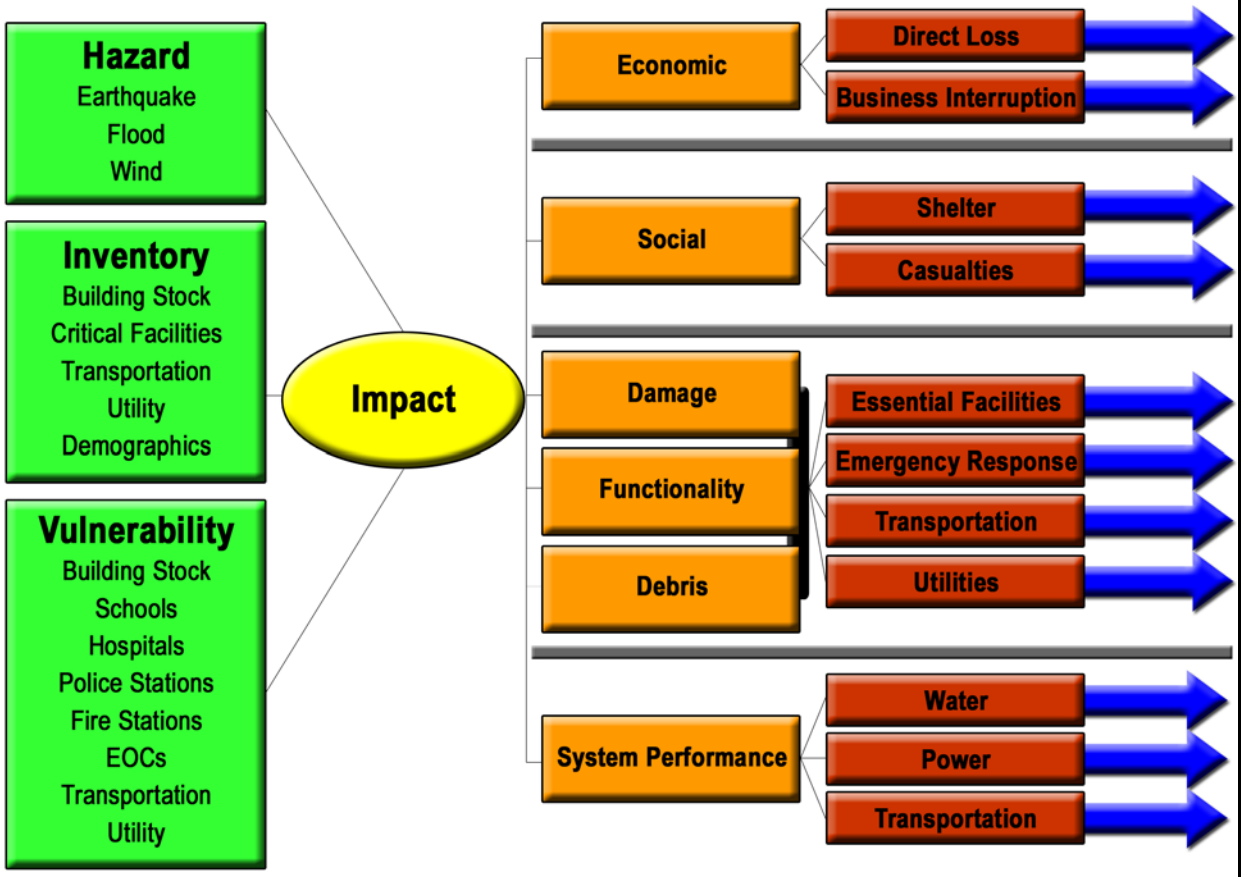
Explanation of Hazus^{MH} and Statistical Risk Assessment Methodology

Hazus^{MH} is FEMA's nationwide standardized loss estimation software package, built on an integrated GIS platform with a national inventory of baseline geographic data (including information on Mecklenburg County's general building stock and dollar exposure). Originally designed for the analysis of earthquake risks, FEMA has expanded the program to allow for the analysis of multiple hazards: namely the flood and wind (hurricane wind) hazards. By providing estimates on potential losses, Hazus^{MH} facilitates quantitative comparisons between hazards and may assist in the prioritization of hazard mitigation activities.

[2] For the 2015 plan update process, the most current version of Hazus 2.2 was used which included an updated general building stock inventory, among other features.

Hazus[MH] uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information. The Hazus[MH] risk assessment methodology is parametric, in that distinct hazard and inventory parameters—such as wind speed and building type, for example—were modeled using the Hazus[MH] software to determine the impact (damages and losses) on the built environment. **Figure 6.1** shows a conceptual model of Hazus[MH] methodology. More information on Hazus[MH] loss estimation methodology is available through FEMA at www.fema.gov/hazus.

Figure 6.1: Conceptual Model of HAZUS[MH] Methodology



Sources: Federal Emergency Management Agency

For hazards outside the scope of Hazus[MH], a specific statistical risk assessment methodology was designed and applied to generate potential loss estimates. The approach is based on the same principals as Hazus[MH], but does not rely on readily available automated software. First, historical data is compiled for each hazard to relate occurrence patterns (frequency, intensity, damage, etc.) with existing hazard models. Statistical evaluations are then applied in combination with engineering modeling to develop damage functions that can generate annualized losses.

The use of Hazus[MH] software along with the statistical risk assessment methodology provides a determination of estimated annualized loss[3] for the following hazards:

- Flood
- Hurricanes and Tropical Storms
- Severe Thunderstorms
- Tornadoes
- Winter Storms
- Earthquakes
- Landslides
- Sinkholes
- Wildfire
- Dam/Levee Failure

Due to a lack of historical data on dollar losses to the drought hazard, combined with the lack of alternative, consistent methodologies for reliably quantifying the economic impacts of drought, a third risk assessment methodology was applied for the drought hazard. This method is described in the Drought portion of this section.

When possible, quantitative hazard loss estimates are compared with historical damage data as recorded through the National Weather Service/National Climatic Data Center and other reliable data sources. For those hazards in which Hazus[MH] was used, probabilistic "worst case scenario" results were produced to show the maximum potential extent of damages. It is understood that any smaller events that could occur would likely create lesser losses than those estimated here.

Explanation of GIS-based (Non-Hazus[MH]) Risk Assessment Methodology

In addition to generating annualized loss estimates for each hazard, GIS technology was further utilized (independent of the Hazus[MH] software) to quantify and analyze potentially at-risk populations and community assets such as buildings, critical facilities and infrastructure. GIS analysis was completed for those hazards that can be spatially defined in a meaningful manner (i.e., hazards with an officially determined geographic extent) and for which digital GIS data layers are readily available. For Mecklenburg County, this includes the following hazards:

- Flood
- Wildfire

The first step in conducting this analysis included the collection of relevant GIS data from local, state and national/federal sources. These sources include the Mecklenburg County GIS Department, the North Carolina Center for Geographic Information and Analysis (CGIA) and federal agencies such as FEMA, the United States Geological Survey (USGS), and the National Oceanic and Atmospheric Administration (NOAA). Once all data was acquired, ESRI® ArcGIS™ 10.2 was used to assess specific risks to people, buildings and infrastructure utilizing digital hazard data in combination with the locally-available GIS data layers. Primary data layers include Census 2010 data along with local building footprints, tax parcel records and geo-referenced point locations for critical facilities and infrastructure elements. Using these

[3] By annualizing estimated losses, the historic patterns of frequent smaller events are coupled with infrequent but larger events to provide a balanced presentation of the overall, long-term risk.

data layers, risk was assessed and described by determining the census blocks or point locations that intersected with delineated hazard areas.

QUALITATIVE METHODOLOGY

The qualitative assessment relies less on technology, but more on historical and anecdotal data, community input and professional judgment regarding expected hazard impacts. The qualitative assessment completed for Mecklenburg County is based on the Priority Risk Index (PRI), a tool used by the County to measure the degree of risk for identified hazards in a particular planning area. The PRI is also used to assist community officials in ranking and prioritizing those hazards that pose the most significant threat to their area based on a variety of factors deemed important by the Mitigation Planning Committee and other stakeholders in the hazard mitigation planning process.

While the quantitative assessment focuses on using best available data, computer models and GIS technology, the PRI system relies more on historical data, local knowledge and the general consensus of the Mitigation Planning Committee. The PRI is used for hazards with no available GIS data or relevant information to perform quantitative analyses, and also provides an important opportunity to compare, crosscheck or validate the results of those that do have available data.

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[4], as summarized in **Table 6.1**.

To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

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

According to the weighting scheme applied for Mecklenburg County, the highest possible PRI value is 4.0. Prior to being finalized, PRI values for each hazard were reviewed and accepted by the Mitigation Planning Committee.

SUMMARY

Using both the qualitative and quantitative analyses to evaluate the hazards that impact Mecklenburg County provides members of the Hazard Mitigation Planning Team with a dual-faceted review of the hazards. This allows officials to not only recognize those hazards that may potentially be the most costly, but also to plan and prepare for those hazards that, although may not cause much monetary damage, could put a strain on the local resources needed to recover after their impact on the county.

All conclusions of the vulnerability assessment completed for Mecklenburg County and its incorporated jurisdictions are presented in “Conclusions on Hazard Risk” at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows, beginning with an overview of general asset inventory and exposure data for Mecklenburg County.

[4] The Hazard Mitigation Planning Team based upon any unique concerns for the planning area may also adjust the PRI weighting scheme.

Table 6.1: Summary of Priority Risk Index (PRI)

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	

Source: Mecklenburg County Hazard Mitigation Planning Team

* Determining impact was based upon its estimated maximum severity level[5] as indicated below.

Hazard	Estimated Maximum Severity Level
Flood	500-Year Flood (0.2% annual chance flood elevations)
Hurricanes and Tropical Storms	Category 2 Hurricane (96-110mph winds)
Severe Thunderstorms	Severe Thunderstorm Winds (55mph winds)
Tornadoes	EF4 Tornado (166-200mph winds)
Winter Storms	Severe Winter Storm (50mph winds, snow accumulations of greater than one foot and/or ice accumulations of greater than 1 inch)
Earthquakes	MMI VI Earthquake
Landslides	Only minor naturally occurring events in isolated, undeveloped areas
Sinkholes	Only minor naturally occurring events in isolated, undeveloped areas
Drought	PDSI -4.0 (Extreme Drought)
Wildfire	20 acres burned along urban/wildland interface
Dam/ Levee Failure	Complete failure of high-hazard dam

While Mecklenburg County is potentially vulnerable to each of the hazards identified in this Plan, estimated maximum severity levels helps assign values for potential impact (answering the question of "how bad can it be?") based on available scientific data and previous hazard occurrences as described in Section 5: Hazard Analysis.

[5] Estimated maximum severity levels (i.e., magnitude or extent) were classified according to scientific scales such as the Saffir-Simpson Scale for hurricanes, Palmer Drought Severity Index for drought, Modified Mercalli Intensity Scale for earthquakes and Enhanced Fujita Scale for tornadoes (more thoroughly described in Section 4: *Hazard Identification*). For hazards with no scientific scale applied, only concise qualitative descriptions of severity are provided based on the results of the hazard analysis as summarized in Section 5.

OVERVIEW OF MECKLENBURG COUNTY VULNERABILITY

POPULATION

According to the U.S. Census Bureau, the total population of Mecklenburg County in 2013 was 990,997. (For comparison, the total population for the state of North Carolina as a whole was 9,943,964.) Mecklenburg County is among the most densely populated areas in the state. The average number of persons and housing units per square mile is 1,755.5 and 780 respectively. The City of Charlotte contains the greatest population and housing units among cities and towns in the county. **Table 6.2** provides a summary of population, land area and density for the planning area.

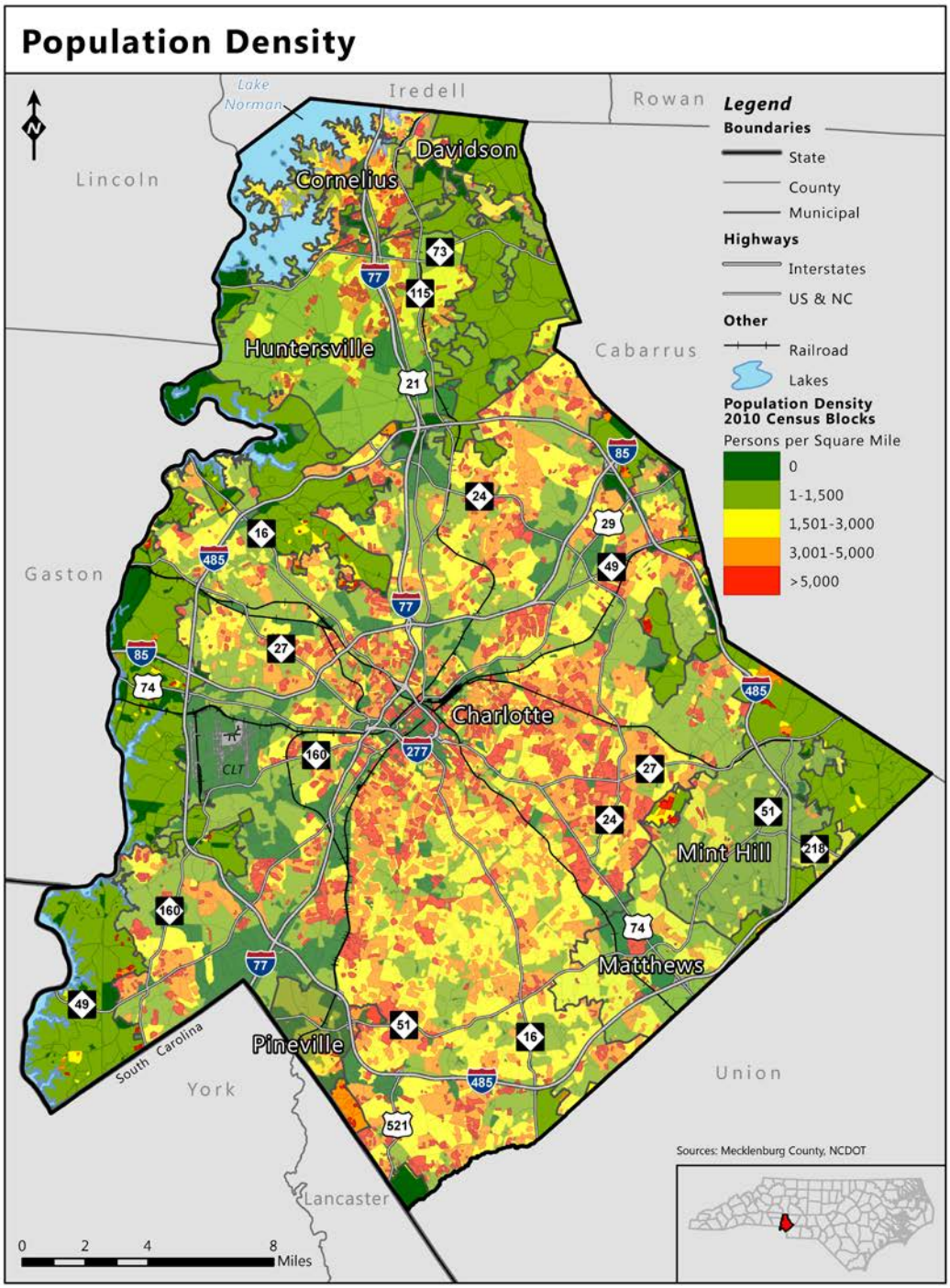
Table 6.2: Summary of Population, Land Area and Density

JURISDICTION	POPULATION (2013)	AREA IN SQUARE MILES			DENSITY PER SQUARE MILE OF LAND AREA	
		TOTAL AREA	WATER AREA	LAND AREA	POPULATION (2010)	HOUSING UNITS (2010)
Mecklenburg County	990,977	547.91	22.07	525.84	1,755.5	780
City of Charlotte	792,862	299.67	1.99	297.68	2,457.1	1320
Town of Cornelius	26,898	12.38	0.3	12.08	2,058.4	1412
Town of Davidson	11,750	6	0.25	5.75	1,903.0	875
Town of Huntersville	50,458	39.77	0.16	39.61	1,180.8	593
Town of Matthews	29,384	17.19	0.08	17.11	1,589.6	775
Town of Mint Hill	24,543	24.15	0.23	23.92	949.8	431
Town of Pineville	8,061	6.66	0.04	6.62	1,129.4	1134
NORTH CAROLINA	**9,848,917**	**53,818.51**	**5,107.63**	**48,617.91**	**196.1**	**78**

Source: U.S. Census Bureau, July 1, 2010, and 2013 Estimates

Figure 6.2 shows the distribution of this population across the county based on the number of persons per census block. Composite maps showing population distribution overlaid with the flood and wildfire hazards—the two hazards addressed in this risk assessment that can be spatially defined in a meaningful manner through GIS technology—are presented in those respective sections of this vulnerability assessment.

Figure 6.2: Population Density



GENERAL ASSET INVENTORY

The total dollar exposure of buildings within Mecklenburg County is estimated to be approximately $188.4 billion. This figure is based on an estimated 300,795 residential, commercial, industrial and other buildings located throughout the county, derived from Hazus[MH] data[6] (**Table 6.3**). The total dollar exposure accounts for both building value ($116.1 billion) and contents value ($72.3 billion). Taken together, the building and contents values provide an estimate of the aggregated total replacement value for the county's assets.

Table 6.3: Building Inventory in Mecklenburg County

BUILDING TYPE	NUMBER OF BUILDINGS	CONTENTS VALUE	BUILDING VALUE
Residential	291,355	$45,921,817,000	$91,834,203,000
Commercial	7,250	$18,254,389,000	$17,342,221,000
Industrial	1,146	$5,250,279,000	$3,783,442,000
Other[7]	1,044	$2,908,180,000	$3,212,284,000
TOTAL	**300,795**	**$72,334,665,000**	**$116,172,150,000**

Source: Hazus[MH]

Figures 6.3 through 6.5 illustrate the density of total dollar exposure for residential, commercial and industrial buildings across Mecklenburg County according to dollars per square mile.

[6] Hazus[MH] Version 2.2 uses Census 2010 and Dunn and Bradstreet (2006) data for its default inventories. Any values unavailable in the current version of the Hazus[MH] software are not reflected.
[7] "Other" includes any buildings used for agriculture, government, religious or education purposes.

Figure 6.3: Residential Building Exposure

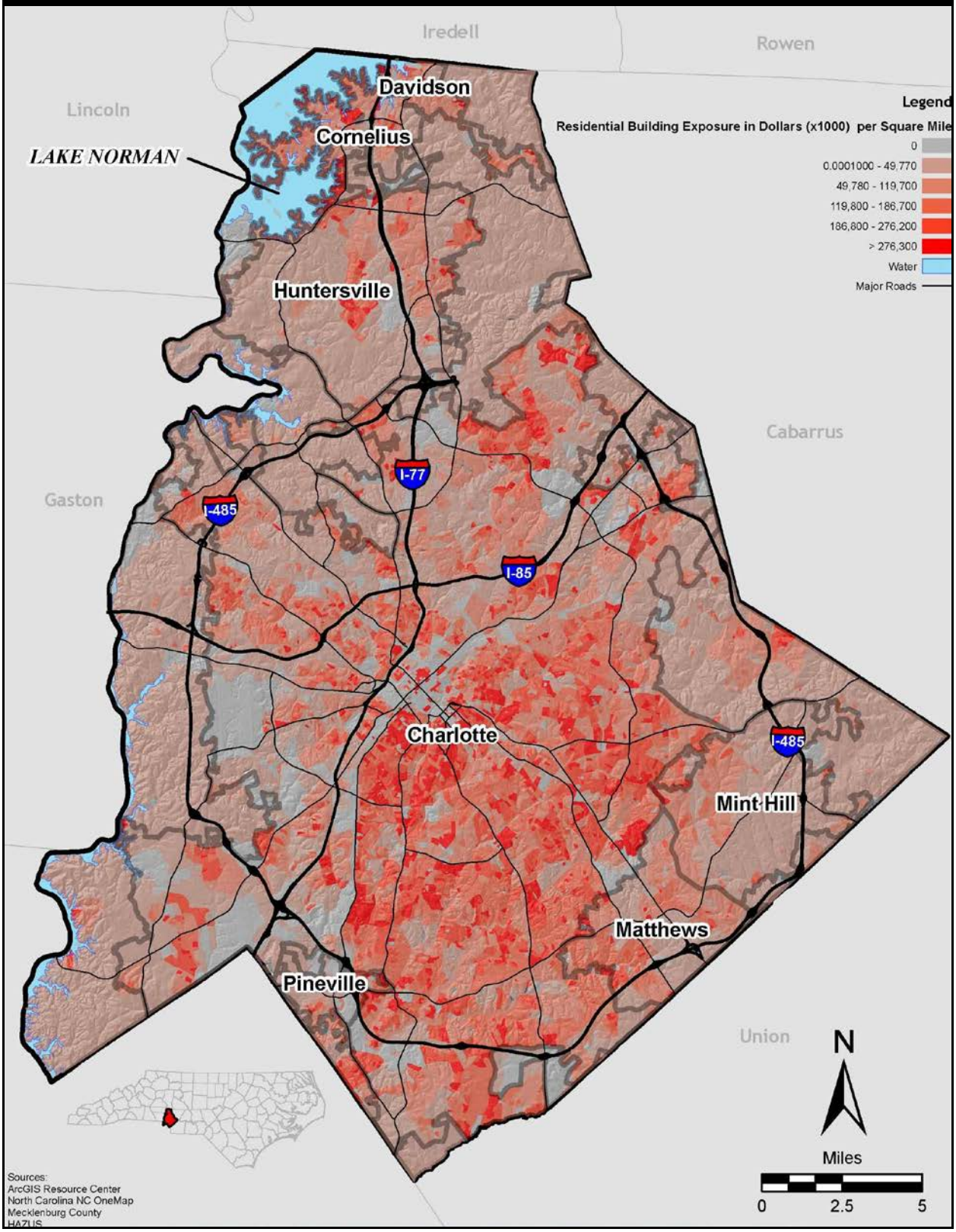


Figure 6.4: Commercial Building Exposure

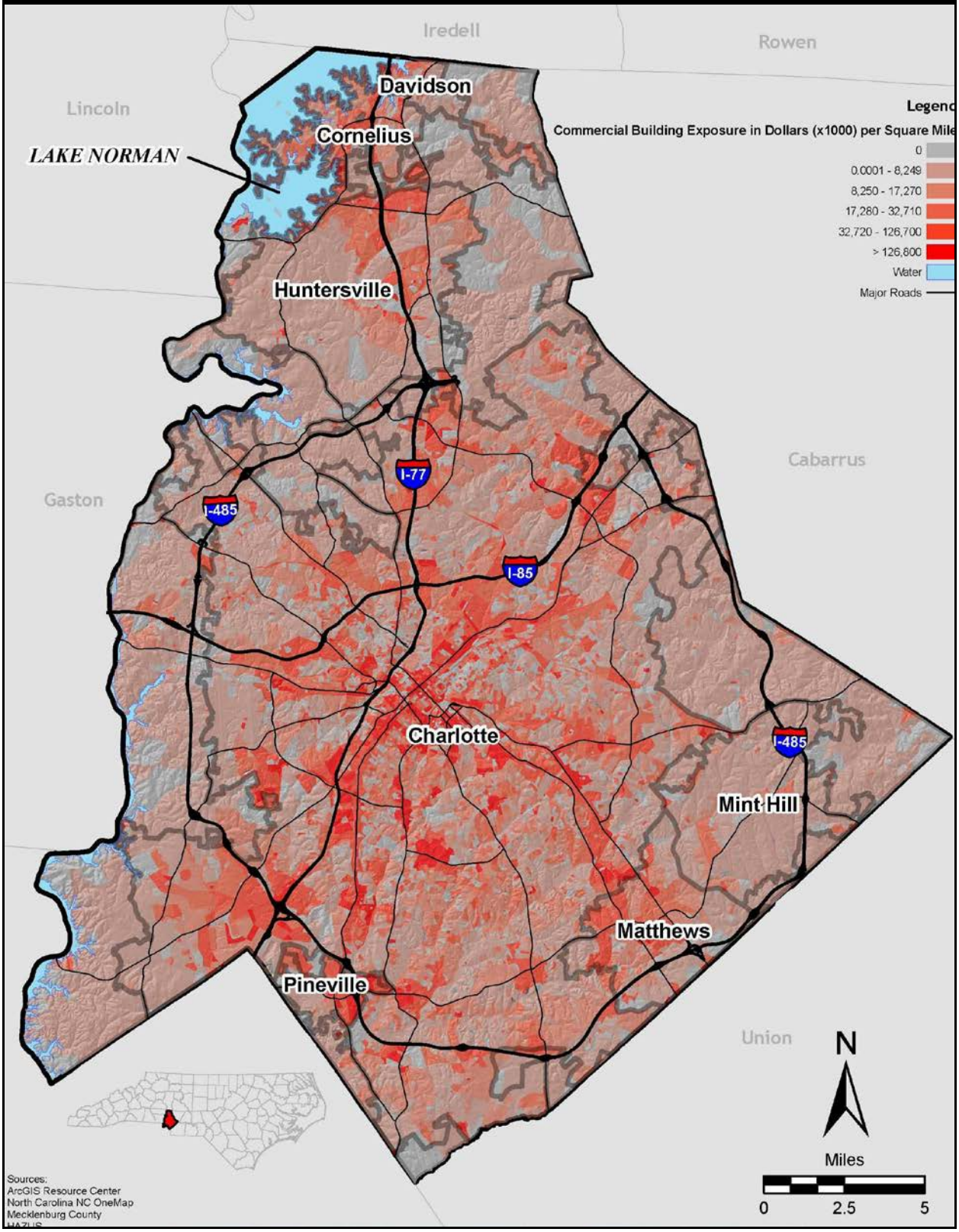
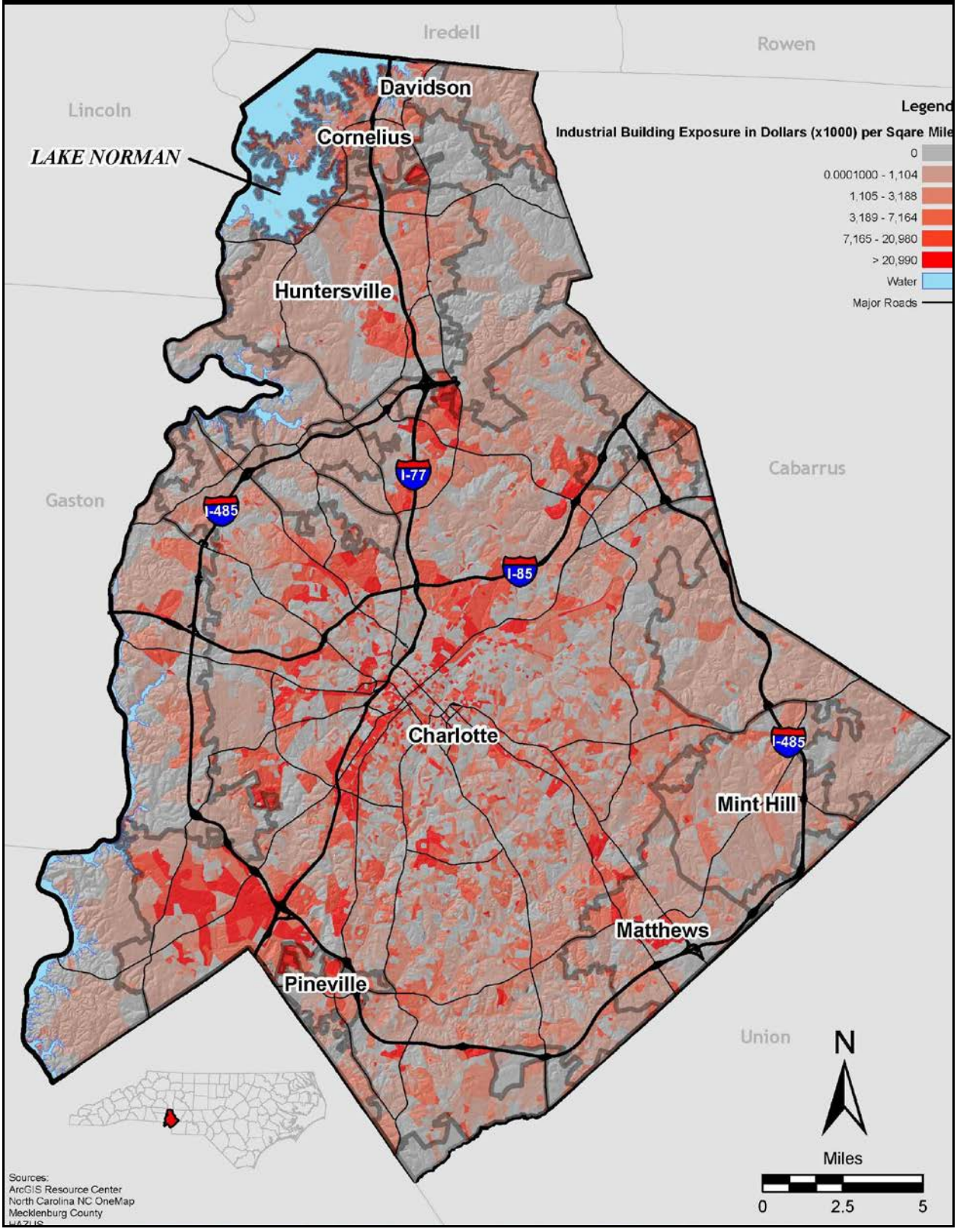


Figure 6.5: Industrial Building Exposure



CRITICAL FACILITIES

A GIS analysis was performed to identify the number and approximate location of critical facilities throughout the county and how critical facilities may relate to known hazard areas. **Table 6.4** lists the types of facilities included in this analysis along with a summary of their potential vulnerability.[8]

As can be seen in the table, it has been determined based on simple GIS analysis that 19 critical facilities are potentially at-risk to current flood hazards (existing FEMA 100-year floodplain) and an additional 3 may become potentially at-risk to future flood hazards (future Community 100-year floodplain) based on projected build-out conditions. Only two facilities were found to be located in areas of high wildfire potential, and 52 facilities were found to be located in areas of moderate wildfire potential. Location within an identified hazard area is not automatically an indicator that a particular facility is vulnerable to that hazard, and more site-specific analysis of these facilities is recommended as part of the process for identifying and evaluating any specific hazard mitigation actions to be proposed in this Plan.

Table 6.4: Critical Facilities

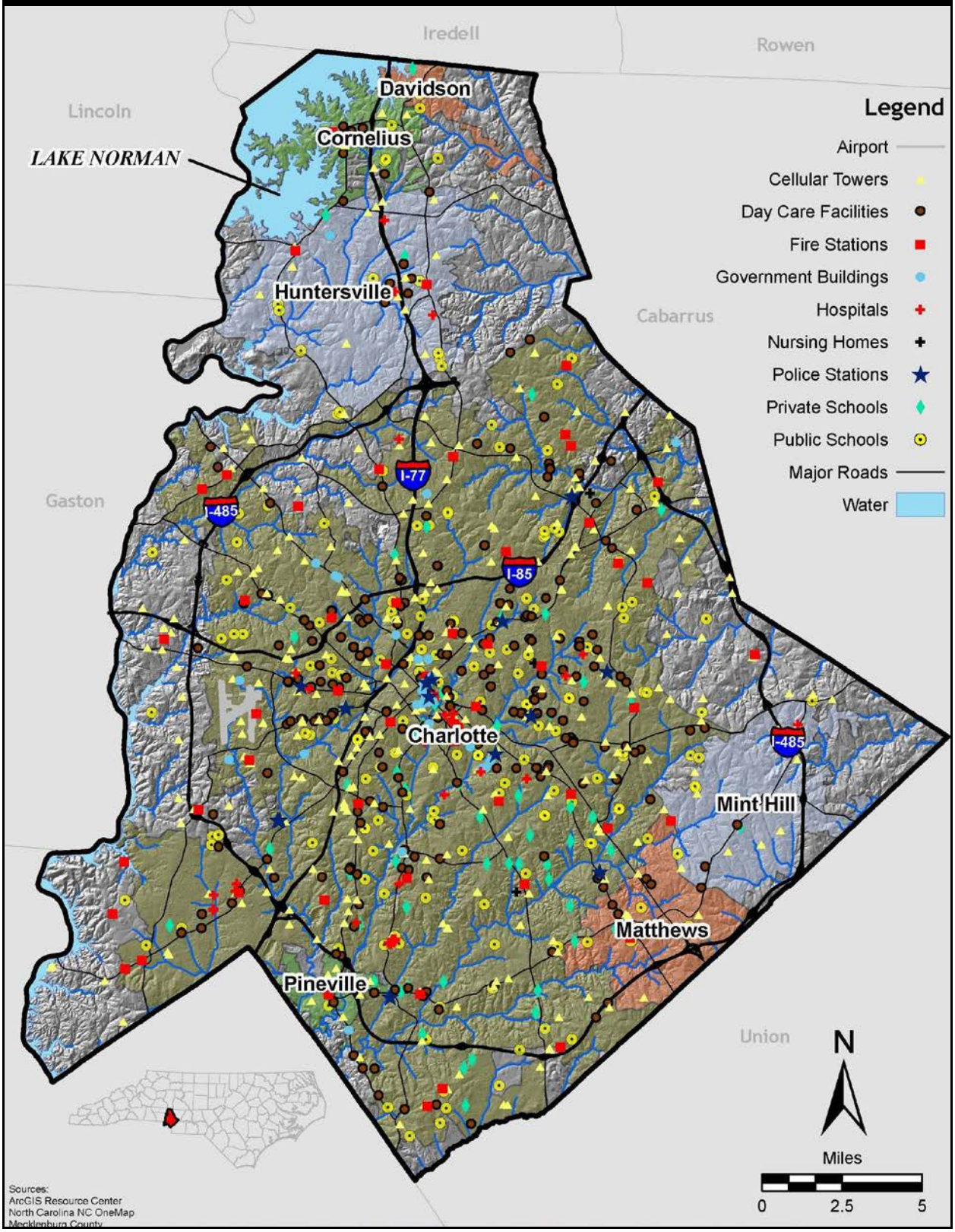
FACILITY TYPE	NUMBER OF FACILITIES	NUMBER IN CURRENT FEMA 100-YEAR FLOODPLAIN	NUMBER IN FUTURE COMMUNITY 100-YEAR FLOODPLAIN	NUMBER IN AREAS OF HIGH WILDFIRE POTENTIAL	NUMBER IN AREAS OF MODERATE WILDFIRE POTENTIAL
Airport	1	0	0	1	1
Cell Tower	307	3	3	0	13
Day Care Facilities	254	6	6	0	9
Fire Services	42	0	0	0	2
Government	40	4	5	0	2
Law Enforcement	16	0	0	0	0
Nursing Homes	3	0	0	0	0
Private Hospital	24	2	2	0	1
Private School	87	1	1	0	3
Public Hospital	2	0	0	0	1
Public School	191	1	1	3	17
Volunteer Fire Services	19	0	0	0	3
TOTAL	**938**	**19**	**22**	**2**	**51**

Sources: Mecklenburg County; GIS Analysis, including Hazus

Figure 6.6 shows the approximate location of the critical facilities included in this analysis by facility type.

[8] The analysis of at-risk critical facilities was limited to only the flood and wildfire hazards for which specific, geographically-defined hazards areas have been established. While landslide hazards may indeed be defined spatially (and USGS maps of general landslide susceptibility are provided in Section 5: *Hazard Analysis*), no detailed landslide hazard studies have been completed for Mecklenburg County.

Figure 6.6: Approximate Location of Critical Facilities



The following 18 critical facilities are believed to be within the 100-year floodplain according to the GIS analysis performed:

Private Hospitals

FEMA Floodplain:

- Charlotte Mecklenburg Hospital Authority; 1000 Blythe Blvd, Charlotte
- Aldersgate United Methodist Retirement Community; 3800 Shamrock Dr, Charlotte

Public Schools

FEMA Floodplain:

- Corvian Community School; Kindergarten to 4th Grade; 9501 David Taylor Dr, Charlotte

Private Schools

FEMA Floodplain:

- The John Crosland School; 5146 Parkway Plaza Boulevard, Charlotte

Registered Day Care Facilities

FEMA Floodplain:

- 7000 Shannon Willow Rd, Charlotte
- 1700 Providence Rd, Charlotte
- 3038 Hilliard Dr, Charlotte
- 1004 Willis St, Charlotte
- 9501 David Taylor Dr, Charlotte
- 9625 David Taylor Dr, Charlotte

Government

FEMA Floodplain:

- Mecklenburg County Board of Elections; 741 Kenilworth Ave, Charlotte
- Irwin Creek Wastewater Treatment Plant; 4000 Westmont Dr, Charlotte
- Sugar Creek Wastewater Treatment Plant; 5301 Closeburn Rd, Charlotte
- McAlpine Creek Wastewater Treatment Plant; 12701 Lancaster Hwy, Charlotte

Community Floodplain:

- Mallard Creek Wastewater Treatment Plant; 12400 US 29 Hwy, Charlotte

Cell Towers

FEMA Floodplain

- 17103 Statesville Rd, Cornelius
- 11603 Mallard Creek Rd, Charlotte
- 8115 Fallsdale Dr, Charlotte

The following 3 critical facilities are believed to be within areas of high wildfire potential according to the GIS analysis performed:[9]

Public Schools

- Independence High School; 9th to 12th Grade; 1967 Patriot Dr, Mint Hill
- Northeast Middle School; 6th to 8th Grade; 5960 Brickstone Dr, Mint Hill
- Lebanon Road Elementary School; 7300 Lebanon Rd, Charlotte

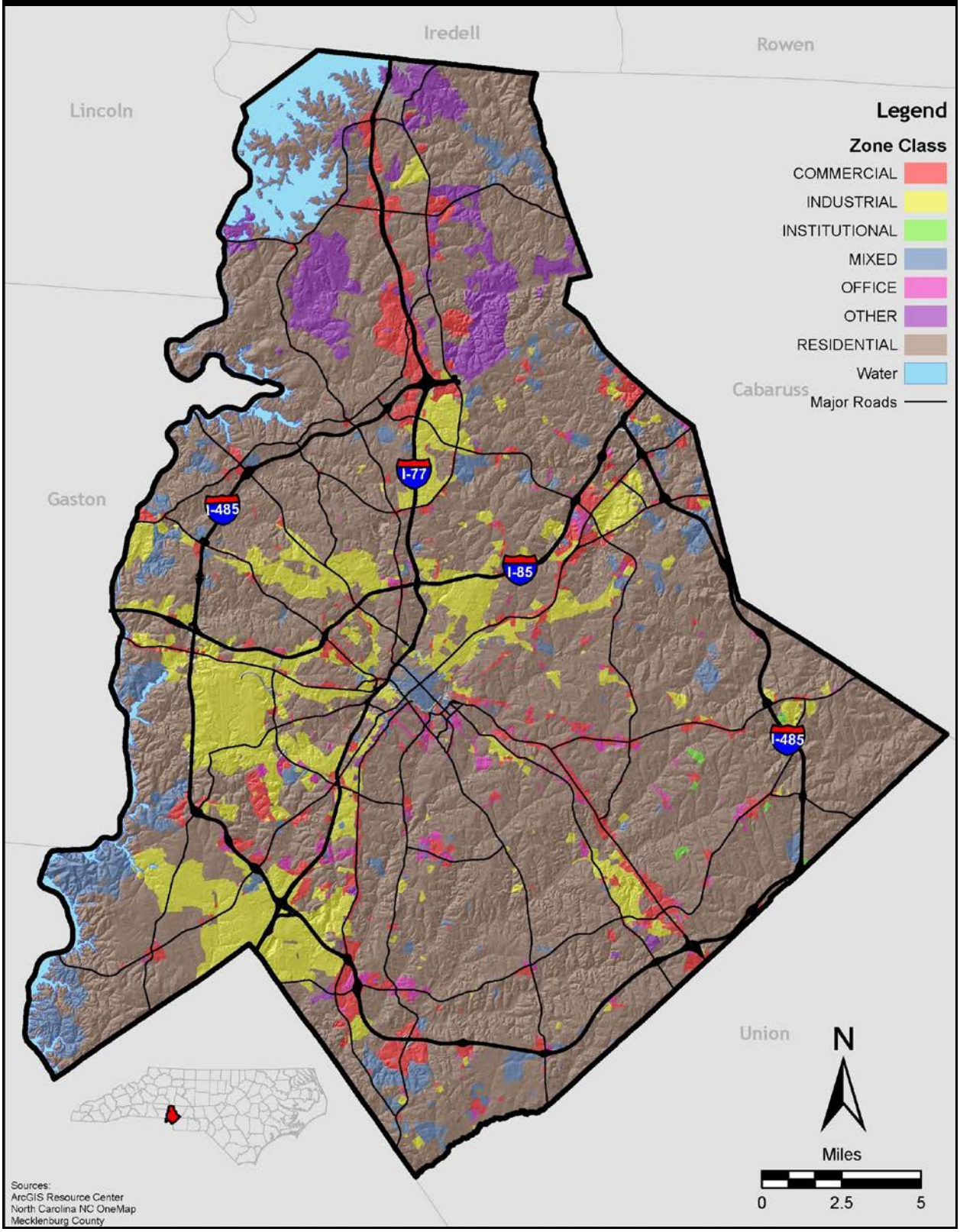
[9] The 51 critical facilities listed within areas of moderate wildfire potential are not listed herein as it's been determined more site-specific assessment should be done in advance of classifying the facilities as potentially at risk to wildfire.

ZONING AND LAND USE

In order to regulate current and future land use and guide overall development patterns, Mecklenburg County, the City of Charlotte and the towns of Cornelius, Davidson, Huntersville, Matthews, Mint Hill and Pineville have each adopted a zoning ordinance that enforces standards for designated zoning districts. Zoning maps are useful planning tools, demonstrating the type and location of projected community development.

Figure 6.7 shows generalized zoning designations for unincorporated Mecklenburg County and its seven incorporated municipalities on one countywide map. Composite maps showing zoning information overlaid with the flood and wildfire hazards—the two hazards addressed in this risk assessment that can be spatially defined in a meaningful manner through GIS technology—are presented in those respective sections of this vulnerability assessment. While this alone is not a firm indicator of future vulnerability as it relates to land use and development trends, these composite maps are presented under the Future Vulnerability and Land Use heading of these hazard discussions as a means of illustrating in a general way where future development may occur in relation to known potential hazard areas.

Figure 6.7: Countywide Zoning Designations for Mecklenburg County



MANUFACTURED HOUSING AND THE AGE OF BUILDINGS

Of the 291,355 residential buildings estimated for Mecklenburg County, approximately 7,402 or 3 percent are classified as manufactured homes (Hazus®MH). According to the U.S. Census Bureau (2006-2008 American Community Survey), it is estimated that 37 percent of total housing units in Mecklenburg County were reportedly built prior to 1980. In general, these residential buildings are presumed to be more susceptible to natural hazards.

The vulnerability of manufactured versus those built on-site can vary due to several factors. These include the age of construction, the materials and construction techniques used, the design and adherence to past and current building codes, and the method of installation. In the case of manufactured housing, their proper installation can significantly affect vulnerability. For instance, with regard to wind-related hazards such as tropical cyclones, severe thunderstorms and tornadoes, estimates based on regional trends show that 50 percent of manufactured homes built prior to 1976 (pre-HUD structures) are not secured with tie downs. Of the manufactured homes built between 1976 and 1993, 25 percent have no tie downs. Of those built from 1994 to 2004, only 1 percent have no tie downs. These statistics demonstrate that older manufactured homes—specifically those with no tie downs—are at greater risk from high wind hazards (Blue Sky Foundation of North Carolina).

Older buildings, particularly those built prior to 1980, are generally considered more susceptible to earthquake and wind hazards due to their age but also the absence of today's strong seismic and wind design standards. For example, history has proven that the greatest amount of damage following earthquakes will be to older buildings, such as unreinforced masonry structures, that were not designed with seismic hazards in mind. A similar logic applies to the age of buildings and flood hazard vulnerability. As described in Section 7: *Capability Assessment*, most communities in Mecklenburg County joined the National Flood Insurance Program (NFIP) after 1980. In order to join the NFIP, each participating jurisdiction is required to adopt and enforce its own floodplain management ordinance that requires certain construction hazards aimed at preventing future flood damages. As a result, structures built after joining the NFIP are assumed to be less vulnerable to future flood hazards than pre-FIRM construction, assuming other environmental conditions remain constant (data on the number of such buildings for each participating jurisdiction are included within this section for Flood). It is important to note, however, that continued development, for example, can cause a significant rise in flood elevations.

The above information suggests that Mecklenburg County and its participating jurisdictions should consider manufactured homes and particularly older residential structures to likely be at significantly higher risk to natural hazards, and more in need of attention through possible future hazard mitigation strategies.

DEVELOPMENT TRENDS

Two factors that contribute to an overall understanding of development trends are population change and economic growth. According to the U.S. Census Bureau, the rate of population growth in Mecklenburg County between 2000 and 2010 was 32 percent, significantly higher than the state average of nearly 15 percent. Much of this growth is centered in the City of Charlotte and surrounding areas. The North Carolina Office of State Budget and Management projects that the population for Mecklenburg County will increase from 919,628 in 2010 to more than 1.4 million in 2030 (a 48 percent increase), indicating that high growth rates for Mecklenburg County are to be expected and planned for accordingly by its local jurisdictions. Population estimates for 2034 are now expected to be 1,447,850.

As the population increases, new housing construction also increases which creates jobs and increases the inflow of dollars to the local economy. According to the Charlotte Chamber of Commerce, in the past ten years the area has recruited 7,011 new companies, 61,174 new jobs, and $12 billion in new investment

which translated into a significant building boom. However, Mecklenburg County was hit hard along with the rest of the nation following the major economic downturn in late 2007. After 18 months of no reported growth in Charlotte's coincident economic index, the area reversed the trend in November 2009 fueled by solid retail sales and the addition of thousands of new jobs. Local employment and retail sales continue to look positive for the immediate future; however the issuance of building permits continues to be well below recent averages. In 2014, a total of over 88,000 building permits were issued. While there is much debate on how quickly the economy will fully recover, it is anticipated that any increase in the broader economy will produce large percentage gains in the number of building permits issued.

More information on the growth and land use trends for Mecklenburg County and its participating municipal jurisdictions is provided in Section 3: *Community Profile*. More information on how each jurisdiction is currently addressing future development trends through local planning mechanisms, including a local self-assessment of how each is positioned to grow safely relative to natural hazards, is provided in Section 7: *Capability Assessment*.

FLOOD

PRI Value: 3.3
Annualized Loss Estimate: $4,864,000

The vulnerability assessment for the flood hazard includes the findings of the qualitative assessment conducted, a series of jurisdiction-level maps showing existing and future potential flood hazard areas (**Figures 6.8 – 6.14**), an overview of National Flood Insurance Program (NFIP) statistics, repetitive loss properties (as defined and identified by the NFIP), estimates of potential losses, social vulnerability, and future vulnerability and land use. As described in detail in the *Hazard Analysis* section, Mecklenburg County has experienced 103 significant flood events in the past 124 years amounting to approximately $41.4 million in reported property damage, providing evidence that Mecklenburg County—historically—is vulnerable to the flood hazard and that flood events occur on a fairly frequent basis.

According to the qualitative assessment performed using the PRI tool, the flood hazard scored a PRI value of 3.3 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.5** summarizes the risk levels assigned to each PRI category.

Table 6.5: Qualitative Assessment for Flood

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Highly Likely	Critical	Moderate	6 to 12 Hours	Less than 1 Week

Source: Mecklenburg County Hazard Mitigation Planning Team

Figure 6.8: Potential Flood Hazard Areas, City of Charlotte

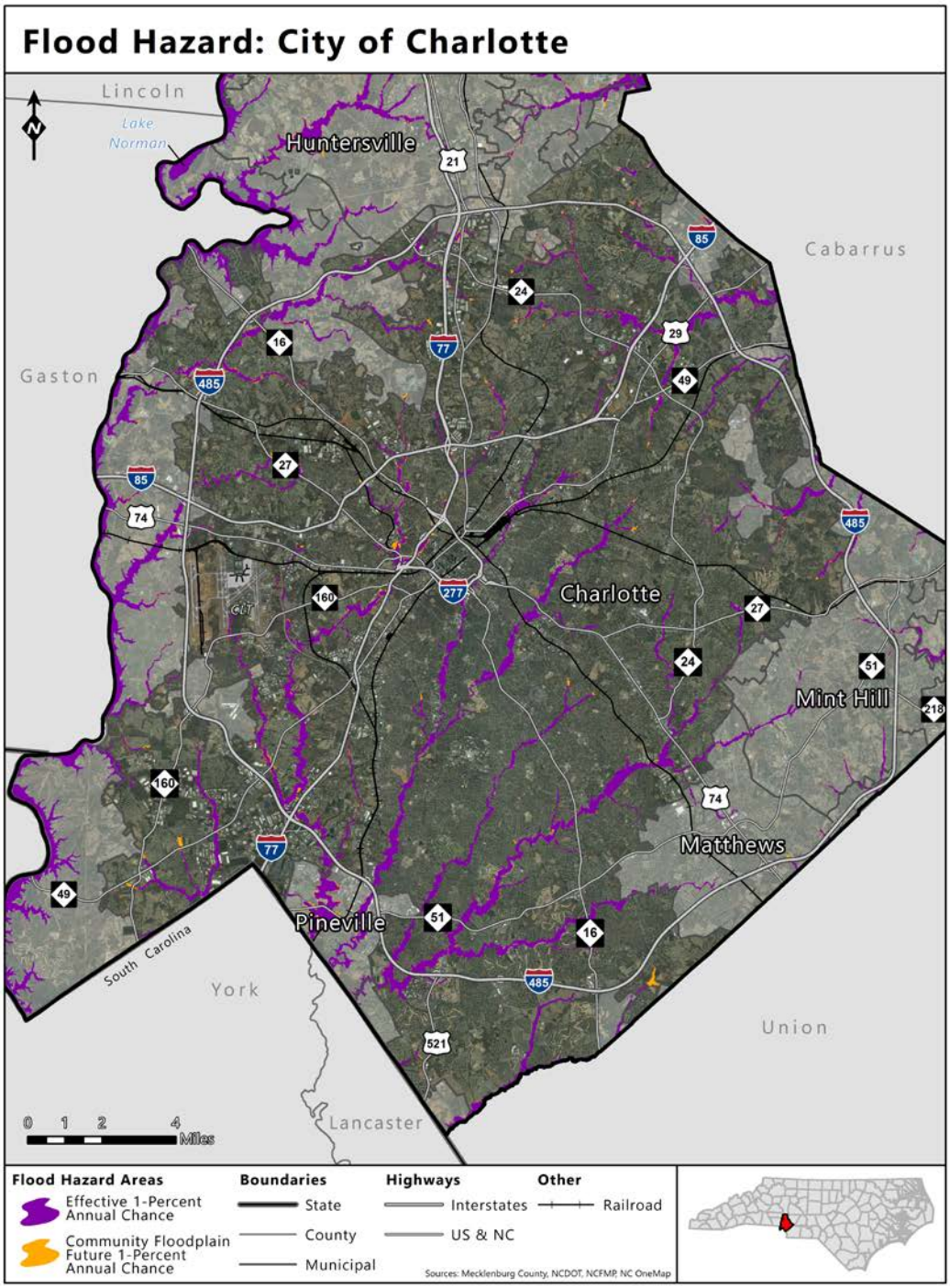


Figure 6.9: Potential Flood Hazard Areas, Town of Cornelius

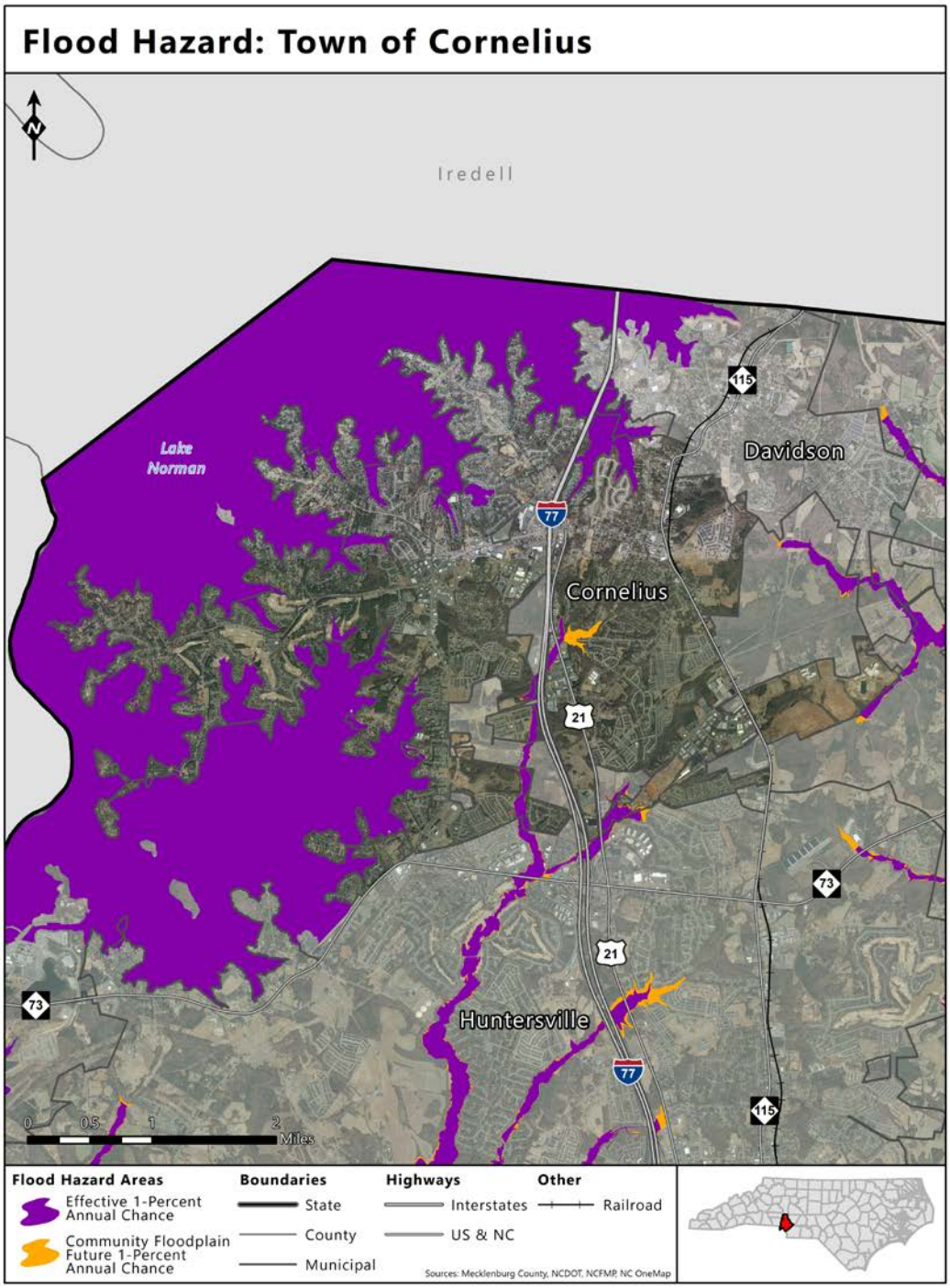


Figure 6.10: Potential Flood Hazard Areas, Town of Davidson

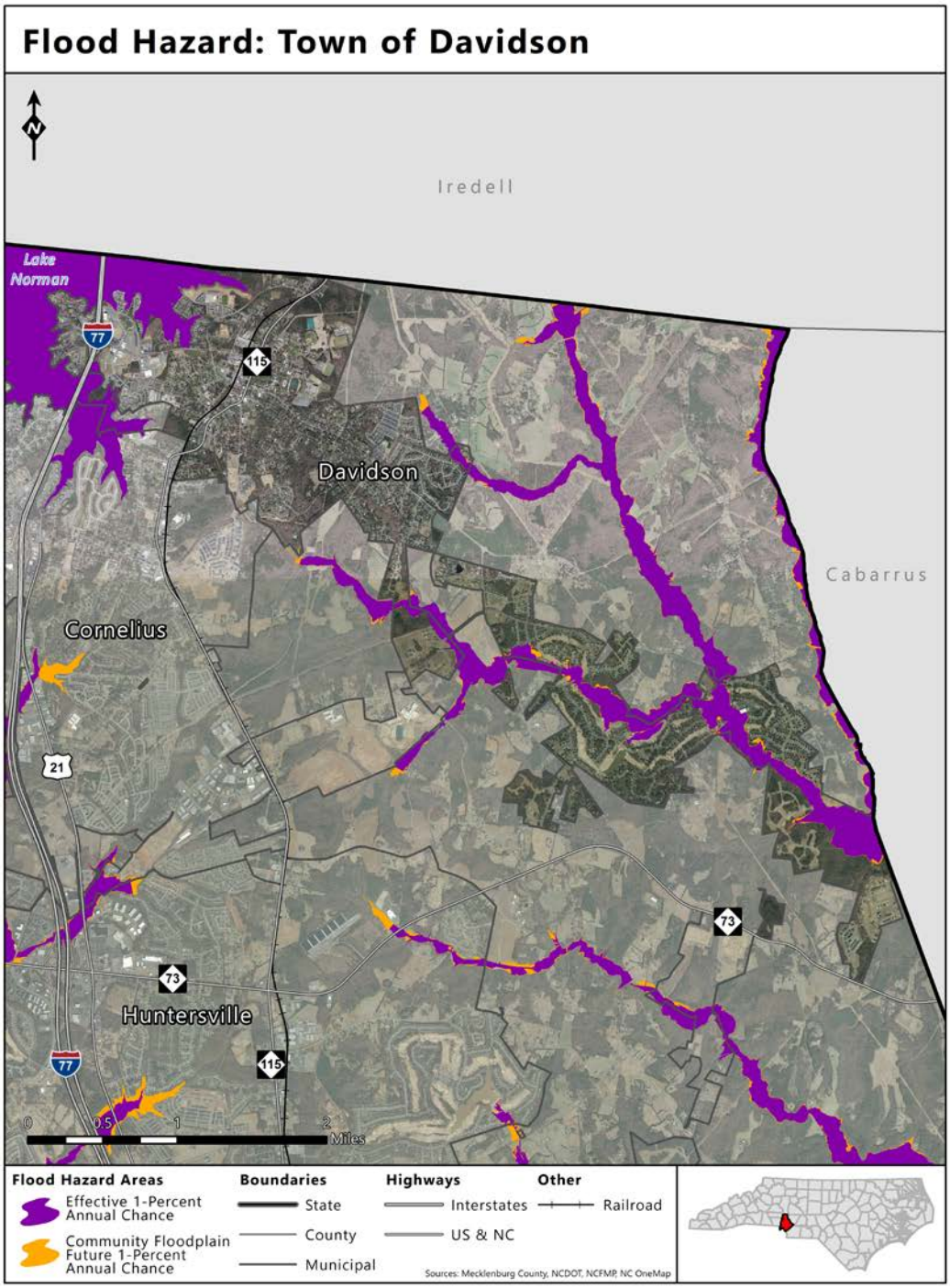


Figure 6.11: Potential Flood Hazard Areas, Town of Huntersville

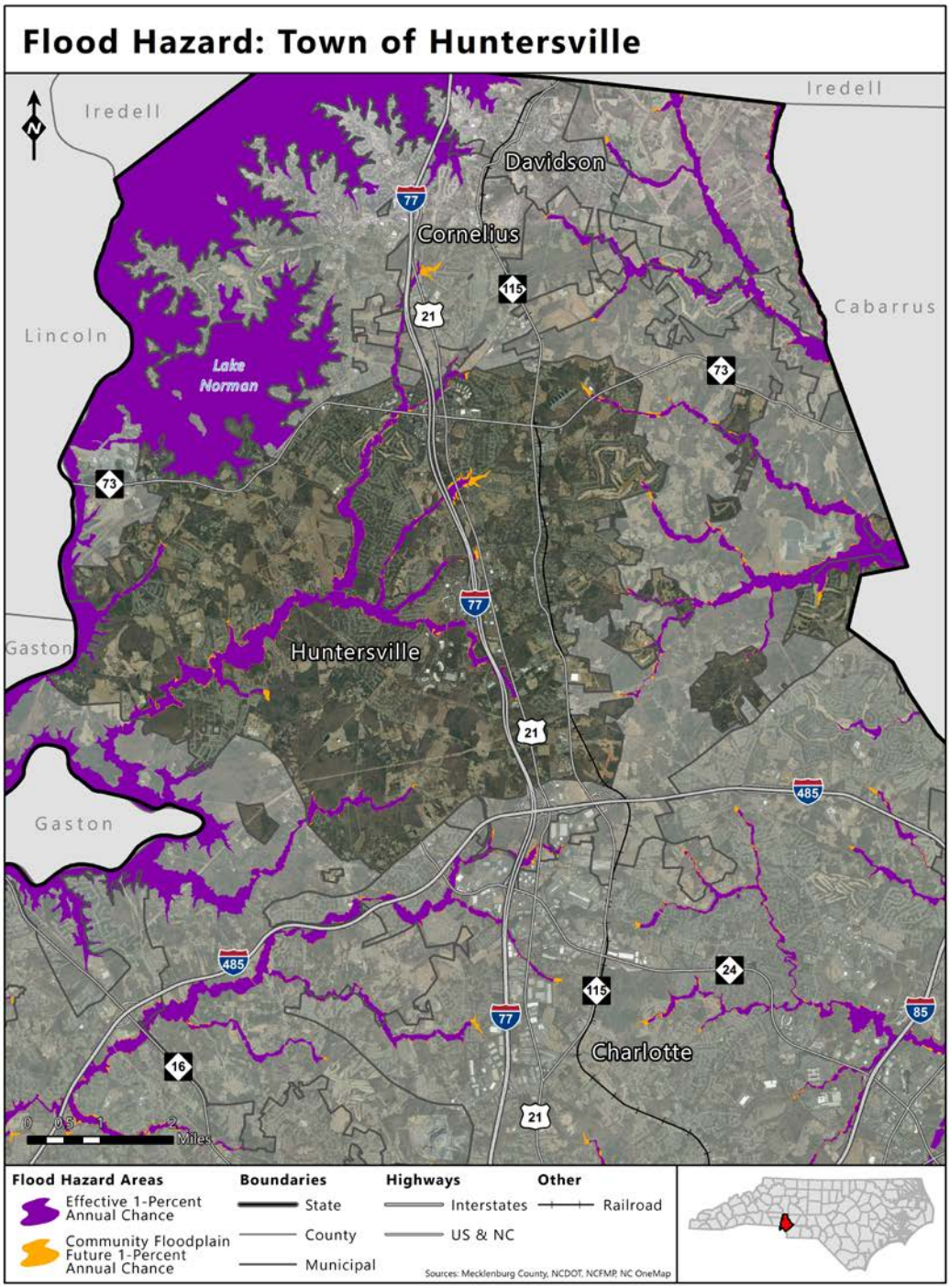


Figure 6.12: Potential Flood Hazard Areas, Town of Matthews

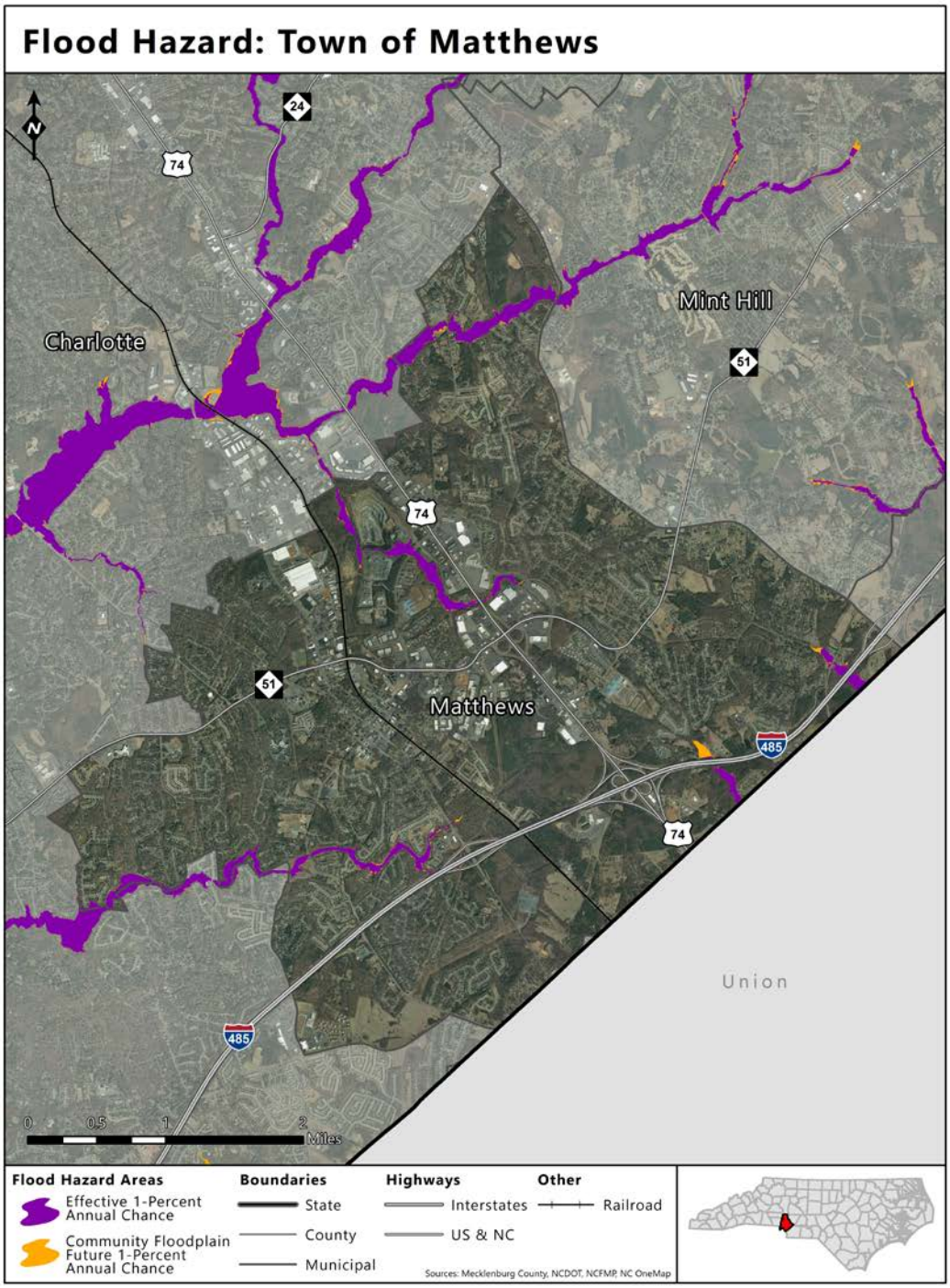


Figure 6.13: Potential Flood Hazard Areas, Town of Mint Hill

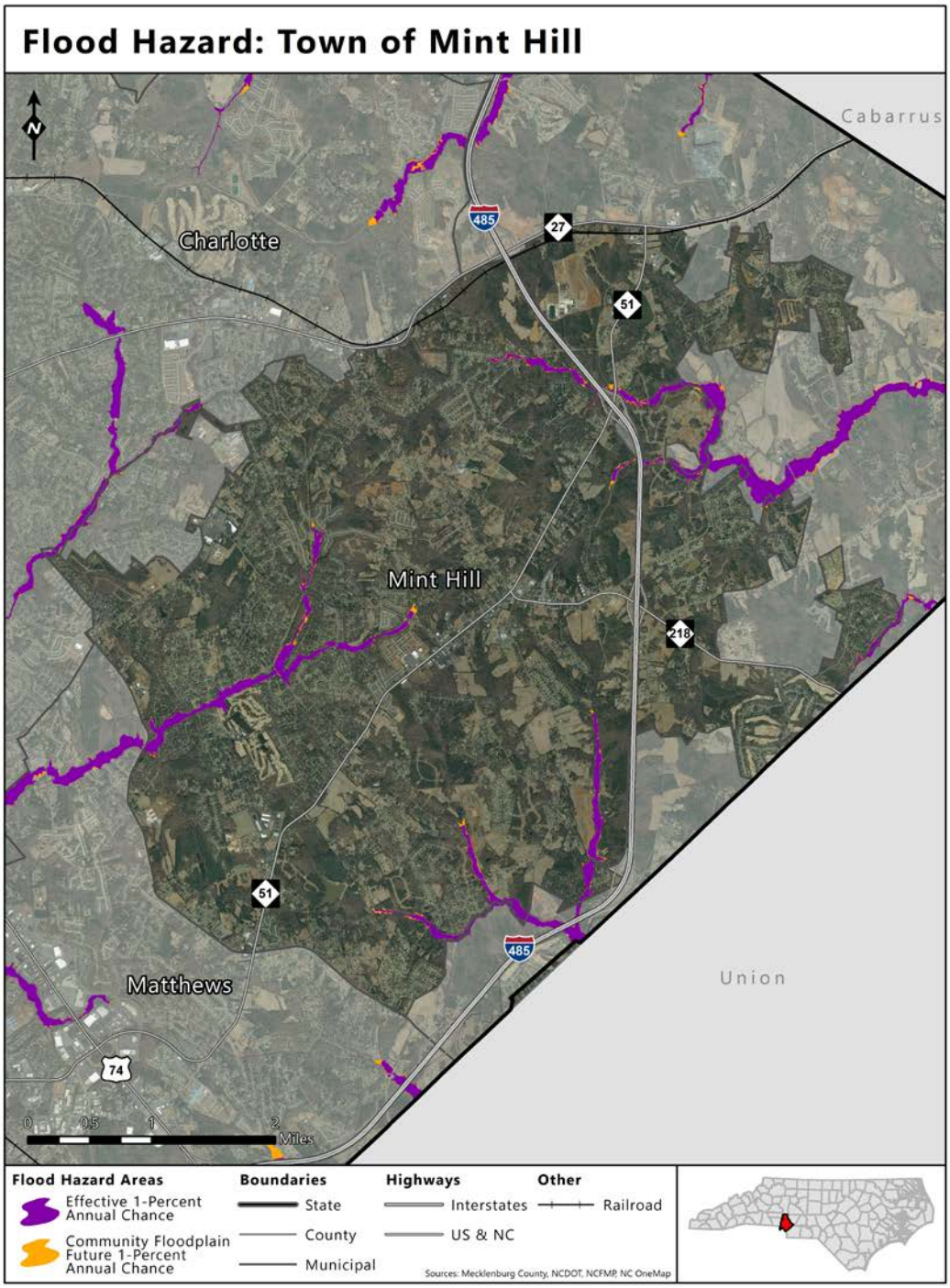
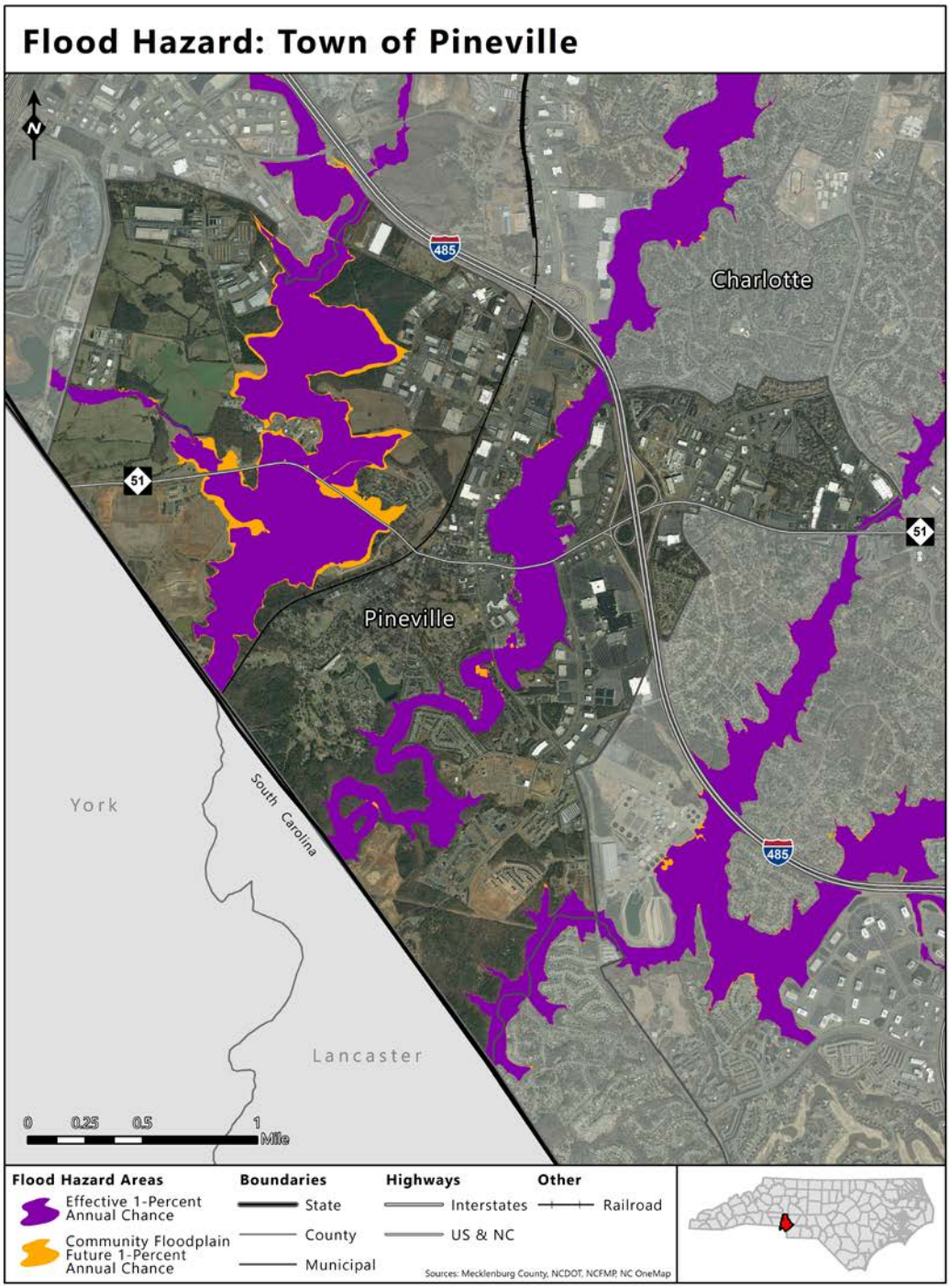


Figure 6.14: Potential Flood Hazard Areas, Town of Pineville



NFIP STATISTICS AND REPETITIVE LOSS PROPERTIES

According to FEMA databases as of early 2014, there are currently 3,727 flood insurance policies in place in Mecklenburg County with nearly $900 million in coverage, with a total number of 2,345 losses amounting to nearly $40 million.[10] **Table 6.6** provides details for each jurisdiction with regard to the community's date of entry into the National Flood Insurance Program (NFIP), date of the community's current effective Flood Insurance Rate Map (FIRM), number of flood insurance policies in place, amount of coverage, total losses and total dollar amount of payments. The table also includes the number of *repetitive loss properties* identified through separate FEMA databases for each jurisdiction, as defined by the NFIP.[11]

Reducing the number of repetitive loss properties insured by the NFIP is a nationwide emphasis of FEMA. According to FEMA's repetitive loss database, a total of 332 repetitive loss properties are located within Mecklenburg County, and all but one are located in the City of Charlotte (with the other listed as being located in the Town of Huntersville). In conducting further research using data provided by Charlotte-Mecklenburg's Storm Water Services and GIS departments, it was determined that 102 of these properties have already been mitigated through Charlotte-Mecklenburg's *Floodplain Buyout (Acquisition) Program* (further discussed in Section 7: *Capability Assessment*). All of the repetitive loss properties acquired through this flood mitigation program were located in the City of Charlotte and following structural demolition are being maintained permanently as open space with no potential for future land development. Repetitive loss properties will remain a high priority for future flood mitigation efforts.

Table 6.6: NFIP Statistics and Repetitive Loss Properties

JURISDICTION	NFIP ENTRY DATE	CURRENT EFFECTIVE MAP	NUMBER OF POLICIES	AMOUNT OF COVERAGE	TOTAL LOSSES	TOTAL PAYMENTS	NUMBER OF REPETITIVE LOSS PROPERTIES
Mecklenburg County	06/01/1981	03/02/09 & 02/19/2014	516	$131,899,500	188	$2,808,438	0
Charlotte	08/15/1978	03/02/09 & 02/19/2014	2,816	$663,754,200	2,143	$38,007,849	331
Cornelius	09/30/1997	03/02/09	123	$33,740,300	3	$46,001	0
Davidson	10/16/1997	03/02/09	45	$13,538,500	1	$0	0
Huntersville	02/04/2004	03/02/09	104	$27,193,000	0	$0	1
Matthews	02/04/2004	02/19/2014	78	$22,086,200	6	$45,308	0
Mint Hill	12/21/07	02/19/2014	42	$11,467,700	2	$18,105	0
Pineville	03/18/1987	03/02/09 & 02/19/2014	48	$113,376,800	3	$18,000	0
TOTAL			**3,872**	**$837,056,200**	**2,346**	**$40,943,701**	**332**

Source: Federal Emergency Management Agency (as of 02/28/2015)

[10] While these figures are reported according to FEMA's NFIP policy and claim statistics data, it was noted by Mecklenburg County Storm Water Services that many of the policies listed for the County are for properties that are actually located within the incorporated municipalities (estimated up to 500 policies may be listed inaccurately).

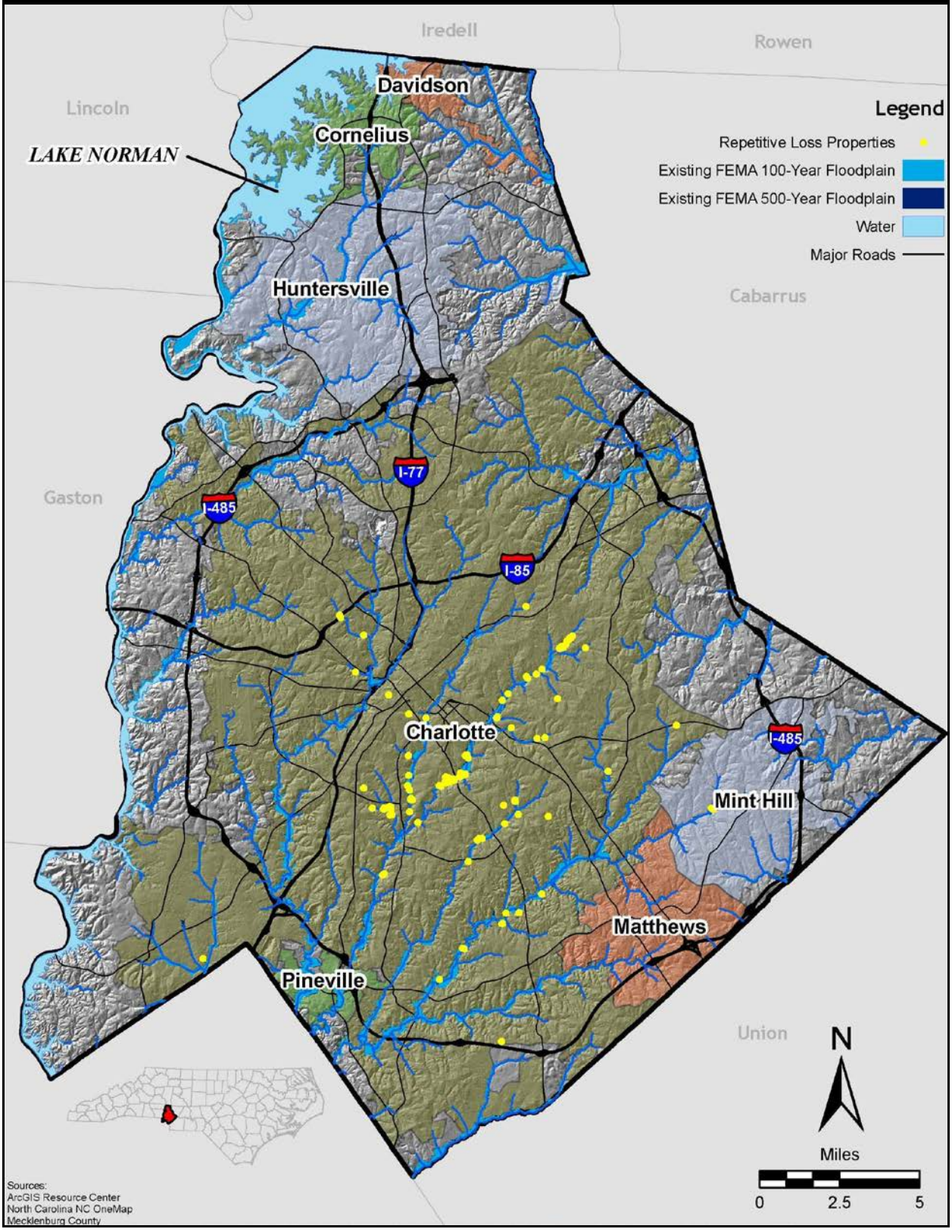
[11] Under the NFIP, FEMA defines a repetitive loss property as "any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property. "

The breakdown of repetitive loss properties by use type is as follows:

- Apartment (23)
- Commercial (4)
- Condominium (58)
- Institutional (4)
- Office (2)
- Single Family (232)
- Warehouse/Industrial (9)

Figure 6.15 illustrates general locations of repetitive loss properties located in Mecklenburg County, with many located along Briar, McAlpine, McDowell and McMullen creeks. NFIP repetitive loss data is protected under the federal Privacy Act of 1974 (5 U.S.C. 552a), which prohibits personal identifiers (i.e., owner names, addresses, etc.) from being published in local hazard mitigation plans.

Figure 6.15: Approximate Location of Repetitive Loss Properties



ESTIMATES OF POTENTIAL LOSSES

In order to provide a comprehensive update on the current estimated exposure and potential losses to flood prone structures in Mecklenburg County, two analyses were completed. First, a detailed GIS analysis of the study area was conducted using best available data, including Digital Flood Insurance Rate Map (DFIRM) data for the existing FEMA 100-year Floodplain in combination with locally updated building footprint layers and digital tax parcel records. In order to quantify potentially at-risk properties, all buildings of at least 600 square feet (eliminating those that are likely accessory structures versus habitable buildings) that intersected with delineated floodplain areas were identified. The output data was then linked to current tax parcel records to estimate the assessed value and year built information for each building. Following the analysis it was estimated that there are 3,812 structures located in the current 100-year floodplain with a total assessed building value of nearly $2.5 billion in exposure. Of these, 2,130 structures are estimated to be Pre-FIRM[12] with a total assessed building value of nearly $952 million. **Table 6.7** provides a detailed listing of the number of structures, number of structures determined to be pre-FIRM based on year built, and the assessed value of structures within the existing 100-year floodplain for each of Mecklenburg County's incorporated jurisdictions.

Table 6.7: Overview of Potentially At-Risk Properties (Flood)

JURISDICTION	NFIP ENTRY DATE	CURRENT EFFE CTIVE FIRM	EXISTING 100-YEAR FLOODPLAIN			
			NUMBER OF STRUCTURES	ASSESSED VALUE	NUMBER OF PRE-FIRM STRUCTURES	VALUE OF PRE-FIRM STRUCTURES
Mecklenburg County	06/01/1981	03/02/09	2,035	$696,265,276	281	$36,722,200
Charlotte	08/15/1978	03/02/09	3,320	$1,653,249,846	1,547	$847,337,908
Cornelius	09/30/1997	03/02/09	828	$41,019,700	68	$17,795,800
Davidson	10/16/1997	03/02/09	45	$31,095,100	20	$11,103,200
Huntersville	02/04/2004	03/02/09	185	$25,177,600	95	$16,447,300
Matthews	02/04/2004	03/02/09	33	$3,054,700	18	$3,054,700
Mint Hill	12/21/2007	03/02/09	84	$9,605,600	72	$9,605,600
Pineville	03/18/1987	03/02/09	93	$36,165,200	29	$9,605,100
TOTAL			**6,623**	**$2,495,633,022**	**2,130**	**$951,641,808**

Sources: National Flood Insurance Program (as of 12/31/2009); Mecklenburg County; GIS Analysis

In order to quantify potential loss estimates to the flood hazard in Mecklenburg County, a Level-2 analysis was completed using FEMA's Hazus^{MH} loss estimation methodology. In so doing, GIS analysts imported a detailed, countywide depth grid created from the latest DFIRM data for the existing FEMA 100-year Floodplain versus relying on Hazus to generate floodplain data based on rough digital elevation models. However, due to limited time and budget for data processing, analysts had to rely on the default national inventory data for general building stock as summarized in the beginning of this section versus incorporation of creation of any local user-supplied datasets. **Table 6.8** summarizes the estimated direct economic loss[13] associated with the worst-case 100-year flood for each of Mecklenburg County's participating jurisdictions.

[12] "Pre-FIRM" indicates that the structure was built prior Flood Insurance Rate Maps (FIRMs) and to the local enforcement of NFIP standards and is therefore considered to be at potentially greater risk from the flood hazard.
[13] Direct economic loss figures include building, content and inventory loss along with business interruption losses (income, relocation, rental income, wages, etc.).

Table 6.8: Estimated Potential Losses, by Jurisdiction (100-Year Flood Event)

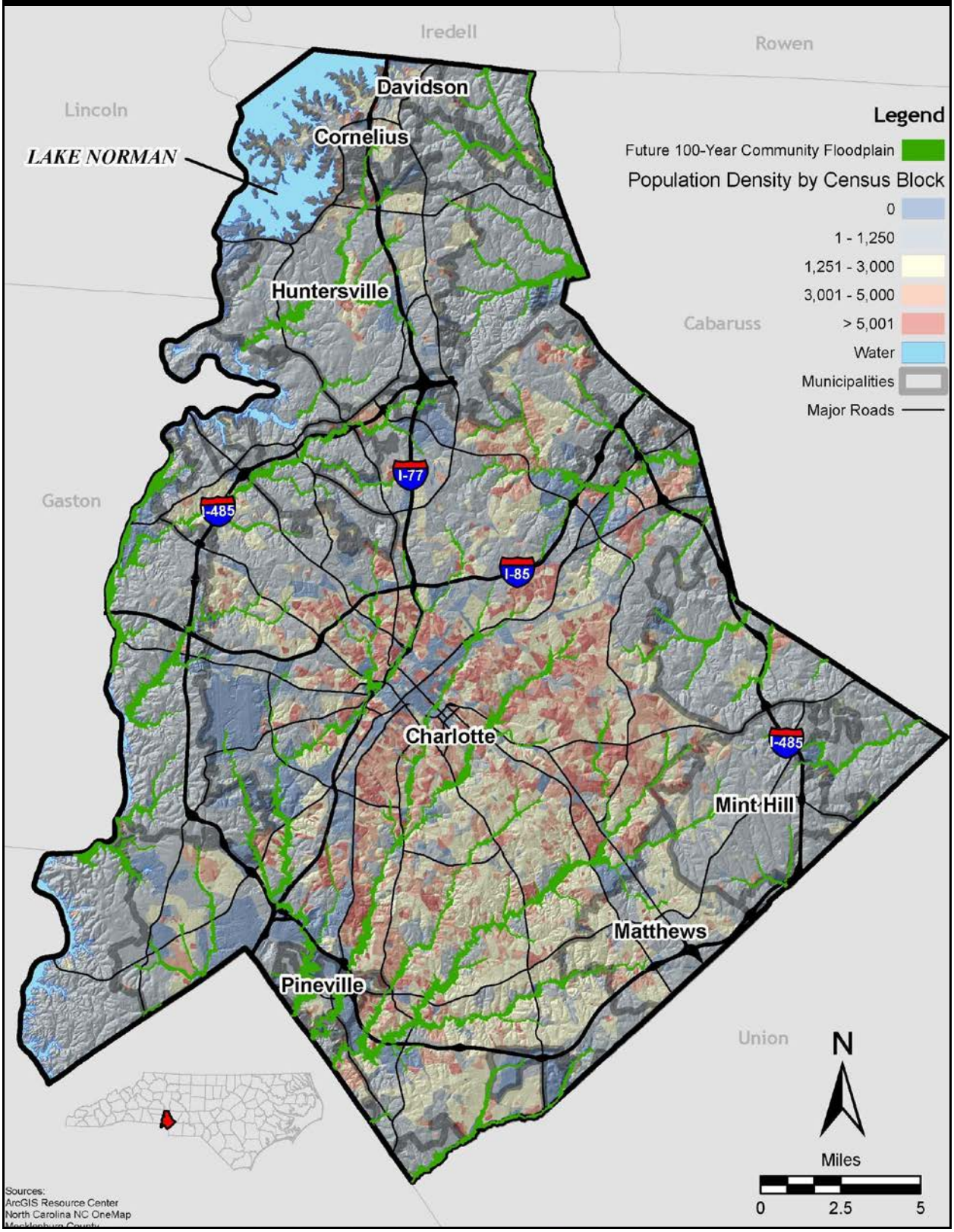
JURISDICTION	DIRECT ECONOMIC LOSS
Mecklenburg County	$193,909,000
Charlotte	$1,924,293,000
Cornelius	$16,456,000
Davidson	$26,334,000
Huntersville	$168,429,000
Matthews	$37,899,000
Mint Hill	$14,193,000
Pineville	$141,909,000

Upon completion of the analysis, a countywide annualized loss estimate of $4,864,000 was determined for Mecklenburg County. To remain consistent with other annualized loss estimates this figure includes total building damage only (the annualized loss estimate for total direct economic loss is nearly $10 million).

SOCIAL VULNERABILITY

Figure 6.16 shows potential vulnerable population density according to those census blocks that intersect with the future 100-year floodplain. While this alone does not identify specific at-risk populations, it does create a base-level understanding of the general number of persons living in proximity to known flood hazard areas. According to the Census 2010 data records, the data suggests that nearly 280,000 people live within proximity areas that are in the projected future 100-year floodplain based on build-out conditions.

Figure 6.16: Census Blocks Intersecting Existing 100-year Floodplain



FUTURE VULNERABILITY AND LAND USE

In order to quantify potential future flood hazard vulnerability, a similar detailed GIS analysis of the study area as completed for current flood vulnerability (described above) was performed using best available GIS data including the *future* Community 100-year Floodplain (described in Section 5: *Hazard Analysis*) to identify the number and value of existing structures that may be located in future flood hazards areas as expanded due to anticipated "build-out" conditions (i.e., fully developed according to zoning and future land use projections). In order to quantify potentially at-risk properties, all buildings of at least 600 square feet (eliminating those that are likely accessory structures versus habitable buildings) that intersected with delineated future floodplain areas were identified. The exposure analysis does not include any estimates for new structures that will be constructed and located in the floodplain, as it is assumed that new construction will be protected against the 100-year flood according to local development regulations that include reference to future Community 100-year Floodplain maps.[14] Further, five jurisdictions have already adopted regulatory standards that prohibit any new development in existing FEMA 100-year Floodplains. These include Mecklenburg County, the City of Charlotte and the towns of Matthews, Mint Hill and Pineville.

According to the future vulnerability analysis, a total of 7,149 properties are anticipated located in 100-year floodplain areas at build-out conditions with a total assessed building value of approximately $4.4 billion. Of these, 3,812 structures are estimated to be Pre-FIRM with a total assessed building value of approximately $1.8 billion. **Table 6.9** provides a detailed listing of the number of structures estimated to be located within the future Community Floodplain along with their assessed building values, along with the number of those structures determined to be pre-FIRM based on year built and their assessed building values.

Table 6.9: Overview of Potentially At-Risk Properties at "Build-out" Conditions

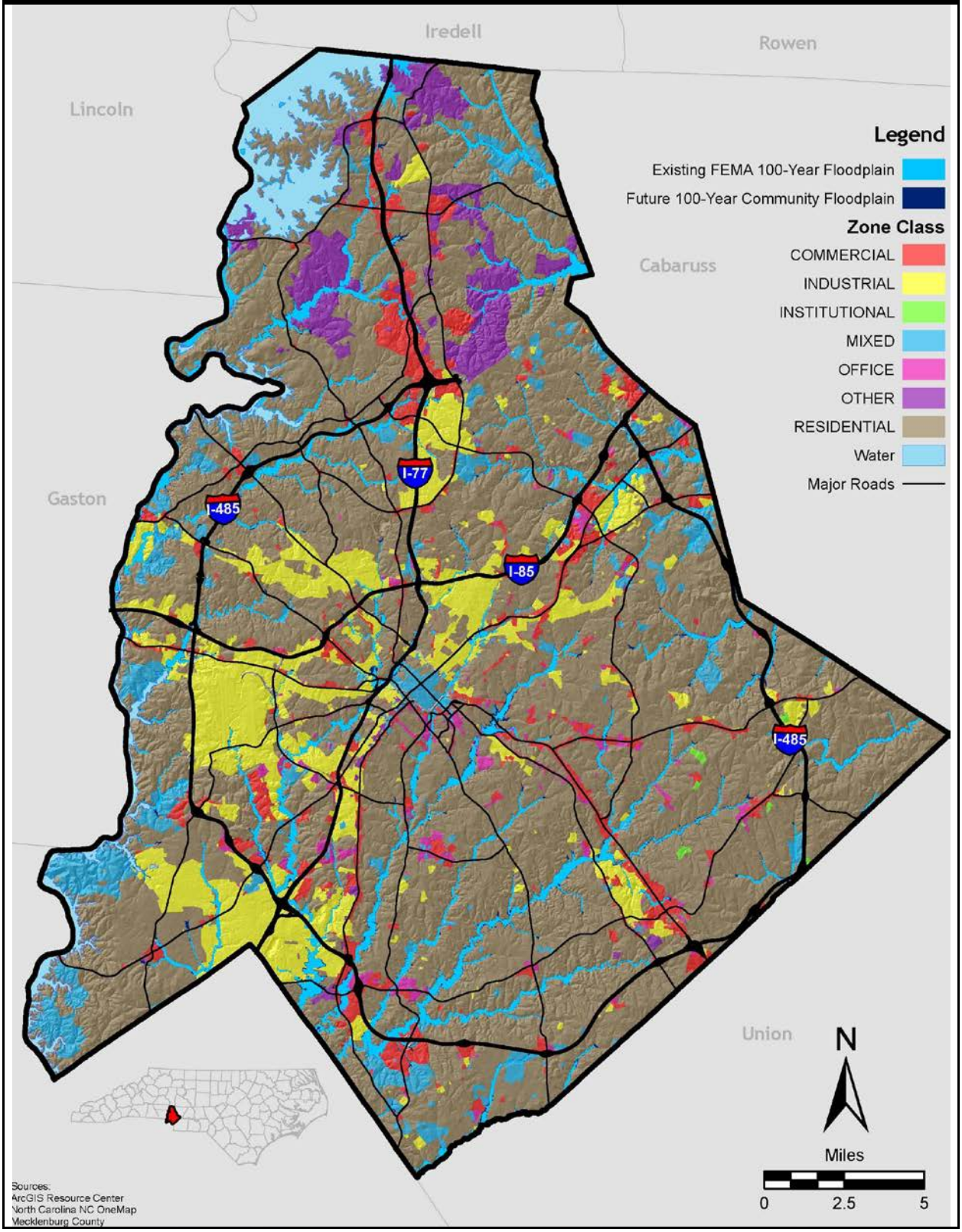
JURISDICTION	NFIP ENTRY DATE	CURRENT EFFECTIVE FIRM	FUTURE 100-YEAR FLOODPLAIN			
			NUMBER OF STRUCTURES	ASSESSED VALUE	NUMBER OF PRE-FIRM STRUCTURES	VALUE OF PRE-FIRM STRUCTURES
Mecklenburg County	06/01/1981	03/02/09	1,121	$776,689,676	373	$54,595,100
Charlotte	08/15/1978	03/02/09	5,188	$3,400,739,249	2811	$1,631,004,616
Cornelius	09/30/1997	03/02/09	117	$42,960,400	73	$18,200,800
Davidson	10/16/1997	03/02/09	61	$39,732,800	23	$12,915,500
Huntersville	02/04/2004	03/02/09	293	$61,285,100	235	$44,781,300
Matthews	02/04/2004	03/02/09	68	$22,481,100	65	$21,764,000
Mint Hill	12/21/07	03/02/09	149	$21,198,800	148	$21,004,400
Pineville	03/18/1987	03/02/09	152	$62,686,800	84	$22,000,700
TOTAL			**7,149**	**$4,427,773,925**	**3,812**	**$1,826,266,416**

Sources: National Flood Insurance Program (as of 12/31/2009); Mecklenburg County; GIS Analysis

Figure 6.17 shows generalized zoning designations for unincorporated Mecklenburg County and its seven incorporated municipalities on one countywide map. While this alone is not a firm indicator of future vulnerability as it relates to the flood hazard, land use and development trends, this composite map is presented here as a means of illustrating in a general way where future development may occur in relation to known potential flood hazard areas. Both the existing and future 100-year floodplain delineations are illustrated in the figure.

[14] All jurisdictions in Mecklenburg County have adopted and enforce regulatory standards that exceed NFIP minimums. For more information on these standards, please see Section 7: *Capability Assessment*.

Figure 6.17: Comparison of Zoning Designations with Future 100-Year Floodplain



HURRICANES AND TROPICAL STORMS

PRI Value: 2.9
Annualized Loss Estimate: $6,921,500

Historical evidence shows that Mecklenburg County is vulnerable to damaging hurricane and tropical storm-force winds despite the county's inland location.[15] As discussed in detail in the *Hazard Analysis* section, 32 hurricanes and tropical storms have passed within 75 miles of Mecklenburg County since 1851, seven of which crossed directly through the county. This translates into an estimate that 0.29 storms may potentially impact Mecklenburg County on an annual basis.

According to the qualitative assessment performed using the PRI tool, the hurricane and tropical storm hazard scored a PRI value of 2.9 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.10** summarizes the risk levels assigned to each PRI category.

Table 6.10: Qualitative Assessment for Hurricanes and Tropical Storms

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Likely	Critical	Large	More than 24 Hours	Less than 24 Hours

Source: Mecklenburg County Hazard Mitigation Planning Team

ESTIMATES OF POTENTIAL LOSSES

Detailed loss estimates for the hurricane and tropical storm hazard (as these hazards relate to wind) were developed based on probabilistic scenarios using Hazus^{MH} (Level 1 analysis).[16] **Table 6.11** shows estimates of potential building damage for the 100- and 500-year return periods, as well as annualized losses, by building occupancy type. In summary, Mecklenburg County may be susceptible to an estimated total of approximately $116 million in building damages from a 100-year wind event, increasing to up to $614 million for a 500-year event. Annualized losses are estimated to be $6,921,500. These figures are based on "worst-case" scenarios.

Table 6.11: Estimates of Potential Building Damage

BUILDING OCCUPANCY TYPE	100-YEAR EVENT	500-YEAR EVENT	ANNUALIZED
Residential	$112,330,000	$586,285,000	$6,446,000
Commercial	$2,599,000	$24,205,000	$351,000
Industrial	$483,000	$4,873,000	$77,000
Agriculture	$26,000	$444,000	$6,500
Education	$115,000	$648,000	$15,000
Government	$40,000	$232,000	$5,000
Religion/Non-profit	$165,000	$1,240,000	$21,000
TOTAL	**$115,999,000**	**$613,927,000**	**$6,921,500**

Source: Hazus^{MH}

[15] Refer to the *Hazard Analysis* section of this risk assessment for detailed historical information.
[16] According to FEMA's Hazus Web site, "a Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities."

Hazus^{MH} was also used to produce building damage estimates based on percentage of damage (by damage state) for the 100- and 500-year return periods (**Table 6.12**). In summary, for the 100-year event 0.67 percent of the total building area might potentially suffer minor damage with no buildings being completely destroyed. For the 500-year event, nearly 10 percent of the total building area might potentially suffer minor damage with still less than one percent being completely destroyed.

Table 6.12: Estimates of Potential Building Damage by Damage State

BUILDING OCCUPANCY TYPE	TOTAL SQUARE FEET	MINOR (%)		MODERATE (%)		SEVERE (%)		DESTRUCTION (%)	
		100-YR	500-YR	100-YR	500-YR	100-YR	500-YR	100-YR	500-YR
Residential	448,117,500	1.00	13.73	0.06	1.71	0	0.01	0	0
Commercial	129,504,330	1.59	9.25	0.07	1.92	0	0.08	0	0
Industrial	36,154,630	1.42	8.15	0.01	0.79	0	0.15	0	0.01
Agriculture	2,597,860	1.67	9.18	0.05	1.58	0	0.58	0	0.02
Education	6,949,270	1.12	6.59	0.06	0.43	0	0.01	0	0
Government	2,590,390	0.77	4.36	0	0.29	0	0.	0	0
Religion/Non-profit	10,008,420	1.09	8.03	0.03	0.52	0	0.03	0	0
TOTAL	635,922,400	1.23	8.43	0.28	1.03	0	0.12	0	0.004

Source: Hazus^{MH}

FUTURE VULNERABILITY AND LAND USE

All future structures built in Mecklenburg County will likely be exposed to hurricane and tropical storm-force winds and may also experience damage not accounted for in the loss estimates presented in this section. However, continued enforcement of building codes, flood damage prevention ordinances and other local regulatory tools and policies designed to mitigate the effects of high hazard winds is expected to minimize future losses as construction and planning continue to seek higher standards. Based on historical events the most significant local impacts for Mecklenburg County and its participating town to future events will likely be damage to trees (and the requisite management of vegetative debris) and widespread power outages to the area.

SEVERE THUNDERSTORMS

PRI Value: 2.7
Annualized Loss Estimate: $286,000

Historical evidence shows that Mecklenburg County is vulnerable to severe thunderstorm activity, including related hazardous elements such as lightning and hail that often accompany these severe weather events.

According to the qualitative assessment performed using the PRI tool, the severe thunderstorm hazard scored a PRI value of 2.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.13** summarizes the risk levels assigned to each PRI category.

Table 6.13: Qualitative Assessment for Severe Thunderstorms

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Highly Likely	Limited	Small	Less than 6 Hours	Less than 6 Hours

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Because it cannot be predicted where severe thunderstorm, lightning or hail damage may occur, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $92.5 billion for all buildings and contents within Mecklenburg County is considered to be exposed and could potentially be impacted on some level by this hazard. Based on historic property damages for the past 55 years (1950 to 2009), an annualized loss estimate of $286,000 was generated for the severe thunderstorm hazard. This annualized loss is presented in **Table 6.14** by hazardous element.

Table 6.14: Estimated Annualized Losses

HAZARDOUS ELEMENT	ANNUAL PROBABILITY	ANNUALIZED LOSSES
Severe Thunderstorm (High Wind)	3.16	$51,000
Lightning	0.31	$210,000
Hail	2.33	$25,000
TOTAL	**5.80**	**$286,000**

Source: Statistical Risk Assessment Methodology

FUTURE VULNERABILITY AND LAND USE

All future structures built in Mecklenburg County will likely be exposed to severe thunderstorms, lightning and hail and may experience damage not accounted for in the estimated losses presented in this section. Based on historical property damage records and current projections of population growth in Mecklenburg County, the county may experience an estimated $389,000 (in 2009 dollars) in annualized losses by the year 2030.

TORNADOES

PRI Value: 2.7
Annualized Loss Estimate: $170,000

Historical evidence shows that Mecklenburg County is vulnerable to tornado activity, which often is associated with other severe weather events such as thunderstorm or tropical cyclone activity.

According to the qualitative assessment performed using the PRI tool, the tornado hazard scored a PRI value of 2.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.15** summarizes the risk levels assigned to each PRI category.

Table 6.15: Qualitative Assessment for Tornadoes

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Likely	Critical	Small	Less than 6 Hours	Less than 6 Hours

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Because it cannot be predicted where a tornado may strike, it is not possible to map geographic boundaries for this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $92.5 billion for all buildings and contents within Mecklenburg County is considered to be exposed and could potentially be impacted on some level by the tornado hazard.

Based on historic property damages for the past 60 years (1950 to 2009), an annualized loss estimate of $170,000 was generated for the tornado hazard. This annualized loss is presented in **Table 6.16** by magnitude of event (Enhanced Fuijita Scale).

Table 6.16: Estimated Annualized Losses

MAGNITUDE OF EVENT	ANNUAL PROBABILITY	ANNUALIZED LOSSES
F0	10%	$12,000
F1	20%	$45,000
F2	10%	$113,000
TOTAL	**41%**	**$170,000**

Source: Statistical Risk Assessment Methodology

FUTURE VULNERABILITY AND LAND USE

All future structures built in Mecklenburg County are likely to be exposed to the tornado hazard and may experience damage not accounted for in the estimated losses presented in this section. Based on projections of population growth in Mecklenburg County, the county may experience an estimated $231,000 (in 2009 dollars) in annualized losses by 2030.

WINTER STORMS

PRI Value: 3.0
Annualized Loss Estimate: $1,178,000

Historical evidence shows that Mecklenburg County is vulnerable to winter storm activity, including heavy snow, ice, extreme cold, freezing rain, sleet and mixed winter weather.

According to the qualitative assessment performed using the PRI tool, the winter storm hazard scored a PRI value of 3.0 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.17** summarizes the risk levels assigned to each PRI category.

Table 6.17: Qualitative Assessment for Winter Storms

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Likely	Critical	Large	More than 24 Hours	Less than 1 Week

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Because winter storms typically affect large areas beyond county and municipal boundaries, it is not possible to map geographic locations within the county at specific risk from this hazard or produce detailed loss estimates. Therefore, the total dollar exposure figure of $92.5 billion for all buildings and contents within Mecklenburg County is considered to be exposed and could potentially be impacted on some level by the winter storm hazard.

Based on historic property damages for the past 16 years (1994 to 2009), an annualized loss estimate of $1,178,000 was generated for the winter storm hazard. This annualized loss is presented in **Table 6.18** along with annual probability for severe winter storms causing reported property damages. It should be understood that with the winter storm hazard, potential losses may be further inflated by additional, difficult to calculate factors such as the costs associated with the removal of snow from roadways, debris clean-up, indirect losses from power outages, etc.

Table 6.18: Estimated Annualized Losses

ANNUAL PROBABILITY	ANNUALIZED LOSSES
25%	$1,178,000

Source: Statistical Risk Assessment Methodology

FUTURE VULNERABILITY AND LAND USE

All future structures built in Mecklenburg County are likely to be exposed to the winter storm hazard and may experience damage not accounted for in the estimated losses presented in this section. Based on projections of population growth in Mecklenburg County, the county may experience an estimated $1,602,000 (in 2009 dollars) in annualized losses by 2030.

EARTHQUAKES

PRI Value: 2.6
Annualized Loss Estimate: $1,235,000

The annual probability of an earthquake event impacting the study area is estimated at 5 percent based on historical data. While the probability of an earthquake occurrence is relatively low, moderate losses should a significant earthquake event occur are possible.

According to the qualitative assessment performed using the PRI tool, the earthquake hazard scored a PRI value of 2.6 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.19** summarizes the risk levels assigned to each PRI category.

Table 6.19: Qualitative Assessment for Earthquakes

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Possible	Critical	Moderate	Less than 6 Hours	Less than 6 Hours

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Table 6.20 provides generalized building damage estimates by occupancy for the 100-, 500- and 1,000-year return periods as well as annualized losses based on probabilistic scenarios using Hazus^{MH}. The annualized building damage estimate for the earthquake hazard is $1,235,000, and in that estimate residential and commercial properties suffer more than 90 percent of the total damage. It is anticipated that the greatest amount of property damage in during an earthquake event will be to older buildings not built to today's seismic design standards, and particularly unreinforced masonry buildings. According to the default inventory data within Hazus^{MH}, there are approximately 26,000 unreinforced buildings located in Mecklenburg County, all classified as low-story units.

Table 6.20: Estimates of Potential Building Damage

BUILDING OCCUPANCY TYPE	100-YEAR EVENT	500-YEAR EVENT	1,000-YEAR EVENT	ANNUALIZED
Residential	$0	$85,111,000	$237,190,000	$857,000
Commercial	$0	$24,650,000	$67,260,000	$273,000
Industrial	$0	$5,300,000	$15,203,000	$59,000
Agriculture	$0	$263,000	$751,000	$3,000
Education	$0	$1,495,000	$3,994,000	$16,000
Government	$0	$502,000	$1,375,000	$6,000
Religion/Non-profit	$0	$2,086,000	$5,678,000	$21,000
Total	**$0**	**$119,407,000**	**$331,451,000**	**$1,235,000**

Source: Hazus^{MH}

Hazus^{MH} was also used to produce building damage estimates based on percentage of damage (by damage state) for the 100-, 500-, and 1,000-year return periods (**Table 6.21**). Note that the building occupancy types differ slightly from Table 6.20 in that "Single Family Residential" and "Other Residential" are presented separately consistent with the Hazus^{MH} software output.

Table 6.21: Estimates of Potential Building Damage by Damage State

BUILDING OCCUPANCY TYPE (# OF BUILDINGS)	SLIGHT			MODERATE			COMPLETE		
	100-YR	500-YR	1,000-YR	100-YR	500-YR	1,000-YR	100-YR	500-YR	1,000-YR
Single Family Residential	0	4,689	11,037	0	638	1,789	0	3	9
Other Residential	0	585	1,234	0	177	428	0	0	1
Commercial	0	181	371	0	54	132	0	0	1
Industrial	0	27	56	0	8	20	0	0	0
Agriculture	0	2	4	0	1	1	0	0	0
Education	0	2	4	0	0	1	0	0	0
Government	0	6	12	0	1	4	0	0	0
Religion/Non-profit	0	16	32	0	4	11	0	0	0
TOTAL	**0**	**5,508**	**12,750**	**0**	**883**	**2,386**	**0**	**3**	**12**

Source: Hazus[MH]

FUTURE VULNERABILITY AND LAND USE

All future structures built in Mecklenburg County will be exposed to and on some level vulnerable to seismic events, however their susceptibility to major damages is low due to the fact that seismic design standards are included in today's building code requirements. As explained earlier in this section, the greatest damage from an earthquake will likely be to older buildings (particularly unreinforced masonry buildings), as well as those facilities or infrastructure elements not maintained or upgraded to withstand the forces of potential ground shaking events – the identification of which is beyond the scope of this study.

LANDSLIDES

PRI Value: 1.4
Annualized Loss Estimate: Negligible (less than $5,000)

As documented in the *Hazard Analysis* section, historical evidence shows no significant landslide events in Mecklenburg County, despite the fact that the United States Geological Survey shows the county to be in zones of "high incidence" and "high susceptibility, moderate incidence." Minor landslide events are considered possible in localized, steep-sloped areas during extremely wet conditions.

According to the qualitative assessment performed using the PRI tool, the landslide hazard scored a PRI value of 1.4 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.22** summarizes the risk levels assigned to each PRI category.

Table 6.22: Qualitative Assessment for Landslides

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Possible	Minor	Negligible	12 to 24 Hours	Less than 6 Hours

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Due to the lack of any historical landslide damage data or detailed local landslide hazard studies or maps, future damages caused by landslides and associated dollar losses are expected to be negligible.

FUTURE VULNERABILITY AND LAND USE

Given that there is no historical evidence of landslide activity resulting in measurable damages, and that potential loss estimates for this hazard are considered to be negligible, it is difficult to assess what future vulnerabilities may exist or how land use may factor into this.

SINKHOLES

PRI Value: 1.8
Annualized Loss Estimate: Negligible (less than $5,000)

As documented in the *Hazard Analysis* section, existing soil types in Mecklenburg County are not conducive to the formation of natural sinkholes. There is a higher potential for soil piping and/or erosion caused by leakage from drainage pipes, culverts, and other human infrastructure activities or failures.

According to the qualitative assessment performed using the PRI tool, the sinkhole hazard scored a PRI value of 2.0 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.23** summarizes the risk levels assigned to each PRI category.

Table 6.23: Qualitative Assessment for Sinkholes

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Possible	Limited	Negligible	6 to 12 Hours	Less than 6 Hours

Source: Mecklenburg County Mitigation Planning Committee

FUTURE VULNERABILITY AND LAND USE

Given that there is little historical evidence of natural sinkhole activity resulting in measurable damages, and that potential loss estimates for this hazard are considered to be negligible, it is not possible to assess what future vulnerabilities may exist or how land use may factor into discussion of this hazard.

DROUGHT

PRI Value: 2.6
Annualized Loss Estimate: $792,000

Drought can impact natural systems as well as the ability of cities, towns and neighborhoods to function effectively. Specific effects may include a reduction in the production of food grains and other crops, the size and quality of livestock and fish, available forage for livestock and wildlife, and the availability of water supplies needed by communities and industry.

According to the qualitative assessment performed using the PRI tool, the drought hazard scored a PRI value of 2.6 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.24** summarizes the risk levels assigned to each PRI category.

Table 6.24: Qualitative Assessment for Drought

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Likely	Limited	Moderate	More than 24 Hours	More than 1 Week

Source: Mecklenburg County Mitigation Planning Committee

ESTIMATES OF POTENTIAL LOSSES

Although FEMA has estimated that the average annual losses due to drought in the United States are $6-8 billion[17], very little is known about the direct and indirect economic impacts of drought events. It is generally understood that while severe to extreme drought conditions will cause minimal property damages, significant economic losses will be experienced across various sectors (agricultural, recreational, manufacturing, energy, etc.) at local, regional and even national scales. However, reliable data on the estimates of historical losses caused by drought are rarely available (though the National Drought Mitigation Center is working to improve on this), making the application of a statistical risk assessment methodology very difficult.

Due to the lack of quantifiable data on documented historic losses across various sectors caused by the effects of drought in Mecklenburg County, this study is limited to only a simple estimation of potential losses to the agricultural sector as it is often the most directly affected (particularly in North Carolina, as documented by the North Carolina Department of Agriculture and Consumer Services[18]), and due to the fact that some local agricultural data is available as it relates to current exposure. It is anticipated that more thorough loss estimation techniques may be applied during future updates to this Plan as FEMA and/or the NDMC develop methodologies to conduct better loss estimation analyses, and as the quality of locally available data improves.

In order to generate a potential annualized dollar loss estimate for drought to the agricultural sector in Mecklenburg County, the following assumptions were made: (1) severe to extreme drought conditions will decrease countywide agricultural production by 20 percent[19]; and (2) Mecklenburg County experiences

[17] National Mitigation Strategy: Partnerships for Building Safer Communities. FEMA, 1995.
[18] According to economic loss estimates caused by drought conditions in 2002, agriculture losses made up 95% of total recorded losses.
[19] The figure of 20 percent is based on estimates and anecdotal data provided in those publications reviewed as part of this study, including documents from the National Drought Mitigation Center and other statewide economic impact studies for past droughts.

severe to extreme drought conditions 7.5 percent of the time.[20] According to the 2007 Census of Agriculture, the annual net cash farm income in Mecklenburg County was $52,774,000 which includes all crops and livestock.[21] Using this data in combination with the assumptions listed above, total annualized losses to severe and extreme drought conditions is estimated to be $792,000.

FUTURE VULNERABILITY AND LAND USE

It is estimated that annualized losses to the drought hazard will decrease over time due to the continued trend of decreasing agricultural production within Mecklenburg County, much of which has to do with decreases in the number of farms and land available for farming. According to a comparison between the 2007 and 2002 Census of Agriculture, the number of farms decreased by 21 percent and the total acres used for agricultural purposes declined by nearly 25 percent. This number is consistent with other past studies which recorded a 24 percent decrease in cropland for Mecklenburg County between 1987 and 1997. However, as noted above, while future agricultural losses may decrease other sectors of Mecklenburg County that are dependent on water supply will likely continue to experience future economic impacts during periods of severe to extreme drought conditions.

[20] The figure of 7.5 percent is based on the long-term average percent of time in severe and extreme drought conditions according to the Palmer Drought Severity Index (PDSI), as discussed in Section 5: *Hazard Analysis*.
[21] Further breakdowns of agricultural statistics for Mecklenburg County are not made available through the 2007 Census of Agriculture (such data is withheld to avoid disclosing data for individual farms).

WILDFIRE

PRI Value: 2.6
Annualized Loss Estimate: $168,000

Similar to the flood hazard and as discussed in the Methodology earlier in this section, a more robust GIS-based risk assessment has been completed for the wildfire data due to the fact that wildfire hazard areas often have a recognizable geographic boundary and the availability of geo-spatial data that can be used to differentiate between various potential hazard risk zones. The vulnerability assessment for the wildfire hazard includes the findings of the qualitative assessment conducted, a series of jurisdiction-level maps showing existing and future potential flood hazard areas (**Figures 6.18 – 6.24**), estimates of potential losses, social vulnerability, and future vulnerability and land use. As documented in the *Hazard Analysis* section, Mecklenburg County experiences an average of 37 wildfire events per year. While most of these events result in no property damages, there has been a reported total of $1.7 million in property damages since the year 2000.

According to the qualitative assessment performed using the PRI tool, the wildfire hazard scored a PRI value of 2.6 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.25** summarizes the risk levels assigned to each PRI category.

Table 6.25: Qualitative Assessment for Wildfire

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Highly Likely	Minor	Small	Less than 6 Hours	Less than 1 Week

Source: Mecklenburg County Hazard Mitigation Planning Team

ESTIMATES OF POTENTIAL LOSSES

Table 6.26 shows wildfire event data from 2000 to 2009 in Mecklenburg County (according to the North Carolina Division of Forest Resources) that contribute to an annualized loss estimate of approximately $168,000 for the wildfire hazard.

Table 6.26: Historical Wildfire Damages

YEAR OF EVENT	PROPERTY DAMAGES (IN 2009 DOLLARS)
2000	$7,600
2001	$22,532
2002	$2,802
2003	$0
2004	$0
2005	$12,084
2006	$5,853
2007	$10,961
2008	$1,594,308
2009	$22,025
ANNUALIZED AVERAGE	**$167,816**

Sources: NCDFR; Statistical Risk Assessment Methodology

Figure 6.18: Potential Wildfire Hazard Areas, City of Charlotte

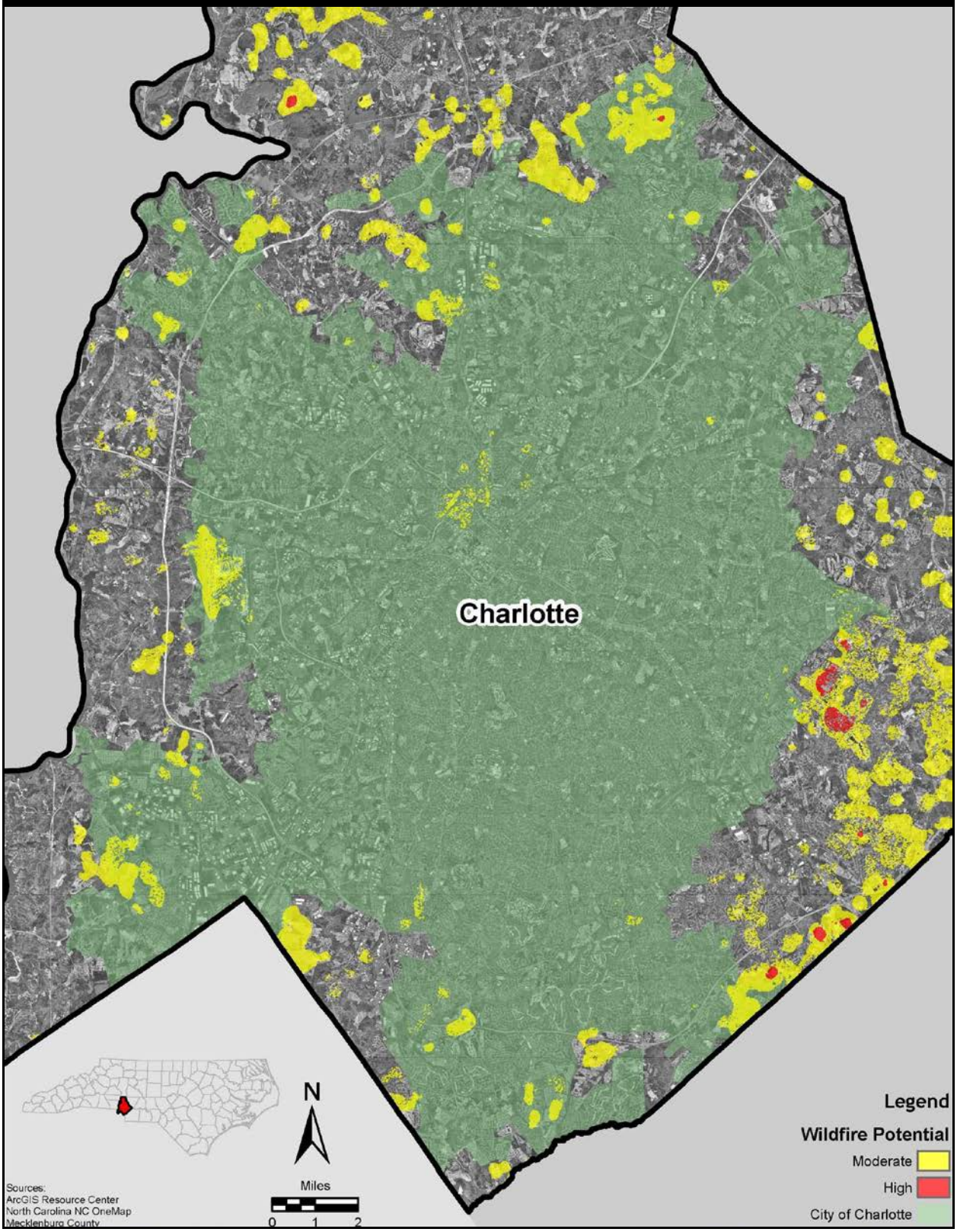


Figure 6.19: Potential Wildfire Hazard Areas, Town of Cornelius

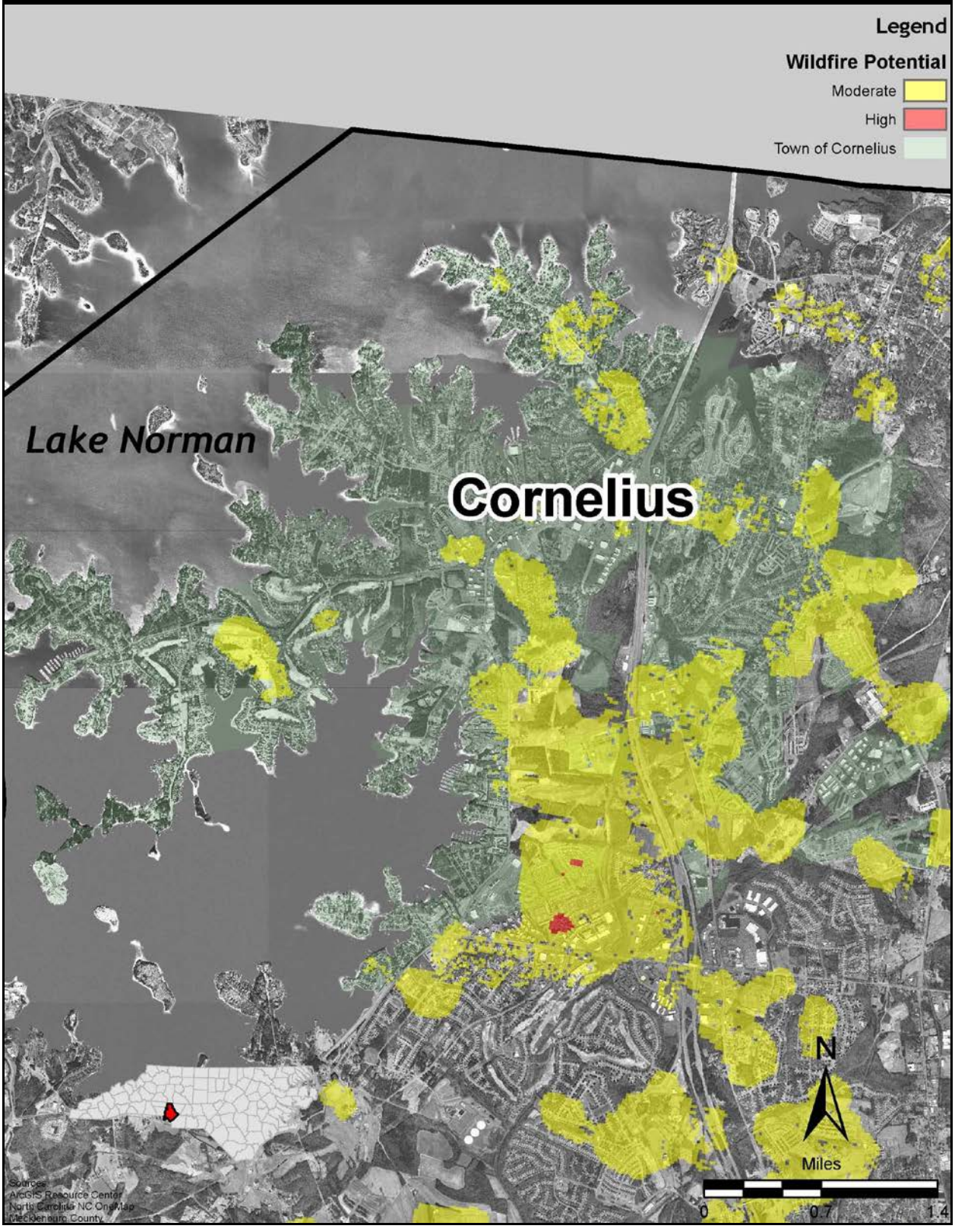


Figure 6.20: Potential Wildfire Hazard Areas, Town of Davidson

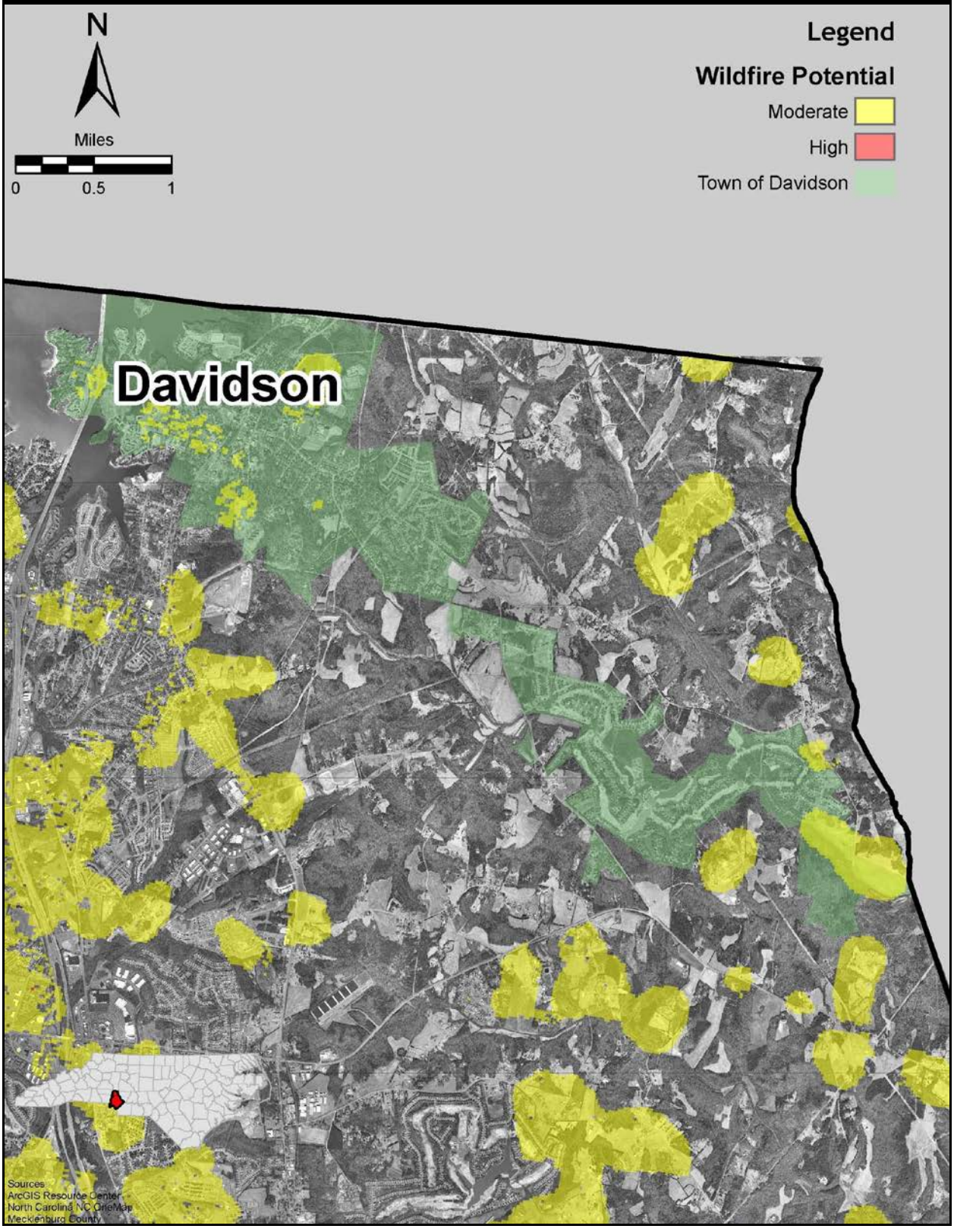


Figure 6.21: Potential Wildfire Hazard Areas, Town of Huntersville

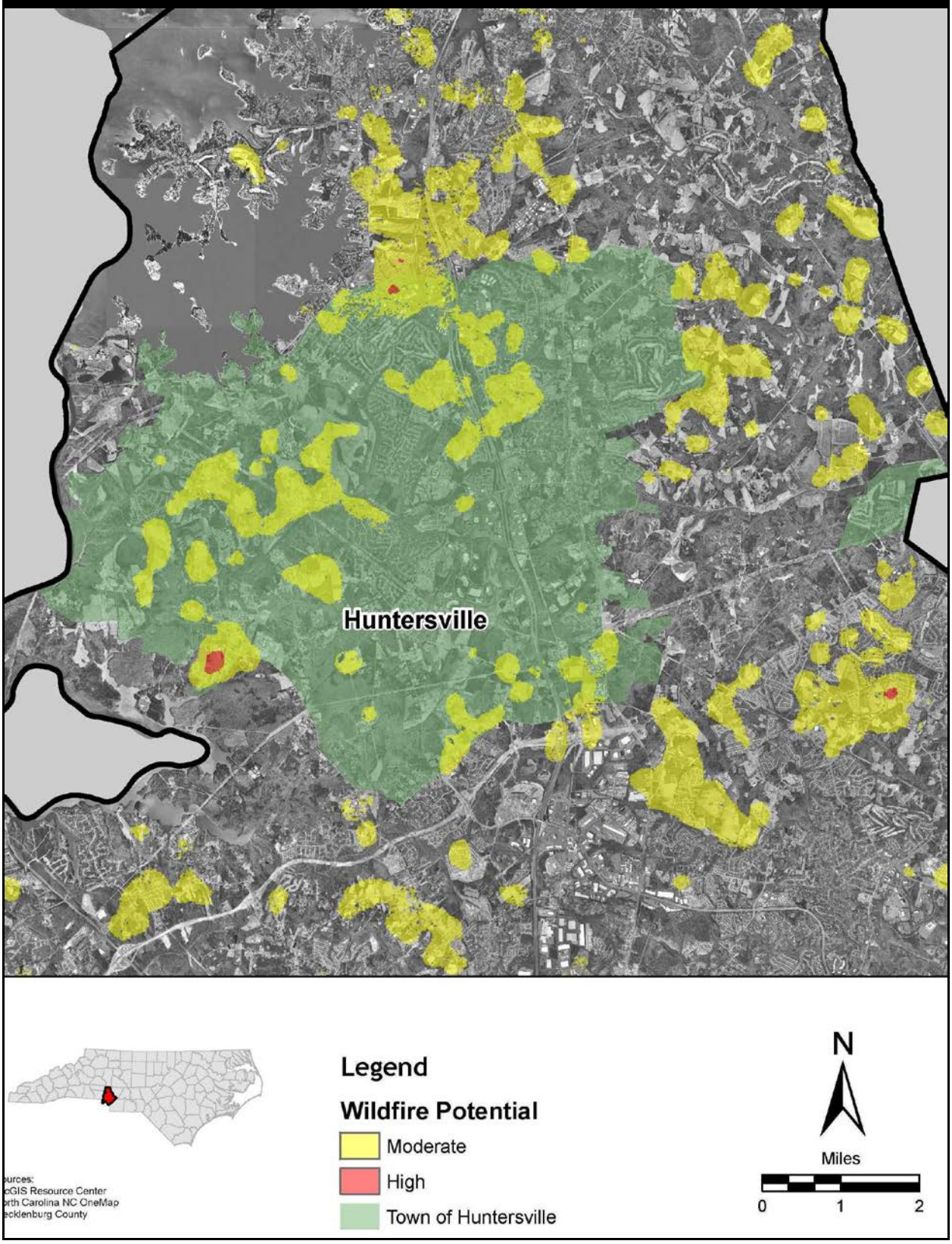


Figure 6.22: Potential Wildfire Hazard Areas, Town of Matthews

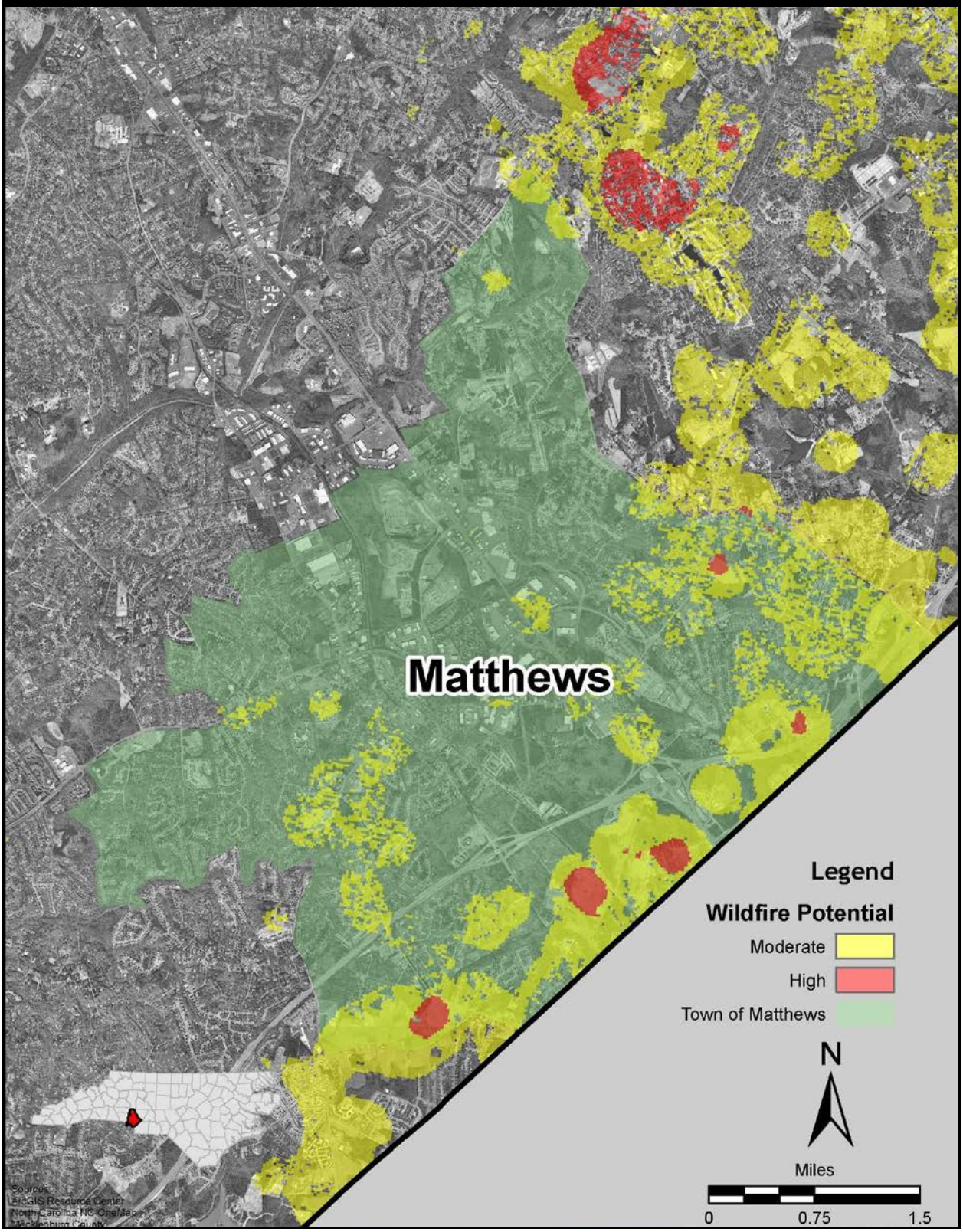


Figure 6.23: Potential Wildfire Hazard Areas, Town of Mint Hill

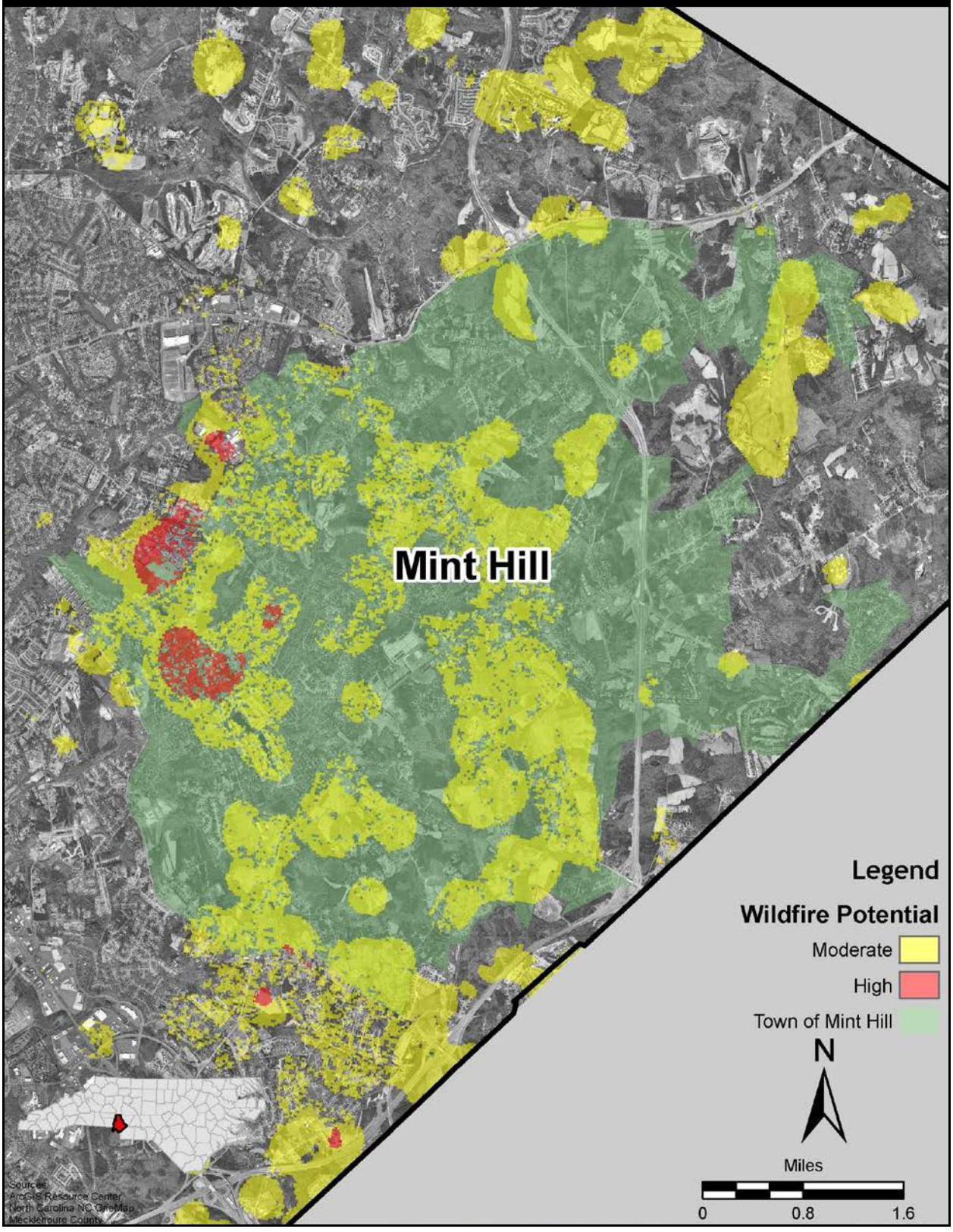
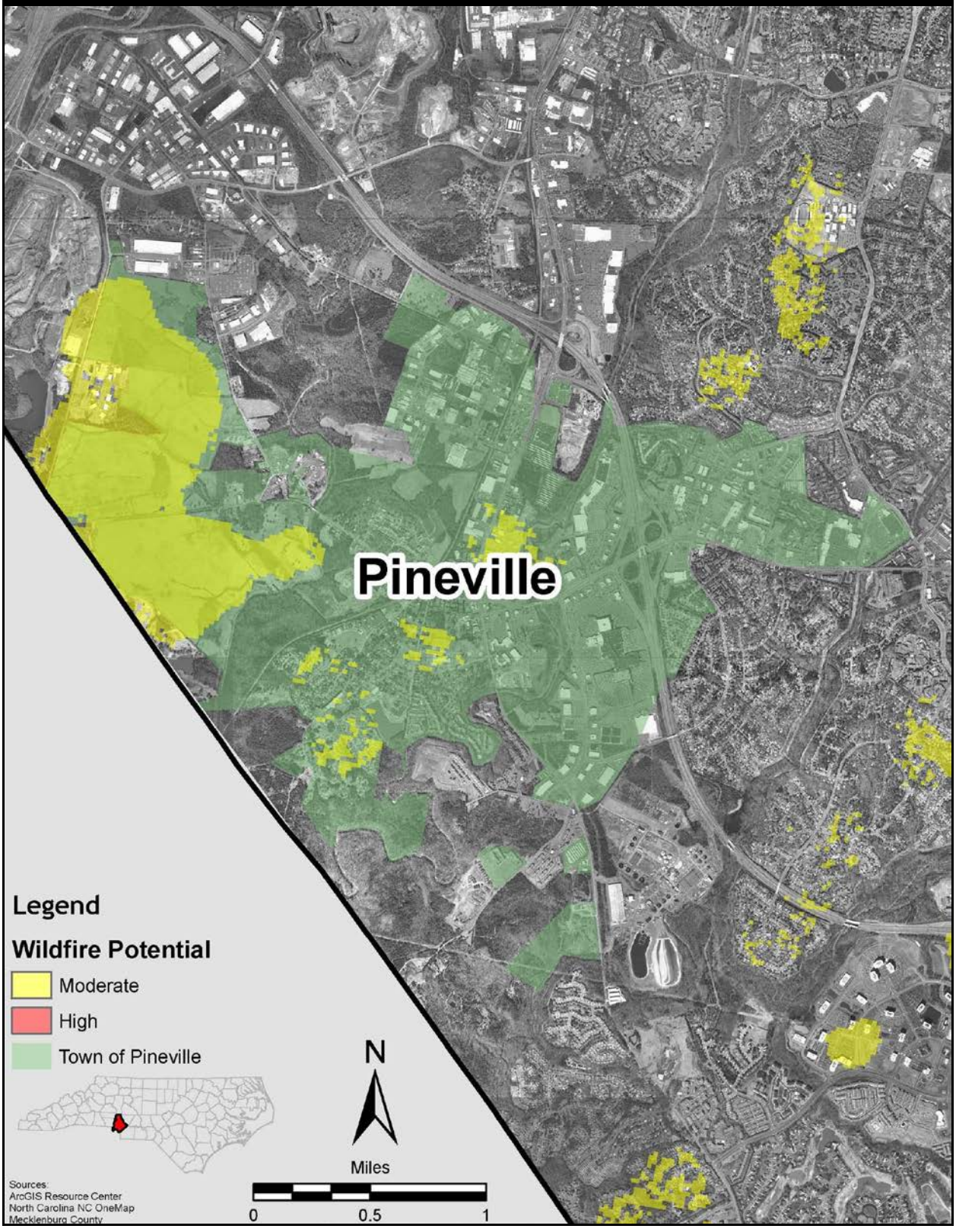


Figure 6.24: Potential Wildfire Hazard Areas, Town of Pineville



Following a detailed GIS analysis of the study area using best available GIS data including the delineation of areas of high and moderate wildfire potential according to NCDFR data, nearly 20,000 structures (greater than 600 square feet) were determined to be potentially at-risk to wildfire hazards amounting to a total net present worth of approximately $4.5 billion in exposure. **Table 6.27** provides a detailed listing of the number of structures estimated to be located within potentially high and moderate wildfire hazards areas along with their assessed building values.

Table 6.27: Overview of Potentially At-Risk Properties (Wildfire)

JURISDICTION	HIGH POTENTIAL WILDFIRE AREA		MODERATE POTENTIAL WILDFIRE AREA	
	NUMBER OF STRUCTURES	ASSESSED VALUE	NUMBER OF STRUCTURES	ASSESSED VALUE
Mecklenburg County	253	$73,430,100	3,706	$558,100,159
Charlotte	10	$1,445,700	6,080	$1,681,381,372
Cornelius	9	$1,514,000	1,606	$388,284,200
Davidson	0	$0	169	$139,481,600
Huntersville	74	$42,204,000	2,940	$697,584,889
Matthews	45	$6,261,100	1,756	$396,286,800
Mint Hill	199	$27,357,300	2,881	$470,129,316
Pineville	0	$0	81	$25,657,343
TOTAL	**590**	**$152,212,200**	**19,219**	**$4,356,905,679**

Sources: North Carolina Division of Forest Resources; Mecklenburg County; GIS Analysis

SOCIAL VULNERABILITY

Figure 6.25 shows potential vulnerable population density according to those census blocks that intersect with areas of high and moderate wildfire potential. While this alone does not identify specific at-risk populations, it does create a base-level understanding of the general number of persons living in proximity to potential wildfire hazard areas. According to the Census 2000 data records, the data suggests that nearly 8,000 people live within proximity to areas of high wildfire potential and approximately 138,000 people live within areas of moderate wildfire potential.

FUTURE VULNERABILITY AND LAND USE

Figure 6.26 shows generalized zoning designations for unincorporated Mecklenburg County and its seven incorporated municipalities on one countywide map. While this alone is not a firm indicator of future vulnerability as it relates to the wildfire hazard, land use and development trends, this composite map is presented here as a means of illustrating in a general way where future development may occur in relation to known potential wildfire hazard areas. Delineations for both the high and moderate potential wildfire areas are illustrated in the figure.

Figure 6.25: Population Distribution and Wildfire Potential

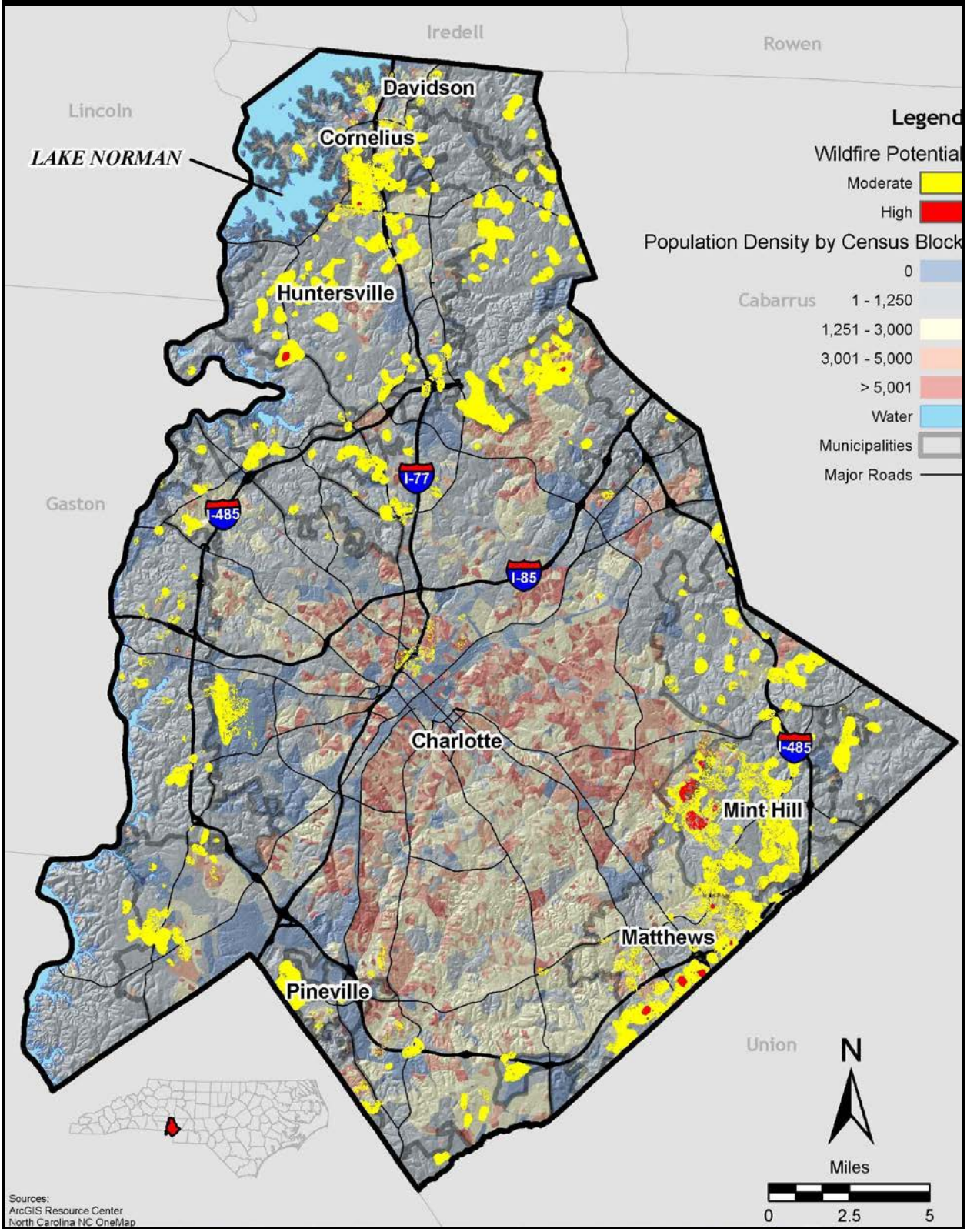
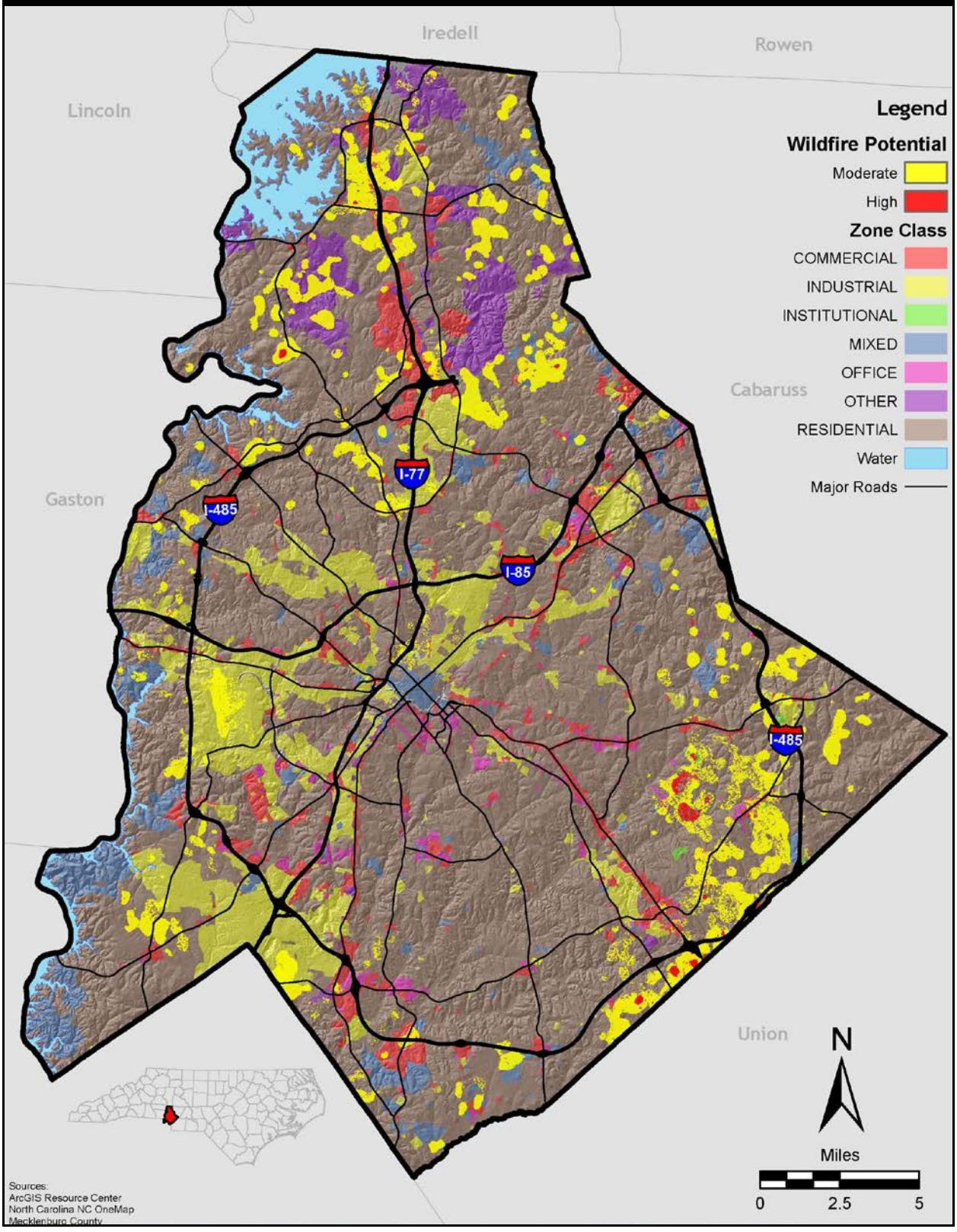


Figure 6.26: Comparison of Zoning Designations with High Wildfire Potential



DAM/LEVEE FAILURE

PRI Value: 2.3
Annualized Loss Estimate: Negligible (less than $5,000)

As documented in the *Hazard Analysis* section, there are five major dams in Mecklenburg County, defined as being 50 feet or more in height, or with a normal storage capacity of 5,000 acre-feet or more, or with a maximum storage capacity of 25,000 acre-feet or more. There is no record of any damages, deaths or injuries associated with dam failure in Mecklenburg County.

According to the qualitative assessment performed using the PRI tool, the dam/levee failure hazard scored a PRI value of 2.3 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.28** summarizes the risk levels assigned to each PRI category.

Table 6.28: Qualitative Assessment for Dam/Levee Failure

PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Unlikely	Critical	Small	Less than 6 Hours	Less than 1 Week

Source: Mecklenburg County Hazard Mitigation Planning Team

ESTIMATES OF POTENTIAL LOSSES

Generally speaking, failure or mis-operation of a dam classified as "high" hazard would result in the probability of at least one death and more than $200,000 in economic damages. As documented in detail in the *Hazard Analysis* section, there are four major dams in Mecklenburg County classified as high hazard. **Table 6.29** shows the surface area, primary purpose and owner of the four major high hazard dams in the county. According to North Carolina's Dam Safety Office, there are a total of 69 high-hazard state-regulated dams across Mecklenburg County. Due to the lack of any recorded historical events and relatively low probability of dam failure in Mecklenburg County, annualized loss for this hazard is considered to be negligible (less than $5,000).

Table 6.29: Inventory and Details of Major High Hazard Dams in Mecklenburg County

DAM NAME	SURFACE AREA (ACRES)	PRIMARY PURPOSE	OWNER
Cowans Ford	32,510	Hydroelectric Power	Duke Power Co.
Mountain Island	3,235	Hydroelectric Power	Duke Power Co.
Hicks Crossroad Dike	32,510	Hydroelectric Power	Duke Power Co.
250 Mg Raw Water Reservoir	0	Water Supply	Char-Meck Utility

Source: National Inventory of Dams

FUTURE VULNERABILITY AND LAND USE

Future updates to this Plan will attempt to address dam failure vulnerability in greater detail, if warranted. This may include a detailed analysis of properties located in dam failure inundation zones (data not currently available) or those determined to be located directly downstream of high hazard dams in order to better determine the number of people and value of properties located in potential inundation zones and thereby vulnerable to dam failure. Once a baseline of this detail is established, it should become easier to then assess future vulnerability and land use.

CONCLUSIONS ON HAZARD RISK

The vulnerability assessment performed for Mecklenburg County provides significant findings that allow the Mitigation Planning Committee to prioritize hazard risks and proposed hazard mitigation strategies and actions. Prior to assigning conclusive risk levels for each hazard, the Hazard Mitigation Planning Team reviewed the results of quantitative and qualitative assessments shown in the following tables.

Table 6.30 summarizes the degree of risk assigned to each category for all identified hazards in Mecklenburg County based on the application of the Priority Risk Index (PRI) tool fully introduced in "Methodologies Used." Assigned risk levels were based on historical and anecdotal data, as well as input from the Mitigation Planning Team. The results were then used in calculating PRI values and making conclusions for the qualitative assessment.

Table 6.30: Summary of Qualitative Assessment

HAZARD	CATEGORY/DEGREE OF RISK				
	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION
Flood	Highly Likely	Critical	Moderate	6 to 12 Hours	Less than 1 Week
Hurricanes and Tropical Storms	Likely	Critical	Large	More than 24 Hours	Less than 24 Hours
Severe Thunderstorms	Highly Likely	Limited	Small	Less than 6 Hours	Less than 6 Hours
Tornadoes	Likely	Critical	Small	Less than 6 Hours	Less than 6 Hours
Winter Storms	Likely	Critical	Large	More than 24 Hours	Less than 1 Week
Earthquakes	Possible	Critical	Moderate	Less than 6 Hours	Less than 6 Hours
Landslides	Possible	Minor	Negligible	12 to 24 Hours	Less than 6 Hours
Sinkholes	Possible	Limited	Negligible	6 to 12 Hours	Less than 6 Hours
Drought	Likely	Limited	Moderate	More than 24 Hours	More than 1 Week
Wildfire	Highly Likely	Minor	Small	Less than 6 Hours	Less than 1 Week
Dam/Levee Failure	Unlikely	Critical	Small	Less than 6 Hours	Less than 1 Week

Source: Mecklenburg County Hazard Mitigation Planning Team

Table 6.31 summarizes the annualized loss estimates that were generated for the applicable hazards based on the quantitative assessment and compares them with the PRI values determined for each hazard based on the qualitative assessment. The results and comparisons of both assessments aided the Hazard Mitigation Planning Team in determining the final conclusions on overall hazard risk for Mecklenburg County.

Table 6.31: Comparison of Annualized Loss Estimates and Priority Risk Index (PRI) Values

QUANTITATIVE ASSESSMENT FINDINGS		QUALITATIVE ASSESSMENT FINDINGS	
HAZARD	**ANNUALIZED LOSS ESTIMATES**	**HAZARD**	**PRI VALUE**
Flood	**$4,864,000**	Flood	**3.3**
Hurricanes and Tropical Storms	**$6,921,500**	Winter Storms	**3.0**
Earthquakes	**$1,235,000**	Hurricanes and Tropical Storms	**2.9**
Winter Storms	**$1,178,000**	Severe Thunderstorms	**2.7**
Drought	**$792,000**	Tornadoes	**2.7**
Severe Thunderstorms	**$286,000**	Drought	**2.6**
Tornadoes	**$170,000**	Earthquakes	**2.6**
Wildfire	**$168,000**	Wildfire	**2.6**
Dam/Levee Failure	**Negligible**	Dam/Levee Failure	**2.3**
Sinkholes	**Negligible**	Sinkholes	**1.8**
Landslides	**Negligible**	Landslides	**1.4**

Source: Mecklenburg County Mitigation Planning Committee, 2010

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the Hazard Mitigation Planning Team, were fitted into three categories for a final summary of hazard risk for Mecklenburg County based on High, Moderate or Low designations (**Table 6.32**). It should be noted that although some hazards are classified as posing Low risk, their occurrence of varying or unprecedented magnitudes is still possible and will continue to be reevaluated during future updates of this Plan.

Table 6.32: Conclusions on Hazard Risk for Mecklenburg County

HIGH RISK	**Flood** **Winter Storms** **Hurricanes and Tropical Storms** **Severe Thunderstorms** **Tornadoes**
MODERATE RISK	**Drought** **Earthquakes** **Wildfire**
LOW RISK	**Dam/Levee Failure** **Sinkholes** **Landslides**

Source: Mecklenburg County Hazard Mitigation Planning Team

7 CAPABILITY ASSESSMENT

This section of the Plan discusses the capability of Mecklenburg County and participating municipal jurisdictions to implement hazard mitigation activities. The *Capability Assessment* section consists of the following six subsections:

- WHAT IS A CAPABILITY ASSESSMENT?
- CONDUCTING THE CAPABILITY ASSESSMENT
- CAPABILITY ASSESSMENT FINDINGS
- PREVIOUSLY IMPLEMENTED MITIGATION MEASURES
- CONCLUSIONS ON LOCAL CAPABILITY
- LINKING THE CAPABILITY AND RISK ASSESSMENTS TO THE MITIGATION STRATEGY

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 and 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: an inventory of a local jurisdiction's relevant plans, ordinances or programs already in place and an analysis of its capacity to carry them out. A careful examination of local capabilities will detect any existing gaps, shortfalls or weaknesses associated with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate 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 if possible through future mitigation efforts.

The capability assessment serves as a critical part of the planning process, including the development of an effective multi-jurisdictional hazard mitigation strategy. Coupled with the Risk Assessment, the *Capability Assessment* section helps identify and target meaningful mitigation actions for incorporation into the *Mitigation Strategy*. It not only helps establish the goals for Mecklenburg County to pursue under this Plan, but also ensures that those goals and the mitigation actions that follow are realistically achievable given local conditions.

[1] While the Interim 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 to develop a mitigation strategy that meets the needs of each jurisdiction 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)). Further, the State of North Carolina Division of Emergency Management recommends a local capability assessment to be completed for local hazard mitigation plans, as does the new *Local Mitigation Planning Handbook* published by FEMA in 2013.

CONDUCTING THE CAPABILITY ASSESSMENT

In order to facilitate the inventory and analysis of local government capabilities throughout Mecklenburg County, a detailed *Capability Assessment Survey*[2] was distributed to Mecklenburg County's departments and local municipal jurisdictions. The survey questionnaire, which was completed by local government officials in 2005, again during the 2010 plan update process, and again during the 2015 plan update process, requested information on a variety of "capability indicators" such as existing local plans, policies, programs or ordinances that may reduce, or in some circumstances, increase the community's hazard vulnerability. Other indicators included information related to each jurisdiction's fiscal, administrative and technical capabilities such as access to local budgetary and personnel resources necessary to implement mitigation measures, and also education and outreach capabilities. Survey respondents were also asked to comment on the current political climate in their jurisdiction to implement mitigation actions, an important consideration for any local planning or decision making process.

At a minimum, survey results provide an extensive inventory of existing local plans, ordinances, programs and resources in place or under development in addition to their overall effect on hazard loss reduction. Local officials were also required to conduct a self-assessment of their jurisdiction's specific capabilities. The survey instrument thereby not only helps to accurately assess each jurisdiction's degree of local capability, but also serves as a good source of introspection for those jurisdictions wishing to improve their capability as identified gaps, weaknesses or conflicts can be recast as opportunities to implement specific mitigation actions.

The information provided by participating jurisdictions was incorporated into a database for further analysis. A general scoring methodology[3] was then applied to quantify and rank each jurisdiction's overall capability relative to one another. According to the scoring system, each indicator was assigned a point value based on its relevance to hazard mitigation. Additional points were added based on each jurisdiction's self-assessment of their own planning and regulatory capability, administrative and technical capability, fiscal capability, education and outreach capability, and political capability.

A general capability rating of "High," "Moderate" or "Limited" was then determined for each jurisdiction according to the total number of points received. These classifications are designed to provide a general assessment of each individual jurisdiction's local capability relative to one another. In combination with the narrative responses provided by local officials, the results of this multi-jurisdictional capability assessment lend critical information for developing an effective and meaningful mitigation strategy.

CAPABILITY ASSESSMENT FINDINGS

The findings of the 2015 capability assessment are summarized in this Plan in order to provide insight into the abilities of participating jurisdictions to implement a feasible hazard mitigation strategy. All information is based upon the input provided by local government officials through the *Capability Assessment Survey* and during meetings of the Hazard Mitigation Planning Team.

[2] The *Capability Assessment Survey* instrument used to assess county and municipal capabilities, as well as individual surveys completed by participating jurisdictions are available through Mecklenburg County upon request.
[3] The scoring methodology used to quantify and rank each jurisdiction's capability is fully described in this section of the Plan.

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, including reconstruction following a disaster. Examples include emergency response, mitigation and recovery planning, comprehensive land use planning, transportation planning and capital improvements planning. Additional examples include the enforcement of zoning or subdivision ordinances and building codes that regulate how land is developed and structures are built. These planning initiatives 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 in place or under development for jurisdictions in Mecklenburg County, along with their potential effect on hazard 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 Mecklenburg County's participating local governments. A checkmark indicates (✓) that the item is currently in place and being implemented and integrated by the local jurisdiction (or in some cases by the County on Behalf of that jurisdiction), or that is currently under development.

Table 7.1: Relevant Plans, Ordinances and Programs

JURISDICTION	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Plan	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evacuation Plan	Disaster Recovery Plan	Capital Improvements Plan	Economic Development Plan	Historic Preservation Plan	Transportation Plan	Flood Damage Prevention Ordinance	Zoning Ordinance	Subdivision Ordinance	Site Plan Review Requirements	Unified Development Ordinance	Post-disaster Redevelopment / Recovery Ordinance	Building Code	Fire Code	Community Wildfire Protection Plan	NFIP	NFIP Community Rating System
Mecklenburg County	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓
Charlotte	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
Cornelius	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Davidson	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Huntersville	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓		✓	
Matthews	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Mint Hill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓		✓	✓		✓	
Pineville	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓

A more detailed discussion of each jurisdiction's planning and regulatory capability follows, along with the incorporation of additional information based on the narrative comments provided by local officials in response to the survey questionnaire. The most significant areas of improvement between the 2010 plan update and the 2015 plan update is in the development of Unified Development Ordinances and Post-disaster Redevelopment/Recovery Ordinances. Two new types of plans considered for the 2015 plan update include Site Plan Review Requirements and Community Wildfire Protection Plans. These plans will be monitored over the next five-year period to determine their effect on mitigation planning.

Emergency Management

Hazard mitigation is widely recognized as one of the four primary phases of emergency management. The three other phases include preparedness, 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 ideally implemented before a disaster strikes. Examples include the acquisition or elevation of flood-prone structures or the enforcement of regulatory policies that prevent construction in known hazard areas. In reality, the post-disaster environment provides another important "window of opportunity" to implement hazard mitigation projects and policies. During this time period, federal disaster assistance, including the Hazard Mitigation Grant Program (HMGP), may be available. In addition, elected officials and disaster victims may be more willing to implement mitigation measures in order to avoid similar events occurring in the future.

Figure 7.1: Four Phases of Emergency Management

Sources: Federal Emergency Management Agency; PBS&J

Planning for each phase 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 each jurisdiction's 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.

- All local incorporated jurisdictions in Mecklenburg County actively participated in the development of the initial Multi-jurisdictional Hazard Mitigation Plan in 2005 and again during the 2010 plan update process, and again during the 2015 plan update process. This Plan assesses all natural hazard threats facing the area and the local capabilities to reduce their potential impact, and through ongoing intergovernmental coordination establishes countywide mitigation goals and individual mitigation actions plans aimed at reducing future losses to natural hazards.

- Mecklenburg County has prepared and adopted 10 Watershed Flood Mitigation Plans. The watersheds encompass approximately 85 percent of flood-prone buildings in the Charlotte-Mecklenburg area. While the watershed plans do not meet the requirements established by the Disaster Mitigation Act of 2000, they have been incorporated into this Multi-jurisdictional Hazard Mitigation Plan, which is designed to meet all federal and state hazard mitigation planning rules and regulations. The flood hazard analysis and flood mitigation projects identified in the watershed plans represent a strong commitment to flood loss reduction in the county. The Plan will build on the work already completed to include an assessment of all natural hazards and the identification of specific measures intended to reduce their impact.

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.

- The practice of disaster recovery is generally covered in the Charlotte-Mecklenburg County Integrated Response Plan for All Hazards. The Response Plan is prepared and maintained by the staff of the Charlotte-Mecklenburg Emergency Management Office (CMEMO) in coordination with other city and county departments. Initially adopted in 1953, the plan was amended in June 2004. The plan clearly delineates roles and responsibilities to support accountability and liability and enhance public safety in response to a disaster. While the plan strongly addresses emergency operations that will foster a prompt, efficient and coordinated response to a disaster, it does not fully address long-term recovery and reconstruction.

- All jurisdictions have indicated that guidelines for local disaster recovery procedures and operations are coordinated through CMEMO as an annex to the Integrated Response Plan for All Hazards.

- The preparation of a countywide disaster recovery plan should be considered by the Mitigation Planning Committee as a potential mitigation action to propose in this Plan's *Mitigation Strategy* or through future Plan updates. Mecklenburg County is aware of the State-sponsored pilot disaster recovery planning initiative in Brunswick County and will evaluate the possibility of preparing its own multi-jurisdictional recovery plan following a review of that effort and forthcoming tools from the North Carolina Emergency Management (NCEM).

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

- All municipal jurisdictions are covered under the Mecklenburg County All Hazards Plan and cooperate accordingly, although some have also prepared their own local emergency operations plans. These include the municipalities of Matthews, Huntersville and Davidson.

- The All Hazards Plan has been determined to have a moderate effect on loss reduction, as its emphasis focuses on preparedness and response operations versus hazard mitigation activities.

Continuity of Operation Plan: A continuity of operations plan establishes a clear chain of command, line of succession and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster event.

- Survey results indicate three (3) jurisdictions, Mecklenburg County, the City of Charlotte and Town of Huntersville, have continuity of operations plans in place or under development. The other municipal jurisdictions have indicated they fall under procedures identified in the Charlotte-Mecklenburg County All Hazards Plan; however do not have their own stand-alone continuity of operations plan.

Radiological Emergency Plan: A radiological emergency plan delineates roles and responsibilities for assigned personnel and the means to deploy resources in the event of a radiological accident.

- The McGuire Nuclear Power Station is located in Mecklenburg County. Radiological hazards are addressed in the Duke Power Company's Emergency Response Plan on behalf of all jurisdictions in Mecklenburg County. The plan prescribes those actions to be taken by Mecklenburg County and threatened municipalities in order to protect the health and safety of the general public who may be affected by radiation exposure and environmental contamination resulting from an accident or terrorist attack at the McGuire site.

- Radiological hazards are also addressed in the Charlotte-Mecklenburg County Integrated Response Plan for All Hazards.

SARA Title III Emergency Response Plan: A SARA Title III Emergency Response Plan outlines the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. These plans are required by federal law under Title III of the Superfund Amendments and Re-authorization Act (SARA), and the Emergency Planning and Community Right-to-Know Act (EPCRA).

- An Emergency Response Plan for chemical emergencies throughout the county is addressed in Annex P of the Mecklenburg County All Hazards Plan. A comprehensive rewrite of the Annex was completed and adopted in June 2004.

- The Local Emergency Planning Committee (LEPC) is a sub-committee of the Charlotte Mecklenburg All Hazards Advisory Committee (AHAC). A variety of local government officials, chemical industry representatives and media outlets participate in the LEPC planning process per EPCRA requirements.

General Planning

The implementation of hazard mitigation activities involves departments 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 may complement hazard mitigation goals even though they are not designed as such. Therefore, the *Capability Assessment Survey* also asked questions regarding each jurisdiction's general planning capabilities and

the degree to which hazard mitigation is integrated into other planning efforts. The results of this survey are outlined below, along with the general findings of a separate section incorporated into the Plan during the 2010 plan update that addresses the degree to which local planning mechanisms are currently being used by each jurisdiction to achieve "safe growth" according to another separately completed survey.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and a guide to future governmental decision making. Typically a comprehensive plan is comprised of demographic conditions, land use patterns, transportation elements and proposed 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 serve as a far reaching, long-term risk reduction tool.

- Survey results indicate that all jurisdictions possess a comprehensive land use plan in addition to other growth and development-related policy documents. As described in Section 3: *Community Profile* local jurisdictions in Mecklenburg County are committed to managing growth in a responsible and often cooperative manner. Some jurisdictions maintain small area plans addressing specific issues and concerns. All participating municipalities indicated that their land use plans either strongly support or help facilitate hazard loss reduction and are periodically updated.

- The Town of Matthews reports that its comprehensive plan has undergone a rewrite as a unified development ordinance.

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 to guide future development away from identified hazard areas. Limiting public investment in hazardous areas is one of the most effective long-term mitigation actions available to local governments.

- Survey results indicate that seven (7) out of eight (8) jurisdictions have a capital improvements plan in place or under development. Most are five-year plans that are updated annually. All survey respondents indicated that capital improvement plans either support or facilitate loss reduction efforts in their community. In the City of Charlotte, various departments prepare plans depending on the type of capital improvement program they maintain. For example, the City of Charlotte Storm Water Services division addresses flood control projects.

- The Town of Mint Hill reportedly does not have a capital improvements plan currently in place.

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 to include the identification of the most effective way to reduce future damages.[4] 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.

- Survey results indicate that six (6) out of eight (8) jurisdictions have completed a stand-alone historic preservation plan with rules and regulations that govern those properties (and neighborhoods) included in their local inventory and listed on the National Register of Historic Places.

[4] See *Protecting the Past from Natural Disasters*. 1989. Nelson, Carl. National Trust for Historic Preservation: Washington, D.C.

- The towns of Huntersville and Mint Hill do not currently have a historic preservation plan in place.

Zoning Ordinances: 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 area. 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, it can serve as a powerful tool when applied in identified hazard areas.

- Survey results indicate that all jurisdictions in Mecklenburg County have adopted and enforce a zoning ordinance. All jurisdictions indicated that their zoning ordinance either strongly supports or helps facilitate hazard loss reduction.

- The towns of Cornelius, Matthews and Mint Hill indicated that they currently administer their zoning and subdivision regulations through a locally adopted Unified Development Ordinance.

Subdivision Ordinances: A subdivision ordinance is intended to regulate the development of housing, 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.[5]

- Survey results indicate that all jurisdictions in Mecklenburg County have adopted and enforce a subdivision ordinance. All jurisdictions indicated that their ordinance either strongly supports or helps facilitate hazard loss reduction, with some intending to strengthen their ordinance through proposed mitigation actions as part of this Plan.

- The towns of Cornelius, Matthews and Mint Hill indicated that they currently administer their zoning and subdivision regulations through a locally adopted Unified Development Ordinance.

Building Codes, Permitting and Inspections: Building Codes regulate construction standards. In many communities, permits are issued for, and inspections of work take place on, 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.

- Per the General Assembly, communities in North Carolina are required to follow a statewide mandatory building code. The 2009 North Carolina Building Code is based on the 2006 International Building Code (IBC), with heavy modifications being made by the North Carolina Building Code Council (although few related to life and safety issues). Local governments may also amend the code pursuant to state approval.

- Mecklenburg County performs building code enforcement for all municipal 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

[5] For additional information regarding the use of subdivision regulations in reducing flood hazard risk, see *Subdivision Design in Flood Hazard Areas*. 1997. Planning Advisory Service Report Number 473. American Planning Association: Washington, D.C.

Office, Inc. (ISO).[6] Under the BCEGS program, ISO 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.

In conducting the assessment, ISO collects information related to personnel qualifications 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 the lower grade being more ideal. A BCEGS grade of 1 represents an exemplary commitment to building code enforcement, and a grade of 10 indicates less than a minimum level of recognized protection.

- Building code enforcement, which is handled by Mecklenburg County for all jurisdictions, has received a BCEGS rating of "4" for personal lines and an exemplary BCEGS rating of "1" for commercial and industrial lines.

2010 Safe Growth Survey

As part of the 2010 plan update process, each jurisdiction was also asked to complete a *Safe Growth Survey*. This unique survey instrument was drawn from a technique proposed by David Godschalk, FAICP and professor emeritus of city and regional planning at the University of North Carolina at Chapel Hill, to help better evaluate the extent to which each local jurisdiction in Mecklenburg County is positioned to grow safely relative to its natural hazards. The survey was completed by appropriate planning, zoning and/or community development staff for each of jurisdiction and the results are summarized in **Table 7.2**. In completing the survey each respondent was asked to indicate how strongly they agree or disagree with the "Safe Growth Statements" as they relate to their own jurisdiction's current plans, policies and programs for guiding future community growth and development, according to the following scale:

1 = Strongly Disagree **2** = Somewhat Disagree **3** = Neutral **4** = Somewhat Agree **5** = Strongly Agree

Table 7.2: Results of 2010 Safe Growth Survey

Safe Growth Statement	Mecklenburg County*	Charlotte*	Cornelius	Davidson**	Huntersville	Matthews	Mint Hill	Pineville
COMPREHENSIVE PLAN								
The comprehensive plan includes a future land use map that clearly identifies natural hazard areas.	5	5	1		5	2	4	5
Current land use policies discourage development and/or redevelopment within natural hazard areas.	5	5	5		5	4	5	5
The comprehensive plan provides adequate space for expected future growth in areas located outside of natural hazard areas.	5	5	1		5	4	4	5
Transportation								
The transportation element limits access to natural hazard areas.	3	3	4		5	3	4	3
Transportation policy is used to guide future growth and development to safe locations.	4	4	4		5	3	4	3
Transportation systems are designed to function under disaster conditions (e.g., evacuation, mobility for fire/rescue apparatus, etc.).	5	5	3		3	3	3	3

[6] Participation in BCEGS is voluntary and may be declined by local governments if they do not wish to have their local building codes evaluated.

Table 7.2: Results of 2010 Safe Growth Survey

Safe Growth Statement	Mecklenburg County*	Charlotte*	Cornelius	Davidson**	Huntersville	Matthews	Mint Hill	Pineville
Environmental Management								
Environmental features that serve to protect development from hazards (e.g., wetlands, riparian buffers, etc.) are identified and mapped.	4	4	5		5	3	4	5
Environmental policies encourage the preservation and restoration of protective ecosystems.	5	5	4		5	3	4	5
Environmental policies provide incentives to development that is located outside of protective ecosystems.	4	4	1		3	3	3	3
Public Safety								
The goals and policies of the comprehensive plan are related to and consistent with those in the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan.	4	4	2		5	3	4	4
Public safety is explicitly included in the plan's growth and development policies.	3	3	4		5	3	4	4
The monitoring and implementation section of the plan covers safe growth objectives.	3	3	4		5	3	4	4
ZONING ORDINANCE								
The zoning ordinance conforms to the comprehensive plan in terms of discouraging development and/or redevelopment within natural hazard areas.	5	5	4		5	5	4	5
The ordinance contains natural hazard overlay zones that set conditions for land use within such zones.	5	5	4		5	3	4	3
Rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use.	4	4	2		5	4	3	2
The ordinance prohibits development within, or filling of, wetlands, floodways, and floodplains.	4	4	5		5	5	5	5
SUBDIVISION REGULATIONS								
The subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas.	4	4	2		5	4	4	2
The regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources.	5	5	5		5	3	3	1
The regulations allow density transfers where hazard areas exist.	5	5	1		1	2	4	1
CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE POLICIES								
The capital improvement program limits expenditures on projects that would encourage development/redevelopment in areas vulnerable to natural hazards.	4	4	4		5	3	4	4
Infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.	5	5	4		5	3	4	4
The capital improvements program provides funding for hazard mitigation projects identified in the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan.	5	5	1		3	3	4	2
OTHER								
Small area or corridor plans recognize the need to avoid or mitigate natural hazards.	5	5	5		5	4	3	5
The building code contains provisions to strengthen or elevate new or substantially improved construction to withstand hazard forces.	5	5	4		5	4	3	5
Economic development/redevelopment strategies include provisions for mitigating natural hazards or otherwise enhancing social and economic resiliency to hazards.	5	5	4		1	3	4	4

Table 7.2: Results of 2010 Safe Growth Survey

Safe Growth Statement	Mecklenburg County*	Charlotte*	Cornelius	Davidson**	Huntersville	Matthews	Mint Hill	Pineville
AVERAGE SURVEY RATINGS	4.4	4.4	3.3		4.4	3.3	3.8	3.7

** Responses submitted jointly for the City of Charlotte and Mecklenburg County by the Charlotte-Mecklenburg Planning Department, a joint city-county agency charged with guiding growth and development for the City of Charlotte and the surrounding region*
*** As of this writing, the Safe Growth Survey had yet to be returned for the Town of Davidson.*

While somewhat of a subjective exercise, the *Safe Growth Survey* was used to provide some quantitative measures of how adequately existing planning mechanisms and tools for each jurisdiction were being used to address the notion of safe growth as currently advocated by organizations such as FEMA and the American Planning Association (APA). In addition, the survey instrument was aimed at further integrating the subject of hazard risk management into the dialogue of local planners throughout Mecklenburg County and to possibly consider and identify new mitigation actions as it relates to those local planning policies or programs already in place. It is anticipated that the survey will be used again during future plan updates to help measure progress over time and to continue identifying possible mitigation actions as it relates to future growth and community development practices, and how such actions may better be incorporated into local planning mechanisms.

The *Safe Growth Survey* was revisited during the 2015 plan update, however it will likely make the most sense to conduct a careful re-examination every 10 years to determine more significant changes in the survey rating. Therefore, the 2020 plan update will provide a more detailed update to this section. Also as part of the 2015 plan update, Mecklenburg County agreed to participate in a new "resiliency scorecard" pilot project in partnership with AECOM. The results of this separate scoring system will be incorporated into the Plan at a later date.

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, but is promoted by FEMA as a crucial means to implement and sustain an effective hazard mitigation program.

In order for a county or municipality to join 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 buildings will be protected from damage by the 100-year flood, and that new floodplain development will not aggravate existing flood problems or increase damage to other properties.

Another key service provided by the NFIP is the mapping of identified flood hazard areas. Once prepared, 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 7.3 summarizes NFIP participation for each of Mecklenburg County's local jurisdictions along with general NFIP policy data.[7]

Table 7.3: NFIP Participation in Mecklenburg County

JURISDICTION	NFIP ENTRY DATE	CURRENT EFFECTIVE MAP	NUMBER OF POLICIES	AMOUNT OF COVERAGE
Mecklenburg County	06/01/1981	03/02/09 & 02/19/2014	589	$149,592,500
Charlotte	08/15/1978	03/02/09 & 02/19/2014	2,882	$673,891,000
Cornelius	09/30/1997	03/02/09	113	$32,191,100
Davidson	10/16/1997	03/02/09	2	$205,000
Huntersville	02/04/2004	03/02/09	107	$28,678,500
Matthews	02/04/2004	02/19/2014	66	$18,236,600
Mint Hill	12/21/2007	02/19/2014	40	$10,707,900
Pineville	03/18/1987	03/02/09 & 02/19/2014	44	$12,149,200

Sources: Federal Emergency Management Agency (as of 1/13/2015)

When it comes to floodplain management, the City of Charlotte and Mecklenburg County are among the most ambitious and progressive local governments in the United States. As eluded to throughout other sections of this Plan, they routinely coordinate on stormwater and flood-related issues and have long since gone above and beyond the minimum regulatory standards of the NFIP. This includes developing and adopting community floodplain maps that go beyond FEMA's standard for mapping only current flood risk but *future* floodplain conditions based on anticipated growth and development that will likely increase those risks. Further, they have coordinated with each of the other municipal jurisdictions in Mecklenburg County to consider and adopt higher regulatory standards through their own flood damage prevention ordinances. **Table 7.4** provides a brief description of the higher regulatory standards adopted in Mecklenburg County, and **Table 7.5** summarizes which of these higher standards are currently being enforced in each jurisdiction according to local ordinances.

Table 7.4: NFIP Higher Regulatory Standards in Mecklenburg County

HIGHER STANDARD	DESCRIPTION	BENEFITS	FEMA MINIMUMS
Parking Lots Must be Elevated	• Applies to parking spaces for new non-single family buildings • Flood depths no more than 6 inches deep in any parking space during Community Flood event.	• Vehicles will be safe from flood damage • Water quality benefits • Emergency response to vehicles reduced	N/A
Dry land Access	• Driveways to new or substantially improved buildings must be elevated above the Community Base Flood Elevation and must connect to a public street above the Community Base Flood Elevation • Exemptions available when no dry public street • Variance are allowed	• This ensures safe access for regular and emergency vehicles to buildings	N/A

[7] General NFIP policy data (number and coverage) is current as of 12/31/2009 and is provided by the Federal Emergency Management Agency.

Table 7.4: NFIP Higher Regulatory Standards in Mecklenburg County

HIGHER STANDARD	DESCRIPTION	BENEFITS	FEMA MINIMUMS
Flood Maps Community Floodplains (Future Conditions) Wider Floodways	• Current maps show floodplain areas based on future land use conditions. • New buildings must be built with the lowest floor elevated at least one foot above the Community (Future) Base Flood Elevation. • Wider floodways are shown, which are areas on the maps reserved to allow the free flow of floodwaters while limiting development in these areas.	• New Buildings will be constructed so that they will not incur damage from higher flood levels in the future. • Less floodplain area will be filled or built upon	• Map the existing conditions 100-year floodplain. • Lowest floors allowed at existing conditions base flood elevation • More floodplain area can be built upon (wider floodways)
Critical Facilities Located Out of 500-year Floodplain	• New Critical Facilities such as daycare facilities, nursing homes, schools, hospitals, fire, police and medic facilities etc, must be located above the 500-year flood level.	• Vulnerable facilities or facilities essential to the community will be less at risk.	N/A
Levee Restrictions	• Many restrictions regarding construction of levees	• Likelihood of levees being constructed will be small resulting in less potential damage that could occur from levee failure.	N/A
Higher floor elevation requirement (Freeboard)	• Floors of new or substantially improved buildings must be elevated at least one (1) foot above the Community (future). (2 feet on Catawba)	• This will provide an extra degree of safety for factors not accounted for in the mapping such as, stream blockages, sedimentation in culverts, and inaccuracies in the mapping models.	• FEMA allows construction at existing conditions base flood elevations
Cumulative Substantial/Damage Improvement	• Improvements costing over 25% of the building value are cumulated within a 10-year period to meet the 50% maximum improvement value requirement.	• Buildings will be brought up to compliance and made safer in a shorter time period.	• Value only counted from one damage event or building improvement greater than 50% of the value of the structure
Below Flood Level Basements Not Allowed on Filled Lots	• Basement floors of new buildings cannot be located below the Community Base Flood Elevation on lots that have been elevated by fill	• Prevents possible damage from groundwater infiltration and meets FEMA recommendation.	• Encourages communities to meet this standard, but not required.

Table 7.5: NFIP Higher Regulatory Standards in Mecklenburg County, by Jurisdiction

REGULATION	Mecklenburg County	Charlotte	Cornelius	Davidson	Huntersville	Matthews	Mint Hill	Pineville
Parking Lots Must be Elevated	✓	✓	✓	✓	✓	✓	✓	✓
Dry land Access	✓	✓	✓	✓	✓	✓	✓	✓
Community Floodplains (Future Conditions)	✓	✓	✓	✓	✓	✓	✓	✓
Wider Floodways	✓	✓	✓	✓	✓	✓	✓	✓
Critical Facilities Located Out of 500-year Floodplain	✓	✓	✓	✓	✓	✓	✓	✓
Levee Restrictions	✓	✓	✓	✓	✓	✓	✓	✓
Higher floor elevation requirement (freeboard)	✓	✓	✓	✓	✓	✓	✓	✓
Cumulative Substantial/Damage Improvement	✓	✓	✓	✓	✓	✓	✓	✓
Below Flood Level Basements Not Allowed on Filled Lots	✓	✓	✓	✓	✓	✓	✓	✓
No Development In FEMA Floodplain	✓	✓		✓		✓	✓	✓

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, 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 identified thresholds are reached, communities can apply for an improved CRS class rating. Class ratings, which run from 10 to 1, are tied to flood insurance premium reductions as shown in **Table 7.6**. As class ratings improve (decrease), the percent reduction in flood insurance premiums for NFIP policy holders in that community increases.

Table 7.6: 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: Federal Emergency Management Agency

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 in order to make the program more user friendly, and extensive technical assistance is available for communities who request it.

- Mecklenburg County (Class 6), the City of Charlotte (Class 5) and the Town of Pineville (Class 6) actively participate in the CRS and are aiming to increase their CRS rating through the completion of this plan update process in addition to the implementation of other recommended mitigation actions. It is anticipated that additional jurisdictions may also seek to join the CRS as a result of this plan update process and following their own evaluation procedures.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for the identification and implementation of corrective and preventative measures designed to reduce flood-related impacts.

- Survey results indicate that all jurisdictions in Mecklenburg County are covered under the County's floodplain management plan that supports flood loss reduction efforts. The Town of Matthews has indicated that it also has adopted its own floodplain management plan in cooperation with County staff. The jurisdictions also cited flood damage prevention ordinances, policies and codes that are in place or under development as part of other community planning and regulatory programs.

Open Space Management Plan: An open space management plan is designed to preserve, protect and restore largely undeveloped lands, and to expand or connect areas in the public domain, including 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.

- Survey results indicate that all jurisdictions in the county except the Town of Mint Hill (which is covered under some County efforts) have prepared or are preparing their own open space management plan or a similar plan (i.e., Greenway Master Plan or Conservation and Downtown Plan) that addresses open space. Mecklenburg County Stormwater Services, working with other county agencies, has closely linked the acquisition of flood-prone properties with the ongoing expansion of their bike and pedestrian greenways system.

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.

- Survey results indicate that while some jurisdictions have prepared a stormwater management plan, most do not have a plan in place at the local level. However, significant technical and financial assistance is provided to municipal governments to support stormwater management planning, design, construction and maintenance through Mecklenburg County Storm Water Services staff. This essentially covers all participating jurisdictions.

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 is 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 associated with the implementation and success of proposed mitigation activities. Technical capability is 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 7.7** provides a summary of the results for each jurisdiction in Mecklenburg County. A checkmark (✓) indicates that local staff members are tasked with the services listed. Additional information on administrative and technical capability is provided in the completed surveys.

Table 7.7: Relevant Staff / Personnel Resources

JURISDICTION	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	Building Official	Emergency manager	Floodplain manager	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 Geographic Information Systems (GIS) and/or HAZUS	Resource development staff or grant writers	Maintenance programs to reduce risk	Warning systems/services	Mutual Aid Agreements
Mecklenburg County	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	
Charlotte	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Cornelius	✓	✓	✓		✓	✓				✓	✓		✓	✓
Davidson	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓
Huntersville	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓
Matthews	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓
Mint Hill	✓	✓	✓		✓	✓				✓	✓			
Pineville	✓	✓	✓		✓	✓				✓		✓		

For the 2015 plan update, the categories of Building Official, maintenance programs to reduce risk, warning systems/services and Mutual Aid Agreements were added as additional indicators of staff/personnel resources. These categories will be monitored and evaluated as part of the next five-year plan update to determine their relevance to mitigation planning.

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.[8] This may take the form of grant funding or locally-based

[8] Gaining access to federal, state or other sources of funding is often an overriding factor driving the development and implementation of hazard mitigation plans. However, an important objective of local governments seeking a more sustainable future is the concept of self-reliance. Over time, local jurisdictions should seek the means to become less dependent on federal assistance, developing a more diversified approach that assesses the availability of federal, state and locally generated funding to implement mitigation actions. The countywide adoption of a stormwater utility fee is indicative of this approach. Additional assistance may be available from the business and corporate sector as well as certain non-profit organizations. A broad-based mitigation strategy should also include an attempt to identify mitigation measures that cost little or no money, yet may compliment the larger array of actions identified in the Plan.

revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied 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 each jurisdiction's fiscal capability through the identification of locally available financial resources. **Table 7.8** provides a summary of the results for each jurisdiction in Mecklenburg County. A checkmark (✓) indicates that the listed fiscal resource is locally available for hazard mitigation purposes (including match funds for state and federal mitigation grant funds). Additional information on fiscal capability is provided in the completed surveys, which can be obtained through Mecklenburg County.

Table: 7.8: Relevant Fiscal Resources

JURISDICTION	Capital Improvement Programming	Community Development Block Grants	Special Purpose Taxes	Gas / Electric Utility Fees	Water / Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation Bonds	Revenue Bonds	Special Tax Bonds
Mecklenburg County	✓				✓	✓				
Charlotte	✓	✓		✓	✓	✓		✓	✓	✓
Cornelius	✓	✓	✓	✓		✓		✓	✓	✓
Davidson	✓	✓	✓			✓	✓	✓	✓	✓
Huntersville	✓	✓		✓		✓		✓		
Matthews	✓	✓				✓		✓		
Mint Hill		✓		✓		✓		✓		
Pineville	✓	✓		✓	✓	✓	✓	✓	✓	✓

Education and Outreach Capability

This type of local capability refers to education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information. Examples include natural disaster or safety related school programs; participation in community programs such as Firewise or StormReady; and activities conducted as part of hazard awareness campaigns such as a Tornado Awareness Month.

Table 7.9 provides a summary of the results for Mecklenburg County with regard to relevant education and outreach resources. A checkmark (✓) indicates that the given resource is locally available for hazard mitigation purposes.

Table: 7.9: Education and Outreach Resources

JURISDICTION	Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Natural disaster or safety related school programs	StormReady certification	Firewise Communities certification	Public-private partnership initiatives addressing disaster-related issues	Other
Mecklenburg County	✓	✓		✓		✓	
Charlotte	✓	✓		✓		✓	
Cornelius		✓		✓		✓	
Davidson	✓	✓		✓		✓	
Huntersville		✓		✓		✓	
Matthews	✓	✓		✓		✓	
Mint Hill				✓		✓	
Pineville		✓		✓		✓	

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. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. Or mitigation in general may not generate the same level of interest among local officials when compared with competing priorities. Therefore the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions. For example, the mapping of the county's floodplains in a manner that take into account future development and the resulting increase in flood elevations required a high degree of political support. This was accomplished through the extensive, long-term involvement of developers, county officials and concerned landowners. The adoption of a countywide stormwater utility fee represents another example of a policy measure that requires a significant level of commitment from elected officials and public support of hazard mitigation principles.

The *Capability Assessment Survey* was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of 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.). **Table 7.9** provides a summary of the individual responses for each jurisdiction.

Table 7.10: Political Capability	
JURISDICTION	**COMMENTS**
Mecklenburg County	1. Water supply watershed protection standards exceed State minimums. 2. Recent floodplain regulations reduced amount of filling in floodplain fringe; remapping of floodplains includes future land use for regulatory purposes. 3. Stream Buffer Requirements. 4. Greenway Master plan/open space programs. 5. Adopted Watershed Flood Mitigation Plans. 6. Local matching funds continually approved for HMGP and FMA grants for flood prone property acquisition.
Charlotte	Watershed Protection standards exceed State minimums; Post Construction Controls Ordinance exceed State minimums; Storm Water Utility Fee; Floodplain regulations reduced amount of filling in the floodplain fringe; Floodplain maps include future land use conditions and are used for regulatory purposes. Adopted future land use maps show most floodplain areas as open/green space.
Cornelius	No comments provided.
Davidson	In general Davidson's political leadership is willing to take action to protect the community, even when faced with opposition. For example, the Board of Commissioners' willingness to raise storm water fees when needed.
Huntersville	1. Low Impact Design (LID) Development (Mecklenburg County manual). 2. Steer development away from steep slopes, SWIM buffers mad lake buffers through zoning ordinance and subdivision regulations. 3. New strict floodplain regulations passed in March 2, 2009 (Code of Ordinances & zoning ordinance). 4. Stormwater management fee & guidelines. 5. Watershed areas limiting impervious surface.
Matthews	The Board has been willing to adopt policies and ordinances as suggested by the County, especially related to floodplain development standards when presented. Very interested in environmental aspects of all rezoning and development requests that come before them.
Mint Hill	No comments provided.
Pineville	The Town of Pineville Town Council and Mayor are both highly motivated to enact policies and programs that reduce hazard vulnerabilities in the community. Our Zoning Ordinance and Subdivision Ordinance are very strict on new development to ensure hazard areas are protected. Our local development standards found in these ordinances are highly emphasized and strongly take into account Pineville's natural hazard areas and possible routes of mitigation. We are a forward-thinking town which takes great care in preparing for the future.

County and Municipal Self Assessment

In addition to the inventory and analysis of specific local capabilities, the *Capability Assessment Survey* required each local jurisdiction to conduct its own self assessment of its capability to implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. They were also encouraged to consider their jurisdiction's ability to expand and improve their existing local tools and capabilities for natural hazard reduction. In response to the survey questionnaire, local officials classified each of the capabilities as either "limited," "moderate" or "high."

Table 7.11 summarizes the results of the self assessment process for each jurisdiction in Mecklenburg County. An "**L**" indicates limited capability; an "**M**" indicates moderate capability; and an "**H**" indicates high capability.

Table 7.11: Self Assessment of Local Capability						
JURISDICTION	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Education and Outreach Capability	Political Capability	Overall Capability
Mecklenburg County	H	H	H	H	H	H
Charlotte	H	H	H	H	H	H
Cornelius	M	M	H	M	H	M
Davidson	H	M	M	H	H	H
Huntersville	H	H	H	M	H	H
Matthews	H	H	M	M	H	H
Mint Hill	L	L	L	L	L	L
Pineville	M	M	M	M	M	M

PREVIOUSLY IMPLEMENTED MITIGATION MEASURES

The success of future mitigation efforts in a community can be gauged to some extent by its past efforts. Previously implemented mitigation measures indicate that there is, or has been, a desire to reduce the effects of natural hazards, and the success of these projects can be influential in building local government support for new mitigation efforts. Mecklenburg County has a well documented history of implementing hazard mitigation measures, most notably in an attempt to reduce the effects of flooding. A summary of those actions proposed by each jurisdiction to address flood and other natural hazards in the initial 2005 version of this Plan are listed in Section 9: *Mitigation Action Plans*, along with a brief status update on each action. However, a more detailed summary of the major flood mitigation measures undertaken by Mecklenburg County in cooperation with its municipal jurisdictions is provided below.

Throughout its history, Mecklenburg County has been subject to flood risk in various locations throughout the county. The rapid growth experienced in particular by Mecklenburg County and the City of Charlotte from the 1970s to the present has accelerated the rate at which these problems have grown. The County and the City have taken a variety of measures to offset and minimize identified problems.

1970s

During the 1970s, the U.S. Army Corps of Engineers undertook drainage improvements to several streams and watersheds within the City of Charlotte. Projects included the straightening, widening and deepening of several streams including Little Sugar Creek and Briar Creek in the areas around uptown Charlotte.

In 1976, the Mecklenburg County and the City of Charlotte joined the National Flood Insurance Program. Flood Insurance Rate Maps were created to identify flood-prone areas within the county and to help guide future development. The original studies were prepared by the USACE in the early 1970s.

In 1978 and 1979, the UNC-Charlotte Institute for Urban Studies and Community Service prepared two reports titled, *Measurement of Potential Flood Damages to Flood-Prone Structures within the City of*

Charlotte and *Measurement of Potential Flood Damages in Mecklenburg County* that provided a comprehensive analysis of the flood risk within the city and county at the time.

1980s

In 1983, the U.S. Army Corps of Engineers produced a report titled, *Sugar Creek Basin, Study to Determine the Feasibility of Providing Flood Control and Related Water Resources Improvements* that detailed alternatives to reduce flooding within the entire Sugar Creek watershed. Suggested mitigation alternatives included the acquisition of flood-prone structures, and the creation of levees and channel modifications. The report was met with a great deal of resistance from property owners and was never pursued.

1990s

The 1990s saw significant progress within the Mecklenburg County and the City of Charlotte to coordinate flood loss reduction strategies, including the implementation of comprehensive plans and specific mitigation measures. An important part of this strategy included the formation of the Charlotte-Mecklenburg Storm Water Services, which provided the organizational structure needed to oversee many of the identified flood-mitigation objectives. Additional actions included the creation of stormwater utilities for both the city and county, which focused on maintaining and improving drainage infrastructure. The creation of a monthly stormwater fee provided a stable funding source to tackle problems that had been exacerbated by decades of growth. Flood events in August 1995 and July 1997 added an increased level of visibility and interest in addressing flood risk across the county.

Mecklenburg County Floodplain Management Guidance Document

In 1995, two floodplain management workshops were held that resulted in the development of the *Mecklenburg County Floodplain Management Guidance Document* (Guidance Document). This document, adopted in December 1997, provided an overarching framework to guide future floodplain management and flood mitigation measures that are still in practice today.

The Guidance Document assessed potential flood mitigation measures across three interrelated perspectives:

- reduce flood risk to existing structures;
- reduce or prevent flood risk for new development; and
- develop new policies that are supportive of other public initiatives (water quality, greenway development, etc.).

Based on the three strategies, the county evaluated a number of floodplain management policies and recommendations. The implementation of several recommendations has had a significant impact on the overall reduction of flood risk within the county. In particular, the initiation of an updated Flood Insurance Rate Map for the city and county spurred renewed interest in evaluating regulatory requirements in the floodplain. A pilot report titled *Mallard Creek Floodplain Analysis and Floodplain Fill Assessment*, prepared in December 1998, evaluated and quantified several key issues, including:

- How much have flood elevations changed since the existing FIRMs were developed?
- What is the impact of allowing fill in the flood fringe?
- What is the impact of future development on flood elevations?

The results of the study served as a catalyst to advance flood hazard mitigation efforts within the county. The answers to these questions, although intuitive to some at the time, were now backed up with solid technical data that was used to support future initiatives. The report showed that within the Mallard Creek watershed, flood elevations on all but the smallest streams increased one foot or more from the previous FIRM. Based on the results of this study, the city and county were able to gain political support necessary to obtain local funding to perform a complete restudy of all watersheds within the county and to develop updated flood elevations for all streams.

Several techniques were used to model the impact of floodplain fill. The findings showed that the impact of floodplain fill ranged from two to seven feet along streams in the watershed. As a result, the city and county moved forward with the following initiatives:

- implementing increased elevation requirements from "one foot above BFE" to "one foot above future conditions BFE;"
- establishing a local floodway based on more restrictive requirements, including a local encroachment standard based on a 0.5 foot increase in elevation instead of the FEMA standard one foot; and
- establishing buffer requirements based on water quality requirements that would further reduce impacts on flooding (this information further supported the findings of the April 9, 1998 *Surface Water Improvement and Management [SWIM] Panel & Staff Consensus Report*).

Based on future conditions land use plans, it was shown that the expected future development within the watershed could increase flood elevations one to four feet in some instances. While the impact in the more urban watershed would be less in many cases, the overall impact was significant. From these findings the county was able to gain support for:

- developing future conditions flood elevations for watersheds in the county as part of the flood map update effort; and
- implementing and adopting new regulations that required all new construction to be built one foot above the future conditions base flood elevation.

After the completion of the updated flood maps for Mecklenburg County, information was available to perform detailed evaluations of mitigation alternatives based on the projected impact of future flood events on existing structures in and immediately adjacent to the floodplain. Specific mitigation measures identified included moving development away from the flood fringe, implementing floodproofing and elevation techniques for businesses and homeowners that remained in the floodplain, and reducing the amount of floodplain fill allowed through new encroachment standards and buffer requirements. Finally, the data allowed the county to more effectively manage new development based on the results of the future conditions mapping effort.

The 1995 and 1997 flood events resulted in significant flood damage to several residential neighborhoods. It was determined that the acquisition or elevation of these properties was among the only available alternatives. Structural measures such as stream channelization ran counter to the county's environmental objectives. In order to obtain potential funding to assist with mitigation efforts, Mecklenburg County developed a summary report evaluating over 1,000 flood-prone properties. Specific factors reviewed included past NFIP claims, repetitive losses and the evaluation of benefit-cost ratios of differing mitigation measures based on FEMA's Benefit-Cost Module. This evaluation narrowed the focus down to eight specific problem areas that had the highest benefit-cost ratio. Grant applications totaling over $12 million were submitted to the State of North Carolina in order to purchase 116 residential structures.

Since that time, the county has leveraged additional local funds through coordinated inter-departmental efforts to acquire additional properties to support their mitigation efforts as well as the efforts to expand the county greenway system. The county mitigation effort continues to identify funding opportunities to maximize the opportunity to further reduce flood damages to existing homes.

SWIM Panel & Staff Consensus Report

In April 1998, the Mecklenburg County Board of County Commissioners adopted the *Surface Water Improvement and Management (SWIM) Implementation Strategy*. This strategy was developed through a coordinated effort of the SWIM Panel, which was comprised of stakeholders from numerous local and state agencies as well as numerous other special interest groups. A variety of measures was identified and has been implemented to help improve overall water quality in Mecklenburg County. These measures include:

- enforce Erosion Control and Sedimentation Control Ordinances;
- enforce current buffers in regulated water supply watersheds;
- establish and maintain vegetative stream buffers;
- address elevated levels of fecal coliform bacteria;
- implement countywide water quality modeling;
- enhance water quality monitoring;
- improve coordination between county agencies;
- conduct stream inventory and assessment; and
- increase public education and awareness.

Many of these initiatives have a direct impact on overall flood mitigation efforts including the establishment of stream buffer requirements for streams throughout the county. Buffer requirements were established for all streams draining an area greater then 100 acres. These requirements exceeded the typical mapped FEMA floodplains, which typically include streams draining an area greater than one square mile. As a result, the buffer regulations have a direct impact on reducing the amount of disturbance and fill that occurs within the regulated floodplains but also has a similar impact on new development in the upper reaches of the watersheds that weren't addressed in the county floodplain ordinance.

Mecklenburg County Greenway Master Plan 1999-2009

In 1999, the county adopted the *Mecklenburg County Greenway Master Plan 1999-2009* that provided a comprehensive update to previous greenway master planning efforts undertaken by the county. This update recommended that the Greenway System be expanded to include floodplain management and water quality buffer objectives. The overall trail system was expanded from the original network defined in the 1980 Master Plan. In addition, the plan included a detailed description of how a variety of existing goals including floodplain management, water quality, recreation and habitat conservation could be linked. As a result, the Greenway Master Plan has become an integral part of the ongoing efforts to acquire existing flood-prone properties.

2000–Present

As part of the implementation of the *Mecklenburg County Floodplain Management Guidance Document*, the county undertook the development of preliminary engineering studies for the ten most urbanized watersheds in Mecklenburg County:

- Briar Creek Watershed
- Four Mile Creek Watershed
- Irwin Creek Watershed
- Lower Little Sugar Creek Watershed
- Mallard Creek Watershed
- McAlpine Creek Watershed
- McDowell Creek Watershed
- McMullen Creek Watershed
- Sugar Creek Watershed
- Upper Little Sugar Creek Watershed

The studies were conducted on a watershed-wide basis between 2000 and 2003 and resulted in one report for each of the watersheds. The primary focus of the reports was to conduct a review of pertinent stream and watershed information, assess flood damages and investigate flood hazard mitigation alternatives within the FEMA regulated floodplains. The compilation of these studies identified several pieces of critical information:

Flood-prone Structures
A total of 2,646 buildings are located within the future conditions floodplains for the 55 study streams located in the 10 watersheds. Of that total, 1,006 of the structures have a finished floor that is below the future conditions flood elevation. Approximately 74 percent of the flood-prone structures are located in the central watersheds within the City of Charlotte (Briar, Irwin, McMullen and Upper Little Sugar Creek).

Roadway Overtopping
Estimated flood depths at road crossings were identified for all structures along the regulated floodplains within the county. It is estimated that there are approximately 250 road crossings that are subject to overtopping from the future conditions floodplain.

Estimated Flood Damage
Flood damages were estimated for the 1,006 structures that are located below the future conditions floodplain using the FEMA Benefit-Cost module. The total present value of flood damages for these 1,006 structures was estimated at approximately $513 million. It should be noted that almost $400 million of those projected damages are located in the Briar Creek Watershed.

Flood Hazard Mitigation Improvement Alternatives
The 1,006 structures that were subject to flood risk were divided into approximately 160 problem areas for the purpose of evaluating mitigation alternatives. Improvement alternatives included acquisition, elevation, construction of floodwalls and levees, infrastructure improvements, and a "no action" alternative. Based on the evaluation of the alternatives and a benefit-cost analysis, the reports recommended a total of approximately $113 million in potential mitigation alternatives. Implementing these alternatives would remove approximately 93 percent of the total $513 million in flood damages predicted in the studies.

Since the completion of these studies, Mecklenburg County has continued to strengthen its floodplain mapping and regulatory efforts, including through the adoption of higher regulatory standards across the county (including for other incorporated municipalities) as listed earlier in this section (see Tables 7.3 and 7.4). It has also been highly successful in its active flood mitigation efforts including the *Floodplain Buyout Program*, further described below.

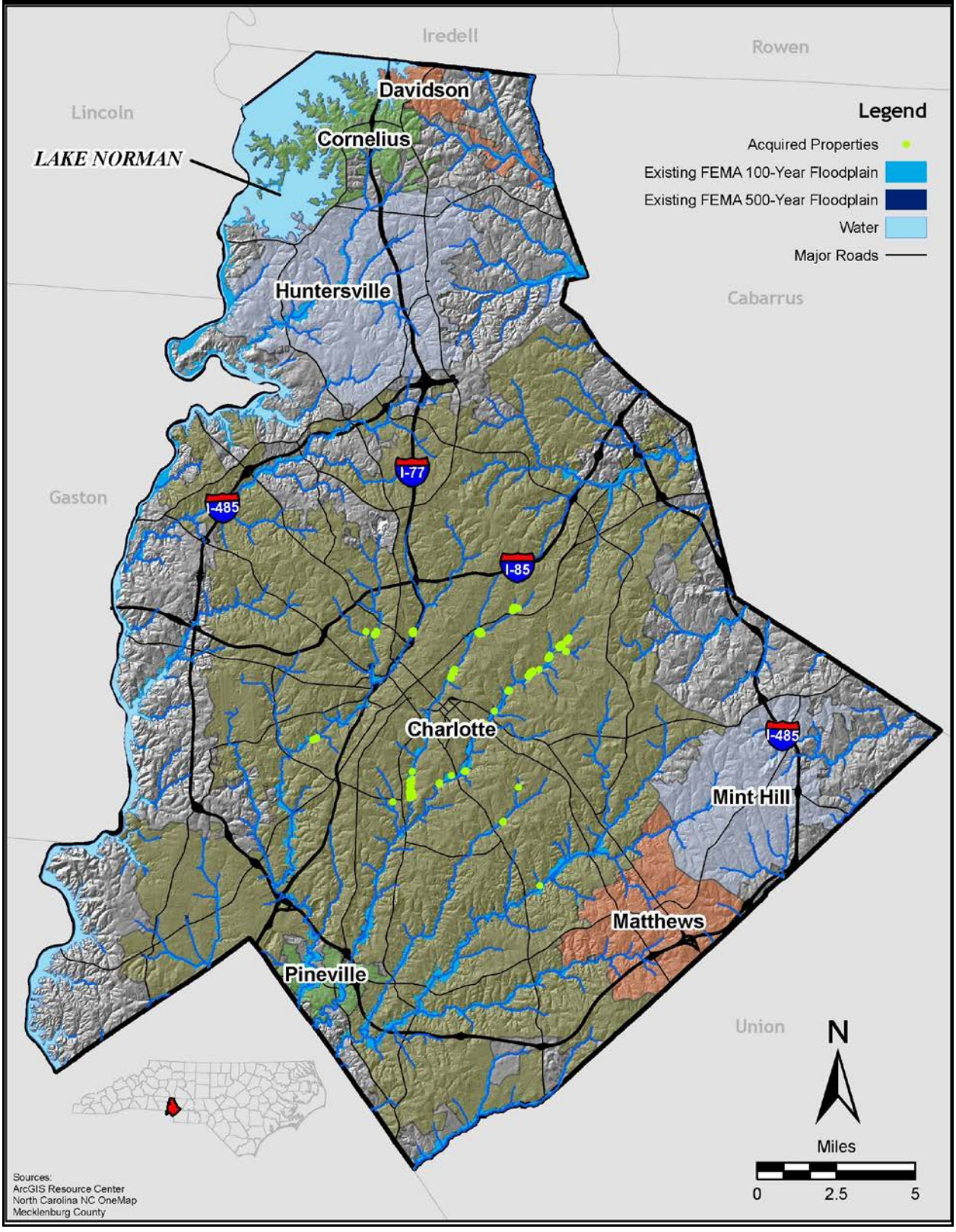
Mecklenburg County Floodplain Buyout (Acquisition) Program

The County's Floodplain Buyout Program is administered by Charlotte-Mecklenburg Storm Water Services (CMSWS). Through this highly successful program the County has to date purchased more than 200 flood-prone structures and relocated more than 400 families that were located in identified special flood hazard areas. These buildings were in more than a dozen neighborhoods along various creeks (see **Figure 7.2**. for general locations of properties acquired), and most were often subject repetitive flooding including those major events highlighted and described in Section 5: *Hazard Analysis*. Funding support for the buyouts comes from a combination of federal, state and local funds. Buildings purchased through the Buyout Program are demolished or relocated, and the floodplain is then restored to a natural state to store and filter excess rainfall and storm water runoff. In total, it is estimated that more than 80 acres of floodplain area has been reclaimed through the County's efforts to be maintained as open space in perpetuity.

As part of the program, the County has also been successful in the implementation of a "Quick Buy" program. The program, which relies solely on local funds (including County Storm Water reserve funds and Park and Recreation Bond funds), allows Storm Water Services to use locally-set criteria to determine which properties are eligible and then quickly buy the approved properties before flood damage is repaired. Quick Buys are processed in a matter of weeks or months. By comparison, it takes more than a year to acquire eligible floodplain properties when outside grants are used.

In the fall of 2008, following the flooding caused by the remnants of Tropical Storm Fay, the Mecklenburg County Board of County Commissioners approved spending up to $6 million through the Quick Buy program to purchase 41 homes or businesses that had been damaged by flooding by willing and voluntary homeowners. Qualifying properties had to meet specific criteria such as risk of flooding or proximity to future greenway or park land. In the end, more than 90% (37 homes) of those invited to participate in the Quick Buy program agreed to sell their homes to the County. All structures were in the portion of the floodplain at highest risk of flooding and built decades ago when there were no restrictions on floodplain construction. Most of these properties were along Briar Creek near Shamrock Drive, Eastway Drive and The Plaza. Property owners were offered fair market value of the house before the flood, minus the flood damages. Owners were not forced to sell, however, those who chose to repair their homes rather than sell had to comply with all regulations for floodplain development. In some cases, that required the owner to raise the elevation of their living space above higher base flood elevations. All properties purchased under the 2008 Quick Buy program will be left as open space and enhanced to improve water quality, and some of the land acquired may eventually be used for recreational purposes such as a greenway

Figure 7.2: Properties Acquired by Mecklenburg County's Floodplain Buyout Program



CONCLUSIONS ON LOCAL CAPABILITY

In order to form meaningful conclusions on the assessment of local capability, a scoring system was designed and applied to the results of the *Capability Assessment Survey*. This approach, further described below, assesses the level of capability for each jurisdiction in Mecklenburg County. It is important to note that the score received by each participating jurisdiction is not intended to compare one to the other. Rather, the scoring system is intended to assist each jurisdiction develop mitigation actions that reflect their abilities and help to identify areas that can be improved through the adoption of specific mitigation actions addressing these weaknesses.

Points System for Capability Ranking

Scoring:

0-24 points = Limited overall capability
25-55 points = Moderate overall capability
56-103 points = High overall capability

I. Planning and Regulatory Capability (Up to 55 points)

Yes=3 points Under Development or Under County Jurisdiction=1 No=0 points

- Hazard Mitigation Plan
- Comprehensive Land Use Plan
- Floodplain Management Plan
- Participate in the NFIP
- Participate in CRS Program
- BCEGS Grade of 1 to 5

Yes=2 points Under Development or County Jurisdiction=1 No=0 points

- Open Space Management / Parks & Rec. Plan
- Stormwater Management Plan
- Emergency Operations Plan
- SARA Title III
- Radiological Emergency Plan
- Continuity of Operations Plan
- Evacuation Plan
- Disaster Recovery Plan
- Flood Damage Prevention Ordinance
- Post-disaster Redevelopment/Recovery Ordinance
- Community Wildfire Protection Plan
- BCEGS Grade of 6 to 9

Yes=1 point No=0 points

- Capital Improvements Plan
- Economic Development Plan
- Historic Preservation Plan
- Transportation Plan
- Zoning Ordinance
- Subdivision Ordinance
- Site Plan Review Requirements
- Unified Development Ordinance
- Building Code
- Fire Code
- Participate in NFIP Program

II. Administrative and Technical Capability (Up to 18 points)

Yes=2 points 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 Geographic Information Systems (GIS) and/or HAZUS
- Resource development staff or grant writers
- Maintenance programs to reduce risk
- Warning systems/services
- Mutual Aid Agreements

III. Fiscal Capability (Up to 11 points)

Yes=1 point No=0 points

- Capital Improvement Programming
- Community Development Block Grants
- Special Purpose Taxes
- Gas / Electric Utility Fees
- Water / Sewer Fees
- Stormwater Utility Fees
- Development Impact Fees
- General Obligation Bonds
- Revenue Bonds
- Special Tax Bonds
- Other

IV. Education and Outreach Capability (Up to 7 points)

Yes=1 point No=0 points

- Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.
- Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)
- Natural disaster or safety related school programs
- StormReady certification
- Firewise Communities certification
- Public-private partnership initiatives addressing disaster-related issues
- Other

V. Self-Assessment of Overall Capability (Up to 12 points)

High=2 points Moderate=1 points Low=0 points (Self-ranked by jurisdiction)

- Technical Capability
- Fiscal Capability
- Administrative Capability
- Education and Outreach Capability
- Political Capability
- Overall Capability

Note: This methodology is based on best available information. If a jurisdiction did not provide information on one of the above items, a point value of zero (0) was assigned for that item.

Table 7.12 shows the results of the capability assessment using the designed scoring methodology in 2005, 2010 and again with the 2015 plan update. According to the 2015 assessment, the local capability of all jurisdictions changed to some degree, and the current average local capability score for all local jurisdictions in Mecklenburg County is **64.38** (which equates to High Overall Capability). This is an increase of more than seven points from the countywide average score of **57.13** as determined through the 2010 capability assessment. All jurisdictions remained at the same overall capability rating as determined in 2010 with the exception of the Town of Pineville which went from a "moderate" capability rating to a "high" capability rating. Some of the changes in scoring are a result of the addition of the Education and Outreach Capability category and various other additions to the other sections, as noted above.

Table 7.12: Capability Assessment Results

JURISDICTION	CAPABILITY SCORE (2004)	CAPABILITY SCORE (2010)	CAPABILITY SCORE (2015)	CAPABILITY RATING (2015)
Mecklenburg County	66	69	70	High
Charlotte	67	76	85	High
Cornelius	50	53	60	High
Davidson	51	53	67	High
Huntersville	59	60	67	High
Matthews	49	57	69	High
Mint Hill	33	40	41	Moderate
Pineville	44	49	56	High

The overall capability of local governments in Mecklenburg County to implement mitigation actions is determined to be moderate to high. Mecklenburg County and most of the municipalities received a high capability rating. The scoring methodology used to conduct this assessment is meant to provide a general understanding of local capability for each jurisdiction. The results are based on the information provided by local officials in response to the *Capability Assessment Survey*, an instrument designed to measure local capability based on those indicators determined to be most relevant for mitigation purposes and referenced in FEMA planning guidance.

According to the assessment, local capability does vary between the local jurisdictions. While some municipalities have significant "in-house" staff resources, like Charlotte and Huntersville, others depend on outside sources such as Mecklenburg County, the Charlotte-Mecklenburg Planning Commission or private contractors to perform certain local functions or services such as emergency management and code enforcement. Smaller local governments typically combine multiple job responsibilities, such as a planning director serving as the floodplain manager, or the town manager serving as the local emergency manager.

Perhaps one of the most significant findings of the assessment is the widespread existence of several planning initiatives, programs and tools already in place across Mecklenburg County that support local planning, growth management and hazard mitigation efforts. As a result, jurisdictions understand the importance of intergovernmental coordination and how it applies to multi-jurisdictional planning. Mecklenburg County's local governments coordinate on a number of issues and strategies related to future land use planning and standards for regulating development, in addition to the provision of infrastructure such as sewer and water or public services such as police and fire protection.

Mecklenburg County's local governments should continue to apply this same level of coordination to hazard mitigation practices, building on the work already being done in floodplain management and emergency management preparedness initiatives. This Plan served as the vehicle to begin this process and the intergovernmental coordination demonstrated in 2005 continues to this day, as exemplified through the 2010 plan update process and the 2015 plan update process. This coordination will continue throughout the implementation and regular maintenance process of this plan as described in Section 10: *Plan Maintenance Procedures*. One of the best ways to obtain local buy-in and long-term success is to identify and implement achievable mitigation actions (as listed in each jurisdictions' individual Mitigation Action Plans) that will facilitate continued intergovernmental coordination not only across the county, but with state and federal agencies as well.

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 a meaningful hazard mitigation strategy. During the process of identifying specific mitigation actions to pursue, each jurisdiction must consider not only their level of hazard risk but also their existing capability to minimize or eliminate that risk. **Figure 7.3** shows a Risk vs. Capability Matrix that is used to illustrate each jurisdiction's overall hazard risk[9] in comparison to their overall capability. This matrix has been completed for each of Mecklenburg County's participating jurisdictions and is included in each jurisdiction's separate and distinct *Mitigation Action Plan* (Section 9).

Figure 7.3: Risk vs. Capability Matrix

		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High			
	Moderate			
	Limited			

In jurisdictions where the overall hazard risk is considered to be HIGH, and local capability is considered LIMITED, then specific mitigation actions that account for these conditions should be considered. This may include less costly actions such as minor ordinance revisions or public awareness activities. Further, if necessary, specific capabilities may need to be improved in order to better address recurring threats. Similarly, in cases where the hazard vulnerability is LIMITED and overall capability is HIGH, more emphasis can be placed on actions that may impact future vulnerability such as guiding development away from known hazard areas.

[9] Overall hazard risk was determined for each jurisdiction using the results of the risk assessment (estimated losses for all natural hazards) combined with specific information on the following factors: total population, population growth rate, land area, historical disaster declarations, unique hazard risks, NFIP participation and the value of existing pre-FIRM structures. More information on the methodology used to determine overall hazard risk is available through Mecklenburg County upon request.

8 MITIGATION STRATEGY

This section of the Plan provides the "blueprint" for Mecklenburg County and participating municipalities to become less vulnerable to natural hazards. It is based on the general consensus of the Hazard Mitigation Planning Team along with the findings and conclusions of the *Capability Assessment* and *Risk Assessment*. The *Mitigation Strategy* section consists of the following four subsections:

- INTRODUCTION
- MITIGATION GOALS
- IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES
- SELECTION OF MITIGATION TECHNIQUES FOR MECKLENBURG COUNTY (INCLUDING PARTICIPATING MUNICIPALITIES)

INTRODUCTION

The intent of the *Mitigation Strategy* is to provide Mecklenburg County and participating municipalities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

In being comprehensive, the development of the strategy included a thorough review of all natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to assist Mecklenburg County and participating municipalities achieve compatible economic, environmental and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to established priorities assigned to specific departments or individuals responsible for their implementation and assigned 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 countywide mitigation goals. Mitigation goals represent broad statements that are achieved through the implementation of more specific, action-oriented tasks listed in each jurisdiction's *Mitigation Action Plan*. These actions include both hazard mitigation policies (such as the regulation of land in known hazard areas), and hazard mitigation projects that seek to address specifically targeted at-risk properties (such as the acquisition and relocation of flood-prone structures). During the 2010 plan update process, each of the countywide mitigation goals established in 2005 were reviewed and discussed with the Hazard Mitigation Planning Team as well as members of the general public and targeted stakeholders. Following these presentations and discussions, the Mitigation Planning Committee reaffirmed the goal statements as currently written and described below in this section.

The second step involves the identification, consideration and analysis of available mitigation measures to help achieve the identified mitigation goals. The identification and evaluation of possible mitigation techniques for Mecklenburg County and its municipalities to reduce the effects of natural hazards is an ongoing process that initially began during the Mitigation Strategy Workshop conducted for the 2005 version of the Plan and has continued with the 2010 and 2015 updates to the Plan.[1] The Plan is designed however, through a regular maintenance and update schedule, to ensure that mitigation goals and additional mitigation measures are reconsidered over time as future risk reduction opportunities are identified, new data becomes available, technology improves and mitigation funding becomes available. This is a long-term, continuous process sustained through the development and maintenance of this Plan

[1] Additional information on the 2005 Mitigation Strategy Workshop is available in Section 2: *Planning Process*.

as described in Section 2: *Planning Process* and Section 10: *Plan Maintenance Procedures*. Alternative mitigation measures will continue to be considered as future mitigation opportunities become identified, as data and technology improve, as mitigation funding becomes available, and as this Plan is updated and maintained over time.

The last step in designing the *Mitigation Strategy* is the creation and maintenance of jurisdictionally specific *Mitigation Action Plans* (MAPs).[2] The MAPs represent the key outcome of the mitigation planning process. MAPs include a prioritized list of proposed hazard mitigation actions (policies and projects) for Mecklenburg County and the participating municipalities, including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources and an estimated target date for completion. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The collection of actions listed in each jurisdiction's MAP also serves as an easily understood synopsis of activities for local decision makers.

In preparing and updating their own *Mitigation Action Plans*, each jurisdiction considered their overall hazard risk and capability to mitigate natural hazards, in addition to meeting the adopted countywide mitigation goals. Prioritizing mitigation actions for each jurisdiction was based on the following five factors: (1) effect on overall risk to life and property; (2) ease of implementation; (3) political and community support; (4) a general economic cost/benefit review;[3] and (5) funding availability. Using these criteria, the representatives from each participating jurisdiction serving on the Mecklenburg County Hazard Mitigation Planning Team were tasked with assigning priority levels for the actions that were being proposed for the 2015 plan update. Each mitigation action was assigned one of the following priority levels (and is included with each jurisdiction's *Mitigation Action Plan* in Section 9):

- **High Priority:** The most immediate, cost-effective and appropriate actions preferably to be accomplished in the short to mid-term (1-2 year) planning horizon.
- **Moderate Priority:** Fairly urgent, cost-effective and appropriate actions but with some possible difficulties associated with implementation. Preferably accomplished in the mid to long-term (2-5 year) planning horizon.
- **Low Priority:** Not urgent, but an action to be considered for implementation at some point over the long-term (5+ years) when implementation is deemed most appropriate.

[2] *Mitigation Action Plans* are found in Section 9: *Mitigation Action Plan*. Additional flood mitigation actions are found in watershed-based flood mitigation plans that have been developed prior to this Plan and are incorporated into this document by reference. The specific watershed-based flood mitigation plans are referenced in Section 7: *Capability Assessment*.

[3] A general economic cost/benefit review was conducted as part of selecting and prioritizing mitigation actions for each jurisdiction. Mitigation actions with "high" priority were determined to be the most cost effective and most compatible with each jurisdiction's unique needs. A more detailed cost/benefit analysis will be conducted as part of an application for funding, as appropriate.

MITIGATION GOALS

44 CFR Requirement

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 goals of the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan were crafted early in the initial 2005 planning process as part of a facilitated discussion and brainstorming session with the Mitigation Planning Committee. These same goals were again revisited by the Committee at two phases of the 2010 plan update process, including the initial plan update kickoff meeting and again following the completion of the risk and capability assessments (more details provided in Section 2: *Planning Process*), and at the same critical points during the 2015 plan update. Following a presentation and discussion of the results from these two assessments, the Committee reaffirmed each of the goal statements as currently written. Each of these goal statements continue to represent a broad target for Mecklenburg County and participating municipalities to achieve through the implementation of their updated *Mitigation Action Plans*.

Goal #1 **Mecklenburg County and participating municipalities will identify and implement hazard mitigation projects designed to reduce the impact of future hazard events.**

Goal #2 **Mecklenburg County and participating municipalities will conduct education and outreach activities intended to better inform people about natural hazards and the steps that can be taken to reduce their impact.**

Goal #3 **Mecklenburg County and participating municipalities will conduct training and exercises intended to better prepare government officials to respond to, mitigate against and recover from emergencies and disasters.**

Goal #4 **Mecklenburg County and participating municipalities will improve their ability to warn people of impending hazards and disasters.**

Goal #5 **Mecklenburg County and participating municipalities will enact planning and policy measures to reduce the impacts of identified hazards.**

Goal #6 **Mecklenburg County and participating municipalities will implement traffic control procedures intended to reduce injuries and the loss of life before, during and after emergencies and disasters.**

A stated objective of the Disaster Mitigation Act of 2000 is to improve the coordination of risk reduction measures between state and local government authorities. Linking local and state mitigation planning goals is an important first step. It has been determined that the goal statements for Mecklenburg County and its participating municipalities are consistent with the State of North Carolina's current mitigation planning goals as identified in the State Mitigation Plan.

IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

44 CFR Requirement

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. The mitigation strategy must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

This CFR requirement is met in the Capability Assessment, Mitigation Strategy *and* Mitigation Action Plans *sections of this risk assessment.*

In formulating Mecklenburg County's *Mitigation Strategy*, a wide range of activities was considered in order to help achieve the countywide goals and the specific hazard concerns of each participating jurisdiction. This includes multiple, detailed discussions of potential mitigation activities with Hazard Mitigation Planning Team members during the initial plan's development in 2005[4] and also during the 2010 and 2015 plan update processes. In addition, a wide range of publications (including NCEM's "*Decision Tree,*" FEMA's "Mitigation Ideas" and relevant CRS planning guidance) and other resources were posted to a dedicated project FTP site for Committee members to review and consider on their own time (further described in Section 2: *Planning Process*). Similar to the initial plan development process in 2005, all activities considered by the committee can be classified under one of the following six broad categories of mitigation techniques:

1. Prevention

Preventative activities are intended to reduce the impact of future hazard events, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are constructed. 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
- Shoreline/riverine/fault zone setbacks

2. Property Protection

Property protection measures involve the modification of existing buildings and structures or the removal of the structures from hazardous locations. Examples include:

- Acquisition
- Relocation
- Building elevation

[4] For more details on the specific activities discussed and considered by the Mitigation Planning Committee during the initial preparation of this Plan, please see the summary of the second committee meeting in 2005 (Mitigation Strategy Workshop) in Section 2: *Planning Process*.

- Critical facilities protection
- Retrofitting (i.e., windproofing, floodproofing, seismic design techniques, etc.)
- Safe rooms, shutters, shatter-resistant glass
- Insurance

3. Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Generally speaking, natural areas may include floodplains, wetlands, steep slopes, barrier islands and sand dunes. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Land acquisition
- Floodplain protection
- Watershed management
- Beach and dune preservation
- Riparian buffers
- Forest and vegetation management (i.e., fire resistant landscaping, fuel breaks, etc.)
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization
- Historic properties and archaeological site preservation

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environment using a number of construction techniques. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Dams/levees/dikes/floodwalls/seawalls
- Diversions/detention/retention
- Channel modification
- Beach nourishment
- Storm sewers

5. Emergency Services

Although not typically considered a “mitigation” technique, emergency services reduce the impacts of a hazard event on people and property. These actions are often taken prior to, during, or in response to an emergency or disaster. Examples include:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Sandbagging for flood protection
- Installing temporary shutters for wind protection

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 used to educate and inform the public include:

- Outreach projects
- Speaker series/demonstration events
- Hazard mapping
- Real estate disclosure

- Library materials
- School children educational programs
- Hazard expositions
- Inter-governmental coordination

Careful consideration was given to the idea of replacing the six mitigation techniques categories listed above with the four categories currently being recommended in the *Local Mitigation Planning Handbook* published in 2013. However, the planning team felt that changes to the categories at this point would create a series of disconnects related to existing mitigation actions as well as CRS guidance. Therefore the decision was made to keep the categories as-is for the 2015 plan update.

As discussed in Section 2: *Planning Process*, a number of specific hazard mitigation actions were presented and discussed during the March 17th, 2010 meeting of the Mecklenburg County Mitigation Planning Committee. These included the following actions:

Multi-hazard Mitigation Actions

- On an annual basis, coordinate with the Charlotte-Mecklenburg Emergency Management Office to provide information on all natural hazards facing the area to local planning staff and elected officials. This should include a report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.
- On an annual basis, coordinate with the Charlotte-Mecklenburg Emergency Management Office on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.
- Coordinate with Duke Energy (or other local utilities) to conduct public outreach activities that educate property owners on the benefits of proper tree pruning on a routine basis. (Utility bill inserts?)
- Prepare and conduct a survey for critical facilities to help identify structural and/or non-structural deficiencies that may lead to increased vulnerability to natural hazards. Include recommended corrective actions in local capital improvements program.
- Identify and prioritize those critical facilities that still need to be equipped with capability for emergency backup power during and after major disaster events.
- In coordination with CMEMO, help sponsor the creation of a Community Emergency Response Team (CERT).
- Review current zoning and/or subdivision ordinances to ensure that all potential natural hazard areas are considered in future land development decisions. Any known hazard areas should be mapped and considered during site plan review.
- Ensure the consideration of all natural hazards is integrated into local infrastructure and capital improvements planning.
- Require/promote the burying of power lines for new subdivisions.
- Prepare a Post-disaster Recovery Plan and/or Ordinance that specifies the policies and procedures for repair and reconstruction following a major disaster event.
- Prepare a Continuity of Operations Plan (COOP) to ensure the essential functions of government can continue to operate during and after a major disaster event.

Flood Mitigation Actions

- Coordinate with Mecklenburg County Storm Water Services to join FEMA's voluntary *Community Rating System (CRS)*.
- Provide direct links to CMSWS from local town websites

- Prepare and maintain a map of areas that flood frequently, particularly those areas outside of FEMA floodplains.
- Hold informative work sessions for newly elected officials and new appointees to planning commissions and appeals/variance boards, to provide an overview of floodplain management, the importance of participating in the NFIP, and the implications of failing to enforce the requirements of the program or failing to properly handle variance requests.
- Encourage local staff member(s) to pursue CFM certification
- Send information about the flood hazard and promote the availability of flood insurance through regular mailings

Drought Mitigation Actions

- Develop public outreach materials to encourage voluntary water-saving measures by residents during periods of severe or extreme drought.
- Assess current and future water needs to help ensure water storage/supply is adequate and prepare contingency plans for actions required during periods of severe or extreme drought.
- Ensure that future land use and development decisions (and water delivery systems) take potential long-term drought events and water shortages into account.
- Draft/revise water use ordinance to prioritize or control water use during periods of severe or extreme drought.
- Promote the availability of crop insurance to farmers.

Wildfire Mitigation Actions

- Encourage the practice of defensible space for structures determined to be at high risk to wildfire.
- Coordinate with the North Carolina Division of Forestry (NCDFR) to identify fire districts with high potential risk to wildfire.
- Coordinate with NCDFR to prepare Community Wildfire Protections Plans for identified high risk communities.
- Promote the national *Firewise Communities* program to those neighborhoods or areas with high potential risk to wildfire.
- For confirmed high risk wildfire areas, revise zoning ordinance to encourage cluster development patterns in defensible areas and away from areas of high risk, such as steep slopes.
- Review and identify the need to revise local ordinances with regard to burning restrictions.

Earthquake Mitigation Actions

- Conduct an inventory of unreinforced masonry buildings and non-ductile concrete facilities in the community that are vulnerable to ground shaking.
- Educate property owners of identified at-risk structures on the potential risk of earthquake damages and methods available to reduce or eliminate that risk.
- Coordinate with NCDOT on the identification of structurally deficient bridges that are more likely to sustain damage from future earthquake events and that should be addressed through future retrofit projects or bridge replacement.
- Identify potentially at-risk fuel pipelines or hazardous material facilities that could cause major fires or hazmat releases following an earthquake event; evaluate and recommend possible mitigation actions.

Dam Failure Mitigation Actions

- Coordinate with State Dam Safety staff on routine inventory and inspection process
- Coordinate with dam owners/operators on preparation and maintenance of Emergency Action Plans (EAPs)
- Coordinate with CMEMO on development of dam failure notification and evacuation procedures

- Prohibit new development and/or the provision of new capital improvements to areas downstream or in mapped dam failure inundation zones

Mitigation Actions Related to Climate Change

- Preserve large, intact forestland through the acquisition and/or dedication of park lands and open space as well as through the zoning and subdivision regulations.
- Conduct a carbon footprint analysis for publicly-owned and operated facilities to better evaluate current policies and identify strategies to reduce greenhouse gases through energy conservation and behavioral change.
- Develop an energy plan to include the pursuit of alternative energy sources, purchasing policies, the sale of carbon credits for forested lands and other community-based strategies to reduce carbon emissions.

During the 2015 plan update, as documented in Section 2: *Planning Process*, significant discussion was devoted to the idea of adding geomagnetic (or solar) storms to the 2015 version of the Plan. The Hazard Mitigation Planning Team agreed to address this new natural hazard in Section 4: *Hazard Identification* and also in Section 9: *Mitigation Action Plans.* The two specific actions the team decided to adopt throughout the *Mitigation Action Plans* were:

- Public outreach and education on the issue of solar events.
- Host a conference on the impacts of solar events (to raise awareness to a higher level such as the State and National levels).

SELECTION OF MITIGATION TECHNIQUES FOR MECKLENBURG COUNTY

In order to determine the most appropriate mitigation techniques for Mecklenburg County and participating municipalities, local government officials reviewed and considered the findings of the *Capability Assessment* and *Risk Assessment*. Other considerations included each mitigation action's effect on overall risk reduction, its ease of implementation, its degree of political and community support, its general cost-effectiveness and funding availability.[5]

FEMA guidance for meeting the planning requirements of the Disaster Mitigation Act of 2000 also specifies that local governments should prioritize their mitigation actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. In response to this requirement, the Mecklenburg County Hazard Mitigation Planning Team completed a Mitigation Technique Matrix (**Figure 8.1**) to make certain they address, at a minimum, those hazards posing the greatest threat.

The matrix provides the committee with the opportunity to cross-reference each of the priority hazards (as determined through the *Risk Assessment)* with the comprehensive range of available mitigation techniques, including prevention, property protection, natural resource protection, structural projects, emergency services, and public education and awareness. It is important to note that Mecklenburg County's individual *Mitigation Action Plans* include an array of actions targeting multiple hazards, not just those classified as either high or moderate risk.

[5] Mitigation actions may or may not require external funding to accomplish. For example, the modification of a given policy to better address identified hazard concerns may require staff time and internal resources, whereas the large-scale acquisition of flood-prone properties may necessitate seeking state or federal funding assistance.

Figure 8.1: Mitigation Technique Matrix

MITIGATION TECHNIQUE	HIGH RISK HAZARDS					MODERATE RISK HAZARDS		
	FLOOD	WINTER STORM	HURRICANE AND TROPICAL STORM	SEVERE THUNDER-STORM	TORNADO	DROUGHT	EARTHQU-AKE	WILDFIRE
PREVENTION	✓	✓	✓	✓	✓	✓	✓	✓
PROPERTY PROTECTION	✓	✓	✓	✓	✓			
NATURAL RESOURCE PROTECTION	✓							
STRUCTURAL PROJECTS	✓	✓	✓	✓	✓		✓	
EMERGENCY SERVICES	✓	✓	✓	✓	✓	✓	✓	✓
PUBLIC EDUCATION & AWARENESS	✓	✓	✓	✓	✓	✓	✓	✓

9 MITIGATION ACTION PLANS

44 CFR Requirement

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. The mitigation strategy must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

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.

Part 201.6(c)(3)(iv): For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

The mitigation actions proposed by each participating jurisdiction are listed in eight (8) individual *Mitigation Action Plans* (MAPs) on the pages that follow. Each MAP has been designed to address the established countywide goals of this Hazard Mitigation Plan, in addition to the particular goals and objectives of each individual jurisdiction. They have also been focused on those hazards presenting the highest potential risks to each jurisdiction as determined through the risk assessment, (Sections 4-6) and based on each jurisdiction's existing local capability as described in the capability assessment (section 7). They will be maintained on a regular basis according to the plan maintenance procedures established for the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan in Section 10: *Plan Maintenance Procedures*. This section also includes a status update for each of the mitigation actions proposed in 2005 and 2010, noting whether the action has been completed, deferred or deleted from the previously approved plan.

CONTENTS

MECKLENBURG COUNTY MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High			✓
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Mecklenburg County MITIGATION ACTION 1	Provide public education to the general public regarding solar events and their potential impacts on the community.
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Solar Events
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	N/A
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Charlotte-Mecklenburg Emergency Management Office
Implementation Schedule:	2015-2020

Mecklenburg County MITIGATION ACTION 2	Participate in the Infragard National EMP SIG table-top exercise and 1-day summit which addresses any high-impact threat that could cause long-term nationwide collapse of critical infrastructure.
Mitigation Goal:	#3; #4
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Solar Events; All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	N/A
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Charlotte-Mecklenburg Emergency Management Office
Implementation Schedule:	December 2015

Mecklenburg County MITIGATION ACTION 3	Build relationships and coordination with critical infrastructure partners, specifically power, utilities, and communications to build local resilience.
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	Solar Events; All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	N/A
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Charlotte-Mecklenburg Emergency Management Office
Implementation Schedule:	2015-2020

Mecklenburg County MITIGATION ACTION 4	**Seek grant funding to retrofit critical facilities and County-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Mecklenburg County
Implementation Schedule:	2015-2020

Mecklenburg County MITIGATION ACTION 5	**Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.**
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Mecklenburg County
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Mecklenburg County MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) Development standards linked to Community Floodplain (Future Conditions)** **b) Require critical facilities protection to 500-year flood levels** **c) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **d) Require dry land access for new or substantially improved buildings (above Community Flood BFE)** **e) Levee restrictions** **f) Cumulative substantial damage improvement provision** **g) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Higher standards were enforced for all new construction in Charlotte-Mecklenburg and the surrounding towns by the Storm Water Permitting & Compliance Program within the County's Water & Land Resources Division. Where applicable, increases in BFEs were incorporated as remapping projects reached preliminary status. Local ordinances were updated to incorporate results of remapping projects and in response to comments received during the September 2011 FEMA/NCEM Community Assistance Visit (CAV).

Mecklenburg County MITIGATION ACTION 2	**Continue participation in the NFIP Community Rating System (CRS) with the goal of increasing CRS credit points to become a Class 5 community or better within five years.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Maintained programs to remain Class 6. Researched impacts of 2013 manual to determine if class change is possible.

Mecklenburg County MITIGATION ACTION 3	**Complete and begin implementation of detailed Flood Hazard Mitigation Plan which will identify specific mitigation options based on risk factor scoring utilizing public and private funding.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$100,000
Potential Funding Sources:	FMA Grant / Local Funding
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Plan completed in FY2014; implementation began with FY2015 capital program. Will continue annually from 2015 to 2020.
2015 Status Update:	**Partially Completed/In Progress.** The Mecklenburg County Flood Risk Assessment and Risk Reduction Tool (RARRT) is now used to guide local mitigation program actions. Flood risk scores, mitigation priority scores and planning level mitigation techniques were developed for all buildings with property touching the floodplain with updated floodplain maps. This covers 2/3 of the county. The remaining buildings will be scored when non-regulatory data is finalized in 2015. This data is now used to develop and prioritize local mitigation efforts.

Mecklenburg County MITIGATION ACTION 4	**Enhance *FloodZone* website to better convey risk and mitigation alternatives.**
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	N/A
Potential Funding Sources:	Local Funding
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Expect completion in 2016 when Phase III remapping becomes effective.
2015 Status Update:	**Partially Completed/In Progress.** Major revisions to the FloodZone 3D website were completed in Summer 2014. The website is now mobile friendly. The revisions incorporate tools to allow property owners to get a better idea of their actual risk. In addition the website will display a list of mitigation alternatives for homeowners to consider reducing future damage from flooding.

Mecklenburg County MITIGATION ACTION 5	Inform public of flood risk by sending annual newsletter to owners of all buildings in floodplain.
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000
Potential Funding Sources:	Local Funding
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Annually, each Spring, 2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Annual "Floodplain Flash" newsletter most recently mailed in April 2014 to owners of over 5,000 flood-prone buildings.

Mecklenburg County MITIGATION ACTION 6	Research possibility of using new H&H models to provide flood forecasting in the Flood Information Notification System (FINS).
Mitigation Goal:	#4
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	Local Funding
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Research/feasibility completed 2010. Forecasting tool development subject to FIRM remapping project for development of new H&H models. (2015-2020)
2015 Status Update:	**Partially Completed/In Progress.** Flood forecast tools have been developed for basins in Phases I & II of FIRM remapping program. Forecast testing and verification delayed by personnel turn over, planned for FY 16.

Mecklenburg County MITIGATION ACTION 7	Research possibility of FINS system to provide inundation mapping based on results of Mitigation Action 6 above and explore alternate methods and expansion into other locations.
Mitigation Goal:	#4
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	Local
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Research phase completed Spring 2011. Alternate methods to be completed by FY 2017.
2015 Status Update:	**Partially Completed/In Progress.** Implemented inundation mapping in proximity of 10 stream gages. Plan to explore alternate methods and expand to other locations in FY 17.

Mecklenburg County MITIGATION ACTION 8	Update Flood Insurance Rate Maps to provide most accurate depiction of flood risk.
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$350,000
Potential Funding Sources:	CTP and Local Funds
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Expect substantial completion in 2016 when Phase III remapping becomes effective.
2015 Status Update:	**Partially Completed/In Progress.** Phase I maps, covering central and southern Mecklenburg, became effective February 19, 2014. Phase II maps, covering western Mecklenburg, are currently in preliminary status, expected to be effective October 2015. Phase III maps, covering northeast Mecklenburg, are draft status now, expected to become effective in 2016. Phase IV, covering Catawba River, is being studied by North Carolina Floodplain Mapping Program, effective date not known.

Mecklenburg County MITIGATION ACTION 9	Complete flood mitigation projects (acquisitions, elevations), with FEMA-defined and locally verified "repetitive loss properties" receiving high priority.
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,000,000
Potential Funding Sources:	FEMA mitigation grant programs (HMGP, PDM, FMA, RFC, SRL) and Local Funds
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Annually 2015-2020, projects defined at beginning of fiscal year and contracted/expanded based on actual owner participation.
2015 Status Update:	**Partially Completed/In Progress.** One hundred properties with approximately 130 homes/apartments and 5 commercial establishments acquired in 2010–2015 period using local funding supplemented with Flood Mitigation Assistance & Pre-Disaster Mitigation grants. No publically funded elevation projects completed. Federal FY 14 grant cycle application approved to acquire four severe repetitive loss single-family residences. Grant award expected in calendar year 2015.

Mecklenburg County MITIGATION ACTION 10	**As determined necessary and upon request from municipal jurisdictions, provide informative presentations and/or work sessions for newly elected officials and new appointees to planning commissions and appeals/variance boards to provide an overview of floodplain management, the importance of participating in the NFIP, and the implications of failing to enforce the requirements of the program or failing to properly handle variance requests.**
Mitigation Goal:	#2 and #3
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	As required/requested 2015 to 2020. CMSWS scheduled to participate in April 2015 regional series "Stormwater for Elected Officials" sponsored by UNC Charlotte IDEAS Center and the Regional Stormwater Partnership.
2015 Status Update:	**Partially Completed/In Progress.** Floodplain Administrator routinely available to address County Commissioners as well as City and Town Councils regarding floodplain management issues. Elected officials briefed on flood mitigation initiatives through formal presentations and written materials directed at both groups and individuals.

Mecklenburg County MITIGATION ACTION 11	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	CMSWS, in coordination with CMEMO (Lead)
Implementation Schedule:	Annually 2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Charlotte Fire Department, Charlotte-Mecklenburg Emergency Management and Charlotte-Mecklenburg Storm Water Services partnered in 2012 to promote ARK (Awareness, Responsibility and Knowledge) to brand before and during storm event messages. "Turn-around-don't drown" jingle was introduced in 2013 and repeated successfully 2014.

Mecklenburg County MITIGATION ACTION 12	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.**
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	CMSWS, in coordination with CMEMO (Lead)
Implementation Schedule:	Annual 2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Annual progress report with mitigation action item updates presented to Mecklenburg Board of County Commissioners, typically in month of December.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Mecklenburg County MITIGATION ACTION 1	**Enhance automated flood warning system to include forecasting and inundation mapping.**
Category:	Warning
Hazard(s) Addressed:	Flood, Severe Thunderstorms
Priority (High, Moderate, Low):	High
Estimated Cost:	Unknown
Potential Funding Sources:	Department of Commerce (NOAA) – Automated Flood Warning System, Flood Mitigation Assistance (FMA) program (technical assistance, planning), Map Modernization Program, Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program
Lead Agency/Department Responsible:	CMSWS; City of Charlotte Fire Department
Implementation Schedule:	See 2010 Mitigation Actions 6 & 7 above for current status.
2010 Status Update:	**Partially Completed / Ongoing**. Research into feasibility of forecasting and inundation mapping completed. Next step will be design and implementation of the forecasting module. Further analysis is needed on inundation mapping.
2015 Status Update:	See 2010 Mitigation Actions 6 & 7 above for current status. This action will be deleted from the next plan update.

Mecklenburg County MITIGATION ACTION 2	Gather and disseminate more information from Duke Power on lake levels and storage capacity.
Category:	Warning
Hazard(s) Addressed:	Flood, Severe Thunderstorms, Hurricanes and Tropical Storms
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA, Flood Mitigation Assistance (FMA) program (technical assistance, planning), Hazard Mitigation Grant Program (HMGP), Flood Recovery Mapping (post-disaster)
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Duke Energy has agreed to release lake level data and work with Charlotte-Mecklenburg Emergency Management when flooding threatens.
2015 Status Update:	**Partially Completed/In Progress.** CMSWS and Mecklenburg County Emergency Management are now participating in annual Duke-sponsored tabletop exercise for Catawba basin emergency managers.

Mecklenburg County MITIGATION ACTION 3	Acquire or elevate flood-prone structures.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Cost based on the number and type of structures
Potential Funding Sources:	Pre-Disaster Mitigation (PDM) program, Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, Community Development Block Grant (CDBG) program, National Flood Insurance Program—Increased Cost of Compliance (ICC)
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	See 2010 Mitigation Action Item 9 above for current status.
2010 Status Update:	**Completed / Ongoing.** Acquired 70 flood prone buildings since 2005.
2015 Status Update:	See 2010 Mitigation Action Item 9 above for current status. This action will be deleted from the next plan update.

Mecklenburg County MITIGATION ACTION 4	Floodproofing of non-residential buildings.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Cost based on the number and type of structures
Potential Funding Sources:	Pre-Disaster Mitigation (PDM) program, Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) program, U.S. Army Corps of Engineers—Planning Assistance to States, Economic Development Administration, U.S. Army Corps of Engineers—Floodplain Management Services
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	2016
2010 Status Update:	**Deferred.** Mecklenburg County Mitigation Plan Summary Report ranks all potential mitigation actions in Charlotte/Mecklenburg. At this point in time, flood proofing is not a recommended mitigation technique for this year. It may come forward in later years. No buildings have been floodproofed this year.
2015 Status Update:	**Partially Completed/In Progress.** Obtained regulatory approval in 2014 to assist individual property owners with flood risk reduction projects using utility fee revenue. Currently developing pilot project to identify and partially fund various mitigation projects using techniques such as floodproofing. Plan to implement pilot in FY 16.

STATUS UPDATE FOR ACTIONS TRANSFERRED FROM CITY OF CHARLOTTE MITIGATION ACTION PLAN (2008)

Mecklenburg County MITIGATION ACTION 5	Digitize smaller, non-FEMA floodplains (100+ areas) into county GIS and display on the Internet.
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$10,000
Potential Funding Sources:	Storm Water Services budget, Map Modernization Program, Flood Mitigation Assistance (FMA) program (technical assistance), Hazard Mitigation Grant Program (HMGP), Flood Recovery Mapping (post-disaster)
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	See City of Charlotte 2010 Mitigation Action 13.
2010 Status Update:	**Deferred to City of Charlotte**. Action item #5 is a major undertaking requiring coordination between City and County Storm Water and Land Development sections. The project continues to be researched further as a component to Action item #9 in the City of Charlotte's 2010 Mitigation Action Plan. If feasible, staff will probably need to phase its implementation and it will likely be a multi-year, ongoing project.
2015 Status Update:	See City of Charlotte 2010 Mitigation Action 13. This action will be deleted from the next plan update.

Mecklenburg County MITIGATION ACTION 7	**Promote better coordination between floodplain management branch and building code officials through the hosting of a semi-annual meeting.**
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Mecklenburg County LUESA, Code Enforcement and Flood Mitigation staff meets annually.
2015 Status Update:	**Partially Completed/In Progress.** No routine coordination meetings currently scheduled. Recent coordination meetings with building code officials have been driven by implementation of electronic plan review process.

CITY OF CHARLOTTE MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High			✓
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

City of Charlotte MITIGATION ACTION 1	Consider the need to add or revise existing policies or regulations to more thoroughly address natural hazards during the update of the City's Zoning Ordinance.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Planning Department budget
Lead Agency/Department Responsible:	City of Charlotte Planning Department, in coordination with Emergency Management and Storm Water Division
Implementation Schedule:	2015-2020

City of Charlotte MITIGATION ACTION 2	Enhance area planning activities to better address potential natural hazards.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Planning Department budget
Lead Agency/Department Responsible:	City of Charlotte Planning Department, in coordination with Emergency Management and Storm Water Division
Implementation Schedule:	Coordinate with Action #1 above (2015-2020).

City of Charlotte MITIGATION ACTION 3	Continue to identify, rank and prioritize capital improvement projects, flood control (FC) projects and pond projects, using pre-established criteria for each.
Mitigation Goal:	#1
Mitigation Category:	Prevention, Structural Projects
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	2015-2020

City of Charlotte MITIGATION ACTION 4	Initiate (plan, design and construct) five (5) projects from the capital improvement project ranking system between 2015 and 2019.
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	2015-2020

City of Charlotte MITIGATION ACTION 5	Identify and map known problem areas/streets subject to repetitive hazardous flooding that are outside of currently mapped floodplain areas based on: (1) recorded 311 calls for storm water assistance; and (2) past incident reports from the Fire Department and the Charlotte-Mecklenburg Police Department for flooding calls, road closings, swift water rescues, etc. This action includes the development of a geodatabase to be maintained and updated in GIS format and used as part of the City's routine inspection process for conveyance issues, capital planning decisions and particularly in advance of predicted severe storm events. This clearinghouse of data will also be used for future updates to this Plan.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	June 2016-2020

City of Charlotte MITIGATION ACTION 6	Develop a complete inventory of all stormwater control measures throughout the city.
Mitigation Goal:	#5
Mitigation Category:	Prevention, Natural Resource Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	All existing stormwater control measures will be inventoried and uploaded into CityWorks by January 4, 2016. New devices will be entered into the database once accepted into service (2016-2020).

City of Charlotte MITIGATION ACTION 7	Create a GIS layer of the parcels that were created prior to regulation of subdivision development for flood protection. This will enable a "flag" for those interested in building on such lots to discuss flood protection provisions prior to commencing construction.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Low
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Land Development in coordination with the Storm Water Division
Implementation Schedule:	June 2017-2020

City of Charlotte MITIGATION ACTION 8	Create GIS layer of all conservation easement areas granted to the City of Charlotte to protect natural and restored buffers.
Mitigation Goal:	#5
Mitigation Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	May 2015-2020. A new protocol is being developed that will increase the functionality of the layer and ensure that the layer is updated and undergoes QC/QA consistently. The protocol will be in place by 5/1/2015 and revised as necessary.

City of Charlotte MITIGATION ACTION 9	Seek grant funding to retrofit critical facilities and City-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	City of Charlotte
Implementation Schedule:	2015-2020

City of Charlotte MITIGATION ACTION 10	Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed city/county critical facilities.
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	City of Charlotte
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

City of Charlotte MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) Development standards linked to Community Floodplain (Future Conditions)** **b) Require critical facilities protection to 500-year flood levels** **c) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **d) Require dry land access for new or substantially improved buildings (above Community Flood BFE)** **e) Levee restrictions** **f) Cumulative substantial damage improvement provision** **g) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Storm Water Division, in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Higher standards were enforced for all new construction in Charlotte-Mecklenburg and the surrounding towns by the Storm Water Permitting & Compliance Program within the County's Water & Land Resources Division. Where applicable, increases in BFEs were incorporated as remapping projects reached preliminary status. Local ordinances were updated to incorporate results of remapping projects and in response to comments received during September 2011 FEMA/NCEM Community Assistance Visit.

City of Charlotte MITIGATION ACTION 2	Continue participation in the NFIP Community Rating System (CRS) with the goal of increasing CRS credit points to become a Class 4 community or better within five years.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Dam/Levee failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Storm Water Division, in coordination with CMSWS
Implementation Schedule:	2015-2020. Pursue reclassification in FY2016.
2015 Status Update:	**Partially Completed/In Progress.** Maintained programs to remain Class 5. Researching impacts of 2013 guidance manual revisions to determine if class change is possible. Incorporate 2005 Mitigation Action 22 to promote purchase of flood insurance in "minor system" areas through execution of CRS Series 300 Public Information activities.

City of Charlotte MITIGATION ACTION 3	Seek opportunities to provide information and education to Planning staff regarding risks associated with natural hazards and potential prevention/mitigation planning strategies.
Mitigation Goal:	#2 and #5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Emergency Management and/or other staff to provide training and/or utilize resources made available through the American Planning Association (including PAS Report: *Integrating Hazard Mitigation into Local Planning*)
Lead Agency/Department Responsible:	City of Charlotte Planning Department, in coordination with Emergency Management and Storm Water Division
Implementation Schedule:	Annual activity (2015-2020)
2015 Status Update:	**Partially Completed/In Progress.** In November 2011, Planning staff hosted a training session on hazard mitigation plan implementation through the American Planning Association. All of the Planning staff was encouraged to attend and staff from other City and County departments was also invited to participate. The training was a virtual session from the 2011 American Planning Association's national conference. The session was entitled "Planning for a Disaster-Resistant Community" and offered participants continuing education credits. The session was intended to help participants understand the relationships between natural hazard mitigation and community planning, how to link local hazard mitigation plans with the comprehensive plan, and how to integrate mitigation strategies into pre- and post-disaster planning. A Planning Staff member attended the Floodplain Administrators Workshop on February 12, 2015. The course is geared toward local government employees responsible for floodplain management but who have little or no training and formal education in the field of floodplain management and/or the National Flood Insurance Program (NFIP). Topics are a basic introduction to the field of describing the Duties of a Floodplain Administrator, Preparing for a Community Assistance Visit (CAV), Available training for FPA's, Basic Insurance Information, How to access the New Flood Risk Information System (FRIS), Building Codes – how they contrast and compare with NFIP regulations, and the Basic Tie-ins with Mitigation Planning and Projects Involving Floodplain Management.

City of Charlotte MITIGATION ACTION 4	Consider the need to add and/or revise exiting policies to more thoroughly address natural hazards during the update to the City's Zoning Ordinance.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Planning Department budget
Lead Agency/Department Responsible:	City of Charlotte Planning Department, in coordination with Emergency Management and Storm Water Division
Implementation Schedule:	Update of the General Development Policies likely to be undertaken within the next 2-3 years (2015-2018).
2015 Status Update:	**Partially Completed/In Progress.** The Update of the General Development Policies is being assessed currently as part of a long range planning policy assessment initiative. A multi-year effort to update the City of Charlotte's Zoning Ordinance is currently underway. Consider the need to add/or revise existing policies or regulations more thoroughly to address natural hazards during the updates of the City's Zoning Ordinance. See 2015 Action #1 for continued activity.

City of Charlotte MITIGATION ACTION 5	Enhance area planning activities to better address potential natural hazards.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Planning Department budget
Lead Agency/Department Responsible:	City of Charlotte Planning Department, in coordination with Emergency Management and Storm Water Division
Implementation Schedule:	Coordinate with Mitigation Action #4, above
2015 Status Update:	**Partially Completed/In Progress.** The City has continued to revise how floodplain areas are visually displayed on maps in area plans. This will be an ongoing process as new area plans are developed and existing plans are updated. With recent adoption of new floodplain maps, additional work is being done to determine impact on area plans. Fuller implementation of this mitigation action can occur after Mitigation Action 4 above is accomplished. No changes/revisions to recommendation are needed. However, the implementation schedule will likely be delayed due to delays in completing Mitigation Action 4 above. In 2015 the City plans to continue to update the visual representation of floodplains within area plans and to consider existing topography and other environmental features as future land use recommendations are developed. See 2015 Action #2 for continued activity.

City of Charlotte MITIGATION ACTION 6	Implement capital improvement project ranking system to identify and prioritize flood areas for flood control (FC) projects and pond projects using pre-established criteria for each.
Mitigation Goal:	#1
Mitigation Category:	Prevention, Structural Projects
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** The major capital improvement ranking system currently has 25 pending flood control projects identified. 10 projects were ranked in fiscal year 2014 bringing the total number of ranked projects on the backlog to 16. The minor capital improvement ranking system currently has 33 pending flood control projects identified. 9 projects were ranked in fiscal year 2014 bringing the total number of ranked projects on the backlog to 29. 174 qualifying ponds/dams are currently ranked, with approximately 20 being added each year (34 were ranked in fiscal year 2014). Only about 15% of the dams ranked have the potential to pose a public safety threat. Ultimately, roughly 400-500 qualifying ponds will be ranked. See 2015 Action #3 for continued activity.

City of Charlotte MITIGATION ACTION 7	Initiate (plan, design and construct) at least two projects per year from capital improvement project ranking system.
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Three flood control projects from the major capital improvement ranking system were initiated in fiscal year 2014. Three flood control projects from the minor capital improvement ranking system were initiated in fiscal year 2014 for a total of six projects. See 2015 Action #4 for continued activity.

City of Charlotte MITIGATION ACTION 8	Create media campaign/message to relay to local media and the general public prior to forecasted severe storm events.
Mitigation Goal:	#4, #2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Dam/Levee Failure
Moderate	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division, in coordination with Corporate Communications Office and Mecklenburg County
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Charlotte-Mecklenburg's "Your Car is Not a Boat" campaign (2013–today) reinvigorated local flood safety outreach, engaged the public in saying—and singing—our message, and led to a more than 500 percent increase in public awareness of our flood safety message. Public recall of our key flood safety message went from 8% in May 2013 to 44% in May 2014. Launched WaterWatchers Facebook page in 2010 and WaterWatcherCLT Twitter account in May 2014, sharing about one (1) flood related message a month. More than 30 flood related messages were shared via social media in 2014. The posts promote the "Turn Around, Don't Drown" message and the ARK message which stands for Awareness, Responsibility and Knowledge. ARK brands the before and during storm event messages. Charlotte-Mecklenburg Storm Water Services sends out "before the storm" information when a large storm is forecasted. Messages include information about what CMSWS does before and during a large storm event, what citizens can do before the event and flood safety messages. Distributed 11 flood safety related news releases before and after events on 8/5/2011, 8/8/2011, 8/12/2011, 3/7/2012, 3/12/2012, 7/20/12, 3/11/2013, 6/7/2013, 7/11/2013, 7/12/2013 and 11/25/2013.

City of Charlotte MITIGATION ACTION 9	**Identify and map known problem areas/streets subject to repetitive hazardous flooding that are outside of currently mapped floodplain areas based on: (1) recorded 311 calls for storm water assistance; (2) FINS data records; and (3) past incident reports from the Fire Department for road closings, water rescues, etc. This action includes the development of a geodatabase to be maintained and updated in GIS format, and used as part of the City's routine inspection process for conveyance issues, and particularly in advance of predicted severe storm events. This clearinghouse of data will also be used for future updates to this Plan.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	2016-2020
2015 Status Update:	**Partially Completed/In Progress.** Since 2010, 2,691 flooding calls for service have been received outside the FEMA floodplain. Since 1999, a total of 15,997 flooding related requests for service have been tracked within the current City of Charlotte jurisdiction. 89% of the calls are on tax parcels that do not intersect the FEMA floodplain. GIS analysts work with Fire, Police, CDOT, Mecklenburg County, and 311 to access data, analyze and report findings to support CMSWS. A comparison of the flood locations gives us a better view of where flood-prone areas are. The process for assessing this information needs to be documented and an interactive map produced to share. See 2015 Action #5 for continued activity.

City of Charlotte MITIGATION ACTION 10	**Review and incorporate revisions to the City's tree ordinance with the goal of preserving and enhancing pervious/natural areas along with urban tree populations in a manner that can minimize potential impacts of flooding, drought, winter storms, wildfires and high wind events. This includes consideration of strategies for proper species selection and planting practices as well as identification and removal of hazard trees per USDA best management practices.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Drought, Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Engineering & Property Management / Landscape Management
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** The tree ordinance was revised and became effective January 2011. The primary purpose of the revisions was to further protect Charlotte's tree canopy while offering flexibility and options for compliance with the ordinance. The previous ordinance included tree save and tree planting requirements for commercial and single family developments. The revisions focused primarily on commercial development. There were twenty-two (22) proposed administrative and technical revisions including two (2) primary changes: 1) Require 15% minimum tree save for commercial development with flexible options allowed for compliance for certain type developments (currently requires tree save in the front setback); and 2) Increase the number of trees in parking lots by decreasing tree spacing from sixty (60) feet to forty (40) feet. Since the 2010 mitigation plan update, a total of 30,801 trees have been planted with an additional 16,199 seedlings given away. Also, a total of 852 acres of trees have been preserved with 837 acres preserved per the Tree Ordinance and 15 acres per the payment in Lieu Program.

City of Charlotte MITIGATION ACTION 11	Review and update the City's Storm Water Design Manual.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	Completed
2015 Status Update:	**Completed.** Updates to the Charlotte-Mecklenburg Storm Water Design Manual were incorporated and made effective on January 1, 2014.

City of Charlotte MITIGATION ACTION 12	Review and update High Water plan for notification and information flow associated with Mountain Island Dam.
Mitigation Goal:	#4
Mitigation Category:	Prevention, Emergency Services
Hazard(s) Addressed:	Flood, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	Emergency Management budget/EMPG
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Completed
2015 Status Update:	**Completed.** Updated contact list of residents below the dam in 2014.

City of Charlotte MITIGATION ACTION 13	Create GIS layer of the "100+1" floodplains platted as part of new land development projects.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	To be deleted
2015 Status Update:	**Deleted.** Nothing has been completed to date. Land Development is now requiring digital plan submittals; however, the format of the submittals does not lend itself to efficient creation of a GIS layer. This action is being removed.

City of Charlotte MITIGATION ACTION 14	Conduct annual inspections on ponds/dams that City of Charlotte Storm Water Services has accepted maintenance responsibility.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Dam Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	June 2016-2020
2015 Status Update:	**Partially Completed/In Progress.** Annual inspections were completed by the end of March 2014 on 32 ponds.

City of Charlotte MITIGATION ACTION 15	Create GIS layer of all conservation easement areas to protect natural and restored buffers.
Mitigation Goal:	#5
Mitigation Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Storm Water Services budget
Lead Agency/Department Responsible:	Storm Water Division
Implementation Schedule:	June 2017-2020
2015 Status Update:	**Partially Completed/In Progress.** A GIS layer has been created for most city stream mitigation projects. The City's easements for pollution prevention projects have not been added to the layer but will be by the end of 2015. Project conservation easements will continue to be added to the layer as projects are completed. A new protocol is being developed that will increase the functionality of the layer and ensure that the layer is updated and undergoes QC/QA consistently. The protocol will be in place by May 1, 2015. See 2015 Action #8 for continued activity.

City of Charlotte MITIGATION ACTION 16	On an annual basis, coordinate with municipalities on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Emergency Management budget/EMPG
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Partially Completed/In Progress.** Email notifications and website information provided to municipalities in 2014. Public outreach efforts continue on a regular basis to all sectors of the population, including children and the elderly. Registration for new emergency notification system also included in public outreach efforts. Additional outreach and education planned for in 2015.

City of Charlotte MITIGATION ACTION 17	On an annual basis, coordinate with municipalities to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Emergency Management budget/EMPG
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Partially Completed/In Progress.** Email notifications and website information provided to municipalities in 2014. Additional outreach and education to Elected Officials planned for 2015. Disaster Preparedness outreach information provided to Towns in 2014, including new Emergency Notification System.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

City of Charlotte MITIGATION ACTION 4	Review all development codes and ordinances to ensure that they include appropriate flood mitigation strategies.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	CMSWS, Code Enforcement
Implementation Schedule:	June 2017
2010 Status Update:	**Completed / Ongoing.** Post-Construction Controls Ordinance adopted in July 2008 which regulates runoff and impervious area for new construction. Zoning Ordinance and Storm Water Design Standards undergoing review.
2015 Status Update:	**Completed.** There are no known issues with incompatible or inappropriate codes or ordinances. Remove from 2020 version of mitigation plan.

City of Charlotte MITIGATION ACTION 8	Implement spring public information campaign aimed at tornado and severe weather awareness to include information on safe rooms.
Category:	Education and Outreach
Hazard(s) Addressed:	Tornadoes and Severe Weather
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$3,000
Potential Funding Sources:	Storm Water Services budget, FEMA and American Red Cross materials free of charge (see FEMA Publication 320—*Taking Shelter from the Storm: Building a Safe Room Inside Your House*), Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Inserts provided in utility bills describing severe weather hazards. Continued work with local TV station (NBC 6) on a series of storm water and flood related stories that were broadcast on several weather newscasts during severe weather awareness week.
2015 Status Update:	**Partially Completed/In Progress.** Emergency Management has conducted multiple public outreach presentations to groups throughout the County, to educate them on disaster preparedness. Groups include the Jaycees, senior citizens, and youth. Most recently, CMSWS, CFD, and EM attended the first annual Weatherfest to educate citizens on flood and severe weather preparedness.

City of Charlotte MITIGATION ACTION 10	Burial of existing and new power lines.
Category:	Mitigation Project
Hazard(s) Addressed:	Winter Storms, Tornadoes, Hurricanes and Tropical Storms, Severe Thunderstorms
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Cost based on amount and type of burial
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Public Assistance (406 Mitigation), Economic Development Administration
Lead Agency/Department Responsible:	Emergency Management; City of Charlotte Planning Department
Implementation Schedule:	Completed
2010 Status Update:	**Completed / Ongoing.** Required in some areas based on land use, zoning and/or Duke Energy Policy. Also addressed in area plans and redevelopment projects. Power lines have been buried in several areas undergoing neighborhood revitalization.
2015 Status Update:	**Completed.** Follow-up will be conducted with CFD and Duke Energy to verify status.

City of Charlotte MITIGATION ACTION 11	Train emergency responders and managers for flood emergencies.
Category:	Training and Exercises
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	Emergency Management Performance Grants (EMPG), Emergency Management Institute, Department of Justice—State and Local Domestic Preparedness Exercise Support, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Additional and specific training was conducted for CFD Battalion Chiefs regarding flood and disaster response while an additional 38 CFD personnel were trained to the swift water rescue technician level. Also, 12 CFD personnel continue to maintain their helicopter aquatic rescue technician status with NCEM during four training sessions- held quarterly. During the late fall of 2007, all 1,065 CFD Operations personnel were provided “hand’s on” recurrent training at the USNWC. An additional 10 hours of flood safety training was provided to 22 EMS personnel and 13 Code Enforcement personnel- who would serve as members of a damage assessment team.
2015 Status Update:	**Partially Completed/In Progress.** Follow-up will be conducted with CFD Operations/Training to obtain statistics.

City of Charlotte MITIGATION ACTION 12	Equip emergency responders and managers for flood emergencies, including swift water rescue.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	Hazard Mitigation Grant Program (7% set aside), Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Equipment and trailers were purchased to fully equip 48 swift water rescue technicians and 12 helicopter rescue technicians to the NIMS standard along with additional PPE and rescue equipment to supplement what is already on all of the fire companies. Also, two new "triple decker" boat trailers were purchased, to ease moving the rescue boats to emergencies, along with two high clearance stake body trucks to tow them. Plans are now underway to purchase an additional nine rescue boats and three more trailers so that each battalion will have its own rescue boat compliant.
2015 Status Update:	**Partially Completed/In Progress.** Annual refresher training provided to Charlotte Fire Swiftwater rescue technicians and boat operators. Both rescue companies conduct regular station training as well as dive certification training.

City of Charlotte MITIGATION ACTION 13	Provide training for 911 dispatchers.
Category:	Training and Exercises
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	Completed
2010 Status Update:	**Completed / Ongoing.** Our CAD (computer aided dispatch) system has flood responses built in and we have SOGs in place to address each type of response. During training all personnel are quizzed on these responses.
2015 Status Update:	**Completed.** All stations were provided with updated flood rescue maps for identified flood rescue points along the stream/creek network in Charlotte. Stations receive annual updates on the creek rescue points and must complete annual refresher training.

City of Charlotte MITIGATION ACTION 14	Purchase new 911 dispatch technology.
Category:	Mitigation Project
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	Completed
2010 Status Update:	**Completed / Ongoing.** Our CAD has a layer on our map for all the streams and waterways in the City and we have the capability of adding in other layers as needed.
2015 Status Update:	**Completed.** New 911 dispatch technology was purchased in 2014 as well as redundant station alerting.

City of Charlotte MITIGATION ACTION 15	Conduct disaster drills for division managers.
Category:	Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Department of Justice—State and Local Domestic Preparedness Exercise Support, Department of Justice—State and Local Domestic Preparedness Training Program, FEMA—First Responder Counter-Terrorism Training assistance, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Table top exercises have been organized and conducted by and on behalf of the CFD Special Operations Deputy Chief. Flood response training and an exercise is now included in the NIMS ICS 300 and ICS 400 curriculums.
2015 Status Update:	**Partially Completed/In Progress.** Tabletop, Functional and Full-scale exercises are regularly conducted within Charlotte-Mecklenburg to test our plans and training. Swiftwater rescue training recurs annually for rescue personnel.

City of Charlotte MITIGATION ACTION 16	Develop and provide all-hazard safety training for city/county employees.
Category:	Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Department of Justice—State and Local Domestic Preparedness Exercise Support, Department of Justice—State and Local Domestic Preparedness Training Program, FEMA—First Responder Counter-Terrorism Training assistance, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	Completed
2010 Status Update:	**Completed / Ongoing.** A PowerPoint has been developed and is available on-line for city-county personnel regarding flood and swift water safety. As previously mentioned, formal curriculums have been developed for EMS and SERT personnel who may respond to flood emergencies. These curriculums include a three hour practical session at the USNWC.
2015 Status Update:	**Completed.** This training was conducted in 2010 and has been completed.

City of Charlotte MITIGATION ACTION 17	Provide and maintain NIMS training for all KBE's, division heads and key government officials.
Category:	Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Emergency Management Institute, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** A large majority has completed such and this is coordinated by the CFD. NIMS 100 through 400 along with NIMS 700 and 800 has been, and is still being, delivered. Additional NIMS specific section chiefs training has been delivered and continues to be offered.
2015 Status Update:	**Partially Completed/In Progress.** All of these courses are required at various points in a firefighter's career. New recruits are required to complete 100, 200, 700, and 800. To be eligible for promotion to Captain, personnel must complete 300. To be eligible for promotion to Battalion Chief, personnel must complete 400. Therefore, these course offerings are offered annually in the Training Division.

City of Charlotte MITIGATION ACTION 21	Develop evacuation routes that are not adversely affected by flooding.
Category:	Traffic Control
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	City of Charlotte Department of Transportation
Implementation Schedule:	June 2017
2010 Status Update:	**Partially Completed.** Geo-clear program will assist with this. CFD mapping and pre-identified road over-topping areas will also assist with this.
2015 Status Update:	**Partially Completed/In Progress.** The Geo-clear program and City of Charlotte Fire Department mapping and pre-identified road over-topping areas data continue to support this action.

City of Charlotte MITIGATION ACTION 22	Conduct public education campaign advocating the purchase of flood insurance in "minor system" areas.
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	CMSWS
Implementation Schedule:	Completed
2010 Status Update:	**Completed / Ongoing.** Direct mailing describing flood insurance sent to homeowners impacted by flooding in 2008.
2015 Status Update:	**Completed.** Insurance promotion is part of a year-round flood awareness program that includes utility bill inserts, participation in realtor expo, and various media campaigns. Outreach efforts are ramped up each spring and into the beginning of hurricane season. Remove this action from future mitigation plans and roll task into 2015 Charlotte Mitigation Action 2 under CRS Community Outreach, Series 300 Public Information.

City of Charlotte MITIGATION ACTION 23	Improve the dissemination of hazard information, including maps, broadcasts, Internet Web site(s) and listserves.
Category:	Education and Outreach
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A, FEMA and American Red Cross materials free of charge, Department of Homeland Security—Citizenship Education and Training
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Worked with local TV station (NBC 6) to produce a series of water/flooding related videos which were broadcast in the spring. Web site is continually being updated with flood mitigation information including updated flood maps. GIS map books are in process of conversion to digital format for CFD to load on laptops to be available in field. The CFD PIO is trained to address flood response, information, and notification issues and often serves as an SME during flood events in the Joint Information Center.
2015 Status Update:	**Partially Completed/In Progress.** The SWS FINS application is available online that shows current stream and rain gauges. EM has linked FINS on its website, available for the public to access. A new emergency notification system was implemented in 2013 to improve the dissemination of flood emergency notification.

City of Charlotte MITIGATION ACTION 24	Maintain the FACT program.
Category:	Education and Outreach
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	City of Charlotte Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Program is being maintained by the CFD and is still available to anyone that requests such.
2015 Status Update:	**Partially Completed/In Progress.** Program is being maintained by the CFD and is still available to anyone that requests such.

City of Charlotte MITIGATION ACTION 25	Provide information regarding encroachments, abandonments, new construction, and leases.
Category:	Education and Outreach
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Code Enforcement, Planning
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Information has been provided for multiple actions on an on-going basis.
2015 Status Update:	**Partially Completed/In Progress.** Information has been provided for multiple actions on an ongoing basis.

TOWN OF CORNELIUS MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High		✓	
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Town of Cornelius MITIGATION ACTION 1	**Plan for development and appropriate flood mitigation strategies in the Land Development Code.**
Mitigation Goal:	#5
Mitigation Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department
Implementation Schedule:	June 2017

Town of Cornelius MITIGATION ACTION 2	**Evaluate 2012 tree inventory with respect to tree size and vicinity to utilities to identify mitigation strategies.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department; Town of Cornelius Public Works Department
Implementation Schedule:	June 2017

Town of Cornelius MITIGATION ACTION 3	**Implement storm water mitigation projects, including the grading of ditches and replacing failing/potentially failing storm water structures.**
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$70,000/year
Potential Funding Sources:	CMSWS Funds
Lead Agency/Department Responsible:	Town of Cornelius Public Works Department
Implementation Schedule:	Annually, 2015-2019

Town of Cornelius MITIGATION ACTION 4	**Work with power companies to educate and gain support for proper preventative tree pruning to reduce the chance of power outages.**
Mitigation Goal:	#2
Mitigation Category:	Education and Outreach
Hazard(s) Addressed:	Winter Storms, Hurricanes and Tropical Storms
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	N/A
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department; Town of Cornelius Public Works Department
Implementation Schedule:	June 2017

Town of Cornelius MITIGATION ACTION 5	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) Require critical facilities protection to 500-year flood levels** **b) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **c) Require dry land access for new or substantially improved buildings (above Community Base Flood Elevation)** **d) Levee restrictions** **e) Floors of new or substantially improved buildings allowed by variance in the floodplain must be elevated at least one (1) foot above the Community (future) Base Flood Elevation.** **f) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department; Town of Cornelius Public Works Department; in coordination with CMSWS
Implementation Schedule:	2015-2020

Town of Cornelius MITIGATION ACTION 6	**Seek grant funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town Administration
Implementation Schedule:	2015-2020

Town of Cornelius MITIGATION ACTION 7	**Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities. (Note: the Town of Cornelius already has generators at all Police Stations and Fire Stations; there is currently not one at Town Hall.)**
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town Administration
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Cornelius MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the Town's amended floodplain ordinance currently in place.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	In coordination with CMSWS
Implementation Schedule:	N/A (to be deleted)
2015 Status Update:	**Deleted.** NFIP minimums plus locally adopted higher standards were enforced for all new construction in the Town by the Storm Water Permitting & Compliance Program within the County's Water & Land Resources Division. Where applicable, increases in BFEs have been incorporated as remapping projects reached preliminary status. The reason this action is marked as "Deleted" is because it is being replaced with Mitigation Action 5 under 2015 Mitigation Actions because it is more specific as it relates to future compliance.

Town of Cornelius MITIGATION ACTION 2	**Enhance the use of existing Emergency Notification System (*Connect*-CTY®) through expansion of existing contact data base.**
Mitigation Goal:	#4
Mitigation Category:	Emergency Services; Public Education and Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	911 Fees
Lead Agency/Department Responsible:	Town of Cornelius Police Department
Implementation Schedule:	Completed.
2015 Status Update:	**Completed.** In coordination with CMEMO, converted to CharMeck Alerts in 2014.

Town of Cornelius MITIGATION ACTION 3	Continue NFIP and nuclear educational campaign for citizens living near lake areas.
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood, Nuclear Accident
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources, NFIP materials free of charge from FEMA, Radiological Hazard information free from Duke Energy
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Public Works Department and Town of Cornelius Planning Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Annual mailer distributed each spring to owners of property in Special Flood Hazard Area. Courtesy copy of mailer provided to Town Mayor and all Council Members. Supplemented outreach with seasonally appropriate flood hazard message distributed 3 to 4 times each year to all public water supply customers as utility bill insert.

Town of Cornelius MITIGATION ACTION 4	Design and construct a stream channel modification and restoration project on the upper section of McDowell Creek which is located on Town-owned property.
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$75,000
Potential Funding Sources:	State Water Grant ($30,000); Storm Water Fees ($45,000)
Lead Agency/Department Responsible:	Town of Cornelius in coordination with CMSWS
Implementation Schedule:	Completed.
2015 Status Update:	**Completed.** The stream channel restoration was completed in 2010.

Town of Cornelius MITIGATION ACTION 5	**Develop an annual tabletop exercise addressing potential hazards faced by Town. This exercise would bring together representatives from all Town departments that would work together creating and implementing a plan to effectively deal with the hazard.**
Mitigation Goal:	#3
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000 / Local staff time
Potential Funding Sources:	General Fund
Lead Agency/Department Responsible:	Town of Cornelius Police Department and Town of Cornelius Public Works Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Developed peninsula evacuation plan in 2014. Annual tabletop exercise scheduled for August 2015.

Town of Cornelius MITIGATION ACTION 6	**Develop and evaluate a town-wide peninsula evacuation action plan.**
Mitigation Goal:	#6
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$4,500 / Local staff time
Potential Funding Sources:	General Fund
Lead Agency/Department Responsible:	Town of Cornelius Police Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Completed.** Completed in 2014.

Town of Cornelius MITIGATION ACTION 7	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department, in coordination with CMEMO (lead)
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** In 2014, began integrating social media into public outreach campaigns.

Town of Cornelius MITIGATION ACTION 8	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.**
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Cornelius Planning Department, in coordination with CMEMO (lead)
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Annual update to elected officials and staff planned for July.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Cornelius MITIGATION ACTION 2	**Establish emergency notification system such as Reverse 911® or pac system to notify citizens of hazard threats and emergencies.**
Category:	Warning
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$60,000
Potential Funding Sources:	Emergency Management Performance Grant (EMPG), FEMA—Hazardous Materials Assistance Program
Lead Agency/Department Responsible:	North Mecklenburg 911 Communications Center, Town of Cornelius Police Department
Implementation Schedule:	Completed.
2010 Status Update:	**Completed/Ongoing.** Installed *Connect*-CTY® service, a town-to-resident notification system which will be utilized in the event of an emergency or hazard necessitating the release of important information.
2015 Status Update:	**Completed.** Implemented *Connect*-CTY in 2008.

Town of Cornelius MITIGATION ACTION 3	**Conduct NFIP educational campaign for citizens living near lake areas.**
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources, NFIP materials free of charge from FEMA
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	Public Works and Planning
Implementation Schedule:	12 months
2010 Status Update:	**Completed/Ongoing.** The Town provides written educational material, free of charge, to public informing them of Flood and Nuclear Hazards.
2015 Status Update:	**Deleted.** This item is a duplicate of 2010 Action 3 above.

TOWN OF DAVIDSON MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High		✓	
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Town of Davidson MITIGATION ACTION 1	**Improve drainage in a public stormwater drainage area to prevent flooding of several homes in the Westside neighborhood.**
Mitigation Goal:	#1
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$60,000 Plus staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Public Works Department
Implementation Schedule:	July 2015. Project is already 90% complete.

Town of Davidson MITIGATION ACTION 2	**Seek grant funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Davidson
Implementation Schedule:	2015-2020

Town of Davidson MITIGATION ACTION 3	Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Davidson
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Davidson MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) Require critical facilities protection to 500-year flood levels** **b) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **c) Require dry land access for new or substantially improved buildings (above Community Base Flood Elevation)** **d) Levee restrictions** **e) Floors of new or substantially improved buildings allowed by variance in the floodplain must be elevated at least one (1) foot above the Community (future) Base Flood Elevation.** **f) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Planning Department; Town of Davidson Public Works Department; in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Continued compliance through planning ordinance; will continue to enforce. (See Section 7.)

Town of Davidson MITIGATION ACTION 2	Continue action items resulting from Emergency Table Top Exercise.
Mitigation Goal:	#3
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Police Department; Town of Davidson Fire Department; Town of Davidson Public Works Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** A meeting is planned with Police, Fire, Public Works, and the Public Information Officer for Fall 2015.

Town of Davidson MITIGATION ACTION 3	Implement Traffic Control Procedures intended to reduce injuries before, during, and after emergencies and disasters.
Mitigation Goal:	#6
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time, NCDOT involvement
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Public Works Department
Implementation Schedule:	Deleted
2015 Status Update:	**Deleted.** No progress has been made in this area. The Town intends to end this item due to lack of staff time available to complete.

Town of Davidson MITIGATION ACTION 4	**The Town will improve its ability to warn people of impending disasters using *Connect*-CTY® system and other media outlets.**
Mitigation Goal:	#4
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Public Works Department; Town of Davidson Communications Department
Implementation Schedule:	Completed
2015 Status Update:	**Completed.** The Town can now reach 3,020 Davidson residents by phone, email, and/or text through *Connect-CTY*.

Town of Davidson MITIGATION ACTION 5	**Implement recommendations of the 2006 Tree Canopy Inventory including pruning and removal of branches and trees that threaten public utilities and structures**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Planning Department; Town of Davidson Public Works Department
Implementation Schedule:	2020
2015 Status Update:	**In Progress (75% complete).** The Town has increased its street tree budget, we have proactively removed around 30 dangerous trees in the public right-of-way, and the tree crew conducts pruning operations every year to help improve structure and safety.

Town of Davidson MITIGATION ACTION 6	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Planning Department; Town of Davidson Public Works Department; in coordination with CMEMO (Lead)
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Deferred.** The Town has coordinated with CMEMO and passed along information regarding the hazard mitigation information to residents. Residents will be notified of all new information included in the hazard mitigation plan for Davidson once it has been approved.

Town of Davidson MITIGATION ACTION 7	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.**
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Davidson Planning Department, in coordination with CMEMO (Lead)
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Deferred.** The Town will coordinate with CMEMO on this action to bring all relevant hazard mitigation planning information to planning and elected officials.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Davidson MITIGATION ACTION 1	**Develop growth policies that account for identified hazard areas.**
Category:	Planning and Policy
Hazard(s) Addressed:	Flood Storm damage to trees and personal property
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	Planning
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2010 Status Update:	**Ongoing.** • Town Planning Staff are finalizing a comprehensive plan to guide growth • Continue to work with Mecklenburg County floodplain officials to enforce the Floodplain Ordinance • Implement recommendations of the 2006 Tree Canopy Inventory including pruning and removal of branches and trees that threaten public utilities and structures (carried over as Action #5 in 2010 Mitigation Action Plan)
2015 Status Update:	**Partially Completed/In Progress.** • Comprehensive plan has been adopted • Tree pruning continues to be an important issue that we constantly attend to • Duke Power has been conducting a large scale pruning operation in Davidson during early 2015

Town of Davidson MITIGATION ACTION 2	**Develop stormwater management plan.**
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP)
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2010 Status Update:	**Completed / Ongoing.** • Ongoing work with NCDENR and U.S. Army Corps of Engineers to mitigate Beatty Dam • Continue storm water improvements • Secure funding for infrastructure repairs through County Storm water fee
2015 Status Update:	**Partially Completed/In Progress.** • Storm water management plan has been approved • All Public Works employees participate in storm water training every year • Multiple improvements have been made from the storm water fees • Beatty Dam mitigation is complete • Cost: $140,000

TOWN OF HUNTERSVILLE MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High		✓	
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Town of Huntersville MITIGATION ACTION 1	**Enhance use of CharMeck Alerts to warn people of impending hazards, potential emergencies, and disasters.**
Mitigation Goal:	#4
Mitigation Category:	Emergency Services; Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000
Potential Funding Sources:	General (local budget) Funding
Lead Agency/Department Responsible:	Town of Huntersville Police Department; Town of Huntersville Public Works Department
Implementation Schedule:	2015-2020

Town of Huntersville MITIGATION ACTION 2	**Seek grant funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Huntersville
Implementation Schedule:	2015-2020

Town of Huntersville MITIGATION ACTION 3	Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Huntersville
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Huntersville MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) New residential buildings must be built with the lowest floor elevated at least one foot above the Community (Future) Base Flood Elevation.** **b) Require critical facilities protection to 500-year flood levels** **c) Require parking lots for new, non single-family habitable buildings to be elevated (no more than six inches deep in any parking space during Community Flood event)** **d) Require dry land access for new or substantially improved habitable structures** **e) Levee restrictions** **f) Cumulative substantial damage improvement provision** **g) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	In coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** The Town will continue education efforts and coordination with Charlotte-Mecklenburg Storm Water Services (CMSWS).

Town of Huntersville MITIGATION ACTION 2	Coordinate with Charlotte-Mecklenburg Storm Water Services (CMSWS) to apply for and join FEMA's Community Rating System (CRS).
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Huntersville Planning Department; Town of Huntersville management to coordinate with CMSWS
Implementation Schedule:	June 2016
2015 Status Update:	**Partially Completed/In Progress.** The Town plans to apply for CRS as part of plan renewal and have commitment from CMSWS to assist in this effort.

Town of Huntersville MITIGATION ACTION 3	Participate in NFIP educational campaign through increased coordination with Charlotte-Mecklenburg County Storm Water Services (CMSWS), including the posting of a hyperlink to their floodplain management website on Huntersville's town website.
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Huntersville Planning Department in coordination with CMSWS
Implementation Schedule:	June 2016
2015 Status Update:	**Partially Completed/In Progress.** The Town is currently coordinating a social media strategy to consistently share messages with residents in cities/towns and in the county. The Town has previously been putting information required by the NFIP and supplied by CMSWS into email newsletters and some of the Town's social media posts. Strategic coordination and utilization of social media should allow for broader reach.

Town of Huntersville MITIGATION ACTION 4	**Enhance use of *Connect*-CTY® to warn people of impending hazards, potential emergencies and disasters.**
Mitigation Goal:	#4
Mitigation Category:	Emergency Services; Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000
Potential Funding Sources:	General (local budget) Funding
Lead Agency/Department Responsible:	Town of Huntersville Police Department; Town of Huntersville Public Works Department
Implementation Schedule:	Completed
2015 Status Update:	**Completed.** The Towns are now part of CharMeck Alerts, no longer with *Connect-CTY* or Blackboard. Additional efforts have been made to address winter storms, such as in FY14-15 when the Town of Huntersville jointly purchased with Cornelius and Davidson a brine making station to allow us more capacity to prepare for winter snow and ice storms. We also plan to make sure future truck purchases allow for mounting of blades to plow snow.

Town of Huntersville MITIGATION ACTION 5	**Implement storm water mitigation projects, including the grading of ditches and replacing failing/potentially failing storm water structures.**
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$400,000
Potential Funding Sources:	CMSWS Funds
Lead Agency/Department Responsible:	Town of Huntersville Public Works Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** The Town continues to fix/repair as structures fail.

Town of Huntersville MITIGATION ACTION 6	Utilize barricades, barriers, cones and signs to adequately and efficiently control traffic flow during emergencies and disasters.
Mitigation Goal:	#6
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	Town of Huntersville
Lead Agency/Department Responsible:	North Carolina Department of Transportation (NCDOT); Town of Huntersville Public Works Department; Town of Huntersville Police Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Completed/To Be Continued.** Huntersville Police Department has a trailer full of cones and typically use their own equipment (cones are great for short durations), but do coordinate as needed with Public Works for barricades and barriers (better for long durations) and maintain good working relationships internally and with NCDOT.

Town of Huntersville MITIGATION ACTION 7	On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management Office (CMEMO) on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Huntersville Planning Department in coordination with CMEMO (Lead)
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Partially Completed/In Progress.** The Town is currently coordinating a social media strategy to consistently share messages with residents in cities/towns and county.

Town of Huntersville MITIGATION ACTION 8	On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management Office (CMEMO) to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Huntersville Planning Department in coordination with CMEMO (Lead)
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2015 Status Update:	**Partially Completed/In Progress.** This action is being coordinated with CMEMO.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Huntersville MITIGATION ACTION 1	Join the Community Rating System (CRS).
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	Huntersville Town Manager
Implementation Schedule:	December 2015
2010 Status Update:	**Deferred.** Action item carried over to Action #2 in 2010 Mitigation Action Plan.
2015 Status Update:	**Deleted.** Charlotte-Mecklenburg Storm Water Services (CMSWS) has committed to helping the Town accomplish this action in 2015 as part of Action #2 in 2010 Mitigation Action Plan.

Town of Huntersville MITIGATION ACTION 2	**Conduct National Flood Insurance Program (NFIP) educational campaign.**
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources, NFIP materials free of charge from FEMA
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Huntersville Town Manager
Implementation Schedule:	2015-2020
2010 Status Update:	**Deferred.** Action item carried over to Action #3 in 2010 Mitigation Action Plan.
2015 Status Update:	**Deleted.** This action was combined to form Action #3 in the 2010 Mitigation Action Plan.

Other factors impacting the Town's responses:

- Staff turnover in Town planning department. Our Planner I typically handles all matters related to stormwater, impervious surface, etc. We have had two Planner I's over the past five years with a gap in between and have been without a Planner I since the end of 2014.

Additional item from an advocacy standpoint:

- We are hoping to be a part of legislation at the state level to allow the City of Charlotte and the six towns within Mecklenburg County to be eligible/allowed to purchase homes in flood-prone areas as Mecklenburg County is authorized to do today.

TOWN OF MATTHEWS MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High		✓	
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Town of Matthews MITIGATION ACTION 1	**Develop a second full-function Emergency Operations Center (EOC) at the Fire Department as a backup to the current EOC at the Police Department.**
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$16,000
Potential Funding Sources:	Town Funds, FEMA
Lead Agency/Department Responsible:	Matthews Police and Fire
Implementation Schedule:	6/2016

Town of Matthews MITIGATION ACTION 2	**Prepare and maintain a map of areas that flood frequently, particularly those areas outside of FEMA floodplains. Digitize and add to County GIS on the Internet.**
Mitigation Goal:	#2
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000
Potential Funding Sources:	Town Storm Water Fees
Lead Agency/Department Responsible:	Public Works in coordination with Planning GIS
Implementation Schedule:	6/2017

Town of Matthews MITIGATION ACTION 3	Update the Matthews Tree Management Plan to assess current tree conditions along road sides and continue to implement the same to minimize potential impacts of ice and wind events.
Mitigation Goal:	#1
Mitigation Category:	Prevention
Hazard(s) Addressed:	Hurricanes and Tropical Storms, Severe Thunderstorms, Tornados, Winter Storms and High Wind Events.
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Town
Lead Agency/Department Responsible:	Landscape Division; Public Works Department.
Implementation Schedule:	6/2017

Town of Matthews MITIGATION ACTION 4	Paint the bonnets on all fire hydrants in the Town Limits to match the NFPA flow color so that all arriving units will be able to visually see the tested flow of the hydrant.
Mitigation Goal:	# 1
Mitigation Category:	Emergency Services - Planning and Policy
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	High
Estimated Cost:	$1,000 material – Labor in house staff time
Potential Funding Sources:	General Funds
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	12/2015

Town of Matthews MITIGATION ACTION 5	Seek grant funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Matthews Public Works Department
Implementation Schedule:	2015-2020

Town of Matthews MITIGATION ACTION 6	Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Matthews Public Works Department
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Matthews MITIGATION ACTION 1	Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions): a) Development standards linked to Community Floodplain (Future Conditions) b) Require critical facilities protection to 500-year flood levels c) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event) d) Require dry land access for new or substantially improved buildings (above Community Flood BFE) e) Levee restrictions f) Cumulative substantial damage improvement provision g) Prohibit basements below flood level on filled lots
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Public Works in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Continued compliance through planning ordinance; will continue to enforce. (See Section 7.)

Town of Matthews MITIGATION ACTION 2	**Coordinate with Mecklenburg County Storm Water Services to consider applying for and joining FEMA's Community Rating System (CRS).**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Public Works in coordination with CMSWS
Implementation Schedule:	6/2016
2015 Status Update:	**Deferred.** The Town is currently working with CMSWS to develop an application for CRS participation.

Town of Matthews MITIGATION ACTION 3	**Mitigate localized flooding caused by existing road and railroad structures by means of increasing the dimensions of drainage culverts in problem areas.**
Mitigation Goal:	#1
Mitigation Category:	Structural Projects
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown—estimated to cost $500,000 or more
Potential Funding Sources:	Bond program, railroad funds, power bill revenues, Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP), U.S. Army Corps of Engineers—Small Flood Control Projects
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Based on access to funding (2022 per NCDOT)
2015 Status Update:	**Partially Completed/In Progress.** The Town has worked with CSX to have CSX complete an upgrade of the culvert under the railroad that caused flooding on Tank Town Road on a regular basis. The revised culvert is supposedly designed to handle the 50-year flood event. Now working with NCDOT to evaluate the Sam Newell Road culvert as part of the eU-2509 widening project on US74.

Town of Matthews MITIGATION ACTION 4	Complete the development of a Town specific Emergency Operations plan to supplement County All-Hazards Plan.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,000
Potential Funding Sources:	FEMA and DHS Grants, local funds
Lead Agency/Department Responsible:	Town Manager's Office, Fire Department
Implementation Schedule:	6/2016
2015 Status Update:	**Partially Completed/In Progress.** The Town Emergency Operations Plan has been completed and is in place. MFD is working to set up our first tabletop exercise for training on the plan in 2015.

Town of Matthews MITIGATION ACTION 5	Develop plan to work with property owners in areas prone to flooding based on "new" County floodplain maps to assist them is seeking insurance and or mitigation.
Mitigation Goal:	# 2
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff Time and Resources
Potential Funding Sources:	Storm Water Budget, MCSWS funds
Lead Agency/Department Responsible:	Public Works, MCSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Deleted.** The Town did not develop a plan, but instead allowed CMSWS to handle this activity.

Town of Matthews MITIGATION ACTION 6	Provide and maintain NIMS training for all department supervisors and appropriate line employees.
Mitigation Goal:	# 3
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,000
Potential Funding Sources:	Emergency Management Institute, DHS, Town Funds
Lead Agency/Department Responsible:	Town Managers Office, All Department Heads
Implementation Schedule:	6/2016
2015 Status Update:	**Partially Completed/In Progress.** NIMS training has been completed for supervisors, with the exception of NIMS 300-400. The Town is planning a tabletop exercise for 2015.

Town of Matthews MITIGATION ACTION 7	**As part of UDO, currently in development, add policies that account for identified hazard areas.**
Mitigation Goal:	#1
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time
Potential Funding Sources:	Town Funds
Lead Agency/Department Responsible:	Planning Department
Implementation Schedule:	18 months (completed within original timeframe)
2015 Status Update:	**Completed.** The purpose of the Floodplain regulations are given at 155.901.D: PURPOSE. It is the purpose of the floodplain regulations to promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to: 1. Restrict or prohibit uses which are dangerous to health, safety and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities; 2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction; 3. Control the alteration of natural floodplains, stream channels and natural protective barriers which are involved in the accommodation of flood waters; 4. Control filling, grading, dredging and other development which may increase erosion or flood damage; and 5. Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands. • The Floodplain Regulations chapter of the UDO includes all the standards as requested by FEMA. • A recent Flood Insurance Study (FIS) and revised FIRMs were updated as of February 2014. • In addition to FEMA Floodways, Community Special Flood Hazard Areas have been delineated to show anticipated flood levels at the time of future build-out of the surrounding area. • Matthews' code includes standards for limiting damage from flooding events. • Matthews' code limits new construction or various improvements within designated flood fringe locations as well as the floodways, to reduce potential damages. • Matthews' UDO also incorporates a chapter on storm water control measures, so that storm water from regularly recurring rain events is managed and maintained on an ongoing basis, and BMPs are designed and inspected for ongoing integrity.

Town of Matthews MITIGATION ACTION 8	**Initiate project to mark all hydrants for easy location at night and by Mutual Aid Departments not familiar with Town streets and hydrant locations.**
Mitigation Goal:	# 1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$5,000
Potential Funding Sources:	Town Funds
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	12/2016
2015 Status Update:	**Deferred.** This has not been accomplished but it is still a desired goal to add blue pavement markings to all streets at hydrant locations before the end of 2016.

Town of Matthews MITIGATION ACTION 9	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	In coordination with CMEMO (Lead)
Implementation Schedule:	Annual
2015 Status Update:	**Deleted.** The Town has deferred to the County to take the lead in this process. The Fire Department has appointed a Lieutenant who is in the process of obtaining Fire Educator Certification. This person will be the Community Safety Outreach for the Fire Department.

Town of Matthews MITIGATION ACTION 10	On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	In coordination with CMEMO (Lead)
Implementation Schedule:	Annual
2015 Status Update:	**Deleted.** The Town has deferred to the County to take the lead in this process.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Matthews MITIGATION ACTION 1	Ensure that local firefighters are properly trained and exercised in brush/forest firefighting techniques.
Category:	Training and Exercises
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	High
Estimated Cost:	$25,000
Potential Funding Sources:	General tax revenues, Department of Homeland Security—Fire Academy Training Assistance, Department of Homeland Security—Fire Academy Education Program, Department of Homeland Security—Fire Management Assistance Grant, local community colleges.
Lead Agency/Department Responsible:	Fire Department, Idlewild Volunteer Fire Department
Implementation Schedule:	12 months
2010 Status Update:	**Completed/Ongoing**. Training held annually. Majority of firefighters are trained to FFII Certification which includes Wildland Firefighting Certification.
2015 Status Update:	**Completed.** The Matthews Fire Department worked with the NC Forest Service to develop a Wildland/Urban Interface Plan for the Matthews Service area, and has implemented the same.

Town of Matthews MITIGATION ACTION 2	Work with power companies to educate and gain support for proper preventative tree pruning to reduce the chance of power outages.
Category:	Education and Outreach
Hazard(s) Addressed:	Winter Storms, Hurricanes and Tropical Storms
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,000
Potential Funding Sources:	General tax revenues, Duke Power Company
Lead Agency/Department Responsible:	Public Works, Landscape Division
Implementation Schedule:	2017
2010 Status Update:	**Completed/Ongoing.** Duke has made several passes through Town in past 5 years pruning. Publicity ahead of time has reduced complaints from citizens, but still a very controversial issue each time.
2015 Status Update:	**Partially Completed/In Progress.** Duke Power has not done any major trimming in the past 5 years. Union Power did do trimming in their service area with very few complaints from citizens.

Town of Matthews MITIGATION ACTION 3	Routinely inspect the functioning of fire hydrants and report findings to CMU for repair.
Category:	Planning and Policy
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Annual (2015, 2016, 2017, 2018, 2019)
2010 Status Update:	**Completed/Ongoing.** Schedule has been established for inspections and flushing all hydrants at least 2X per year. Problems reported to CMU for repair.
2015 Status Update:	**Partially Completed/In Progress.** The Matthews Fire Department has continued their program to inspect and flow all hydrants every year and report problems to Charlotte Water. Reporting of service requests are now done online through a web portal enabling the Town to easily track the status of the repairs.

Town of Matthews MITIGATION ACTION 4	Investigate the feasibility of joining the Community Rating System (CRS).
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	Planning Department
Implementation Schedule:	12 months (goal to complete—12/2016)
2010 Status Update:	**Deferred.** Primarily due to lack of staff time. Action item carried over to Action #2 in 2010 Mitigation Action Plan.
2015 Status Update:	**Deferred.** Intended to be a result of this 2015 Hazard Mitigation Plan update.

Town of Matthews MITIGATION ACTION 5	Train staff to educate themselves and the public regarding hazards and the steps that can be taken to reduce their impact.
Category:	Training and Exercises, Education and Outreach
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$10,000
Potential Funding Sources:	General tax revenues, FEMA Emergency Management Institute courses, FEMA and American Red Cross materials are free of charge, Hazard Mitigation Grant Program (HMGP), Department of Homeland Security—Citizenship Education and Training
Lead Agency/Department Responsible:	Matthews PIO Office and Mecklenburg County
Implementation Schedule:	2017
2010 Status Update:	**Partially Completed.** Town has hired a PIO in the past year (2009) and it is in this person's responsibility to produce these materials, working with the County.
2015 Status Update:	**Partially Completed/In Progress.** The Town PIO has worked with the County in this area. Ongoing training is being conducted with staff using County and online resources.

Town of Matthews MITIGATION ACTION 6	Mitigate localized flooding caused by existing road and railroad structures.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown—estimated to cost $500,000 or more
Potential Funding Sources:	Bond program, railroad funds, power bill revenues, Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP), U.S. Army Corps of Engineers—Small Flood Control Projects
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Based on access to funding
2010 Status Update:	**Partially Completed / Deferred.** Two locations identified. Conversations continuing with CSX, though RR feels that they have no responsibility. With second, DOT is at this time conducting evaluation of the location on their road to seek mitigation possibilities. Action item carried over to Action #3 in 2010 Mitigation Action Plan.
2015 Status Update:	**Deleted.** See #3 status above.

Town of Matthews MITIGATION ACTION 7	Increase the dimensions of drainage culverts in problem areas.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Pre-Disaster Mitigation (PDM) program, Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP), U.S. Army Corps of Engineers—Small Flood Control Projects, Public Assistance (406 Mitigation)
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	24 months
2010 Status Update:	**Deferred.** Action item carried over to Action #3 in 2010 Mitigation Action Plan.
2015 Status Update:	**Deleted.** See status of #3 above.

TOWN OF MINT HILL MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High			
	Moderate		✓	
	Limited			

2015 MITIGATION ACTIONS

Town of Mint Hill MITIGATION ACTION 1	**Seek funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Mecklenburg County Buildings and Inspections Department; Town of Mint Hill Emergency Services
Implementation Schedule:	2015-2020

Town of Mint Hill MITIGATION ACTION 2	**Seek funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.**
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Mecklenburg County Buildings and Inspections Department; Town of Mint Hill Emergency Services
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Mint Hill MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standards (in addition to basic required compliance actions):** **a) Development standards linked to Community Floodplain (Future Conditions)** **b) Require critical facilities protection to 500-year flood levels** **c) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **d) Require dry land access for new or substantially improved buildings (above Community Flood BFE)** **e) Levee restrictions** **f) Cumulative substantial damage improvement provision** **g) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Mint Hill in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Higher standards were enforced for all new construction in Charlotte-Mecklenburg and the surrounding towns by the Storm Water Permitting & Compliance Program within the County's Water & Land Resources Division. Where applicable, increases in BFEs were incorporated as remapping projects reached preliminary status. Local ordinances were updated to incorporate results of remapping projects and in response to comments received during the September 2011 FEMA/NCEM Community Assistance Visit (CAV).

Town of Mint Hill MITIGATION ACTION 2	Prepare and conduct a survey for critical facilities to help identify structural and/or non-structural deficiencies that may lead to increased vulnerability to natural hazards. Include recommended corrective actions in local capital improvements program.
Mitigation Goal:	#1
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$20,000
Potential Funding Sources:	TBD
Lead Agency/Department Responsible:	Town of Mint Hill Public Works Department
Implementation Schedule:	FY 2011 start; 2020 Projected Completion
2015 Status Update:	**Partially Completed/In Progress.** The Town currently has a backup generator at the Fire Department. One is being installed at the Mint Hill Police Department that will have a disconnect, so it will be mobile. In the next year or two, Mint Hill Volunteer Fire Department will be adding a second station and will have a backup generator there also.

Town of Mint Hill MITIGATION ACTION 3	Ensure the consideration of all natural hazards is integrated into local infrastructure and capital improvements planning.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	Town of Mint Hill and CRTPO
Lead Agency/Department Responsible:	Town of Mint Hill Planning Department
Implementation Schedule:	Plan Development 2010 – Implementation 2010-2020
2015 Status Update:	**Deferred Due to Staffing.** This action is now the responsibility of the Charlotte Regional Transportation Planning Organization (CRTPO) (formerly MUMPO). The Town of Mint Hill will continue to assist with this action as needed, however it is being monitored and maintained by CRTPO.

Town of Mint Hill MITIGATION ACTION 4	Prepare and maintain a map of areas that flood frequently, particularly those areas outside of FEMA floodplains.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$5,000
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	In coordination with CMSWS
Implementation Schedule:	Plan Development 2010 – Implementation 2010-2020
2015 Status Update:	**Partially Completed/In Progress.** Phase I maps, covering central and southern Mecklenburg, became effective February 19, 2014. Phase II maps, covering western Mecklenburg, are currently in preliminary status, expected to be effective October 2015. Phase III maps, covering northeast Mecklenburg, are draft status now, expected to become effective in 2016. Phase IV, covering Catawba River, is being studied by North Carolina Floodplain Mapping Program, effective date not known. It should be noted however that while the Town of Mint Hill is involved in this process, this action is being monitored and maintained by Charlotte-Mecklenburg Storm Water Services.

Town of Mint Hill MITIGATION ACTION 5	Coordinate with the North Carolina Division of Forest Resources (NCDFR) to prepare Community Wildfire Protection Plans (CWWPs) for identified high risk communities.
Mitigation Goal:	#2 and #5
Mitigation Category:	Prevention; Public Education & Awareness
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$5,000
Potential Funding Sources:	NCDFR grants; FEMA Pre-Disaster Mitigation (PDM) or Hazard Mitigation Grant Program (HMGP)
Lead Agency/Department Responsible:	Town of Mint Hill Voluntary Fire Department, in coordination with the North Carolina Forest Service
Implementation Schedule:	2015-2020
2015 Status Update:	**Deferred Due to Staffing.** This action is the responsibility of the North Carolina Forest Service. The Town of Mint Hill will continue to assist with this action as needed, however it is being monitored and maintained by NCFS.

Town of Mint Hill MITIGATION ACTION 6	**Coordinate with NCDOT on the identification of structurally deficient bridges that are more likely to sustain damage from future earthquake events and that should be addressed through future retrofit projects or bridge replacement.**
Mitigation Goal:	#1
Mitigation Category:	Prevention; Structural Projects
Hazard(s) Addressed:	Earthquake
Priority (High, Moderate, Low):	Low
Estimated Cost:	TBD
Potential Funding Sources:	TBD with NCDOT
Lead Agency/Department Responsible:	Town of Mint Hill Public Works Department, in coordination with NCDOT
Implementation Schedule:	2015-2020
2015 Status Update:	**Deferred.** There are currently no Town-maintained bridges therefore no action is being taken to further this action at this time. If any bridges become the Town's responsibility during the 2015-2020 timeframe they will be assessed accordingly.

Town of Mint Hill MITIGATION ACTION 7	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Mint Hill in coordination with CMEMO (Lead)
Implementation Schedule:	Annual
2015 Status Update:	**Deferred Due to Staffing.** This action is the responsibility of the Charlotte-Mecklenburg Emergency Management Office (CMEMO). The Town of Mint Hill will continue to assist with this action as needed in coordination with CMEMO.

Town of Mint Hill MITIGATION ACTION 8	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.**
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	The Town of Mint Hill in coordination with CMEMO (Lead)
Implementation Schedule:	Annual
2015 Status Update:	**Deferred Due to Staffing.** This action is the responsibility of the Charlotte-Mecklenburg Emergency Management Office (CMEMO). The Town of Mint Hill will continue to assist with this action as needed in coordination with CMEMO.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Mint Hill MITIGATION ACTION 1	**Improve growth management procedures in identified flood hazard areas.**
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Mint Hill Planning Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed/Ongoing.** The Town joined the National Flood Insurance Program in 2007, and also recently adopted a post construction ordinance which established stream buffers and limits on impervious surface ratios. The Town continues to support the review and updating of its flood damage prevention ordinance with higher regulatory standards than required by FEMA, in coordination with Mecklenburg County Storm Water Services. This includes not allowing residential building in floodplain areas. See Mitigation Action #1 for 2010 plan update for more information on recently passed floodplain regulations.
2015 Status Update:	**Partially Completed/In Progress.** The Town continues to support the review and updating of its Flood Damage Prevention Ordinance with higher regulatory standards than required by FEMA, in coordination with Charlotte-Mecklenburg Storm Water Services (CMSWS). This includes not allowing residential building in floodplain areas.

Town of Mint Hill MITIGATION ACTION 2	**Protect and enhance riparian zones around creeks and streams to control flooding.**
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources, costs associated with purchase of property or easements
Potential Funding Sources:	Non-profit land trusts, Clean Water Management Trust Fund, Department of Commerce—Habitat Conservation, Department of the Interior—Rivers, Trails and Conservation Assistance
Lead Agency/Department Responsible:	Town of Mint Hill Planning Department
Implementation Schedule:	Completed
2010 Status Update:	**Completed/Ongoing.** The Town continues to seek opportunities to protect and enhance riparian zones to not only control flooding but to also protect the natural and beneficial functions of floodplains. It recently adopted a post construction ordinance that established stream buffers, impervious surface ratios, and water quality features such as detention ponds. In 2009 the town adopted a site specific management plan for the Goose Creek basin. Every 10 years the town develops a 10 year comprehensive land use plan that determines areas that should not be developed. This plan is currently being reviewed in 2010.
2015 Status Update:	**Completed.** The Town re-adopted the 2000 Land Use Plan in 2010.

Town of Mint Hill MITIGATION ACTION 3	**Develop emergency operations plan to protect vital services, establish potential shelter sites, and establish a communication center.**
Category:	Planning and Policy
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	FEMA—All Hazards Emergency Operational Planning, Pre-Disaster Mitigation (PDM) program, Hazard Mitigation Grant Program (HMGP), Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	Administration, Police, Fire, Public Works
Implementation Schedule:	Completed
2010 Status Update:	**Partially Completed.** The Town is currently in the process of finalizing a command center for all of the town's vital services to be operated from the Mint Hill Fire Department. This facility has been outfitted with a generator that can operate the entire building to include showers, sleeping quarters, water, kitchen, and has rooms for several computers and meetings. The Police Department's communication center is housed in Pineville and the police communication tower is located in Mint Hill. If the tower becomes inoperable, dispatch has the capability to use south towns mutual aid which is on the City of Charlotte radio system. If the communication center becomes inoperable they are prepared to move to the EOC in Charlotte or CMPD's dispatch center with a mobile communication system. A phone call to BellSouth will route all 911 calls to this communication center. The Fire Department and Paramedic Service operate on the County radio system and would fall under the county protocol if that system becomes disabled.
2015 Status Update:	**Completed.** The Mint Hill Fire Department is set up to be the Town's command center for emergency operations. The Mint Hill Police are on the County's 800 system and being dispatched by Pineville Communications.

TOWN OF PINEVILLE MITIGATION ACTION PLAN

Risk vs. Capability		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High		✓	
	Moderate			
	Limited			

2015 MITIGATION ACTIONS

Town of Pineville MITIGATION ACTION 1	**Seek grant funding to retrofit critical facilities and Town-owned facilities for improved resilience to all hazards with the use of the latest building materials and technology. This could include, but is not limited to: wind retrofits, low water consumption fixtures, leak detectors, backup generators, ignition-resistant materials, 320 or 361 compliant safe rooms, lightning protection, hail resistant roofing, and anchoring fixed building equipment.**
Mitigation Goal:	#1
Mitigation Category:	Property Protection
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Pineville Planning Department
Implementation Schedule:	2015-2020

Town of Pineville MITIGATION ACTION 2	**Seek grant funding to install backup generators or quick connect hook ups for mobile generators on any newly constructed county/town critical facilities.**
Mitigation Goal:	#1
Mitigation Category:	Emergency Services
Hazard(s) Addressed:	All
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined on a case-by-case basis
Potential Funding Sources:	Local, State Grants, UHMA Grants, other federal grants
Lead Agency/Department Responsible:	Town of Pineville Planning Department
Implementation Schedule:	2015-2020

STATUS UPDATE FOR 2010 MITIGATION ACTIONS

Town of Pineville MITIGATION ACTION 1	**Maintain continued compliance with the National Flood Insurance Program (NFIP) through implementation and periodic evaluation of the following higher regulatory standard (in addition to basic required compliance actions):** **a) Development standards linked to Community Floodplain (Future Conditions)** **b) Require critical facilities protection to 500-year flood levels** **c) Require parking lots to be elevated (no more than six inches deep in any parking space during Community Flood event)** **d) Require dry land access for new or substantially improved buildings (above Community Flood BFE)** **e) Levee restrictions** **f) Cumulative substantial damage improvement provision** **g) Prohibit basements below flood level on filled lots**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Currently maintaining protocols from 2010. Staff will attend NFIP training workshops in March 2015 and work to better maintain CRS records. Town has adopted revised Zoning and Subdivision Ordinances which take into account stricter development controls.

Town of Pineville MITIGATION ACTION 2	**In coordination with MCSWS, continue participation in the NFIP Community Rating System (CRS) with the goal of increasing CRS credit points to become a Class 5 community of better within five years.**
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Local staff time
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville in coordination with CMSWS
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** The Town of Pineville has attained the rank of Class 6.

Town of Pineville MITIGATION ACTION 3	**Minimize the potential for future stormwater flooding throughout the Town by means of the following actions:** **1. Encourage residents to keep storm drains clear of debris during/after storms;** **2. Routinely clean storm water drains; and** **3. Repair storm water drains as necessary.**
Mitigation Goal:	#1, #2
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	1. No extra cost – the Town of Pineville maintains a bi-monthly newsletter that can be used to support this action 2. Staff time and resources 3. Costs based on damages, maintenance
Potential Funding Sources:	1. Local budget 2. Staff Time and resources 3. Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP), Public Assistance
Lead Agency/Department Responsible:	1. Town Administrator 2. Public Works/ Mecklenburg County Storm Water 3. Public Works/ Mecklenburg County Storm Water
Implementation Schedule:	Quarterly/bi-annually from 2015 through 2020
2015 Status Update:	**Partially Completed/In Progress.** The Town actively cleans and maintains storm water drains.

Town of Pineville MITIGATION ACTION 4	**Advertise and promote the availability of flood insurance.**
Mitigation Goal:	#2
Mitigation Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	No extra cost – the Town of Pineville maintains a bi-monthly newsletter that can be used to support this action
Potential Funding Sources:	Local Budget
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	Quarterly/bi-annually from 2015 through 2020
2015 Status Update:	**Partially Completed/In Progress.** The Town continues to maintain bi-monthly newsletter used to support this action.

Town of Pineville MITIGATION ACTION 5	Encourage clustering of residential lots outside of known hazard areas through the development and use of subdivision design and review guidelines.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood, Wildfire, Landslide, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning Department
Implementation Schedule:	June 2016
2015 Status Update:	**Partially Completed//In Progress.** The Town maintains Zoning and Subdivision Ordinances to attain this goal. The Subdivision Ordinance has been revised and updated, while the Zoning Ordinance is in the process of being updated, which will encourage residential clustering.

Town of Pineville MITIGATION ACTION 6	Preserve lands subject to repetitive flooding.
Mitigation Goal:	#5
Mitigation Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown/value of land
Potential Funding Sources:	Land Trust, Pre-Disaster Mitigation (PDM) program, Hazard Mitigation Grant Program (HMGP), Clean Water Management Trust Fund
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed//In Progress.** The Town has identified properties in danger of repetitive flooding and intends to preserve or acquire these lands as funds become more available.

Town of Pineville MITIGATION ACTION 7	Limit the percentage of allowable impervious surface within developed parcels.
Mitigation Goal:	#5
Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning and Zoning Department
Implementation Schedule:	June 2016
2015 Status Update:	**Partially Completed//In Progress.** The Town maintains updated and revised Zoning and Subdivision Ordinances to attain this goal.

Town of Pineville MITIGATION ACTION 8	**Continue to limit future development in identified flood hazard areas and prohibit new critical facilities from being located with the 500-year floodplain as required in the Town's flood damage prevention ordinance.**
Mitigation Goal:	#5
Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning and Zoning Department
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed//In Progress.** The Town maintains Zoning and Subdivision Ordinances to attain this goal.

Town of Pineville MITIGATION ACTION 9	**Acquire or relocate structures subject to repetitive flooding.**
Mitigation Goal:	#1
Category:	Property Protection
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD, based on number and type of structures
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, Flood Mitigation Assistance (FMA) program, Repetitive Flood Claims (RFC) program, Community Development Block Grant (CDBG) program
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	As matching grant funds become available.
2015 Status Update:	**Partially Completed/In Progress.** The Town has identified properties in danger of repetitive flooding and intends to preserve or acquire these lands as funds become more available.

Town of Pineville MITIGATION ACTION 10	Conduct cumulative impact analysis/studies for multiple development projects within the same watershed.
Mitigation Goal:	#5
Category:	Prevention
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program
Lad Agency/Department Responsible:	Town of Pineville; CMSWS; Town of Pineville Public Works Department; Town of Pineville GIS Department
Implementation Schedule:	As funds become available.
2015 Status Update:	**Deferred.** With the current economic situation, funds are not available for a cumulative impact analysis; however, the Town requires individual analysis for some major developments to be completed by the managing developer.

Town of Pineville MITIGATION ACTION 11	Continue to coordinate with CMEMO on enhancements to the Town's early warning system and procedures for imminent hazard events.
Mitigation Goal:	#4
Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	FEMA—All Hazards Operational Planning, Hazard Mitigation Grant Program
Lead Agency/Department Responsible:	Town of Pineville Police Department; Town Administrator
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Continue to coordinate with CMEMO on an ongoing basis. So far have not implemented singular public outreach activity due to organizational changes and staff shortages. The Town is currently working on a new website and local television channel with updates for imminent hazardous events.

Town of Pineville MITIGATION ACTION 12	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management on a widespread public outreach activity to provide information on all natural hazards facing the area to local residents, including methods for mitigating and preventing damages from hazardous conditions and how to respond when an imminent hazard threatens.**
Mitigation Goal:	#2
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville in coordination with CMEMO (Lead)
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Continue to coordinate with CMEMO on an ongoing basis. So far have not implemented singular public outreach activity due to organizational changes and staff shortages. The Town is currently working on a new website and local television channel with updates for imminent hazardous events.

Town of Pineville MITIGATION ACTION 13	**On an annual basis, coordinate with Charlotte-Mecklenburg Emergency Management to provide information on all natural hazards facing the area to local planning staff and elected officials. This should be combined with an annual progress report on the status of local mitigation actions as identified in the Multi-jurisdictional Hazard Mitigation Plan.**
Mitigation Goal:	#5
Mitigation Category:	Public Education & Awareness
Hazard(s) Addressed:	Flood, Hurricanes and Tropical Storms, Severe Thunderstorms, Tornadoes, Winter Storms, Earthquakes, Landslides, Sinkholes, Drought, Wildfire, Dam/Levee Failure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Local staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville in coordination with CMEMO (Lead)
Implementation Schedule:	2015-2020
2015 Status Update:	**Partially Completed/In Progress.** Continue to coordinate with CMEMO on an ongoing basis. So far have not implemented singular public outreach activity due to organizational changes and staff shortages.

STATUS UPDATE FOR ONGOING 2005 MITIGATION ACTIONS

Town of Pineville MITIGATION ACTION 3	**Acquire safe sites for public facilities, including schools, police and fire stations, etc.**
Category:	Planning and Policy, Mitigation Project
Hazard(s) Addressed:	Multiple Hazards
Priority (High, Moderate, Low):	High
Estimated Cost:	Dependent on land values, existing ownership of property
Potential Funding Sources:	Town budget
Lead Agency/Department Responsible:	Town Administrator
Implementation Schedule:	2015-2020
2010 Status Update:	**Partially Completed.** The Town is completing a "Master Facilities Plan" which will include new police & fire stations in the future. Planning staff is assisting CMS on locations for potential new schools in the Town limits.
2015 Status Update:	**Partially Completed/In Progress.** The Town has built a new police headquarters and is planning a new fire station in the future. A new elementary school has opened within town limits.

Town of Pineville MITIGATION ACTION 4	**Develop early warning system for hazard events.**
Category:	Warning
Hazard(s) Addressed:	Multiple Hazards
Priority (High, Moderate, Low):	High
Estimated Cost:	$100,000
Potential Funding Sources:	FEMA—All Hazards Operational Planning, Hazard Mitigation Grant Program
Lead Agency/Department Responsible:	Town of Pineville Police Department; Town Administrator
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** The Town has recently implemented a "Reverse 911" calling system to alert residents of potential emergencies on a local level, and the Town continues to partner with CMEMO on a larger scale
2015 Status Update:	**Partially Completed/In Progress.** The Town continues to partner with CMEMO on an ongoing basis.

Town of Pineville MITIGATION ACTION 5	Encourage residents to keep storm drains clear of debris during storms.
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	No extra cost—the Town of Pineville maintains a bi-monthly newsletter that can be used to support this action
Potential Funding Sources:	Local budget
Lead Agency/Department Responsible:	Town Administrator; Town of Pineville Public Works Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Citizens are continually being notified about how it is important not to throw clippings down storm drains.
2015 Status Update:	**Partially Completed/To Be Continued.** Citizens are continually being notified about how it is important not to throw clippings down storm drains. The Town actively cleans and maintains storm water drains.

Town of Pineville MITIGATION ACTION 6	Advertise and promote the availability of flood insurance.
Category:	Education and Outreach
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	No extra cost—the Town of Pineville maintains a bi-monthly newsletter that can be used to support this action
Potential Funding Sources:	Flood Mitigation Assistance (FMA) program (technical assistance or planning), NFIP materials are free of charge from FEMA
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** The Town Clerk is in the process of informing citizens by using the bi-monthly newsletter.
2015 Status Update:	**Partially Completed/To Be Continued.** The Town actively uses the bi-monthly newsletter for this purpose. No new action steps have been undertaken.

Town of Pineville MITIGATION ACTION 7	Develop a "natural runoff" or "zero discharge" policy for storm water in subdivision design regulations.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources (See Planning Advisory Service Report #473—Subdivision Design in Flood Hazard Areas. 1997. American Planning Association.
Potential Funding Sources:	Flood Mitigation Assistance (FMA) program (technical assistance or planning)
Lead Agency/Department Responsible:	Town of Pineville Planning and Zoning Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** On July 1, 2007, the Post-Construction Storm Water Ordinance was in effect for the Town of Pineville. Pineville Staff works with Mecklenburg County Land Development in the initial stages of any development to help control all storm water discharge.
2015 Status Update:	**Completed.** The Town has revised the Subdivision Ordinance which affects storm water regulations, although not specifically in regards to a "natural runoff" or "zero discharge" policy. **In Progress.** Pineville Staff continues to work with Mecklenburg County Land Development in the initial stages of any development to help control all storm water discharge.

Town of Pineville MITIGATION ACTION 8	Limit the percentage of allowable impervious surface within developed parcels.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning and Zoning Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Deferred.** Staff is planning to update the subdivision ordinance within the year.
2015 Status Update:	**Completed.** The Subdivision Ordinance is updated and enforced with stricter regulations regarding impervious surfaces. **In Progress.** The Zoning Ordinance is currently being updated and will reflect changes to regulations related to impervious surfaces.

Town of Pineville MITIGATION ACTION 9	Routinely clean debris from support bracing underneath low-lying bridges.
Category:	Planning and Policy, Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Public Works Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** The Public Works Department routinely checks the supports of the bridges in Town. If any material is stuck, they will clear it out to prevent any clogging and backups.
2015 Status Update:	**Partially Completed/In Progress.** The Public Works Department routinely checks the supports of the bridges in Town. If any material is stuck, they will clear it out to prevent any clogging and backups. No new actions have been implemented.

Town of Pineville MITIGATION ACTION 10	Routinely inspect the functioning of fire hydrants.
Category:	Planning and Policy
Hazard(s) Addressed:	Wildfire
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Fire Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** The Volunteer Fire Department checks the fire hydrants regularly.
2015 Status Update:	**Partially Completed/In Progress.** The Volunteer Fire Department checks the fire hydrants regularly.

Town of Pineville MITIGATION ACTION 11	Provide training for 911 dispatchers during natural disasters.
Category:	Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	High
Estimated Cost:	Cost of 911 equipment training
Potential Funding Sources:	Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	Town of Pineville Police and Fire Departments
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Absolved into normal training practices for 911 dispatchers.
2015 Status Update:	**Partially Completed/In Progress.** This continues to be a part of normal training practices for 911 dispatchers. No new action steps have been undertaken.

Town of Pineville MITIGATION ACTION 12	Train emergency responders and managers for flood emergencies.
Category:	Training and Exercises
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate to High
Estimated Cost:	Cost of equipment and training classes
Potential Funding Sources:	Emergency Management Performance Grants (EMPG), Emergency Management Institute, Department of Justice—State and Local Domestic Preparedness Exercise Support, Department of Homeland Security—Citizen Corps
Lead Agency/Department Responsible:	Town of Pineville Police and Fire Departments
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing,** Absolved into normal training practices for Police and Fire Departments.
2015 Status Update:	**Partially Completed/In Progress.** This continues to be a part of normal training practices for Police and Fire Departments. No new action steps have been undertaken.

Town of Pineville MITIGATION ACTION 13	Equip emergency responders and managers for flood emergencies.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate to High
Estimated Cost:	Cost of equipment
Potential Funding Sources:	Hazard Mitigation Grant Program (7% set aside), Emergency Management Performance Grants (EMPG)
Lead Agency/Department Responsible:	Town of Pineville Police and Fire Departments
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing,** The town has and continues to purchase new equipment for the Police and Fire Departments.
2015 Status Update:	**Partially Completed/In Progress.** The Town has now implemented a Capital Improvements Program to help pay for new equipment for the Police and Fire Departments and other major expenditures to prepare for flood and other emergencies.

Town of Pineville MITIGATION ACTION 14	Train staff and educate the community on local vulnerability to hazards.
Category:	Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources, Hazard Mitigation Grant Program (HMGP), Department of Homeland Security—Citizenship Education and Training
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Public Safety; Town of Pineville Police Department; Town of Pineville Administration
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Staff has worked with MCSWS to educate citizens on different hazards. Mainly through educating with the bi-monthly newsletter.
2015 Status Update:	**Partially Completed/In Progress.** Staff continues to work with CMSWS to educate citizens on different hazards. The bi-monthly newsletter is the main conduit through which education efforts are handled. No new efforts have been undertaken.

Town of Pineville MITIGATION ACTION 18	Improve the level of coordination between the GIS Department and other departments.
Category:	Planning and Policy, Training and Exercises
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning Department; Town of Pineville GIS Department
Implementation Schedule:	Completed
2010 Status Update:	**Partially Completed / Ongoing.** The Town is in the process of purchasing a Large Format Scanner to assist the Planning, Electric, and Telephone Departments by keeping electronic copies of all plans. This will allow for easy access and the ability to send plans with hand written notes to any other governmental agency that might need them without having to mail them.
2015 Status Update:	**Completed.** The Town has purchased, and regularly uses, a Large Format Scanner to assist with Planning, Electric, and Telephone Departments. As of October 2014, the Town has obtained GIS data to more accurately maintain Town maps and information.

Town of Pineville MITIGATION ACTION 20	Encourage clustering of residential lots outside of hazard areas through the use of subdivision design and review guidelines.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood, Wildfire
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Planning and Zoning Department
Implementation Schedule:	Completed
2010 Status Update:	**Partially Completed.** Planning Staff has completed work on revising the Zoning Ordinance, and preparing Small Area Plans which will help to control development. With the next step, staff plans to revise and update the Subdivision Ordinance to reflect changes in Mecklenburg County's Land Development practices.
2015 Status Update:	**Completed.** The Zoning Ordinance is being revised again. Small Area Plans have been completed to help control development. The Subdivision Ordinance has been revised and updated to better reflect changes in Mecklenburg County's Land Development practices.

Town of Pineville MITIGATION ACTION 21	Acquire or relocate structures subject to repetitive flooding.
Category:	Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown, based on number and type of structures
Potential Funding Sources:	Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, Community Development Block Grant Program
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	2015-2020
2010 Status Update:	**Deferred.** With current economic situation, funds are not available.
2015 Status Update:	**Deferred.** With current economic situation, funds are not available.

Town of Pineville MITIGATION ACTION 22	Preserve lands subject to repetitive flooding.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Land Trust, Hazard Mitigation Grant Program (HMGP), Clean Water Management Trust Fund
Lead Agency/Department Responsible:	Town of Pineville
Implementation Schedule:	2015-2020
2010 Status Update:	**Deferred.** Staff has not started on this action yet.
2015 Status Update:	**Partially Completed/In Progress.** Storm Water Plan overseen by Mecklenburg County does not allow new expansions into floodplain, existing structures are grandfathered.

Town of Pineville MITIGATION ACTION 24	Conduct cumulative impact analysis/studies for multiple development projects within the same watershed.
Category:	Planning and Policy
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	Natural Resources Conservation Service—Watershed Protection and Flood Prevention Program, Natural Resources Conservation Service—Watershed Surveys and Planning, U.S. Army Corps of Engineers—Floodplain Management Services, Hazard Mitigation Grant Program (HMGP)
Lead Agency/Department Responsible:	Town of Pineville Administration; CMSWS; Town of Pineville Public Works Department; Town of Pineville GIS Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Deferred.** With current economic situation funds are not available.
2015 Status Update:	**Deferred.** With current economic situation funds are not available for a cumulative impact analysis; however, the Town requires individual analysis for some major developments to be completed by the managing developer.

Town of Pineville MITIGATION ACTION 25	Routinely clean stormwater drains.
Category:	Planning and Policy, Mitigation Project
Hazard(s) Addressed:	Flood
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	N/A
Lead Agency/Department Responsible:	Town of Pineville Public Works Department; CMSWS
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing.** Public Works Department is keeping the streets clean to prevent the build-up of debris. In addition, the Public Works Director works with Mecklenburg County Storm Water Services to inspect and repair storm drains that do not meet minimum standards.
2015 Status Update:	**Partially Completed/In Progress.** The Town Public Works Department is keeping the streets clean to prevent the build-up of debris. In addition, the Public Works Director works with Charlotte-Mecklenburg Storm Water Services to inspect and repair storm drains that do not meet minimum standards.

Town of Pineville MITIGATION ACTION 27	Require bracing of generators, elevators and other vital equipment in hospitals.
Category:	Mitigation Project
Hazard(s) Addressed:	Earthquakes
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Local hospital resources, Mitigation Assistance Program (earthquake program)
Lead Agency/Department Responsible:	Local Hospital; Town of Pineville
Implementation Schedule:	Completed
2010 Status Update:	**Partially Completed / Ongoing.** Carolinas Medical Center is expanding their facilities in Pineville. The Hospital is meeting all current building code requirements.
2015 Status Update:	**Completed.** Carolinas Healthcare System has completed the hospital and meets all current building code requirements.

Town of Pineville MITIGATION ACTION 28	**Develop traffic response plan addressing how to deal with traffic in a commercial area.**
Category:	Traffic Control
Hazard(s) Addressed:	All Hazards
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time and resources
Potential Funding Sources:	NA
Lead Agency/Department Responsible:	Town of Pineville Police Department
Implementation Schedule:	2015-2020
2010 Status Update:	**Completed / Ongoing** The Police Department has traffic control measures in place.
2015 Status Update:	**Partially Completed/In Progress.** The Police Department has traffic control measures in place. The Town is currently working on re-aligning a traffic light for better and more efficient traffic flow with completion set for 2016.

10 PLAN MAINTENANCE PROCEDURES

This section discusses how the *Mitigation Strategy* and Mitigation Action Plans will be implemented by participating jurisdictions and how the overall Multi-jurisdictional Hazard Mitigation Plan will be evaluated and enhanced over time. This section also discusses how the public and participating stakeholders will continue to be involved in the hazard mitigation planning process. This section consists of the following four subsections:

- IMPLEMENTATION
- INTEGRATION INTO EXISTING PLANNING MECHANISMS
- MONITORING, EVALUATION AND ENHANCEMENT
- CONTINUED PUBLIC INVOLVEMENT

IMPLEMENTATION

44 CFR Requirement

Part 201.6(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.

Each jurisdiction participating in this Plan is responsible for implementing specific mitigation actions as prescribed in their locally adopted *Mitigation Action Plan* (Section 9: *Mitigation Action Plans*). In each *Mitigation Action Plan*, every proposed action is assigned to a specific local department or agency in order to increase accountability and therefore the likelihood of implementation. This approach enables individual jurisdictions to update their mitigation strategy as needed without altering the broader focus of the countywide Plan. The separate adoption of locally specific actions also ensures that each jurisdiction is not held responsible for monitoring and implementing the actions of other jurisdictions involved in the planning process. If multi-jurisdictional actions are identified, it is up to the participating jurisdictions to develop the appropriate means to monitor their progress.

In addition to the assignment of a lead department or agency, an implementation time period or a specific implementation date has been established in order to assess whether actions are being implemented in a timely fashion. Mecklenburg County and participating municipalities will seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in each *Mitigation Action Plan*. It is important to note that while the Pre-Disaster Mitigation (PDM) grant program and the Hazard Mitigation Grant Program (HMGP) are important sources of assistance and a community's ability to apply for such funding is directly linked to the development of a hazard mitigation plan, other federal funding sources are identified as appropriate.

INTEGRATION INTO EXISTING PLANNING MECHANISMS

44 CFR Requirement

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.

It is the responsibility of each participating jurisdiction to determine additional implementation procedures beyond those listed within their *Mitigation Action Plan*. This includes integrating the Hazard Mitigation Plan into other local planning documents such as comprehensive or capital improvement plans, when appropriate. Mecklenburg County, the City of Charlotte and the Town of Pineville have already incorporated this Plan into their local NFIP Community Rating System (CRS) programs under Activity 510: Floodplain Management Planning, and will continue to do so as part of their annual CRS recertification process with Insurance Services Office, Inc. The concept of further integrating this Plan into existing local comprehensive plans, subdivision regulations, zoning ordinances and capital improvements plans and infrastructure policies has been discussed among the members of the Hazard Mitigation Planning Team, and through the use of the "*Safe Growth Survey*" described in Section 7: *Capability Assessment* has already been raised with the land use planning and community development staff from each participating jurisdiction. As part of the 2015 plan update, the planning team specifically discussed integration with agency level comprehensive plans, jurisdiction-level comprehensive plans, land use plans, emergency operations plans and Tactical Interoperability Communications Plans (TIC-Ps). The two integration ideas that garnered the most support from planning team members were emergency operations plans and jurisdiction-level comprehensive plans. Integration with TIC-Ps may specifically support the geomagnetic storm hazard discussed earlier in this Plan. This concept will continue to be pursued throughout the monitoring, evaluation and enhancement process outlined within this section. Further, the members of the Hazard Mitigation Planning Team will remain charged with ensuring that the goals and strategies of new and updated local planning documents are consistent with the goals and actions of the Hazard Mitigation Plan, and will not contribute to an increased level of hazard vulnerability in Mecklenburg County. Additional opportunities to 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 through the five-year review process described in this section.

Although it is recognized that there are many possible benefits to integrating components of this Plan into other local plans, the development and maintenance of this stand-alone Multi-jurisdictional Hazard Mitigation Plan is deemed by the Mecklenburg County Hazard Mitigation Planning Team to be the most effective and appropriate method to implement local hazard mitigation actions. The primary means for integrating mitigation strategies into other local planning documents will be accomplished through the revision, update and implementation of each jurisdiction's *Mitigation Action Plan* that require specific planning and administrative tasks (i.e., plan amendments, ordinance revisions, capital improvement projects, etc.). In addition, Mecklenburg County and participating jurisdictions will incorporate existing planning processes and programs addressing flood hazard mitigation into this document by reference.

MONITORING, EVALUATION AND ENHANCEMENT

The agency with the overall responsibility for monitoring this Plan is the Charlotte-Mecklenburg Emergency Management Office (CMEMO). This decision was reaffirmed during the 2015 plan update by polling Hazard Mitigation Planning Team members for their input. Periodic revisions and updates of the 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, state and local regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to each jurisdiction's individual *Mitigation Action Plan*. The Mecklenburg County Hazard Mitigation Planning Team will meet biannually and following any disaster events warranting a re-examination of the mitigation actions being implemented or proposed by the participating jurisdictions.[1] These meetings will either be in-person meetings or conference calls based on the discretion of CMEMO. This will ensure that the Plan is continuously updated to reflect changing conditions and needs within Mecklenburg County. If determined to be appropriate or as requested, an annual report on the Plan will be developed and presented to the local governing bodies of participating jurisdictions in order to report progress on the actions identified in the Plan and to provide information on the latest legislative requirements. The report may also highlight proposed additions or improvements to the Plan.

Following completion of the initial 2005 Plan, CMEMO and Charlotte-Mecklenburg Storm Water Services (CMSWS) coordinated with each of the participating jurisdictions on the evaluation and monitoring activities. This included e-mail correspondence and occasional meetings between Hazard Mitigation Planning Team members. This also included the submission, review and discussion of status updates on each jurisdiction's *Mitigation Action Plan* that addressed which actions were complete, those that were delayed or deferred, and those that should be deleted from the Plan along with explanations for why proposed actions have changed. The results of this process indicated that a majority of the jurisdictions were successful in implementing their *Mitigation Action Plan* (as further described in Section 9: *Mitigation Action Plans*). In preparation of the five-year plan review process, CMEMO staff also attended training sessions sponsored by the North Carolina Division of Emergency Management which helped to ensure that all new planning guidance and requirements were fully understood. In terms of public involvement, the public was not heavily involved in the plan maintenance process until the 2010 plan update process began in October 2009 (as further described in Section 2: *Planning Process*). The public was further involved as part of the 2015 plan update, especially in terms of an online public participation survey and other means of securing citizen involvement.

Charlotte-Mecklenburg staff will continue to attend training workshops sponsored by the North Carolina Division of Emergency Management or others in order to keep up to date with any changing guidance or planning requirements and to communicate that information to representatives of participating jurisdictions. As part of this monitoring, evaluation and enhancement process, each participating jurisdiction will be expected to provide a status update to the County for their respective Mitigation Action Plans in order to evaluate the Plan's implementation effectiveness.

[1] The Hazard Mitigation Planning Team will determine on a case-by-case basis which events necessitate convening a meeting to consider modifying existing Mitigation Action Plans. It is understood that the committee will meet following all state and federally declared disasters in which Mecklenburg County is included. Smaller disasters will also merit attention. For example, Tropical Storm Danny, which impacted a significant number of individuals and caused widespread public and private property damage, did not meet the federal disaster declaration threshold. It did, however, cause the County to evaluate the need to address a number of flood-prone properties. The County eventually acquired over 100 properties as part of their flood hazard mitigation strategy.

ANNUAL PROGRESS REPORTS

CMEMO will coordinate with CMSWS on behalf of the Hazard Mitigation Planning Team to produce an annual progress report to evaluate the Plan's overall effectiveness. This will be coordinated in tandem with those reports necessary for CRS cycle verification through Insurance Services Office, Inc. for Mecklenburg County's participating CRS communities.

FIVE-YEAR PLAN REVIEW

At a minimum, the Plan will be reviewed every five years (more exhaustively than by the annual progress reports) by the Hazard Mitigation Planning Team in order to determine whether there have been any significant changes in Mecklenburg 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, the increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect changes in the content of the Plan.

The plan review provides community 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. CMEMO 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 and actions address current and expected conditions?
- Has the nature or magnitude of hazard risk changed?
- Are current resources adequate to implement the Plan?
- Should additional local resources be committed to address identified hazard threats?
- Are there any issues that have limited the current implementation schedule?
- Have the implementation of identified mitigation actions resulted in expected outcomes?
- Has the Hazard Mitigation Planning Team measured the effectiveness of completed hazard mitigation projects in terms of specific dollar losses avoided?
- Did the jurisdictions, agencies and other partners participate in the plan implementation process as proposed?
- Should other agencies or partners be included in plan maintenance?

Following the five-year review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures outlined in this section. Upon completion of the review and update/amendment process, the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan will be submitted to the North Carolina Division of Emergency Management State Hazard Mitigation Officer for review and approval. The State Hazard Mitigation Officer will submit the Plan amendments to the Federal Emergency Management Agency for final review as required by the Disaster Mitigation Act of 2000.

DISASTER DECLARATION

Following a state or federal disaster declaration, the Hazard Mitigation Planning Team will reconvene and the Plan will be revised as necessary to reflect lessons learned or to address specific circumstances arising from the event. In some circumstances it may be necessary for the committee to convene following localized emergencies and disasters in order to determine if changes in the Plan are warranted. It will be the responsibility of CMEMO to reconvene the Hazard Mitigation Planning Team and ensure that the appropriate stakeholders are invited to participate in the plan revision and update process.

REPORTING PROCEDURES

The results of the five-year review will be summarized by the Hazard Mitigation Planning Team in the relevant sections of the updated plan. This includes: a comprehensive description of the plan update process including an evaluation of plan effectiveness (Section 2); any updates to the community profile (Section 3); any notable revisions or updates to the risk assessment (Sections 4-6) or capability assessment (Section 7); updated mitigation goals and consideration of mitigation action alternatives (Section 8); status updates on previously adopted mitigation action plans (including the identification of reasons for delays or obstacles to their implementation) as well as the identification of newly proposed mitigation actions (Section 9); and revisions or updates to plan maintenance procedures (Section 10).

Any necessary revisions to the countywide Plan must follow the monitoring, evaluation and enhancement procedures outlined herein. During the 2010 plan update process, it was determined that the previously adopted "Plan Amendment Process" was an extraneous process not necessary for the successful implementation of the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan. For changes and updates to the individual *Mitigation Action Plans*, appropriate local designees will assign responsibility for the completion of each task.[2]

CONTINUED PUBLIC INVOLVEMENT

44 CFR Requirement

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 of the mitigation planning process and will continue to be essential as this Plan evolves and is updated over time.

The most appropriate and meaningful opportunities for the general public to be involved in the maintenance and implementation of the Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan is during the five-year plan review process as described earlier in this section. As demonstrated in Section 2: *Planning Process*, Mecklenburg County and its participating jurisdictions have been extremely ambitious in gaining widespread public involvement during the five-year plan review process through multiple methods.

[2] Local jurisdictions do have the authority to approve/adopt changes to their own Mitigation Action Plans without approval from the County; however, the County should be advised of all changes as a courtesy and for consideration for changes or modifications to the countywide Plan. Changes to either the multi-jurisdictional plan or local Mitigation Action Plans will necessitate the adoption of these changes by the appropriate local governing body. Ultimately, the updated Plan or plan component(s) will be submitted to the North Carolina Division of Emergency Management.

While the five-year plan review process represents the greatest opportunity for such involvement, other efforts to involve the public in the maintenance, evaluation and revision process will continue to be made as necessary. These efforts may include:

- Advertising meetings of the Hazard Mitigation Planning Team in the local newspaper, public bulletin boards and/or City and County office buildings;
- Designating willing citizens and private sector representatives as official members of the Hazard Mitigation Planning Team;
- Utilizing local media to update the public of any maintenance and/or periodic review activities taking place;
- Utilizing City and County Web sites to advertise any maintenance and/or periodic review activities taking place; and
- Maintaining copies of the Plan in public libraries or other appropriate venues;
- Posting the Annual Progress Reports on the Plan to City, County and Town Web sites;
- Heavy publicity of the plan and potential ways for the public to be involved after each major event, tailored to the event that has just happened;
- Planned activities during Severe Weather Preparedness Week (or similar), such as sending brief press releases that tie recent hazard occurrences with information from the hazard mitigation plan;
- Keeping websites, social media outlets, etc. updated;
- Drafting articles for the Charlotte Observer and community newspapers/newsletters;
- Holding annual public meetings;
- Utilizing social media accounts (e.g., City of Charlotte Twitter).

A PLAN ADOPTION

44 CFR Requirement

Part 201.6(c)(5): The plan shall include documentation that the plan has been formally adopted by the local governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

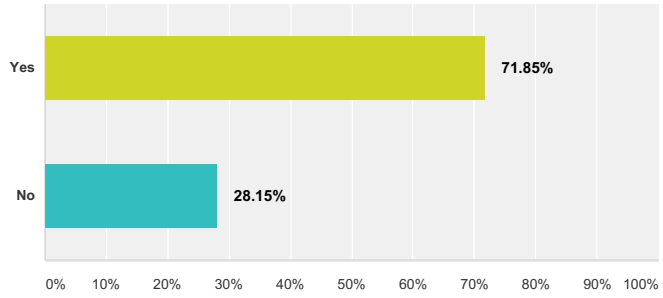
This section of the Plan includes copies of the local adoption resolutions passed by **Mecklenburg County** and the municipal jurisdictions of the City of **Charlotte** and the towns of **Cornelius**, **Davidson**, **Huntersville**, **Matthews**, **Mint Hill** and **Pineville**.

B PUBLIC PARTICIPATION SURVEY RESULTS

This section of the Plan includes a general summary of the results and findings of the online Public Participation Survey. A total of 347 persons responded to the survey during the 2015 update of Mecklenburg County's multi-jurisdictional hazard mitigation plan, and the results provided an added measure of public input during the local planning process.

Q1 Have you ever experienced or been impacted by a disaster?

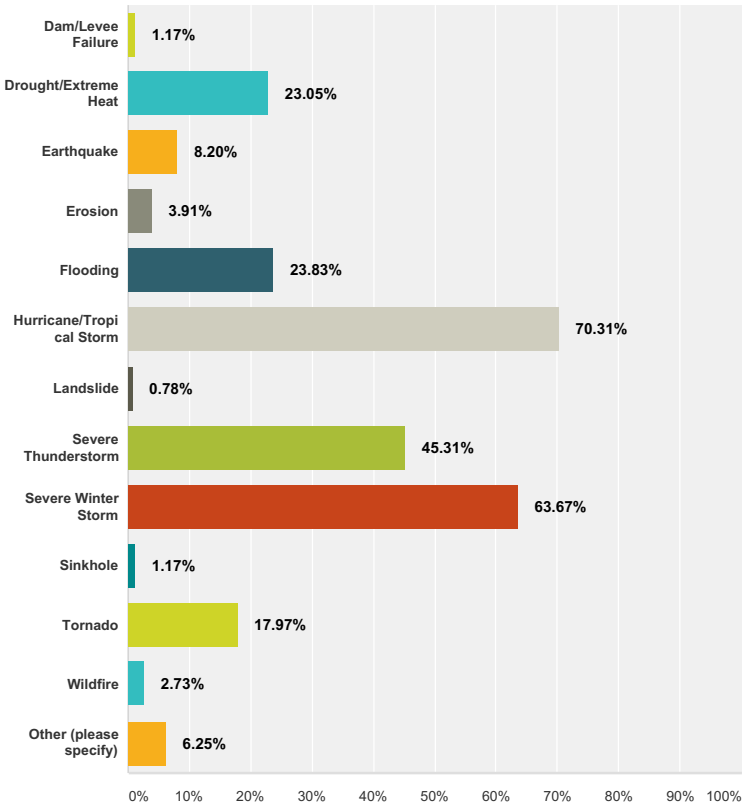
Answered: 341 Skipped: 6



Answer Choices	Responses	
Yes	71.85%	245
No	28.15%	96
Total		341

Q2 If yes, which of these natural hazards have you experienced or been impacted by? (Check all that apply.)

Answered: 256 Skipped: 91



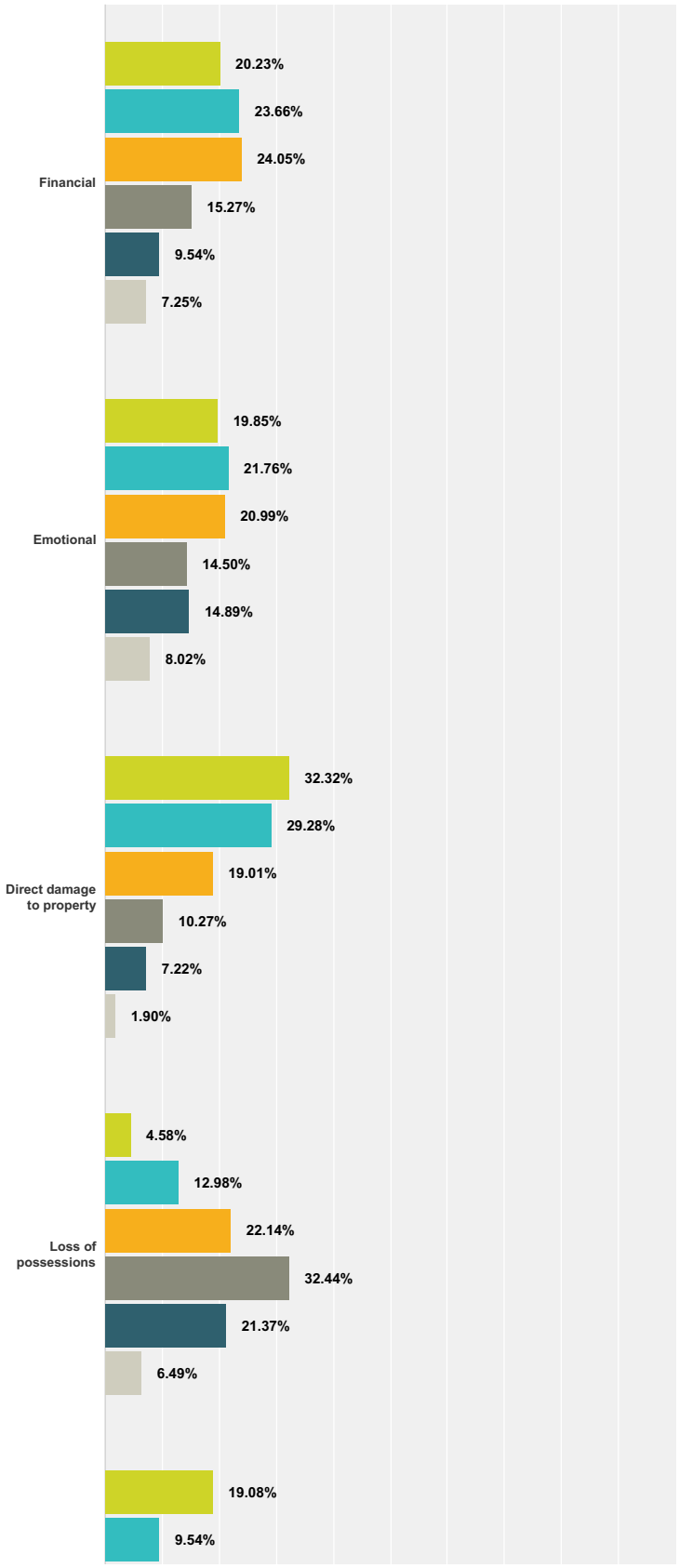
Answer Choices	Responses	
Dam/Levee Failure	1.17%	3
Drought/Extreme Heat	23.05%	59
Earthquake	8.20%	21
Erosion	3.91%	10
Flooding	23.83%	61
Hurricane/Tropical Storm	70.31%	180
Landslide	0.78%	2
Severe Thunderstorm	45.31%	116
Severe Winter Storm	63.67%	163
Sinkhole	1.17%	3
Tornado	17.97%	46
Wildfire	2.73%	7
Other (please specify)	6.25%	16
Total Respondents: 256		

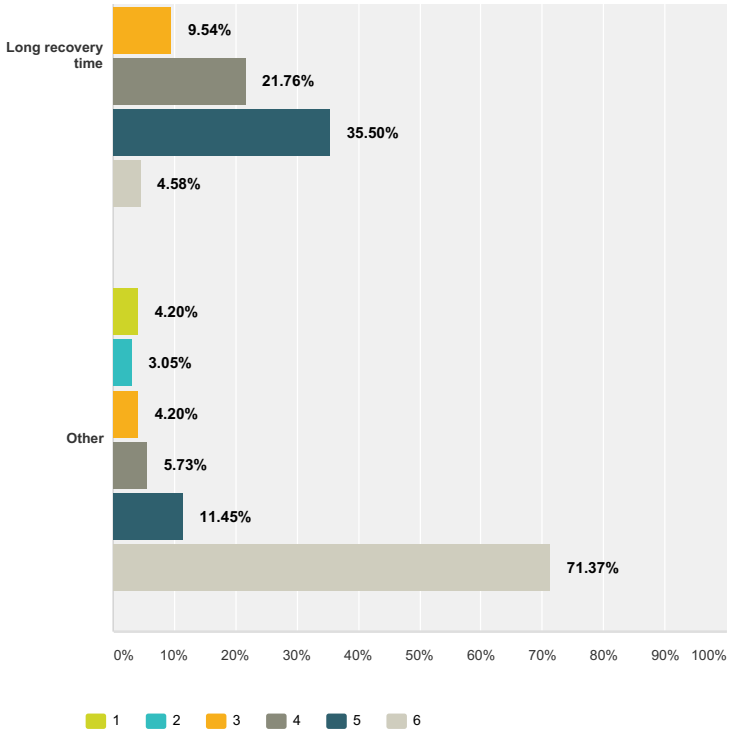
#	Other (please specify)	Date
1	Volcano	12/22/2014 9:55 PM
2	Nearly had stroke due to heat, BAD AIR,and hard work to clean up!!	11/21/2014 4:17 PM
3	Hail Storm	11/21/2014 12:38 PM
4	Ice storm	11/20/2014 5:24 PM
5	Lightning Srike resulting in fire	11/20/2014 11:22 AM

6	Social Unrest following an event (natural or man-caused)	11/20/2014 10:19 AM
7	Ice storm	11/19/2014 9:09 PM
8	basement flooding with a huge storm	11/19/2014 7:44 PM
9	Ice	11/19/2014 12:54 PM
10	war	11/19/2014 12:45 PM
11	911 Terrorist Attacks	11/19/2014 12:12 PM
12	Freezing ice	11/18/2014 10:54 AM
13	Major Natural gas line Problem	11/17/2014 6:27 PM
14	Ice storm	11/5/2014 11:00 PM
15	Severe Ice Storm (no snow)	11/5/2014 6:23 PM
16	Hail and wind damage	11/5/2014 1:28 PM

Q3 What was the most difficult part for you in recovering from past disasters that you have experienced? (1 being most difficult and 6 being least difficult.)

Answered: 263 Skipped: 84

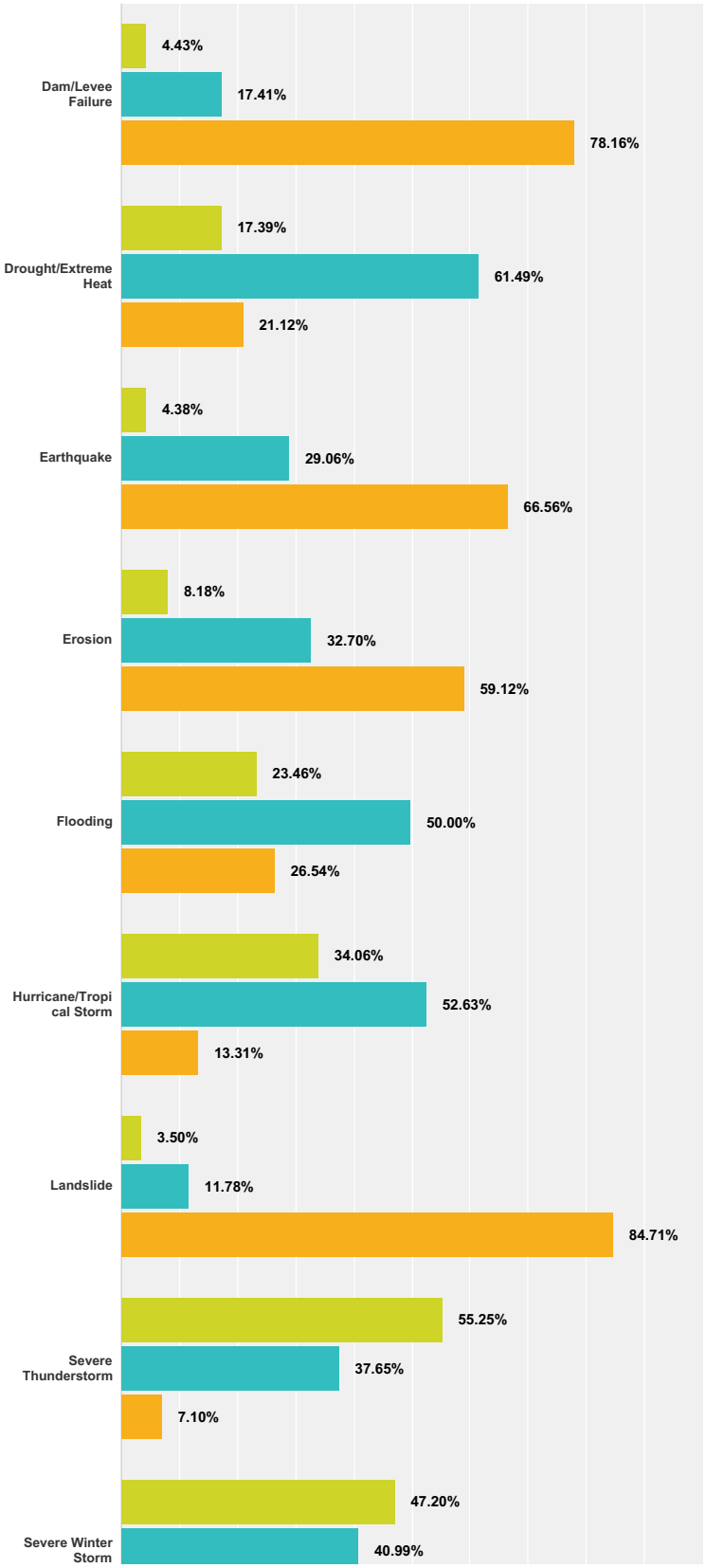


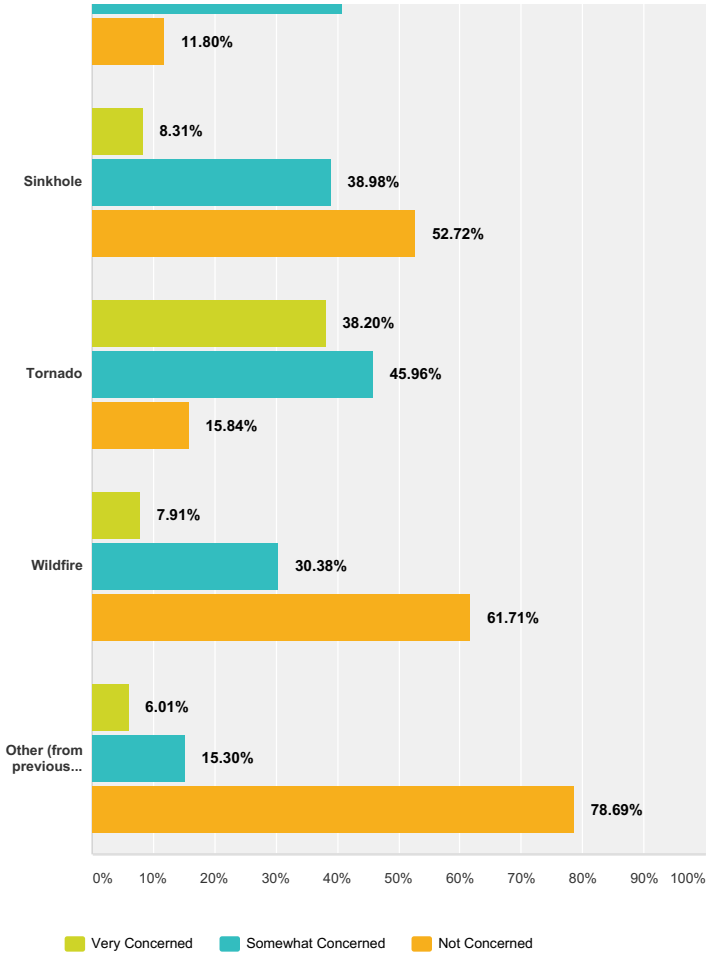


	1	2	3	4	5	6	Total	Score
Financial	**20.23%** 53	**23.66%** 62	**24.05%** 63	**15.27%** 40	**9.54%** 25	**7.25%** 19	262	4.08
Emotional	**19.85%** 52	**21.76%** 57	**20.99%** 55	**14.50%** 38	**14.89%** 39	**8.02%** 21	262	3.93
Direct damage to property	**32.32%** 85	**29.28%** 77	**19.01%** 50	**10.27%** 27	**7.22%** 19	**1.90%** 5	263	4.63
Loss of possessions	**4.58%** 12	**12.98%** 34	**22.14%** 58	**32.44%** 85	**21.37%** 56	**6.49%** 17	262	3.27
Long recovery time	**19.08%** 50	**9.54%** 25	**9.54%** 25	**21.76%** 57	**35.50%** 93	**4.58%** 12	262	3.41
Other	**4.20%** 11	**3.05%** 8	**4.20%** 11	**5.73%** 15	**11.45%** 30	**71.37%** 187	262	1.69

Q4 How concerned are you about the possibility of your community being impacted by each of these natural hazards? (Check the corresponding circle for each natural hazard.)

Answered: 334 Skipped: 13

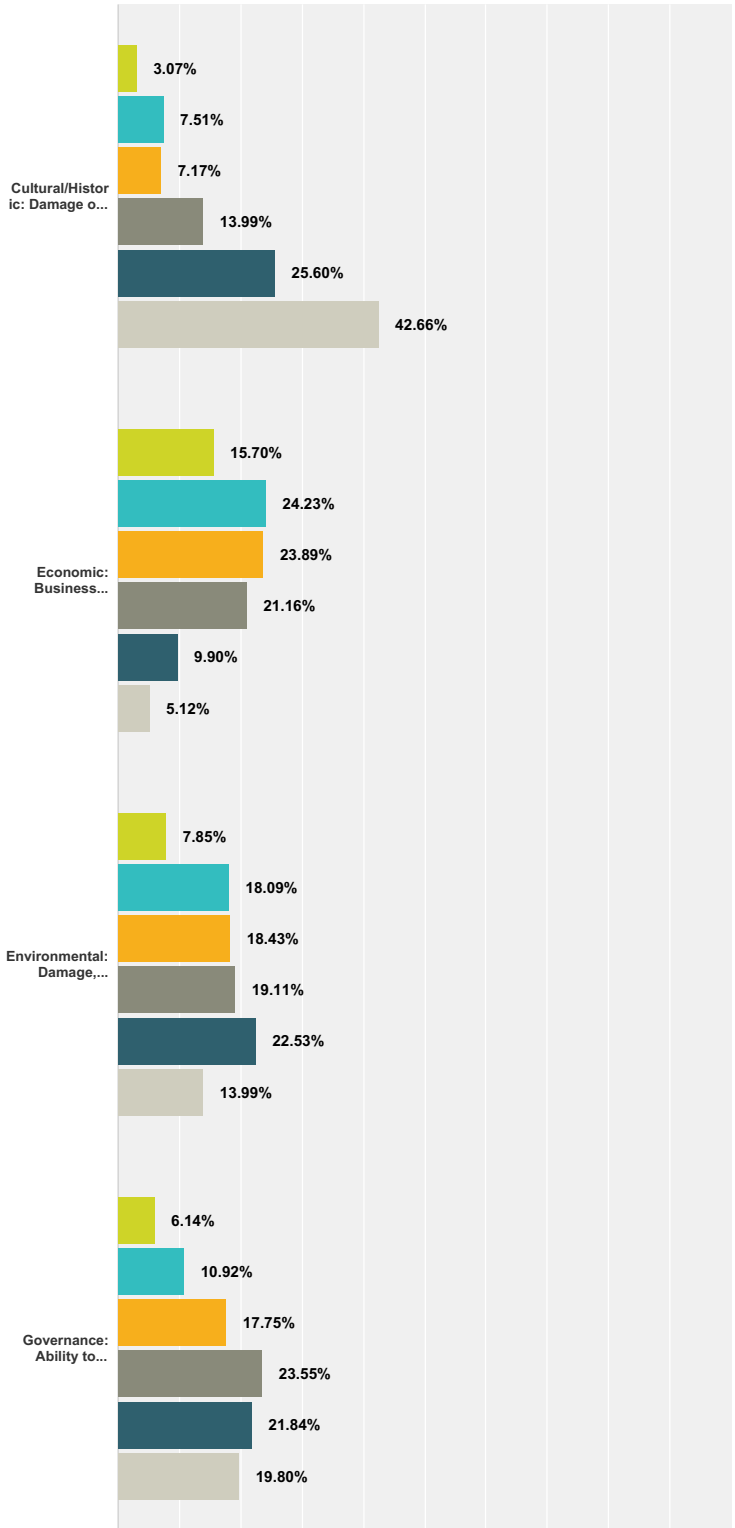


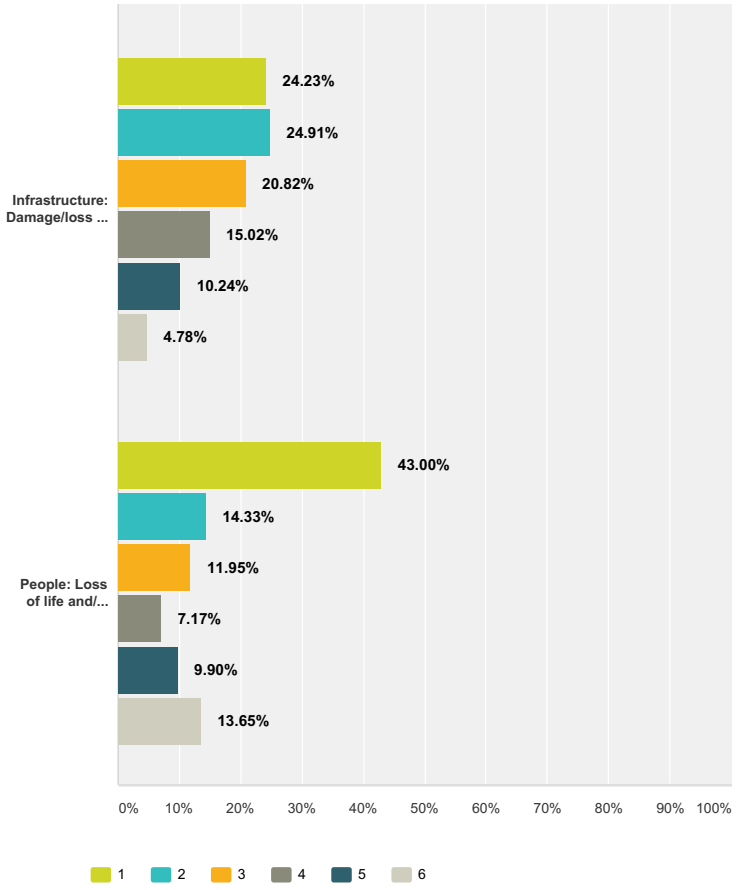


	Very Concerned	Somewhat Concerned	Not Concerned	Total
Dam/Levee Failure	**4.43%** 14	**17.41%** 55	**78.16%** 247	316
Drought/Extreme Heat	**17.39%** 56	**61.49%** 198	**21.12%** 68	322
Earthquake	**4.38%** 14	**29.06%** 93	**66.56%** 213	320
Erosion	**8.18%** 26	**32.70%** 104	**59.12%** 188	318
Flooding	**23.46%** 76	**50.00%** 162	**26.54%** 86	324
Hurricane/Tropical Storm	**34.06%** 110	**52.63%** 170	**13.31%** 43	323
Landslide	**3.50%** 11	**11.78%** 37	**84.71%** 266	314
Severe Thunderstorm	**55.25%** 179	**37.65%** 122	**7.10%** 23	324
Severe Winter Storm	**47.20%** 152	**40.99%** 132	**11.80%** 38	322
Sinkhole	**8.31%** 26	**38.98%** 122	**52.72%** 165	313
Tornado	**38.20%** 123	**45.96%** 148	**15.84%** 51	322
Wildfire	**7.91%** 25	**30.38%** 96	**61.71%** 195	316
Other (from previous question)	**6.01%** 11	**15.30%** 28	**78.69%** 144	183

Q5 In your opinion, which of the following categories are most susceptible to natural hazards in your community? (Rank the community assets in order of vulnerability, 1 being most vulnerable and 6 being least vulnerable.) Please note, the list will automatically re-order itself as you make your selections. You can also drag and drop the items on the list to reorder them.

Answered: 293 Skipped: 54

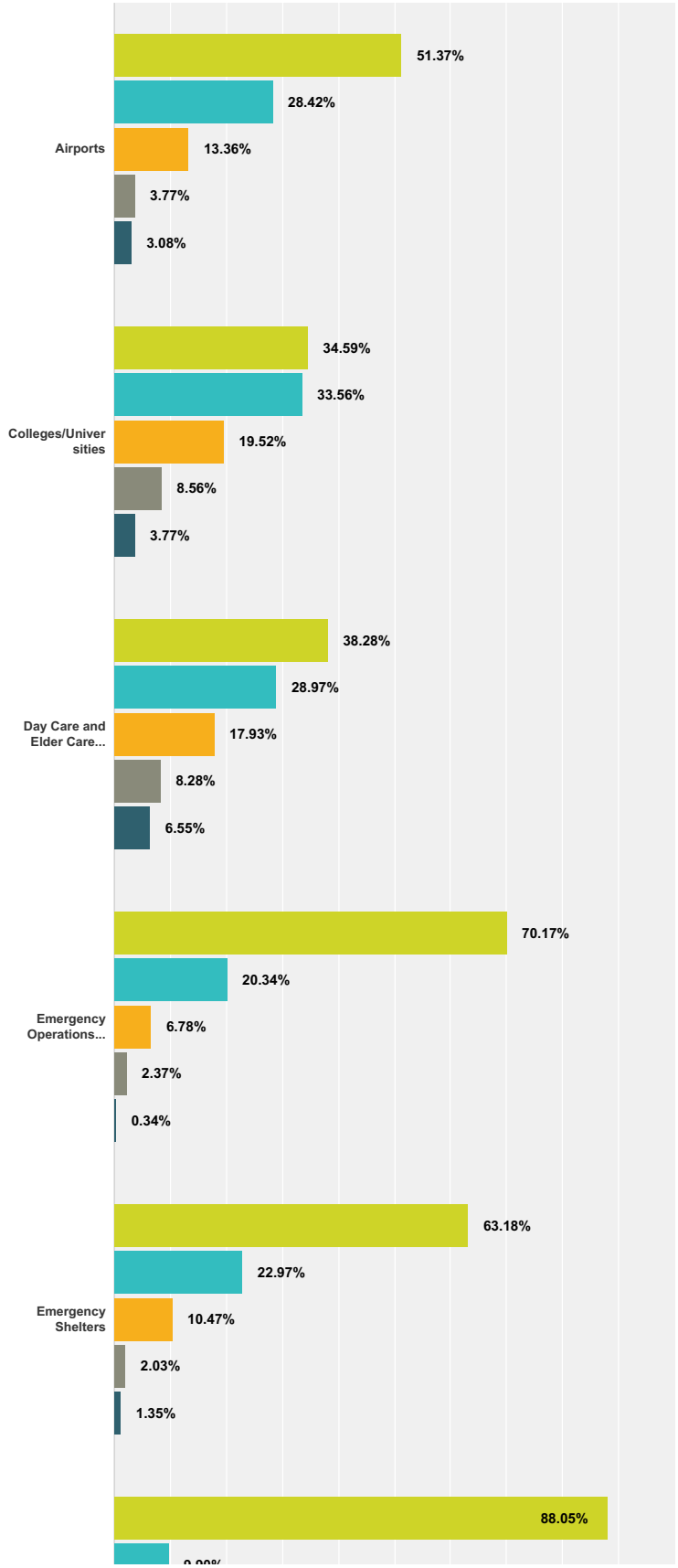


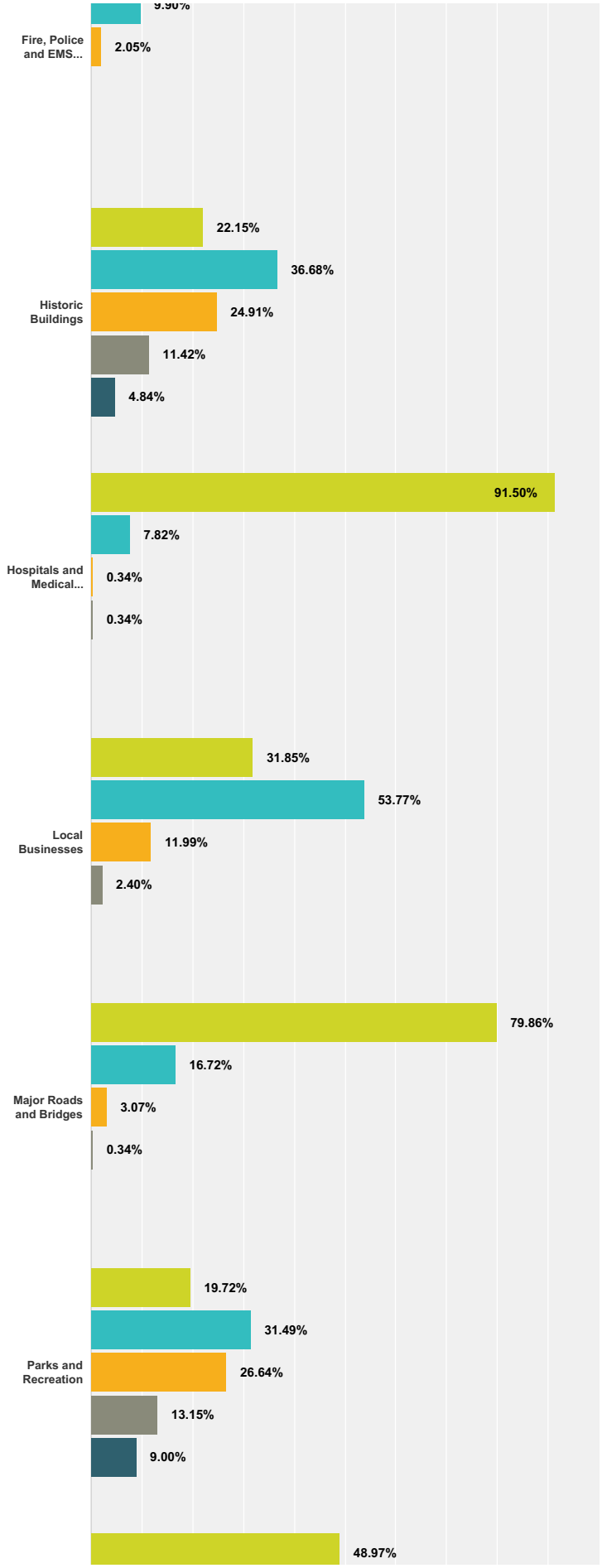


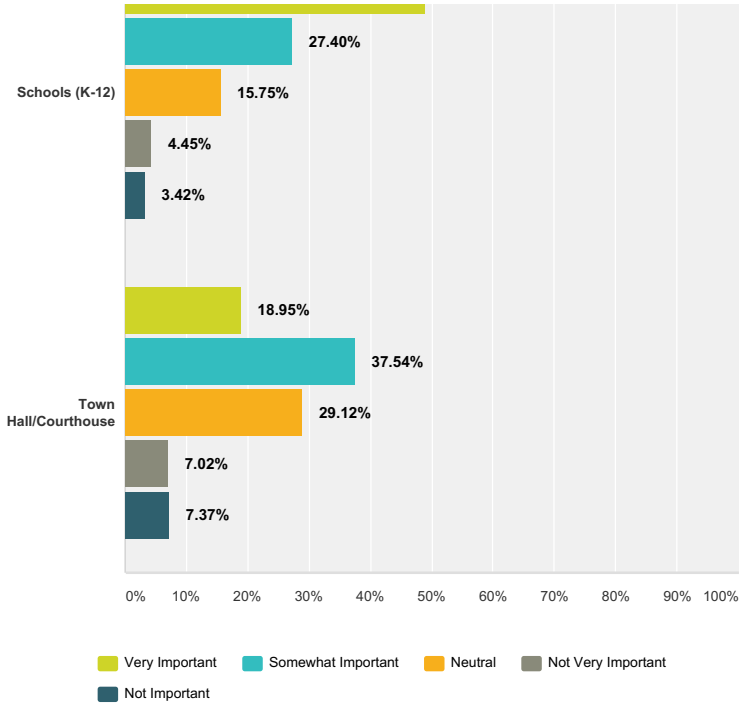
	1	2	3	4	5	6	Total	Score
Cultural/Historic: Damage or loss of libraries, museums, historic properties, etc.	**3.07%** 9	**7.51%** 22	**7.17%** 21	**13.99%** 41	**25.60%** 75	**42.66%** 125	293	2.20
Economic: Business interruptions/closures, job losses, etc.	**15.70%** 46	**24.23%** 71	**23.89%** 70	**21.16%** 62	**9.90%** 29	**5.12%** 15	293	3.99
Environmental: Damage, contamination or loss of forests, wetlands, waterways, etc.	**7.85%** 23	**18.09%** 53	**18.43%** 54	**19.11%** 56	**22.53%** 66	**13.99%** 41	293	3.28
Governance: Ability to maintain order and/or provide public amenities and services	**6.14%** 18	**10.92%** 32	**17.75%** 52	**23.55%** 69	**21.84%** 64	**19.80%** 58	293	2.97
Infrastructure: Damage/loss of roads, bridges, utilities, schools, etc.	**24.23%** 71	**24.91%** 73	**20.82%** 61	**15.02%** 44	**10.24%** 30	**4.78%** 14	293	4.24
People: Loss of life and/or injuries	**43.00%** 126	**14.33%** 42	**11.95%** 35	**7.17%** 21	**9.90%** 29	**13.65%** 40	293	4.32

Q6 How important is each of the following specific community assets to you? (Check the appropriate circle for each asset.)

Answered: 298 Skipped: 49




9.90%
Fire, Police and EMS...
2.05%
22.15%
36.68%
Historic Buildings
24.91%
11.42%
4.84%
91.50%
7.82%
Hospitals and Medical...
0.34%
0.34%
31.85%
53.77%
Local Businesses
11.99%
2.40%
79.86%
16.72%
Major Roads and Bridges
3.07%
0.34%
19.72%
31.49%
Parks and Recreation
26.64%
13.15%
9.00%
48.97%



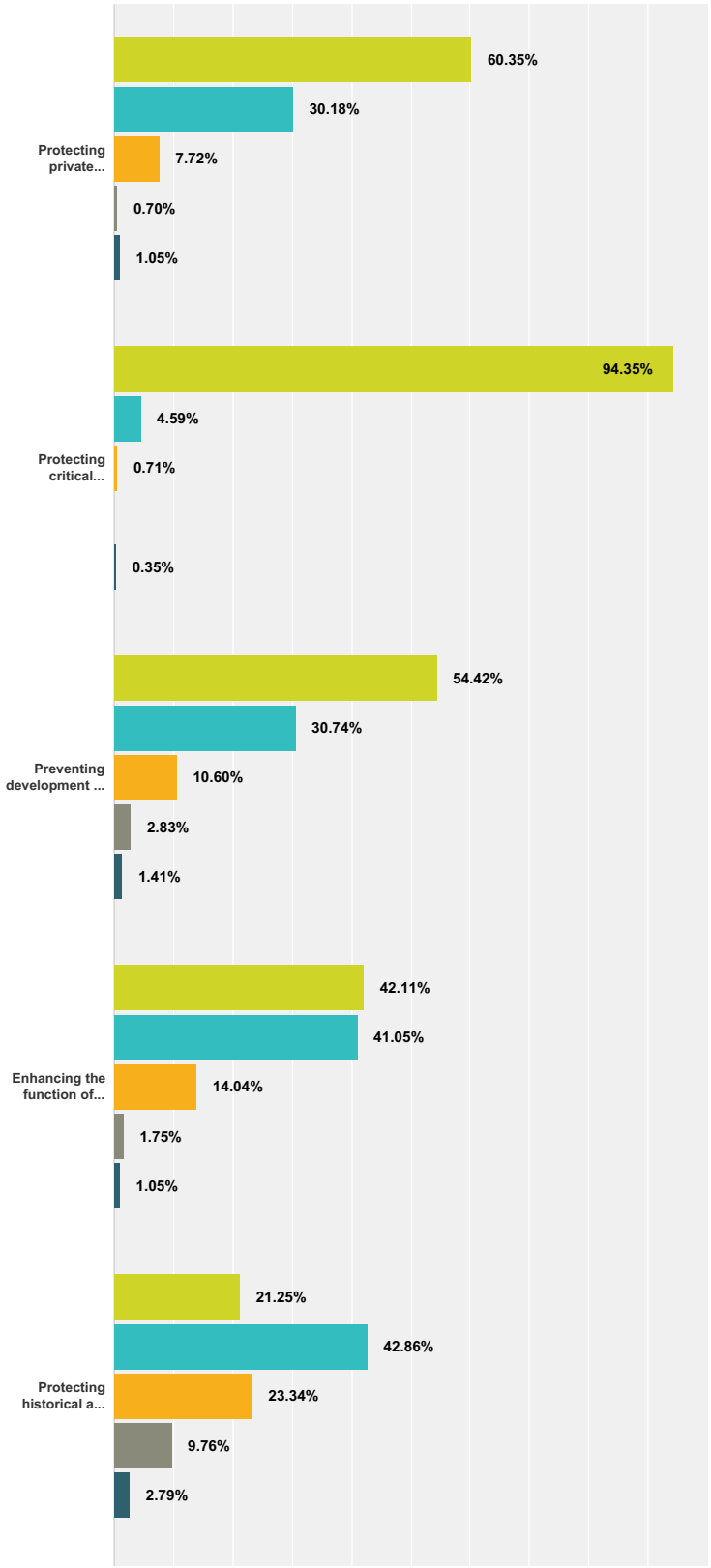
	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important	Total
Airports	**51.37%** 150	**28.42%** 83	**13.36%** 39	**3.77%** 11	**3.08%** 9	292
Colleges/Universities	**34.59%** 101	**33.56%** 98	**19.52%** 57	**8.56%** 25	**3.77%** 11	292
Day Care and Elder Care Facilities	**38.28%** 111	**28.97%** 84	**17.93%** 52	**8.28%** 24	**6.55%** 19	290
Emergency Operations Centers	**70.17%** 207	**20.34%** 60	**6.78%** 20	**2.37%** 7	**0.34%** 1	295
Emergency Shelters	**63.18%** 187	**22.97%** 68	**10.47%** 31	**2.03%** 6	**1.35%** 4	296
Fire, Police and EMS Stations	**88.05%** 258	**9.90%** 29	**2.05%** 6	**0.00%** 0	**0.00%** 0	293
Historic Buildings	**22.15%** 64	**36.68%** 106	**24.91%** 72	**11.42%** 33	**4.84%** 14	289
Hospitals and Medical Facilities	**91.50%** 269	**7.82%** 23	**0.34%** 1	**0.34%** 1	**0.00%** 0	294
Local Businesses	**31.85%** 93	**53.77%** 157	**11.99%** 35	**2.40%** 7	**0.00%** 0	292
Major Roads and Bridges	**79.86%** 234	**16.72%** 49	**3.07%** 9	**0.34%** 1	**0.00%** 0	293
Parks and Recreation	**19.72%** 57	**31.49%** 91	**26.64%** 77	**13.15%** 38	**9.00%** 26	289
Schools (K-12)	**48.97%** 143	**27.40%** 80	**15.75%** 46	**4.45%** 13	**3.42%** 10	292
Town Hall/Courthouse	**18.95%** 54	**37.54%** 107	**29.12%** 83	**7.02%** 20	**7.37%** 21	285

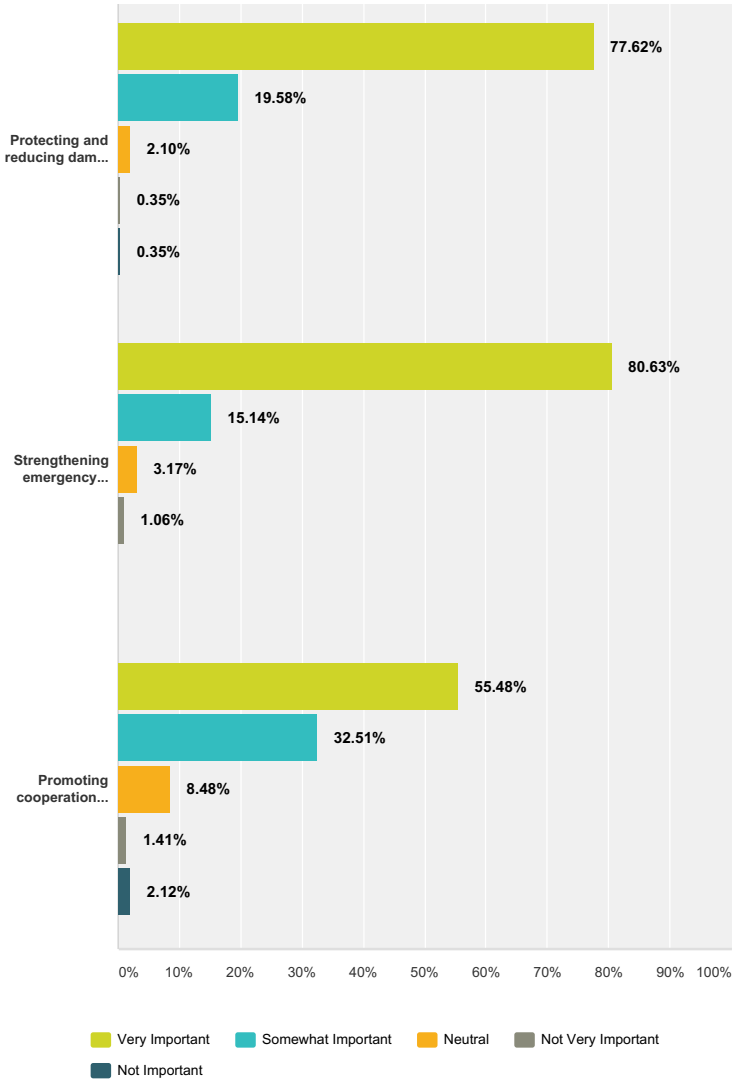
#	Other (please specify)	Date
1	water	1/4/2015 12:02 PM
2	Churches-Very Important	12/22/2014 9:59 PM
3	Businesses that sell food, water, medication, ice, 1 aid needs, gas(both for car and heating) and propane.	12/10/2014 5:24 PM
4	I don't understand this question	12/3/2014 9:36 AM
5	Private property/taxpayers---very important	12/1/2014 3:19 AM
6	Churches are vitally important to me and to community!	11/21/2014 4:21 PM
7	electric grid - the most important	11/21/2014 2:10 PM
8	Media and news outlets (i.e. radio, tv, text messaging)	11/20/2014 5:26 PM
9	Electical Grid (I see this as a community asset)	11/20/2014 1:27 PM

10	Media and communications	11/19/2014 9:13 PM
11	Ability to maintain order in the face of power outages or long term economic collapse	11/19/2014 12:14 PM
12	Libraries	11/18/2014 10:56 AM
13	TV, Radio Emer. Broadcast Systems	11/18/2014 10:07 AM
14	Downtown Community Areas	11/17/2014 4:44 PM
15	Animal Control Facilities	11/6/2014 5:54 PM
16	residences; damage multiplied by construction, dvlopmnt	11/5/2014 3:42 PM
17	Churches	11/5/2014 2:23 PM

Q7 Natural hazards can have a significant impact on a community, but planning for these types of events can help lessen the impacts. Please tell us how important each statement is to you by checking the appropriate circle for each.

Answered: 287 Skipped: 60

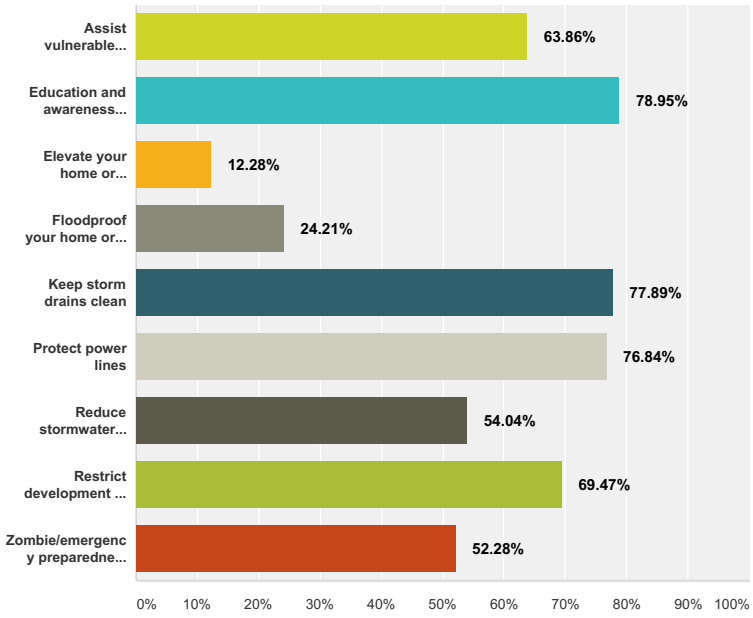




	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important	Total
Protecting private property	**60.35%** 172	**30.18%** 86	**7.72%** 22	**0.70%** 2	**1.05%** 3	285
Protecting critical facilities (for example, hospitals, police stations, fire stations, etc.)	**94.35%** 267	**4.59%** 13	**0.71%** 2	**0.00%** 0	**0.35%** 1	283
Preventing development in hazard areas	**54.42%** 154	**30.74%** 87	**10.60%** 30	**2.83%** 8	**1.41%** 4	283
Enhancing the function of natural features (for example, streams, wetlands, etc.)	**42.11%** 120	**41.05%** 117	**14.04%** 40	**1.75%** 5	**1.05%** 3	285
Protecting historical and cultural landmarks	**21.25%** 61	**42.86%** 123	**23.34%** 67	**9.76%** 28	**2.79%** 8	287
Protecting and reducing damage to utilities	**77.62%** 222	**19.58%** 56	**2.10%** 6	**0.35%** 1	**0.35%** 1	286
Strengthening emergency services (for example, police, fire, ambulance)	**80.63%** 229	**15.14%** 43	**3.17%** 9	**1.06%** 3	**0.00%** 0	284
Promoting cooperation among public agencies, citizens, non-profit organizations, and businesses	**55.48%** 157	**32.51%** 92	**8.48%** 24	**1.41%** 4	**2.12%** 6	283

Q8 What are some steps that you and/or your local government could take to reduce or eliminate the risk of future natural hazard damages in your neighborhood?

Answered: 285 Skipped: 62



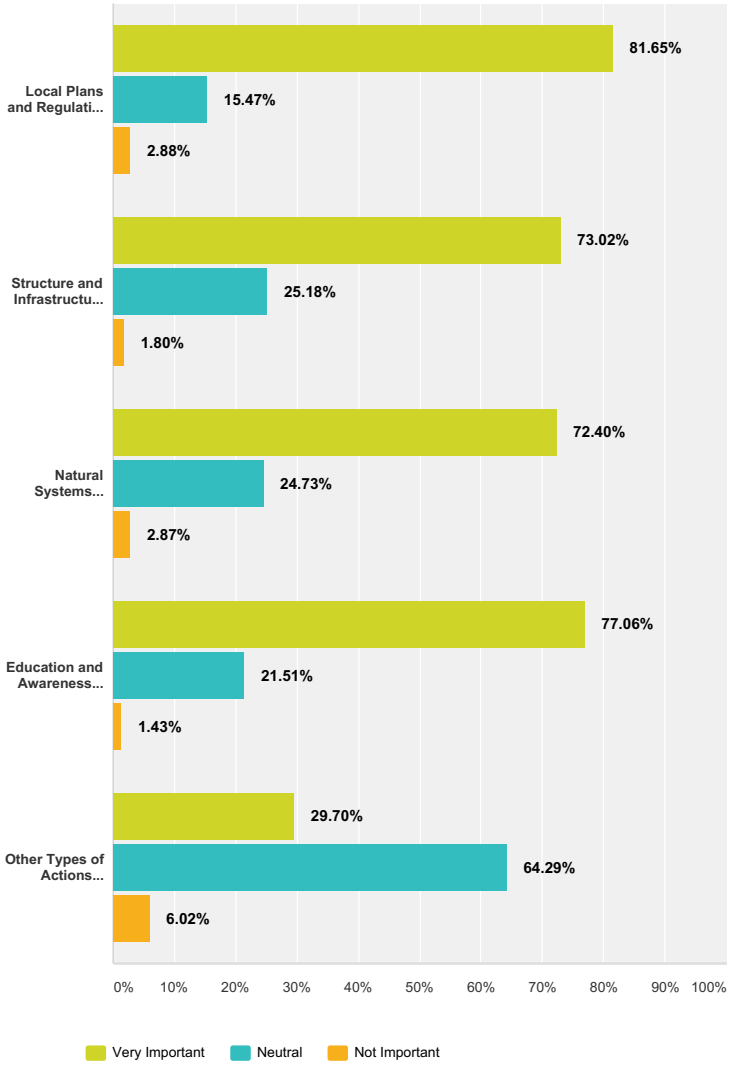
Answer Choices	Responses	
Assist vulnerable populations	63.86%	182
Education and awareness activities	78.95%	225
Elevate your home or business	12.28%	35
Floodproof your home or business	24.21%	69
Keep storm drains clean	77.89%	222
Protect power lines	76.84%	219
Reduce stormwater runoff	54.04%	154
Restrict development in floodplain areas	69.47%	198
Zombie/emergency preparedness kits	52.28%	149
Total Respondents: 285		

#	Other (please specify)	Date
1	Create a neighborhood and community mutual support plan.	12/22/2014 10:01 PM
2	Zombie kits? Reeeeally?	12/22/2014 2:53 PM
3	The awareness and education step needs to include providing evacuation routes for all Char-meck neighborhoods. This information may help avoid citizens attempting to leave their neighborhoods for safety, but wind up being trapped, without resources,in traffic bottlenecks.	12/11/2014 12:25 PM
4	What about vampires?	12/11/2014 10:10 AM
5	Designating emergency routes. Communication and coordination between government agencies.	12/11/2014 9:20 AM
6	I believe the greatest threat is the US Gov. causing an event to take control of our liberty and succession of life. Someone with knowledge and leadership needs to strengthen our electric power grid so when a nuclear EMP is set off above our airspace we will not be affected. The American people is not prepared for such an event. God Bless us.	12/10/2014 8:26 PM
7	Place power lines underground and most important provide a more comprehensive planned trimming of trees close to power lines ie the tree services DON'T CARE about the trees and damage to property...	12/8/2014 3:56 PM
8	This is also a poorly written question	12/3/2014 9:39 AM
9	Better storm drains, curbs/gutters, police and fine for yard waste going into storm water drains, bury powerlines	12/1/2014 3:22 AM
10	Education geared on resident self sufficiency for 7 days	11/24/2014 10:27 PM

11	:) I love The Walking Dead... and it does make me think about how a community and people (individually and collectively) respond to emergency situations.	11/24/2014 1:45 PM
12	Work harder for the environment. Safeguard us from climate change, use more solar and wind power. Keep planting trees to improve air quality and shade especially in poorer areas. Restore services to East side and other under-funded areas to lessen need to travel to shop. Less emphasis on sports! Reduce all kinds of polution! (Thanks for work you do on carpooling and buses.) More bus stop shelters and closer to apartment buildings. None of my bus stops have a roof for shade or shelter.	11/21/2014 4:33 PM
13	Improve water run off control, with large concrete or stone drainage systems, they would direct the water and not allow erosion.	11/21/2014 7:45 AM
14	Retrofit surge protectors on all EHV transformers to prevent those transformers from being burned out by electrical surges during a solar flare / EMP event such as the Carrington Event in 1859, which is overdue for a recurrence.	11/20/2014 6:17 PM
15	Emergency Preparedness check lists. Emergency drills.	11/20/2014 1:30 PM
16	Education is key. Preparedness kits can reduce impact significantly. Year round information for hazards like flooding which can come from melting winter snow as well as summer rains.	11/20/2014 1:09 PM
17	Simple educational and informational meetings/classes would go a long way. Advertisement similar to ready.gov on local stations would be best. A informed public is a prepared public.	11/20/2014 10:45 AM
18	From the previous flash flood I experienced, we were trapped outside the city due to traffic and rapidly rising flood waters and there was no emergency alert, no radio updates, no police intervention (until later) and cars getting trapped. The traffic became extremely backed up on the highway where we spent over an hour in traffic as a river of flood water grew higher and higher beside the trapped cars. After calling 911 and being on hold for a long time, we were eventually rescued from the car by the fire department, we walked through knee deep up to almost waist deep water, navigating past curbs, tipped mailboxes and other debri to get home. Similarly, Charlotte has several traffic bottlenecks, and if one of these routes were to become blocked, travel home or an to alternate safe place would become difficult and dangerous. I think the focus needs to be on alerting the public about unsafe routes/areas, closing dangerous roadways and having a plan in case the city or an area of the city needs to be evacuated for any reason.	11/20/2014 8:02 AM
19	Information and resources.	11/19/2014 5:37 PM
20	I would think our local government would be more creditable than to talk about zombies....get real	11/19/2014 2:15 PM
21	bury power lines in ares with lots of trees	11/19/2014 12:17 PM
22	Make it socially acceptable for each famiy to prepare for disaster - it still is not something that is talked about openly (people think you are nuts) but each family should be able to survive on their own for at least a month if not longer with no power and no outside help.	11/19/2014 12:17 PM
23	No entity can predict future seismic events, so preparations are futile or ill-conceived and wasteful. Tornado-proofing existing homes is prohibitively expensive, but building code changes and mandated provisions will protect future generations.You seldom hear of natural gas system interruptions but ALWAYS hear about electric system disruptions, so REQUIRE all electric distribution to be rebuilt subsurface. Ditto for data-carrying (TV,internet, phone) infrastructure. There is too much aerial fiber being hung on existing lines that are subject to weather and accidents.	11/19/2014 11:50 AM
24	Consider burrying powerlines to make them less succeptible to storms	11/19/2014 11:37 AM
25	Only need emeregency kits, not worried about Zombie..	11/19/2014 11:37 AM
26	Bridges only for housing, co housing, and elevate your home or business while being transparent with the sun's energy.	11/18/2014 11:01 AM
27	Be aware of what's going on in your neighborhood and on your street. Know your neighbors.	11/18/2014 10:12 AM
28	Zombies? Really?	11/17/2014 3:01 PM
29	I checked the last one, just because the CDC has an actual plan for Zombies.	11/13/2014 10:11 AM
30	Designated pet friendly storm shelters.	11/6/2014 5:58 PM
31	floods aren't an issue in my immediate area	11/5/2014 11:25 PM
32	Minimize low income housing in the area. Educate people	11/5/2014 5:31 PM
33	see, now with the jarring placement of the so-old reference to zombies, you've convinced me this survey is a joke and another apparent local government indication of disdain. lame. done with survey	11/5/2014 3:48 PM
34	Getting amateur radio clubs involved in the process. These amateurs, sometimes called "hams" are unpaid volunteers who operate at a professional level reporting as extreme weather spotters whether regardless of the season. There are two amateur (ham) radio clubs in Charlotte, of which the Charlotte Fire Department Communications Center is aware. The hams were involved with the DNC as part of the response and communications process.	11/5/2014 3:43 PM
35	Integrate the militia into disaster preparedness plans.	11/5/2014 2:25 PM
36	Zombie????	11/5/2014 1:33 PM

Q9 A number of community-wide activities can reduce risk from natural hazards. Please tell us how important you think each one is for your community to consider pursuing.

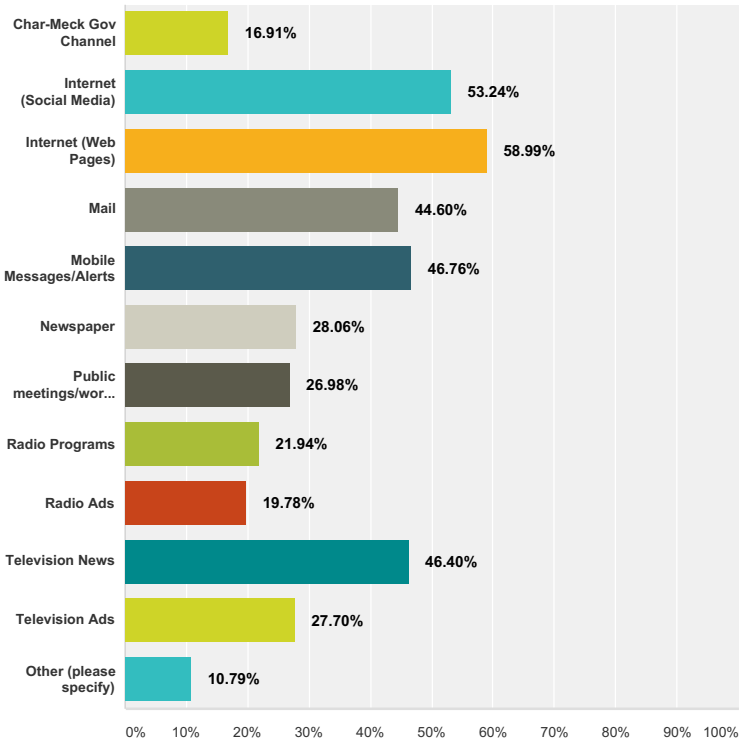
Answered: 281 Skipped: 66



	Very Important	Neutral	Not Important	Total
Local Plans and Regulations (Government policies or codes that influence the way land and buildings are developed and built.)	**81.65%** 227	**15.47%** 43	**2.88%** 8	278
Structure and Infrastructure Projects (Modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area.)	**73.02%** 203	**25.18%** 70	**1.80%** 5	278
Natural Systems Protection (Actions that minimize damage and losses and also preserve or restore the functions of natural systems.)	**72.40%** 202	**24.73%** 69	**2.87%** 8	279
Education and Awareness Programs (Actions that inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them.)	**77.06%** 215	**21.51%** 60	**1.43%** 4	279
Other Types of Actions (Actions that are related to mitigation in ways that make sense to the local government that do not fall into one of the categories above.)	**29.70%** 79	**64.29%** 171	**6.02%** 16	266

Q10 What are the most effective ways for you to receive information about how to make your home and neighborhood more resistant to natural hazards?

Answered: 278 Skipped: 69



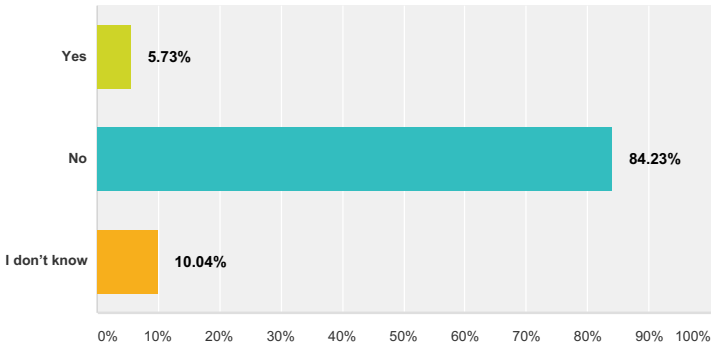
Answer Choices	Responses	
Char-Meck Gov Channel	16.91%	47
Internet (Social Media)	53.24%	148
Internet (Web Pages)	58.99%	164
Mail	44.60%	124
Mobile Messages/Alerts	46.76%	130
Newspaper	28.06%	78
Public meetings/workshops	26.98%	75
Radio Programs	21.94%	61
Radio Ads	19.78%	55
Television News	46.40%	129
Television Ads	27.70%	77
Other (please specify)	10.79%	30
Total Respondents: 278		

#	Other (please specify)	Date
1	small 1-sheet flyers in utlity bills	1/4/2015 12:14 PM
2	Email	12/11/2014 12:31 PM
3	WFAE	12/10/2014 11:07 PM
4	text message	12/10/2014 10:43 PM
5	Landline notifications for impending natural disasters	12/1/2014 3:23 AM
6	Email	11/24/2014 1:48 PM
7	email	11/21/2014 4:36 PM

8	neighboorhood meetings	11/21/2014 12:41 PM
9	e Mail	11/20/2014 6:19 PM
10	County Courses (Master Composter, Master Naturalist.	11/20/2014 1:33 PM
11	Email	11/19/2014 7:38 PM
12	email message	11/19/2014 5:39 PM
13	Business outreach programs	11/19/2014 11:39 AM
14	emails	11/18/2014 1:05 PM
15	Task force on foot with all the badges and information.	11/18/2014 11:04 AM
16	neighborhood meetings	11/18/2014 10:17 AM
17	email	11/17/2014 7:46 PM
18	How can information make a neighborhood more resistant to natural hazards ?	11/17/2014 6:34 PM
19	cable tv channel for govt issues not available with all cable pay tv resources	11/17/2014 12:53 PM
20	email blasts	11/12/2014 10:41 PM
21	web-based community news sites (DavidsonNews.net, CorneliusNews.net)	11/10/2014 3:05 PM
22	email	11/9/2014 3:49 PM
23	Nextdoor.com	11/7/2014 8:38 PM
24	EMS buddies, friends, neighbors (word of mouth)	11/6/2014 6:04 PM
25	NPR RADIO	11/6/2014 5:11 PM
26	University City (newspaper)	11/5/2014 11:02 PM
27	Neighbor.com	11/5/2014 4:23 PM
28	Ham radio operators have their own communications networks and practice daily locally.	11/5/2014 3:45 PM
29	Nextdoor.com	11/5/2014 2:59 PM
30	char meck govt channel is not available on all cable resources	11/5/2014 12:05 PM

Q11 Is your home located in a floodplain?

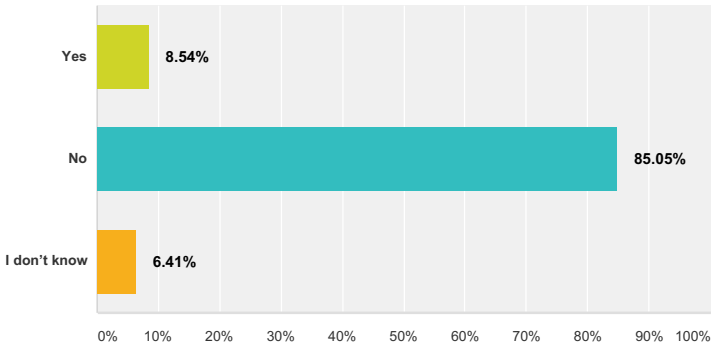
Answered: 279 Skipped: 68



Answer Choices	Responses	
Yes	5.73%	16
No	84.23%	235
I don't know	10.04%	28
Total		279

Q12 Do you have flood insurance?

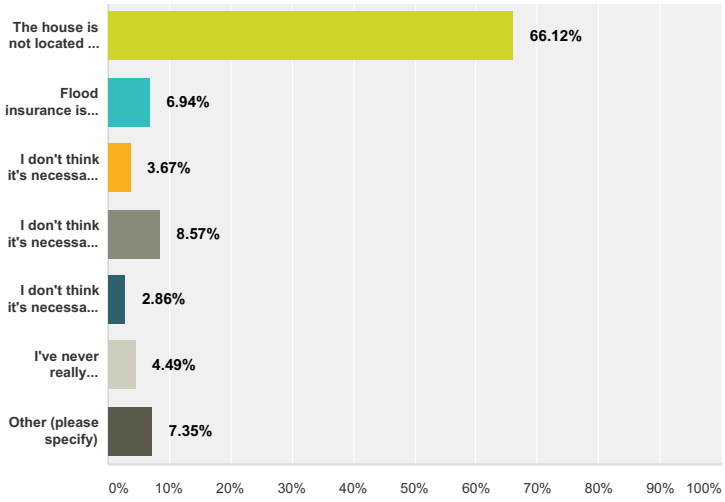
Answered: 281 Skipped: 66



Answer Choices	Responses	
Yes	8.54%	24
No	85.05%	239
I don't know	6.41%	18
Total		281

Q13 If “No,” why not?

Answered: 245 Skipped: 102

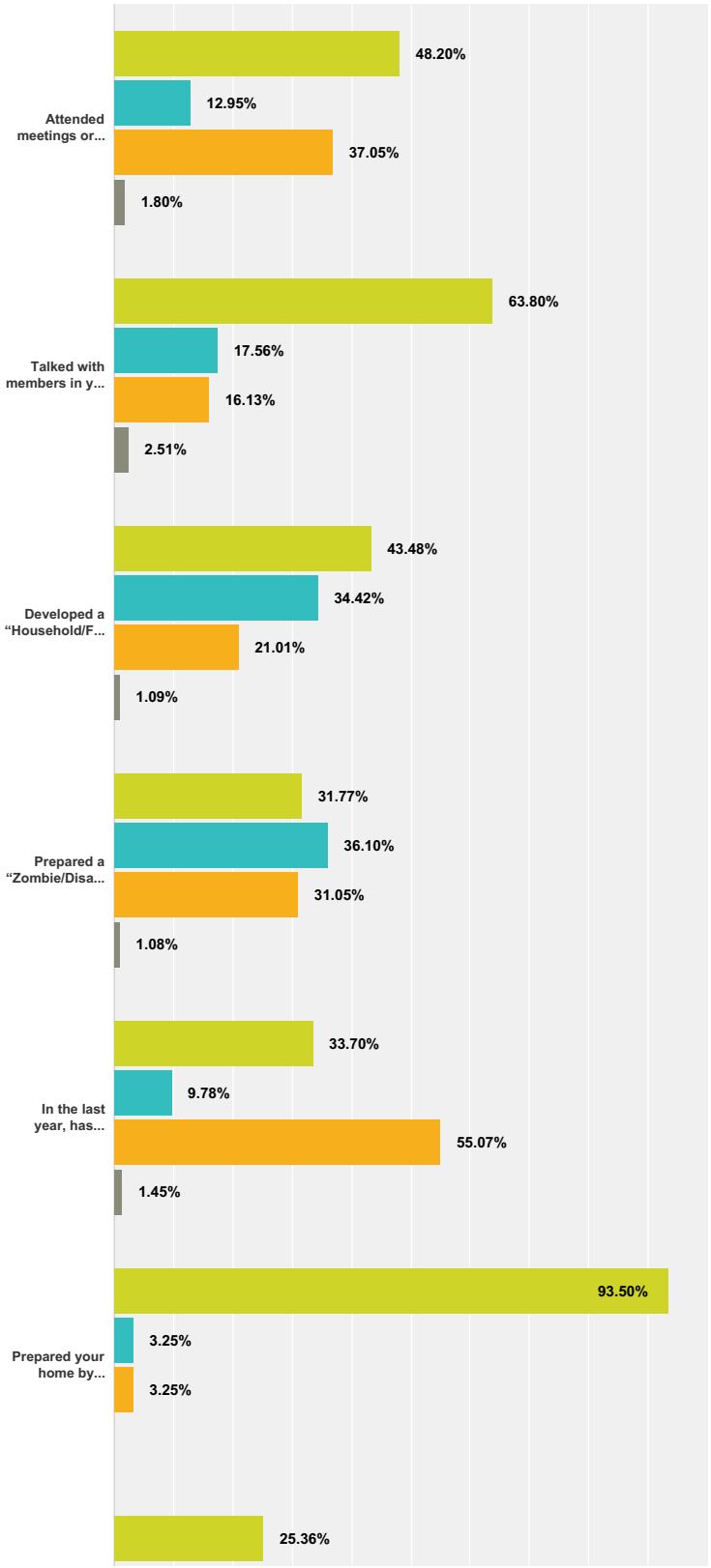


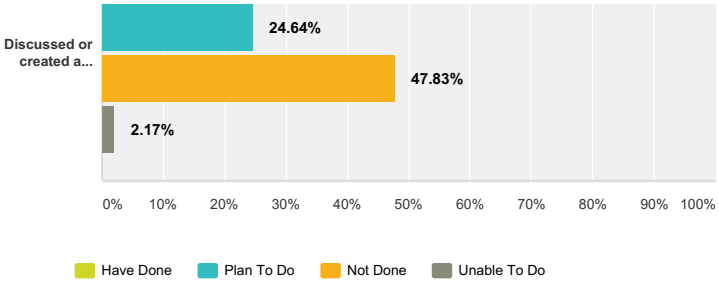
Answer Choices	Responses	
The house is not located in a floodplain	**66.12%**	162
Flood insurance is too expensive	**6.94%**	17
I don't think it's necessary because it never floods	**3.67%**	9
I don't think it's necessary because I'm elevated or otherwise protected	**8.57%**	21
I don't think it's necessary because I have homeowners insurance	**2.86%**	7
I've never really considered it	**4.49%**	11
Other (please specify)	**7.35%**	18
Total		**245**

#	Other (please specify)	Date
1	I'm about 25 yrds from a flood plain in an apt., not a home owner so not as concerned.	12/22/2014 2:54 PM
2	home is lake front; not concidered flood plain	12/16/2014 5:49 PM
3	Renting an apartment not in a floodplain	11/24/2014 2:58 PM
4	Our present home has not flooded.	11/21/2014 4:36 PM
5	Some of the property is in a floodplain but this house is not.	11/20/2014 1:33 PM
6	As a renter, I don't have any insurance but should probably investigate if I could afford it.	11/20/2014 1:11 PM
7	We are renting; we have content insurance.	11/20/2014 8:04 AM
8	house is on top of a hill	11/19/2014 1:32 PM
9	Renting home, not own. Renters insurance covers damage to personal property, but not structure. If I owned, I would have it.	11/19/2014 1:15 PM
10	The ins co said it was too expensive, I'm not in a flood plan, and the bank was not interested in offering the extra ins either! So once again like health ins, people have to succumb to what something bigger than us thinks!!	11/19/2014 12:48 PM
11	Not in floodplain, home is somewhat elevated, might be impacted by Q200 storm or greater	11/19/2014 11:56 AM
12	I dont own a house.	11/18/2014 11:04 AM
13	We are located on the very edge of the floodplain (within 10 fee of last drawings). Spouse doesn't think we need it because we're not in it.	11/17/2014 4:48 PM
14	We do not live on a flood plain but most all the above are something to think about.	11/17/2014 4:34 PM
15	I am on the higher edge of the designated area.	11/6/2014 6:04 PM
16	When uying home not told but found out when the creek overflood	11/6/2014 10:29 AM
17	Getting a quote for flood insurance is a nightmare.	11/5/2014 5:03 PM
18	My husband refuses to buy flood insurance.	11/5/2014 2:09 PM

Q14 In the following list, please check the activities that you have done in your household, plan to do in the near future, have not done, or are unable to do. (Please check one response for each preparedness activity.)

Answered: 279 Skipped: 68



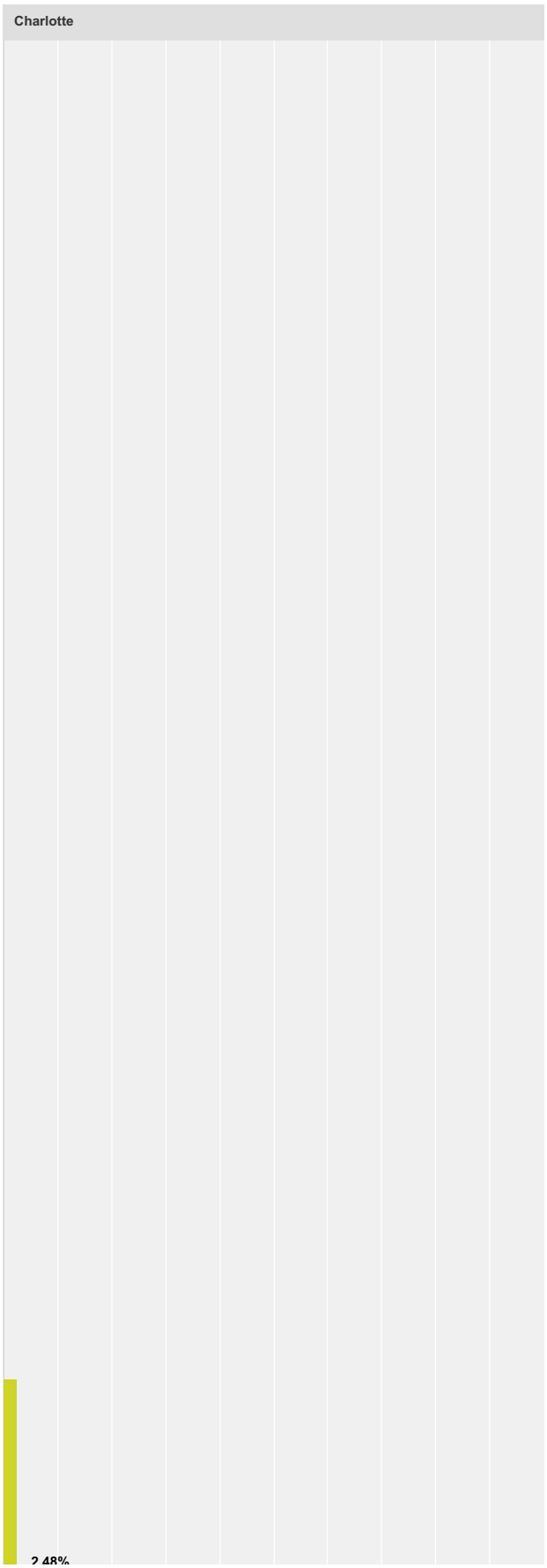


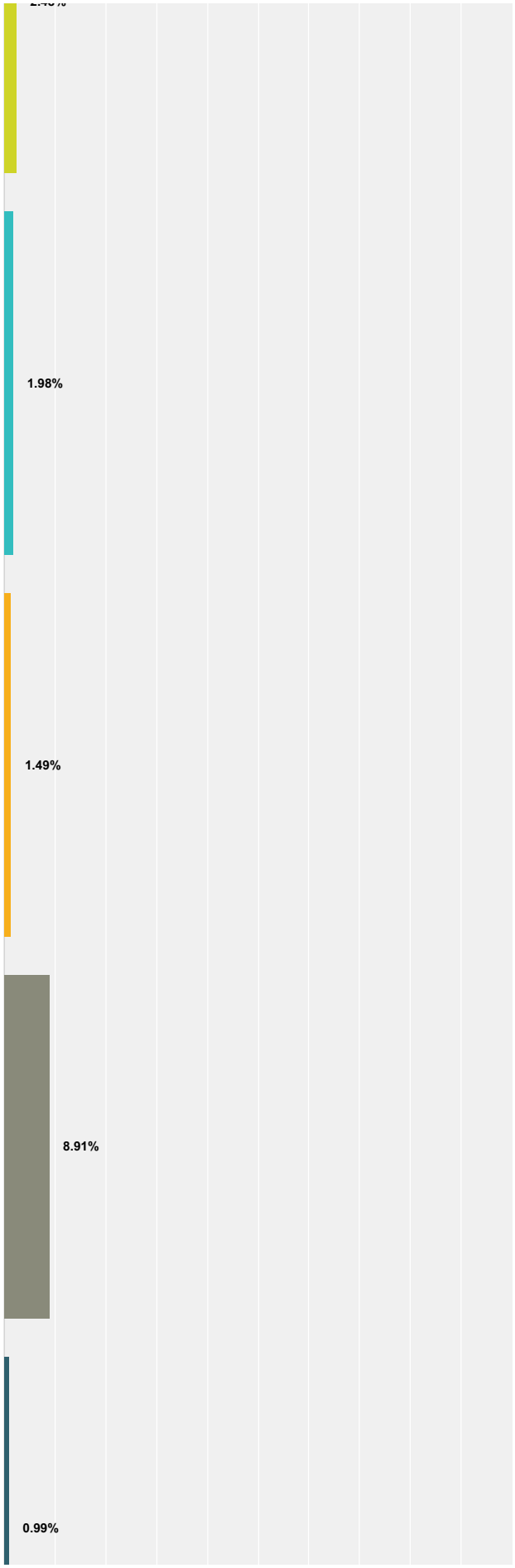
	Have Done	Plan To Do	Not Done	Unable To Do	Total
Attended meetings or received written information on natural disasters or emergency preparedness?	**48.20%** 134	**12.95%** 36	**37.05%** 103	**1.80%** 5	278
Talked with members in your household about what to do in case of a natural disaster or emergency?	**63.80%** 178	**17.56%** 49	**16.13%** 45	**2.51%** 7	279
Developed a “Household/Family Emergency Plan” in order to decide what everyone would do in the event of a disaster?	**43.48%** 120	**34.42%** 95	**21.01%** 58	**1.09%** 3	276
Prepared a “Zombie/Disaster Supply Kit” (stored extra food, water, batteries or other emergency supplies)?	**31.77%** 88	**36.10%** 100	**31.05%** 86	**1.08%** 3	277
In the last year, has anyone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR)?	**33.70%** 93	**9.78%** 27	**55.07%** 152	**1.45%** 4	276
Prepared your home by installing smoke detectors on each level of the house?	**93.50%** 259	**3.25%** 9	**3.25%** 9	**0.00%** 0	277
Discussed or created a utility shutoff procedure in the event of a natural disaster?	**25.36%** 70	**24.64%** 68	**47.83%** 132	**2.17%** 6	276

#	Other (please specify)	Date
1	Keep enough gas in the car to drive at least 2 hours. Non-battery radio and light kit. Watch weather forecasts. Share warnings of potential hazards with others.	12/11/2014 9:24 AM
2	Prepare to live like you are living in 1800.	12/10/2014 8:30 PM
3	Installed an electrical cutover panel to enable our house to switch to auxiliary power.	11/20/2014 6:20 PM
4	Had never considered utility shutoff - is this something general public can do on their own? If so, we need to be educated.	11/20/2014 1:12 PM
5	After being trapped by a flash flood, I had an evacuation plan in that area including several 'safe' evacuation locations (friend's houses in different areas). We are new to this area and have not yet developed a new plan.	11/20/2014 8:06 AM
6	Come on....	11/19/2014 2:19 PM
7	Have practiced an evacuation	11/19/2014 11:58 AM
8	After Hugo, we live differently than before. We do have batteries, extra food and NEVER let our gas tanks go below half full.	11/19/2014 11:40 AM
9	Create and install emergency routes away from danger into gps and radio controlled solar paths on streets or streetlights.	11/18/2014 11:08 AM
10	Crates and leashes for each of 6 pets, rabies tags and IDs nearby...	11/6/2014 6:06 PM
11	Installed carbon monoxide detector, established a location for emergency flashlight,.	11/5/2014 11:06 PM
12	Have you announced any meetings re natural disaster preparedness? If not, these should be a public service announcement carried on tv and radio.	11/5/2014 5:31 PM
13	Living about 3000 yards from a major railroad line, which carries God knows what through the city and area, we have a go bag and plan to move out at a moments notice. I doubt any of my neighbors are prepared. We also have a shelter-in-place action plan.	11/5/2014 3:47 PM

Q15 In which zip code do you live?

Answered: 245 Skipped: 102

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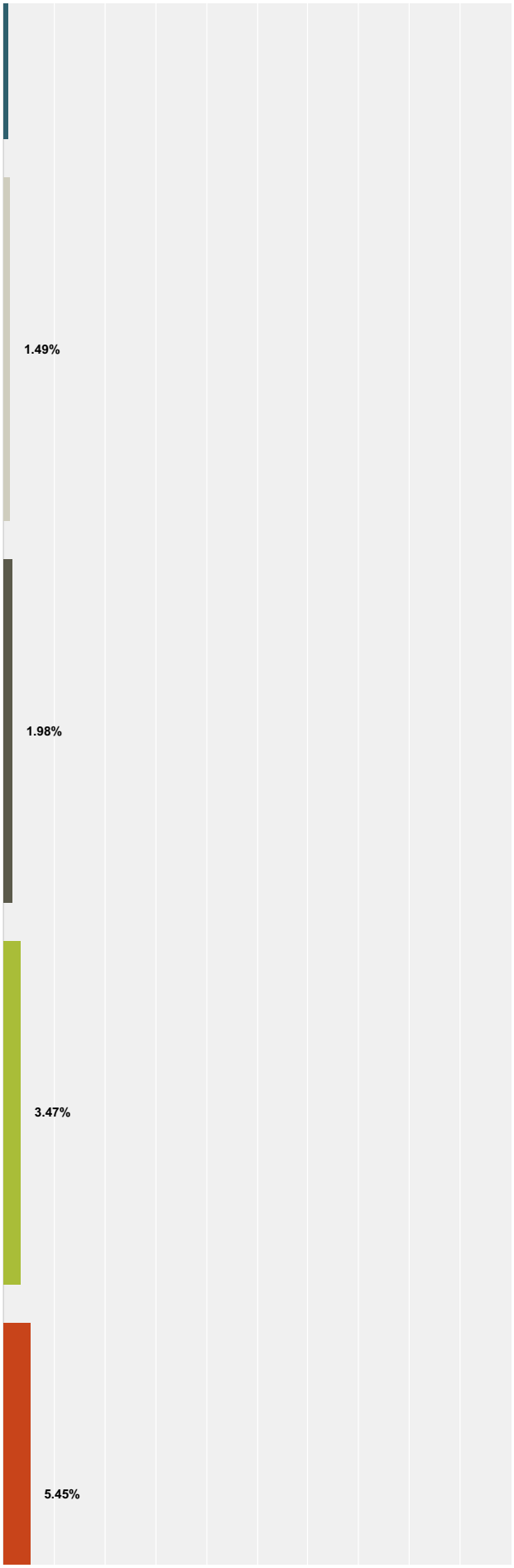
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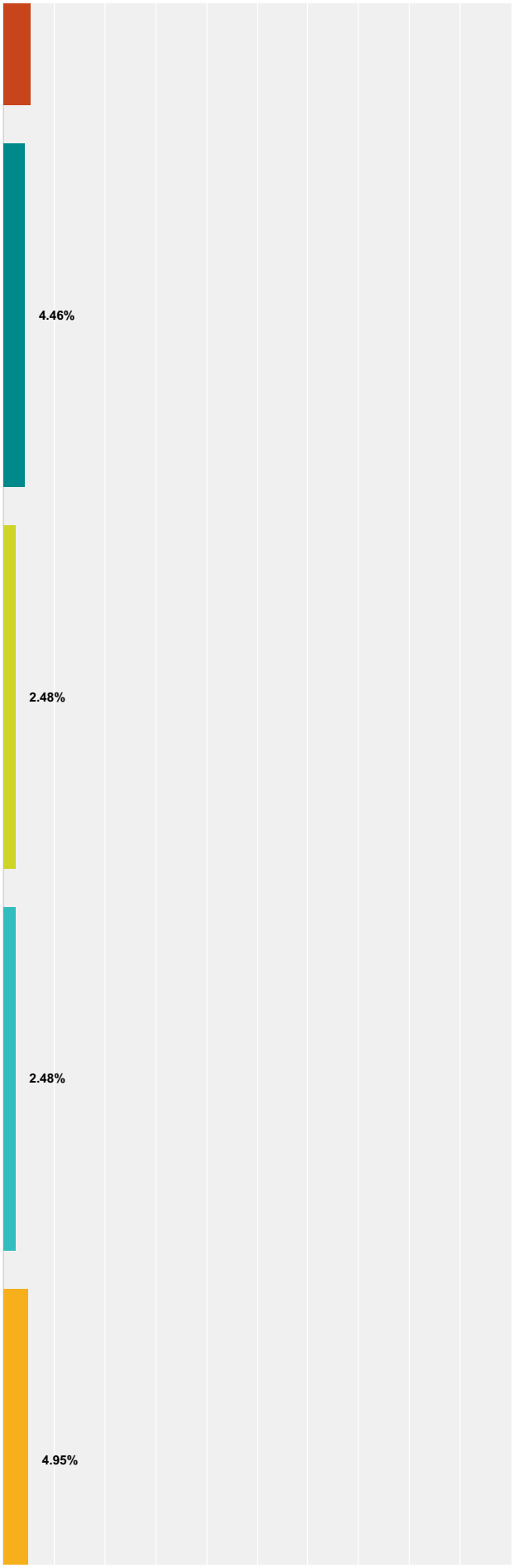
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2.48%
2.48%
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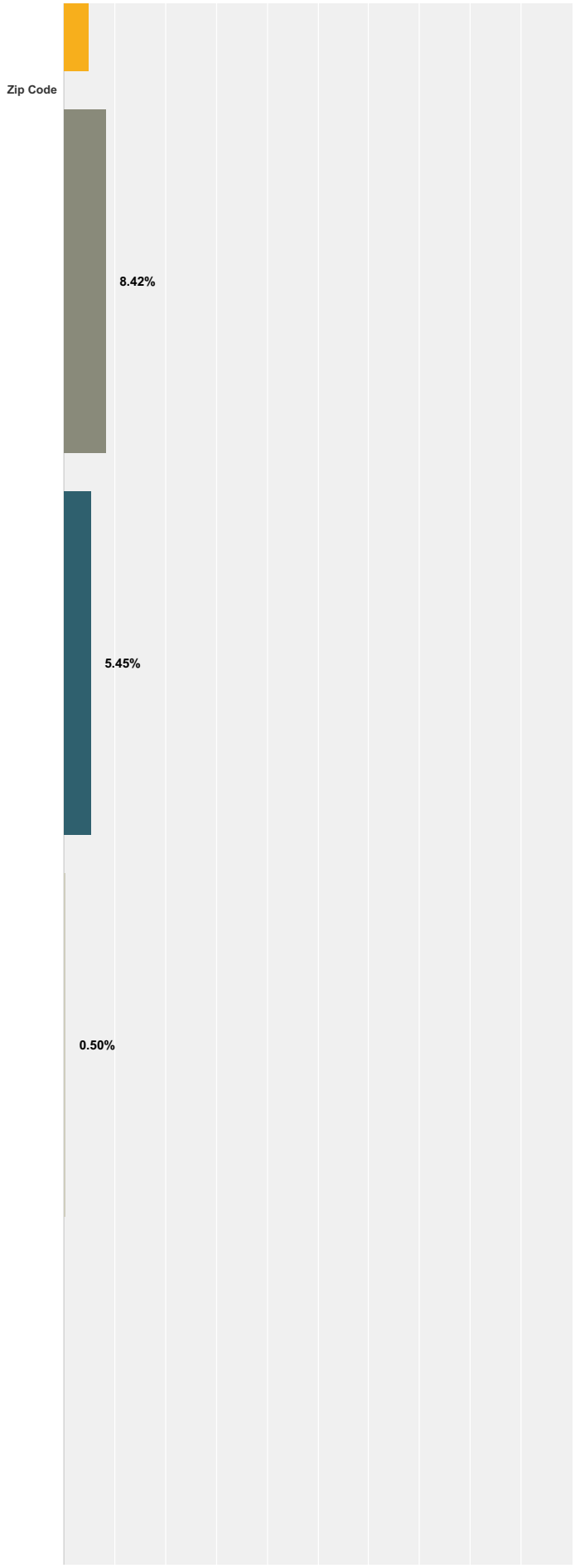
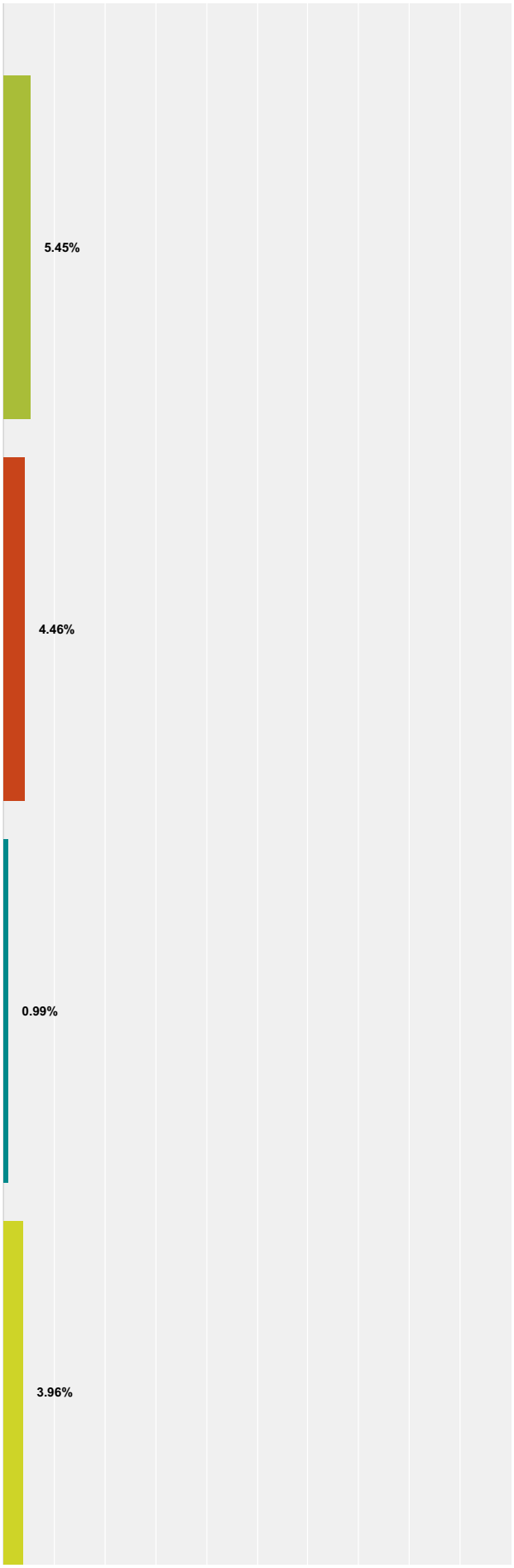

Zip Code
8.42%
5.45%
0.50%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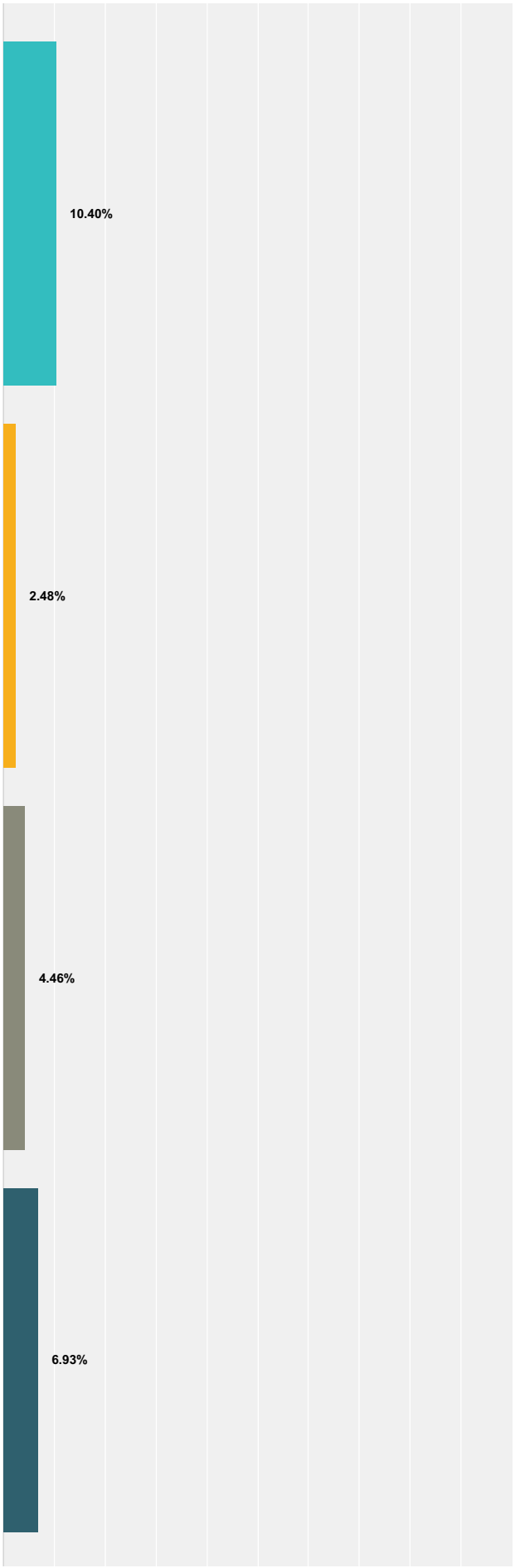
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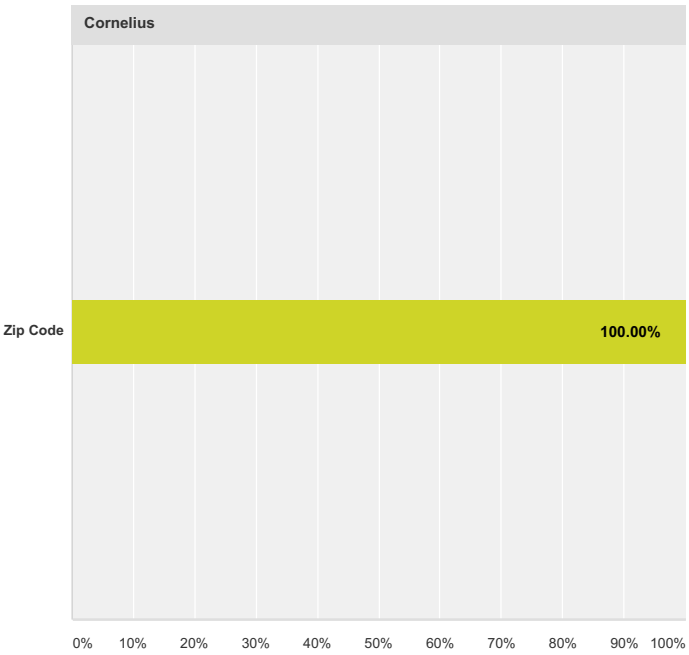
4.46%
6.93%

3.96%

28202 28203 28204 28205 28206 28207 28208
28209 28210 28211 28212 28213 28214 28215
28216 28217 28223 28226 28227 28227 28262
28269 28270 28273 28277 28278



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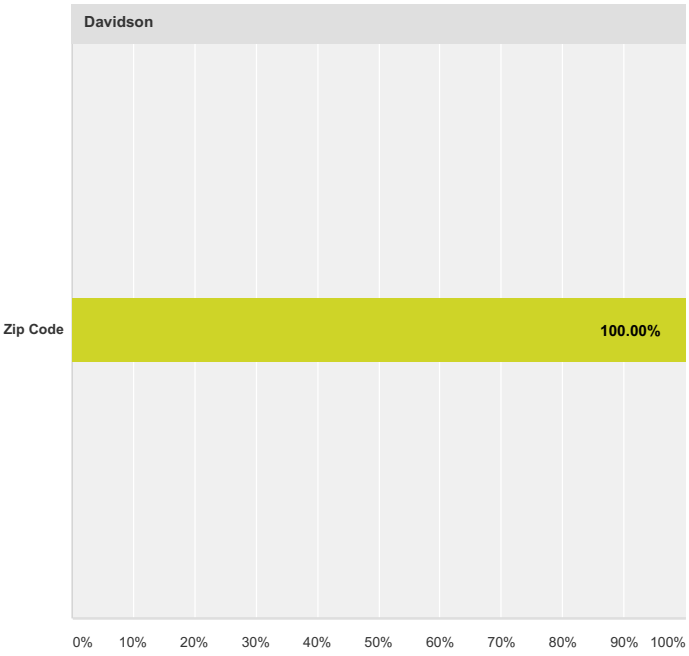

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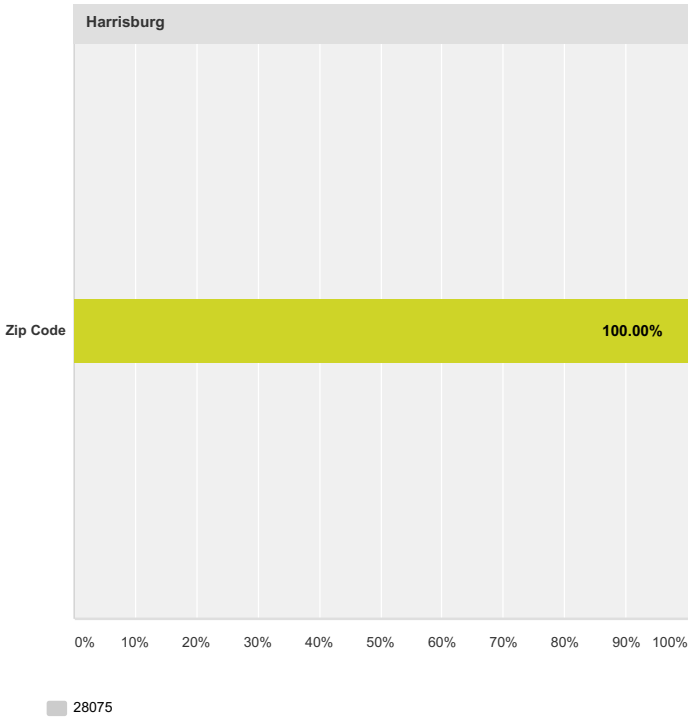
Harrisburg
Zip Code
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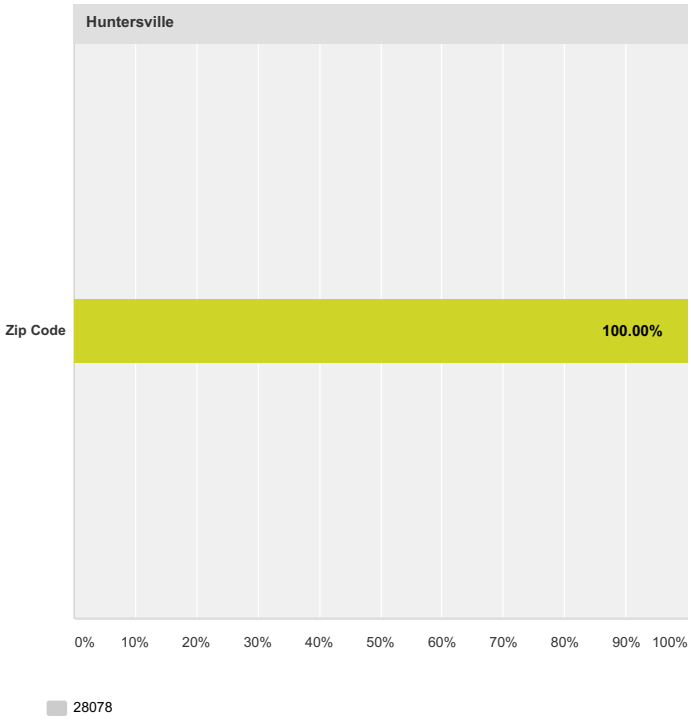
28075


Huntersville
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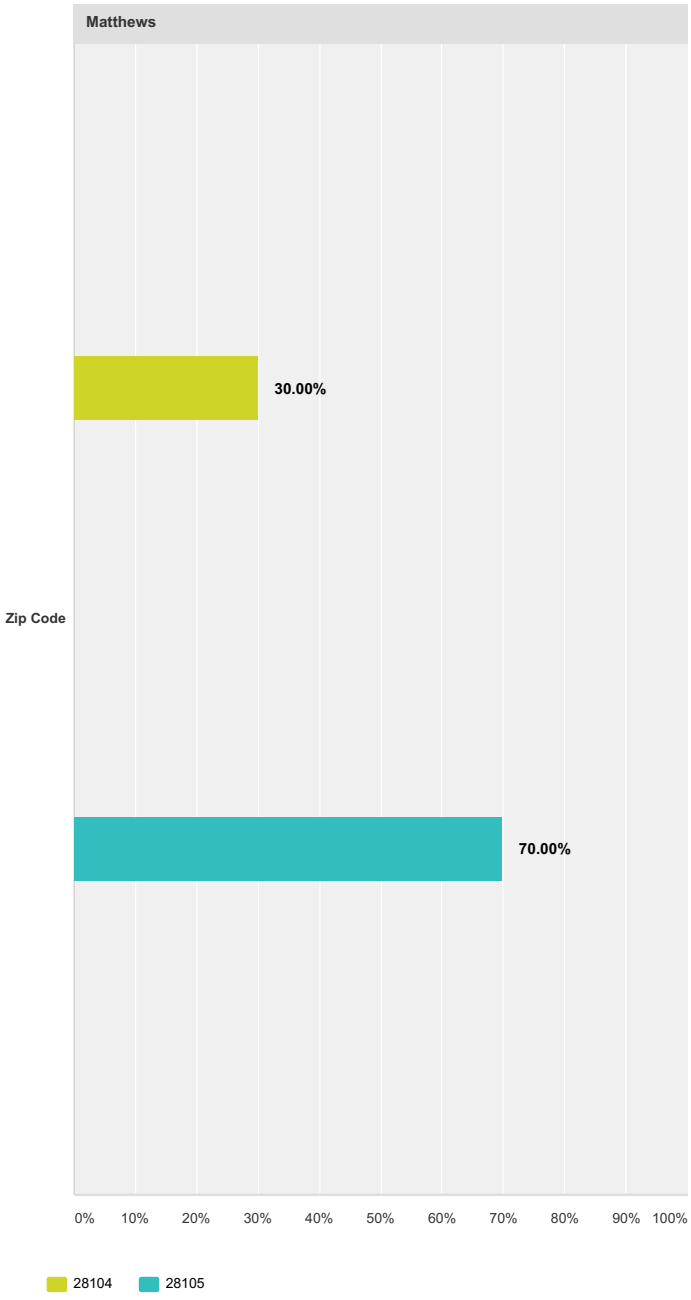
28078


Matthews
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28104
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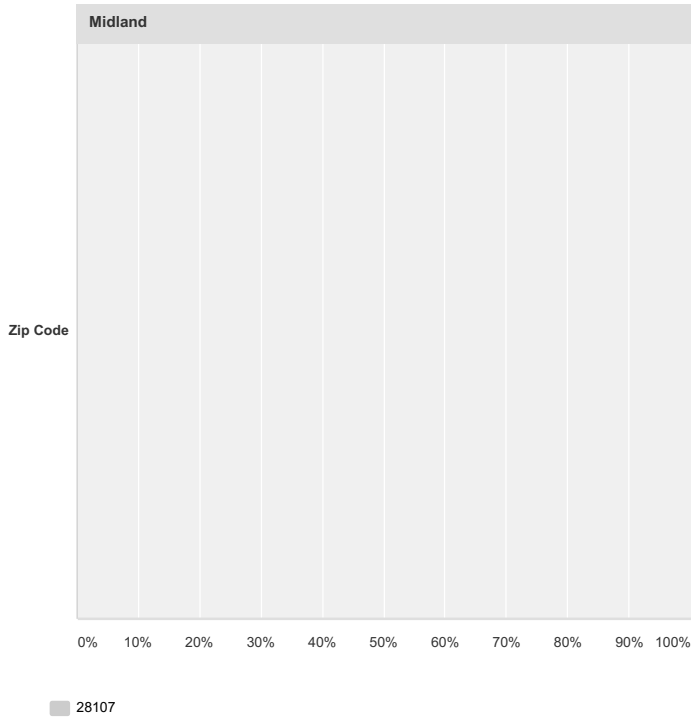
Midland
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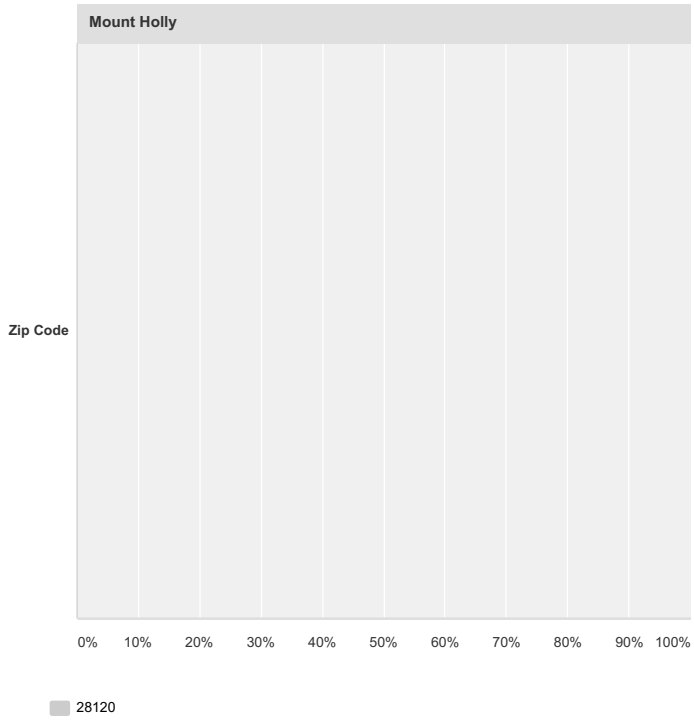
Mount Holly
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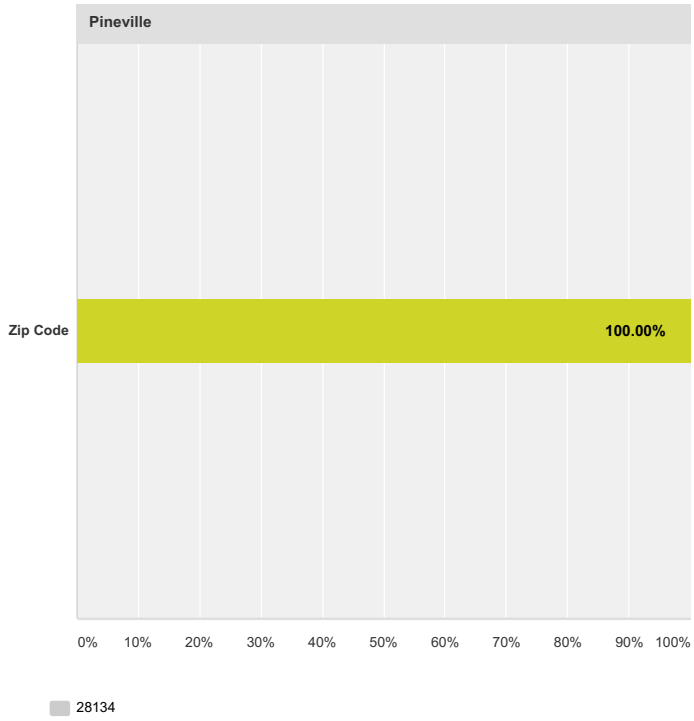


Charlotte																					
	28202	28203	28204	28205	28206	28207	28208	28209	28210	28211	28212	28213	28214	28215	28216	28217	28223	28226	28227	28227	28262
Zip Code	2.48% 5	1.98% 4	1.49% 3	8.91% 18	0.99% 2	1.49% 3	1.98% 4	3.47% 7	5.45% 11	4.46% 9	2.48% 5	2.48% 5	4.95% 10	8.42% 17	5.45% 11	0.50% 1	0.00% 0	5.45% 11	4.46% 9	0.99% 2	3.96% 8

Cornelius		
	28031	Total
Zip Code	100.00% 4	4

Davidson		
	28036	Total
Zip Code	100.00% 15	15

Harrisburg		
	28075	Total
Zip Code	100.00% 1	1

Huntersville		
	28078	Total
Zip Code	100.00% 10	10

Matthews			
	28104	28105	Total
Zip Code	30.00% 3	70.00% 7	10

Midland		
	28107	Total
Zip Code	0.00% 0	0

Mount Holly		
	28120	Total
Zip Code	0.00% 0	0

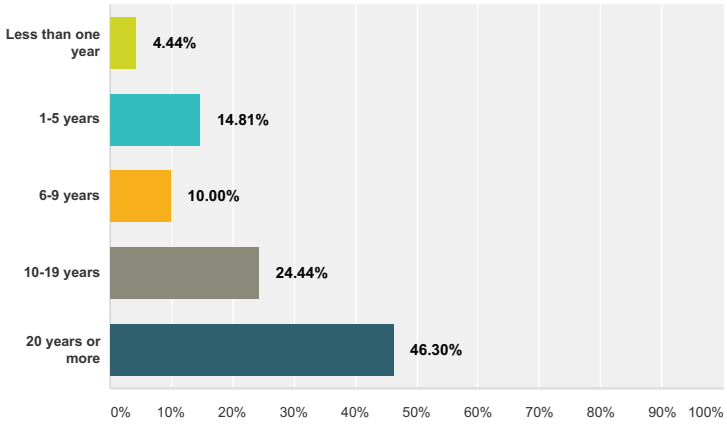
Pineville		
	28134	Total
Zip Code	100.00% 3	3

#	Other (please specify)	Date

1	48073	12/21/2014 7:30 AM
2	28037	12/10/2014 10:45 PM
3	28173	11/24/2014 2:22 PM
4	28027	11/22/2014 11:33 AM
5	also use 28212 and 28215	11/21/2014 4:41 PM
6	28027	11/20/2014 7:58 AM
7	28083	11/19/2014 10:11 PM
8	28037	11/19/2014 4:50 PM
9	29745	11/19/2014 4:17 PM
10	28214	11/19/2014 2:20 PM
11	union county	11/19/2014 12:59 PM
12	28461	11/19/2014 12:42 PM
13	29710	11/19/2014 12:19 PM
14	28025	11/19/2014 12:17 PM
15	28079	11/19/2014 11:46 AM
16	Homeless	11/18/2014 11:09 AM
17	28227 Mint Hill	11/17/2014 7:49 PM
18	Mint hill	11/17/2014 9:09 AM
19	28023	11/6/2014 6:07 PM
20	28270	11/5/2014 3:48 PM

Q16 How long have you lived in Mecklenburg County?

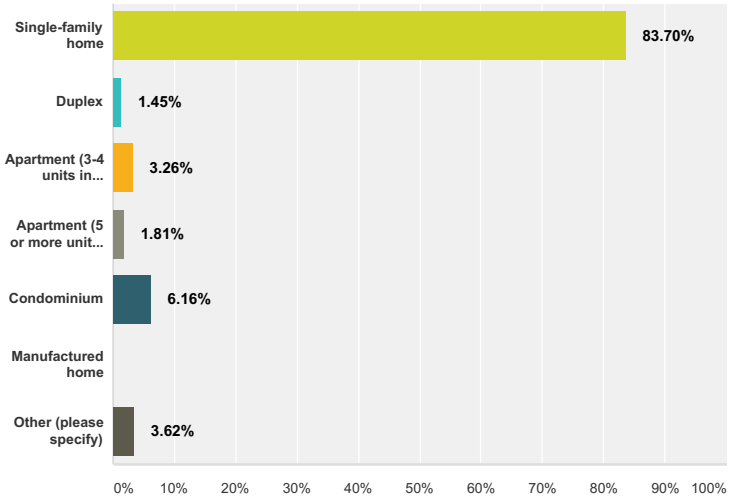
Answered: 270 Skipped: 77



Answer Choices	Responses	
Less than one year	4.44%	12
1-5 years	14.81%	40
6-9 years	10.00%	27
10-19 years	24.44%	66
20 years or more	46.30%	125
Total		270

Q17 What type of building do you live in?

Answered: 276 Skipped: 71



Answer Choices	Responses	
Single-family home	83.70%	231
Duplex	1.45%	4
Apartment (3-4 units in structure)	3.26%	9
Apartment (5 or more units in structure)	1.81%	5
Condominium	6.16%	17
Manufactured home	0.00%	0
Other (please specify)	3.62%	10
Total		276

#	Other (please specify)	Date
1	townhome	12/21/2014 5:08 AM
2	Townhome	12/11/2014 7:33 AM
3	I was born here!	11/19/2014 2:20 PM
4	townhouse	11/19/2014 12:49 PM
5	Outside	11/18/2014 11:09 AM
6	I work at CDIA (The Airport)	11/6/2014 6:07 PM
7	Hotel	11/5/2014 11:35 PM
8	Townhome	11/5/2014 3:01 PM
9	Townhouse	11/5/2014 1:54 PM
10	townhouse community	11/5/2014 1:37 PM

Q18 Additional Comments

Answered: 41 Skipped: 306

#	Responses	Date
1	Please reach out to the multiple Communities of Faith to get more folks involved in this survey.	12/22/2014 10:05 PM
2	north meck crime stoppers should be included in the planning process; 704-987-1650 Dave	12/16/2014 5:54 PM
3	Is there a CERT type program in Mecklenburg for training citizens in disaster response?	12/11/2014 11:30 AM
4	Continuous, consistent educational campaigns using media (TV, radio, social networks, nonprofits and houses of worship) with catchy and important information for children through adults.	12/11/2014 9:27 AM
5	Prepare for an EMP. The worst disaster that ever could happen. 90% of the population would die within 1 year or less.	12/10/2014 8:32 PM
6	Do not waste taxpayer money, especially on coordination among too many agencies. Focus on safety (utilities, police and health systems).	12/1/2014 3:26 AM
7	Team Rubicon USA is a great resource to be connected with for disaster response and preparedness.	11/30/2014 6:51 PM
8	I think working on our environment is our FIRST priority!	11/21/2014 4:42 PM
9	I don't see much concern about preparation for nuclear plan issues!!!!	11/21/2014 3:07 PM
10	Previous hazard mitigation plans have failed to acknowledge my greatest concern - collapse of the electric grid from damage to high voltage transformers due to ground induced currents generated by geomagnetic (solar) storms. Your update needs to finally address this greatest of natural hazards.	11/21/2014 2:20 PM
11	Enact a type of "citizen corp" of off duty employees. Some employees may have formerly lived on a coast, or an area that experianced earthquakes. I lived near Syracuse for 30+ years and weathered blizzrds. These assets could be used during a snow storm or other natural emergency event.	11/20/2014 5:34 PM
12	Hazard Area around Central Ave bridge at Masonic. Flooding Few years ago water entered nearby businesses and the heavily trafficked bridge closed a short time. Briar Creek has steep bank with no wall/guardrail to prevent cars/kids from rolling in. No chainlink please. Downstream side of creek has silted up. Appearance: collects trash from nearby businesses. Simple short stone/concrete walls along banks would provide safety/better appearance/prevent trash from going into creek. This is within feet of entrance to B.Creek greenway but not attractive. Owner(s) of this 2900 block would be prime candidates for façade improvement grants.	11/20/2014 2:28 PM
13	I found out about the first of the three public meetings via my employee email just one day in advance. As a citizen, I would have liked to have seen this in my social media, mail, or other outlets. As an employeee, I would like to have had more advance notice since as a parent I have to schedule things with/around my children.	11/20/2014 1:15 PM
14	Preparedness (prepping) often has a negative connotation due to the television shows depicting gun-toting, crazed individuals with radical views of the world. The best wake-up-call for the public that I've seen to date would be National Geographic's 2-hour show "American Blackout". It would be wise to broadcast this over and over again to give everyone a chance to get to see it and, for lack of a better term, become scared-straight into disaster preparedness.	11/20/2014 10:49 AM
15	Terrorism is not addressed here anywhere; this is an extremely important threat that needs more attention.	11/20/2014 9:29 AM
16	thank you for the opportunity to provide input via survey in addition to public meeting (which I am unable to attend)	11/20/2014 8:41 AM
17	Planning for evacuation or disaster is essential. It's very important to QUICKLY get information to local residents such as directing travelers to alternate routes, announcing flooded/closed roads and alternate routes on local radio channels, announcing areas in danger on radio and television alerts so residents can prepare for evacuation.	11/20/2014 8:10 AM
18	thank you for doing this survey	11/20/2014 8:07 AM
19	I believe the survey is a good way to get feedback from the the community. Having the meeting is an excellent way to educate the public. Thank you.	11/20/2014 6:42 AM
20	need to mention a small stockpile of food and water,and means to secure it.	11/19/2014 10:12 PM
21	Review recent disasters like Hurricanes Sandy, Andrew, Katrina, Rita; events such as Ferguson, MO; wildfire events; and droughts; to prepare the citizens.	11/19/2014 5:42 PM
22	Wow were do I start? The city of charlotte has lost it mind to send me an email talking about zombies. lets worry about real issues like building a street car that is not needed. We need to spend our money more wise.	11/19/2014 2:23 PM
23	It would be nice to help educate on where floodplains are and what areas are impacted the most. Highway drainage also needs reviewed as it does not see they drain well and hydroplaning is common.	11/19/2014 1:18 PM
24	Disasters can and will happen - everyone should be prepared for any type of disaster not just a zombie attack or EMP threat or terrorist event - good planning is like insurance you hope you don't need it but are sure glad you have it if you do.	11/19/2014 12:20 PM
25	Ultimately, folks are responsible for their own safety, but will need resources to help them recover from disasters. Prior deployment of those resources to protected locations should be the responsibility of the local/state governments. Staffing isn't as important because locals can be given on-the-job training to run equipment.	11/19/2014 12:05 PM
26	Thank you for taking time to better prepare our communty	11/19/2014 11:40 AM
27	Winter weather storms and secondary streets not being cleaned after ice is a big threat to residents in our community as they do not have a secondary source of heat during winter power outages. Very diverse population in Finchley-Purser Area.	11/18/2014 1:09 PM
28	Everyone should be accountable for himself and herself. With help, we can accomplish that.	11/18/2014 11:09 AM
29	Keep sending out surveys and information like this and get more citizens involved!	11/18/2014 10:22 AM
30	I would like to know how to build an emergency kit as well as the step-by-step process of what to do in an evacuation.	11/17/2014 4:50 PM

31	Thanks for the survey	11/15/2014 3:44 AM
32	Being on my own and semi-disable, some of this is not relevant... cannot be done by me	11/9/2014 3:51 PM
33	Spend the funding wisely and work closely with other agencies don't reproduce assets. Nice job on the survey.	11/8/2014 8:49 AM
34	I would like to see more CERT programs in the area.	11/7/2014 8:42 PM
35	Since I work at the airport, and also have many coworkers who drive more than 40 miles to work, there is a good chance of being stranded at work, or volunteered to stay for overtime, during bad weather events. Hotel vans come in handy, too.	11/6/2014 6:10 PM
36	Interesting. If you have plans for disaster preparedness where can they be obtained?	11/5/2014 5:31 PM
37	I would hope those responsible engage amateur radio operators and clubs. When modern communications fail, most of not all hams have emergency back up power and could provide the only communications from shelters during a natural or man made disaster, such as a major rail derailment.	11/5/2014 3:49 PM
38	thank you for the opportunity to answer this survey.	11/5/2014 3:30 PM
39	I'm excited that there is more attention to Hazard Mitigation in Charlotte/Mecklenburg Co.	11/5/2014 2:52 PM
40	An owned townhouse, not rental apartment.	11/5/2014 2:35 PM
41	There needs to be a program plan to bury power lines where possible to prevent disruption of power.	11/5/2014 1:46 PM

C KEY FEDERAL MITIGATION FUNDING SOURCES

This section of the Plan includes a listing of some of the key, well-established federal hazard mitigation funding programs available to implement future mitigation projects. Additional sources of mitigation funding are routinely made available through a variety of state and federal agencies, though the program names, funding amounts and eligibility criteria will vary over time.

KEY FEDERAL MITIGATION FUNDING SOURCES

Grant Name	Agency	Purpose	Contact
Pre-Disaster Mitigation Program (PDM)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide funding for States and communities for cost-effective hazard mitigation activities which complement a comprehensive hazard mitigation program and reduce injuries, loss of life, and damage and destruction of property.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Hazard Mitigation Grant Program (HMGP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To prevent future losses of lives and property due to disasters; to implement State or local hazard mitigation plans; to enable mitigation measures to be implemented during immediate recovery from a disaster; and to provide funding for previously identified mitigation measures to benefit the disaster area.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Flood Mitigation Assistance Program (FMA)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To help States and communities plan and carry out activities designed to reduce the risk of flood damage to structures insurable under the NFIP.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Emergency Management Performance Grants (EMPG)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To encourage the development of comprehensive emergency management at the State and local level and to improve emergency management planning, preparedness, mitigation, response, and recovery capabilities.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov

Grant Name	Agency	Purpose	Contact
Community Development Grant Program (CDBG)	U.S. Department of Housing and Urban Development	To develop viable urban communities by providing decent housing and a suitable living environment. Principally for low-to-moderate income individuals.	HUD 451 7th Street, S.W. Washington, DC 20410-7000 Phone: (202) 708-3587 www.hud.gov
Public Assistance Program (PA)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide supplemental assistance to States, local governments, and certain private nonprofit organizations to alleviate suffering and hardship resulting from major disasters or emergencies declared by the President. Under Section 406, Public Assistance funds may be used to mitigate the impact of future disasters.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Flood Control Works / Emergency Rehabilitation	U.S. Department of Defense, Army Corps of Engineers	To assist in the repair and restoration of public works damaged by flood, extraordinary wind, wave, or water action.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil
Emergency Watershed Protection	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide emergency technical and financial assistance to install or repair structures that reduce runoff and prevent soil erosion to safeguard life and property.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov
Watershed Protection and Flood Prevention	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide technical and financial assistance in planning and executing works of improvement to protect, develop, and use land and water resources in small watersheds.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov

Grant Name	Agency	Purpose	Contact
Land and Water Conservation Fund Grants	U.S. Department of the Interior, National Park Service	To acquire and develop outdoor recreation areas and facilities for the general public, to meet current and future needs.	NPS PO Box 37127 Washington, DC 20013-7127 Phone: (202) 565-1200 www.nps.gov
Disaster Mitigation and Technical Assistance Grants	U.S. Department of Commerce, Economic Development Administration	To help States and localities to develop and/or implement a variety of disaster mitigation strategies.	EDA Herbert C. Hoover Building Washington DC, 20230 Phone: (800) 345-1222 www.eda.gov
Pre-Disaster Mitigation Loan Program	U.S. Small Business Administration	To make low-interest; fixed-rate loans to eligible small businesses for the purpose of implementing mitigation measures to protect business property from damage that may be caused by future disasters.	SBA 1110 Vermont Avenue, N.W., 9th Floor Washington, DC 20005 Phone: (202) 606-4000 www.sba.gov
Watershed Surveys and Planning	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide planning assistance to Federal, State, and local agencies for the development of coordinated water and related land resources programs in watersheds and river basins.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov
Clean Water Act Section 319 Grants	U.S. Environmental Protection Agency	To implement non-point source programs, including support for non-structural watershed resource restoration activities.	EPA Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 Phone: (202) 272-0167 www.epa.gov

Grant Name	Agency	Purpose	Contact
National Earthquake Hazards Reduction Program (NEHRP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To mitigate earthquake losses that can occur in many parts of the nation providing earth science data and assessments essential for warning of imminent damaging earthquakes, land-use planning, engineering design, and emergency preparedness decisions.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Assistance to Firefighters Grant	U.S. Department of Homeland Security, Federal Emergency Management Agency	Competitively awarded project grants to provide direct assistance, on a competitive basis, to fire departments for the purpose of protecting the health and safety of the public and firefighting personnel against fire and fire-related hazards.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Fire Management Assistance Grants	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide project grants and the provision of specialized services for the mitigation, management, and control of fires that threatens such destruction as would constitute a major disaster.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Emergency Streambank and Shoreline Protection	U.S. Department of Defense, Army Corps of Engineers	To prevent erosion damages to public facilities by the emergency construction or repair of streambank and shoreline protection works.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil
Small Flood Control Projects	U.S. Department of Defense, Army Corps of Engineers	To reduce flood damages through small flood control projects not specifically authorized by Congress.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil

D LOCAL MITIGATION PLAN REVIEW TOOL

This section of the Plan includes a completed copy of the *Local Mitigation Plan Review Tool* as provided by the North Carolina Division of Emergency Management. This checklist indicates that the Plan has been updated sufficiently to maintain compliance with the Stafford Act as required by FEMA and the State of North Carolina with regard to Planning Process, Risk Assessment, Mitigation Strategy, Plan Maintenance and Additional State Requirements.

APPENDIX D:
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: Mecklenburg County	**Title of Plan:** Mecklenburg County Multi-jurisdictional Hazard Mitigation Plan	**Date of Plan:** July 2015
Local Point of Contact: Stacie Neal	**Address:** 500 Dalton Ave Charlotte, NC 28206	
Title: Emergency Management Coordinator		
Agency: Charlotte-Mecklenburg Emergency Management/Charlotte Fire Department		
Phone Number: 704-516-0026	**E-Mail:** sneal@ci.charlotte.nc.us	

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))	All of Section 2, but specifically pp. 2:29-2:41 for the 2015 plan update		
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, pp. 2:30-2:38		
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, pp. 2:29-2:41		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 2, pp. 2:29-2:41; Sections 4-6 (risk assessment); Section 7 (capability assessment)		
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, pp. 10:5-10:6		
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, pp. 10:3-10:5		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
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))	Sections 4 and 5		
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 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 6 pp. 6:29-6:31; Section 7 pp. 7:11-7:15		
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 7 pp. 7:11-7:15		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 8 p. 8:3		
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 9		
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))	Sections 8 and 9		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
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 10 p. 10:2		
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))	Sections 5 and 6; Section 3; Section 9		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section 9		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 9		
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))	Appendix A (PENDING)		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Appendix A (PENDING)		
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	Mecklenburg	County	Stacie Neal	500 Dalton Avenue Charlotte, NC 28206	sneal@ci.charlotte.nc.us	704-516-0026	Y	Y	Y	Y	Y	
2	Charlotte	City	Jennifer Smith	600 East Fourth Street Charlotte, NC 28202	gsmith@ci.charlotte.nc.us	704-336-7924	Y	Y	Y	Y	Y	
3	Cornelius	Town	Becky Partin	21445 Catawba Avenue 2nd Floor Cornelius, NC 28031	bpartin@cornelius.org	704-896-2460, ext. 114	Y	Y	Y	Y	Y	
4	Davidson	Town	Jesse Bouk	151 W. Walnut Street Davidson, NC 28036	jbouk@townofdavidson.org	704-892-7591	Y	Y	Y	Y	Y	

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
5	Huntersville	Town	Bobby Williams	101 Huntersville-Concord Road Huntersville, NC 28070	BobbyW@huntersville.org	704-875-6541	Y	Y	Y	Y	Y	
6	Matthews	Town	Ralph Messera	1600 Tank Town Road Matthews, NC 28105	rmessera@matthewsnc.gov	704-708-1243	Y	Y	Y	Y	Y	
7	Mint Hill	Town	David Leath	4430 Mint Hill Village Lane Mint Hill, NC 28227	dleath@fire.minthill.com	704-545-4866	Y	Y	Y	Y	Y	
8	Pineville	Town	Julia Zweifel	200 Dover Street Pineville, NC 28134	jzweifel@pinevilledsl.net	704-889-0504	Y	Y	Y	Y	Y	