STATE OF TENNESSEE
HAZARD MITIGATION PLAN

TN 200

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State of Tennessee

Standard State Hazard Mitigation Plan

Tennessee Emergency Management Agency

David Purkey, Director
3041 Sidco Drive
Nashville, TN 37204

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Executive Summary

Naturally occurring atmospheric, geologic, hydrologic, and seismic hazards occur throughout the State of Tennessee (TN) threatening damage to property and exposing its citizens to risk of injury or death. The Tennessee Emergency Management Agency (TEMA) is empowered by state law and by the governor's executive authority to protect the public from disasters and emergencies. The foundation for this authority is Tennessee Code Annotated (TCA) 58 – 2 – 101 through TCA 58 – 2 – 124. It is under this authority that TEMA is charged with overseeing the development of a Federal Emergency Management Agency (FEMA) approved standard state hazard mitigation plan (HMP).

The State of Tennessee Standard Hazard Mitigation Plan was developed in cooperation with state, federal, and local government agencies. The Tennessee Emergency Management Agency served as the coordinating entity and the consulting company, BOLDplanning, served as the plan developer.

The State of Tennessee Standard Hazard Mitigation Plan's risk and vulnerability assessment was performed with the aid of advanced geographic information systems (GIS) technologies, comprehensive regional hazard studies, and a streamlined analysis methodology. The assessment incorporates new and updated data made available by federal and state agencies as well as scientific modeling methods which were unavailable during the previous plan's development.

The State of Tennessee Standard Hazard Mitigation Plan is the primary document detailing the state's mitigation strategy targeting all natural hazards adversely affecting its citizens and their property. The state's mitigation actions and projects directly correspond to its mitigation objectives and focus on the greatest risk hazards established in the plan's risk assessment.

Since the development of the current plan, TEMA has taken aggressive steps toward improving its coordination with and technical assistance programs for local mitigation plan development. The programs in place have proven to be efficient, robust, and highly successful in their implementation. However, this plan outlines improvements for TEMA's mitigation programs by expanding their scope and enhancing program designs to meet the future needs of Tennessee's citizens.

This plan is a living document and will continually evolve to keep pace with changing concerns, technology, best practices, lessons learned, and all applicable state and federal laws, statutes and orders. While adapting to the challenges of today and tomorrow, the state, via the plan, will continue to comply with all applicable federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will be amended whenever necessary to reflect changes in state or federal laws and statutes as required by 44 CFR 13.11(d).

James H. Bassham, Director
Tennessee Emergency Management Agency
3041 Sidco Drive
Nashville, Tennessee 37204

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Adoption Resolution

THE STATE OF TENNESSEE
TENNESSEE EMERGENCY MANAGEMENT AGENCY
EMERGENCY OPERATIONS CENTER
MILITARY DEPARTMENT OF TENNESSEE
3041 SIDCO DRIVE, P.O. BOX 41502
NASHVILLE, TENNESSEE 37204-1502
(615) 741-0001

State Hazard Mitigation Plan Adoption

In accordance with 44 C.F.R. Part 201; Title 58 Chapter 2 Part 103 of the Tennessee Code Annotated; and with the full support of the State Hazard Mitigation Plan Committee, the Tennessee Emergency Management Agency, and the Tennessee Department of Military, the 2013 State Hazard Mitigation Plan Update is hereby adopted by the State of Tennessee.

The State of Tennessee Hazard Mitigation Plan, as updated, meets the requirements of Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended) enacted under the Disaster Mitigation Act of 2000. Section 322 of the Act requires that states, as a condition of receiving federal disaster mitigation funds, have a mitigation plan in place that describes the planning process for identifying hazards, risks and vulnerabilities; identifies and prioritizes statewide hazard mitigation actions; encourages the development of local mitigation plans and projects; and describes technical support mechanisms that can and have been used to promote these efforts.

The newly updated plan illustrates that:

- The State of Tennessee has developed a comprehensive hazard mitigation program.
- The State effectively uses available mitigation funding.
- The State is capable of managing all funding.
- The State of Tennessee does comply, and assures it will continue to comply, with all applicable federal statutes and regulations in effect.

The State of Tennessee will continue to fulfill objectives outlined in this plan and has assigned the Tennessee Emergency Management Agency with the responsible for maintaining and updating this plan, as required, in coordination with the appropriate departments, agencies, and the community at large.

James H. Bassham
9.30-2013

James H. Bassham, Director
Tennessee Emergency Management Agency
Governor's Authorized Representative

Date

1 Oct 2013

Major General Terry M. Haston, Adjutant General
Commissioner, Tennessee Department of Military
Governor's Authorized Representative

Date

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Glossary of Terms

AEPHIS – Animal and Plant Health Inspection Service
ARCF – Agricultural Resources Conservation Fund
BEA – United States Bureau of Economic Analysis
BFE – Base Flood Elevation
CBA – Cost Benefit Analysis
CDBG – Community Development Block Grant Program
CDC – United States Centers for Disease Control and Prevention
CEDEP – Communicable and Environmental Diseases and Emergency Preparedness
CRS – Community Rating System
CUSEC – Central United States Earthquake Consortium
CWPP – Community Wildfire Protection Plan
DART – Disaster Animal Response Team
DCS – Tennessee Department of Children's Services
DFIRM – Digital Flood Insurance Rate Map
DHS – Department of Homeland Security
DMA 2000 – Disaster Mitigation Act of 2000
DWSRF – Drinking Water State Recovery Fund
ECD – Emergency Communication District
EIP – Emerging Infections Program
EMAP – Emergency Management Accreditation Program
EMPG – Emergency Management Performance Grant
EMS – Emergency Medical Services
EOC – Emergency Operations Center
EOP – Emergency Operations Plan
ESC – Emergency Services Coordinator
FMA – Flood Mitigation Assistance Grant Program
FEMA – Federal Emergency Management Agency
FIRM – Flood Insurance Rate Map
FWHP – Farm Wildlife Habitat Program
GIS – Geographic Information Systems
HAZMAT – Hazardous Materials
HHS – United State Department of Health and Human Services
HMEP – Hazardous Materials Emergency Preparedness Grant
HMGP – Hazard Mitigation Grant Program
HMP – Hazard Mitigation Plan
HMPC – Hazard Mitigation Planning Committee
HPC – Hazard Potential Category
HRTS – Healthcare Resource Tracking System
HUD – United States Department of Housing and Urban Development
HVRI – Hazard Vulnerability Research Institute
ICS – Incident Command System
IECC – International Energy Conservation Code
IRC – International Residential Code
LEPC – Local Emergency Planning Committee
LiDAR – Light Detection and Ranging
LPAO – Local Planning Assistance Office
MARS – Mitigation Application Ranking System
MRC – Medical Reserve Corps.
NAHMS – National Animal Health Monitoring System
NEHRP – National Earthquake Hazards Reduction Program
NFHL – National Flood Hazard Layer
NFIP – National Flood Insurance Program
NIMS – National Incident Management System
NMSZ – New Madrid Seismic Zone
NOAA – National Oceanic and Atmospheric Administration
NRCS – Natural Resources Conservation Service
NRF – National Response Framework
NSGIC – National State Geographic Information Council
NSU – National Surveillance Unit
OEM – Office of Emergency Management
OIR – Office for Information Resources
OSHA – Occupational Safety and Health Administration
PDM – Pre Disaster Mitigation Grant Program
PPD – Presidential Policy Directive
RFC – Repetitive Flood Claims
RFP – Request for Proposal
RL – Repetitive Loss
SEOC – State Emergency Operations Center
SHMO – State Hazard Mitigation Officer
SOP – Standard Operating Procedure
SoVI© – Social Vulnerability Index
SRL – Severe Repetitive Loss
SSURGO – Soil Survey Geographic Database
TAEP – Tennessee Agricultural Enhancement Program
TBA – Targeted Brownfield Assessment Grant Program
TBI – Tennessee Bureau of Investigation
TCA – Tennessee Code Annotated
TDA – Tennessee Department of Agriculture
TDH – Tennessee Department of Health
TDEC – Tennessee Department of Environment and Conservation
TDOT – Tennessee Department of Transportation
TDSN – Tennessee Disaster Support Network
TEMA – Tennessee Emergency Management Agency
TEMARR – Tennessee Emerging Medical Awareness, Response, and Resources Program
TEMP – Tennessee Emergency Management Plan
THDA – Tennessee Housing and Development Authority
THIRA – Threat Hazard Identification and Risk Assessment
THP – Tennessee Highway Patrol
TMI – Tennessee Mitigation Initiative
TN – Tennessee
TN ECD – Tennessee Department of Economic and Community Development
TNCAT – Tennessee Catastrophic Training
TNCRN – Tennessee Countermeasures Response Network
TNGIC – Tennessee Geographic Information Council
TNHAN – Tennessee Health Alert Network
TNHMC – Tennessee Hazard Mitigation Council
TNVM – Tennessee Volunteer Mobilizer
TRA GPSD – Tennessee Regulatory Authority Gas Pipeline Safety Division
TSMP – Tennessee Stream Mitigation Program
TTAP – Tennessee Technology Access Program
TVA – Tennessee Valley Authority
USACE – United States Army Corps. of Engineers
USDA – United States Department of Agriculture
USGS – United States Geological Survey
VS – Veterinary Services
WRAPS – Watershed and Protection Strategy
WUI – Wildland Urban Interface

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Introduction to Mitigation

This plan represents the primary planning document to fulfilling the State of Tennessee's mitigation mission under the National Preparedness Goal, released in September, 2011. The new National Preparedness Goal, defines what it means for the whole community to be prepared for all types of disasters and emergencies. The goal itself is succinct:

"A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk."

These risks include events such as natural disasters, disease pandemics, chemical spills and other manmade hazards, terrorist attacks and cyber-attacks. The graphic below illustrates the missions of the National Preparedness Goal.

Prevention	Protection	Mitigation	Response	Recovery
				
Preventing, avoiding, or stopping potential or actual acts of terrorism.	Protecting the homeland *(people, assets, systems, networks, etc.)* against terrorism and man-made or natural disasters.	Mitigating the loss of life and property by lessening the impact of future disasters.	Responding quickly to save lives, protect property, and meet basic human needs.	Recovering through timely restoration, strengthening, and revitalization of infrastructure, housing, the economy, etc. affected by a disaster.

Mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural, man-made, and technological hazards. It is carried out as any sustained action to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation encourages long-term reduction of hazard vulnerability. As is the goal of emergency management, the goal of mitigation is to save lives and reduce property damage.

Engaging in mitigation planning provides the State of Tennessee with a number of benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship, and reduced short-term and long-term recovery and reconstruction costs. The dramatic increase in the costs associated with natural disasters over the past decades has fostered interest in identifying and implementing effective means of reducing vulnerability.

The Tennessee Emergency Management Agency has the responsibility to coordinate all state activities relating to hazard evaluation and mitigation, and to prepare and submit to FEMA a standard hazard mitigation plan, following the criteria established in 44 CFR 201.4 and Section 322 of the Disaster Mitigation Act of 2000 (Public Law 106-390).

The Disaster Mitigation Act of 2000 (DMA 2000)

In the past, federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 became law on October 30, 2000, and amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the “Stafford Act”) (Public Law 93-288, as amended). Regulations for these activities can be found in Title 44 of the Code of Federal Regulations Part 206, Subpart M.

This legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. This act establishes a pre-disaster hazard mitigation program and new requirements for the national, post-disaster, Hazard Mitigation Grant Program.

Section 322 of the act specifically addresses mitigation planning at the state and local levels. It identifies new requirements that allow Hazard Mitigation Grant Program (HMGP) funds to be used for mitigation planning activities, and increases the amount of HMGP funds available to states that have developed a comprehensive, enhanced mitigation plan prior to a disaster. States and communities must have an approved mitigation plan in place prior to receiving post-disaster HMGP funds. Local and tribal mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual communities.

DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. It encourages and rewards local and state pre-disaster planning and promotes sustainability as a strategy for disaster resistance. This enhanced planning network will better enable local and state governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects. To implement the new DMA 2000 requirements, FEMA prepared an interim final rule, published in the Federal Register on February 26, 2002, at 44 CFR Parts 201 and 206, which establishes planning and funding criteria for states and local communities.

On October 31, 2007, FEMA subsequently published an Interim Rule in the Federal Register, which ensures the Flood Mitigation Assistance (FMA) program planning requirements are consistent with the mitigation planning regulations as cited in the Code of Federal Regulations (CFR) at Title 44, Chapter 1, Part 201 (44 CFR Part 201).

This interim rule established that local communities must comply with mitigation planning requirements to be eligible to apply for FEMA mitigation project grant funding, including FMA and FEMA's Severe Repetitive Loss Program (SRL). Meeting the requirements of the regulations cited above ensures participating jurisdictions in the planning area will be eligible to receive disaster assistance, including hazard mitigation grants available through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288, as amended.

The Tennessee Emergency Management Agency

Through state law, the Tennessee Code Annotated (TCA 58-2-104) established the Tennessee Emergency Management Agency and its authority to develop, plan, analyze, conduct, provide, implement, and maintain programs for disaster mitigation, preparedness, response, and recovery. Furthermore, the Tennessee Code Annotated restates the TEMA mandate to prepare the State of Tennessee to deal with disasters, preserve the lives and property of the people of the state, and protect the public peace, health, and safety in the event of a disaster.

> ***Tennessee Code Annotated (TCA) Title 58, Chapter 2, Section 104 – Creation of Agency***
> *The governor is hereby authorized and directed to create a state agency to be known as the "Tennessee emergency management agency" (TEMA) under the adjutant general for day-to-day administrative purposes and, upon the recommendation of the adjutant general, to appoint a director of the TEMA, who shall be the administrator thereof. The director shall hold office at the pleasure of the governor, and shall receive such salary as is fixed by the adjutant general and approved by the governor. The agency shall authorize the creation of local organizations for emergency management in the political subdivisions of the state, and authorize cooperation with the federal government and the governments of other states.* [Acts 2000, ch. 946, § 1.]

Tennessee was 1 of 29 states accredited nationally in 2013 by the Emergency Management Accreditation Program (EMAP) of the National Emergency Managers Association. There are 63 standards for states to meet the accreditation and no single standard can be failed to achieve accreditation. Maintaining Tennessee's EMAP accreditation was a primary consideration in the development of this plan. An EMAP Assessor team will return to Tennessee in 2018 for an external reaccreditation assessment.

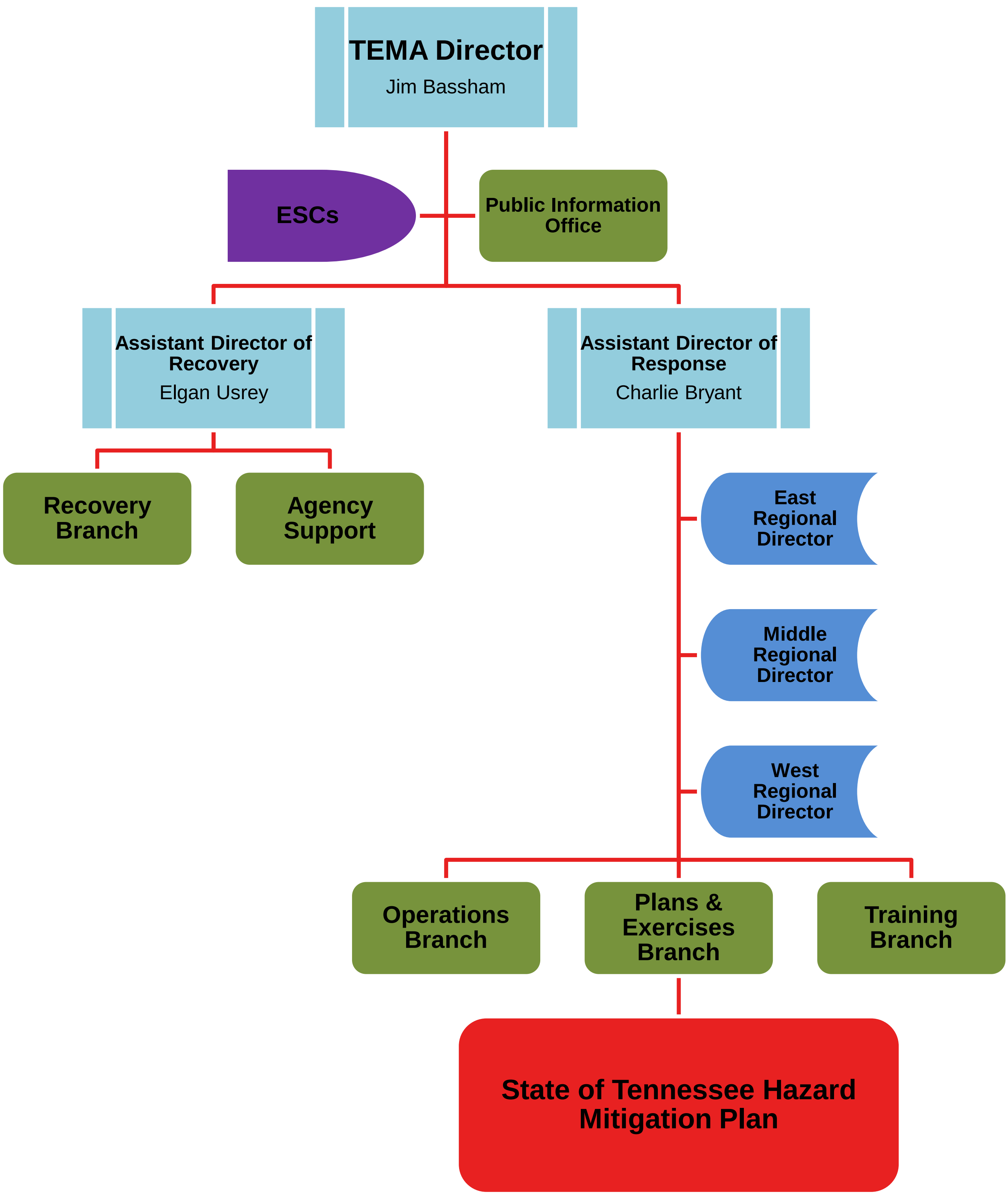
TEMA had a 2012 operating budget of $12,833,900 in a mix of state and federal funds. In 2011, TEMA oversaw operations for 5 Presidential disasters, the most out of any state in the country. These Presidential disasters alone affected 66 out of Tennessee's total 95 counties.

Objectives

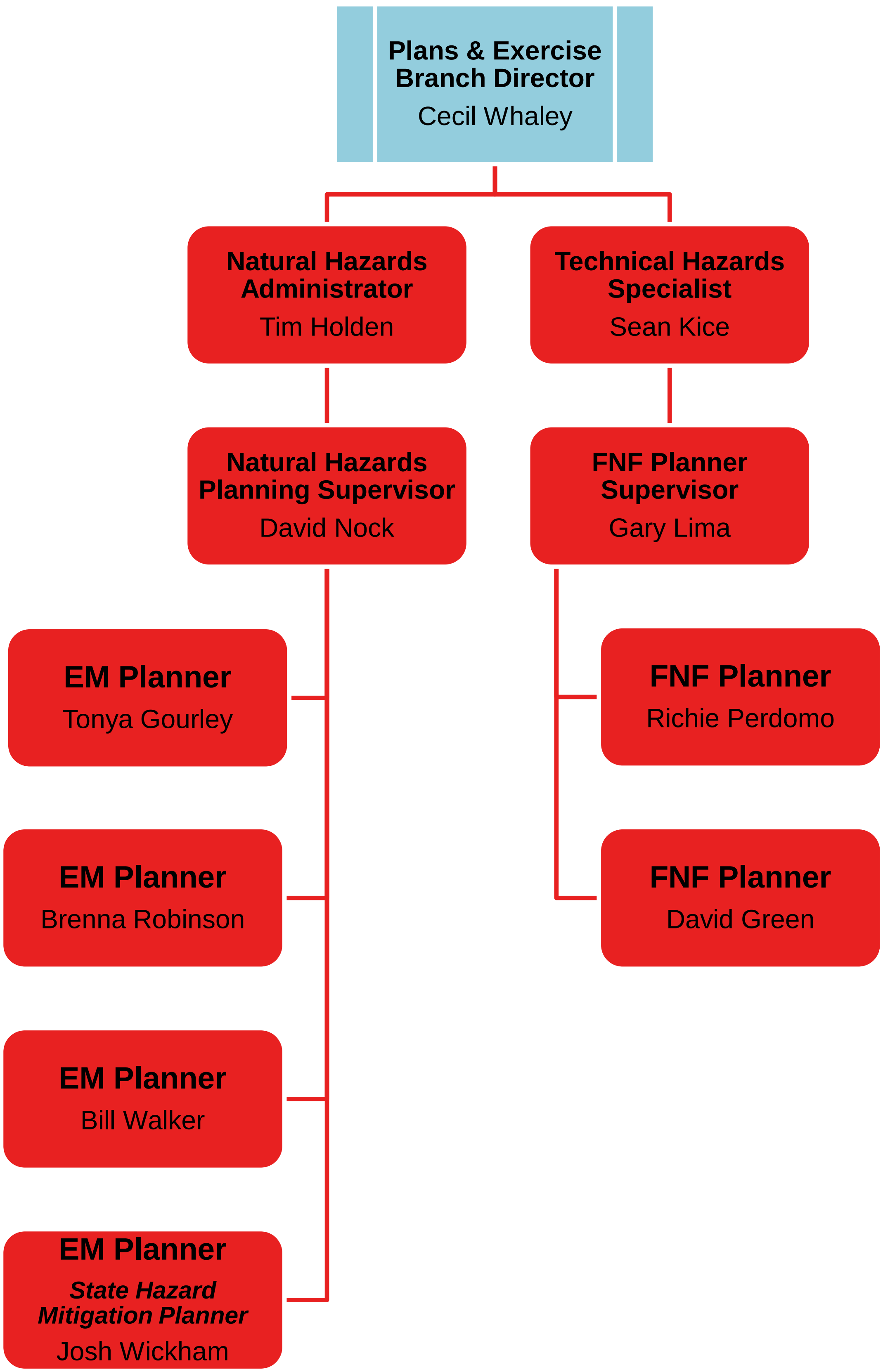
Hazard mitigation objectives help guide the direction of future activities and projects toward reducing risk and preventing losses from disaster events. Additionally, the objectives facilitate cooperation between TEMA and its partner state agencies by creating a clear, succinct, and uniform mission. The State of Tennessee Hazard Mitigation Plan has been developed in alignment with TEMA's mitigation objectives listed below:

- I.) Protect life and prevent injury resulting from all hazards.
- II.) Prevent public and private property damage from all hazards.
- III.) Reduce the long term risk from all hazard events using whole community cooperation.
- IV.) Increase the disaster resiliency of local, state, and regional communities.
- V.) Reduce the disruption caused by disasters to critical infrastructure and essential services.
- VI.) Minimize the disruption caused by disasters to local and state economies.
- VII.) Continue to improve TEMA's mitigation program and its effectiveness.

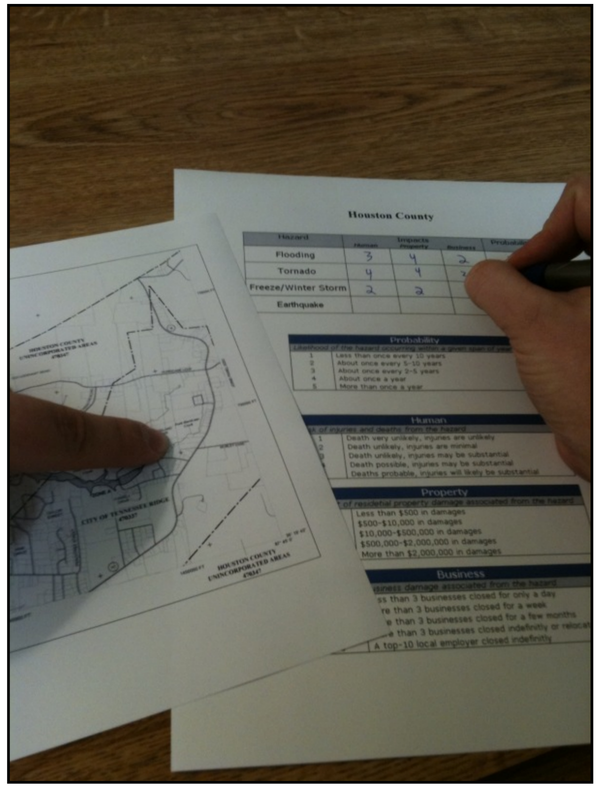
TEMA Organization Chart



Plans & Exercise Branch



Section 1 – Planning Process



Federally approved state and local mitigation plans are a prerequisite for mitigation project grants. Development and FEMA approval of the State of Tennessee Hazard Mitigation Plan will ensure the state's future eligibility for federal disaster mitigation funds through the HMPG, Pre Disaster Mitigation Grant Program (PDM), Repetitive Flood Claims (RFC), SRL, and FMA grant programs.

The plan is maintained and updated in accordance with FEMA's required three year planning cycle. This update strives to improve on the planning methodology of Tennessee's previous hazard mitigation plans. Significant steps have been taken over the past 3 years to improve TEMA's mitigation program, specifically improvements to local plan integration and technical assistance programs. This plan takes further steps in building a robust hazard mitigation program by vastly increasing the accuracy and extensiveness of the risk and vulnerability assessment. This plan's improved risk and vulnerability assessment drives a more effective and capable mitigation strategy.

1.1 – Planning Process Methodology

TEMA sought grant funding from FEMA to update its hazard mitigation plan toward the latter part of the 2010 – 2013 Tennessee Hazard Mitigation Plan cycle. In December 2011, TEMA was awarded an HMGP grant for this purpose. In October of 2012, TEMA released its Request for Proposal (RFP) and began the procurement process for soliciting mitigation planning services. BOLDplanning Inc. was competitively selected based on its general qualifications and experience, technical qualifications and experience, project approach, and cost. In January of 2013, BOLDplanning Inc. was contracted to provide hazard mitigation planning services to TEMA and the State of Tennessee. They serve as the primary plan writers and developers while TEMA would serve as the primary facilitators.

Shortly after the contract was signed by the involved parties, TEMA and BOLDplanning began their work. Project initiation began with a meeting of the primary stakeholders to establish the Hazard Mitigation Planning Committee (HMPC). The core members of the HMPC then established and wrote the projects Standard Operating Procedures (SOP), established expectations, solidified, and accelerated plan development timeline, and created project milestones. Additionally, the team reviewed and discussed how the plan would incorporate EMAP requirements, approach each FEMA requirement, and integrate into TEMA's mitigation program and other emergency management planning efforts. After completing an initial review of the approved 2010 plan, it was agreed upon that the 2013 plan would be submitted and reviewed as a plan update, but would be developed as a complete re-write.

The next step in plan development was to inform, invite, and involve other mitigation plan stakeholders throughout the state. This group includes, but was not limited to, federal agencies, state agencies, regional groups, businesses, non-profits, local emergency management organizations, and the public.

Tapping into the HMPC's now established resources, data was collected on all related state plans and initiatives, local plans' hazard risk, local plans' mitigation strategies and actions, state owned facilities, flood plains, RL/SRL properties, hazard events, on-going and completed mitigation actions, and mitigation program changes since the development of the previous plan. Additionally, all related and relevant state and local plans were reviewed for integration and incorporation.

Following the gathering of resources and data collection phases, the HMPC developed their planning and project management process. These actions outline the processes the HMPC will follow throughout plan development, the methodology to be used, review procedures, details about plan development changes, interagency coordination, planning integration, and the organization and contribution of stakeholders.

Next, the HMPC developed and updated their profile of the State of Tennessee. Although it's not required by FEMA or EMAP, the state profile is essential to a comprehensive and full understanding of the plan's subsequent assessments and analyses.

Following the state profile, the HMPC began its risk and vulnerability assessment. TEMA's hazards list is agency wide as it is incorporated in multiple planning, operations, and training efforts. For this plan various agency branch chiefs met to discuss changes to their hazards list. TEMA put forth an increased effort to improve upon its past risk and vulnerability assessments. It focused on a GIS driven approach to depicting hazard risk and vulnerability. TEMA used hazard specific data which was unavailable in previous years to attain a high level of accuracy. This included using FEMA National Flood Hazard Layer (NFHL), Wildland Urban Interface (WUI), Soil Survey Geographic Database (SSURGO), and other federal and state agency resources. Analyses were conducted at the state level, county by county, of state owned facilities, and county by county drawing on local assessments.

Completing the risk and vulnerability assessment allowed the HMPC to develop their comprehensive mitigation strategy effectively addressing their hazards and mitigation program objectives for the following 3 years. This included identifying state and local capabilities, reviewing pre and post disaster policies and programs, identifying objectives and goals, identifying mitigation actions and projects, and assessing mitigation actions and projects. In order to successfully develop their strategy, the HMPC conducted a series of conferences and meetings to discuss these items and solicit input from the appropriate stakeholders.

An integral part of improving TEMA's mitigation program since the development of the last plan was to significantly increase its capability to provide technical assistance to local mitigation programs and planning efforts. The increase in capability was well documented and reviewed. Further suggestions and plans were made to increase TEMA's ability to integrate state and local planning, align objectives, and develop programs.

Nearing the end of the mitigation plan and establishment of TEMA's program for the next 3 years, the HMPC met to discuss the plan's maintenance cycle. These meetings were necessary to develop and codify the plan's maintenance SOPs and their associated processes. Additionally, a timeline was established to include plan upgrades and improvements based on on-going mitigation projects and actions.

After submitting the plan to FEMA for review and approval, TEMA's director will petition the Governor's Office of the State of Tennessee for a letter of formal plan adoption.

The following documents served as primary sources in the assistance of developing this plan. They were used to provide technical assistance, planning guidelines, and document production procedures. The specific details are as follows.

FEMA Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000
This publication was developed to help states better understand the mitigation planning regulations cited in CFR 44. This document was a cornerstone in developing a state mitigation plan designed to meet and exceed FEMA's planning requirements.

FEMA 386 "How-to" Guides
These publications provided the plans overall format guidance, planning procedures, and risk assessment assistance. The publication is divided into the following guides:

FEMA 386 – 1 – Building Support for Mitigation Planning
FEMA 386 – 2 – Identifying Hazards and Estimating Losses
FEMA 386 – 3 – Identifying Mitigation Actions and Implementation Strategies
FEMA 386 – 4 – Implementing the Hazard Mitigation Plan
FEMA 386 – 5 – Using Benefit Cost Review in Mitigation Planning
FEMA 386 – 6 – Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning
FEMA 386 – 7 – Integrating Manmade Hazards Into Mitigation Planning
FEMA 386 – 8 – Multi-Jurisdictional Mitigation Planning
FEMA 386 – 9 – Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects

FEMA Multi-Hazard Identification and Risk Assessment
This publication is a reference to assist hazard identification, risk assessment, and mitigation specialists in refining the understanding of hazards and their impact on people and their environment.

FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards
This document provides communities a guide to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

FEMA Guidelines and Specifications for Flood Hazard Mapping Partners
This publication details the processes, guidelines, and specifications by which FEMA develops and updates flood insurance rate maps (FIRM) and collateral flood insurance study reports. The mapping assessment guidelines within this document were incorporated into all flood mapping and models produced for this HMP.

Emergency Management Standard, EMAP
This publication details the hazard mitigation planning guidelines and requirements for compliance with EMAP.

1.1.1 – Hazard Mitigation Plan Overview

Section 1 – Planning Process

This section is comprised of planning procedures, processes, and coordination details as they relate to the development of this plan, the previous plan, and events and changes between the development of the last plan and this one. Section 1 covers the FEMA Review Crosswalk requirements under Planning Process: Documentation of the Planning Process, Coordination Among Agencies, and Program Integration.

Section 2 – The State of Tennessee

This section details, tabulates, and maps out various conditions of the State of Tennessee including its topography, climate, rivers and watersheds, transportation systems, demographics, social vulnerability and state facilities. Section 2 is not required by the FEMA review crosswalk. However, a complete picture of the State of Tennessee is necessary for a comprehensive understanding and interpretation of the plan's risk assessment and mitigation strategy.

Section 3 – Hazard Profiles

This section profiles each of Tennessee's identified at-risk hazards. It begins by outlining the sections methodology and the rational for organization and selection of the at-risk hazards. The hazard profiles cover each hazard's description, seasonal and climatic patterns, historical impacts, location and extent, historic events, and EMAP requirements. Section 3 covers the FEMA Review Crosswalk requirements under Risk Assessment: Identifying Hazards, Profiling Hazards, and Severe Repetitive Loss Strategy: Repetitive Loss Mitigation Strategy.

Section 4 – Risk Assessment

This section maps, models, and calculates the hazard risk associated with Tennessee's counties and state owned facilities based on compiled hazard profiles. This plan's risk assessment is heavily GIS driven by HAZUS' earthquake and flood modeling, FEMA's NFHL, the National WUI database, and the United States Department of Agriculture's (USDA) SSURGO database. Additional data was pulled from the US Census Bureau, the TN Office of Information Resources (OIR), and the Department of Homeland Security (DHS). Section 4 covers the FEMA Review Crosswalk requirements under Risk Assessment: Assessing Vulnerability, and Estimating Potential Loss.

Section 5 – Mitigation Strategy

This section details the collaboration between TEMA and its partners to create an effective and realistic mitigation strategy. The mitigation strategy is based on TEMA's mitigation objectives, available resources and the efficient allocation of those resources, the findings of the risk assessment, and cost-benefit analysis. Additionally, it includes state and local assessments of funding capabilities, mitigation programs, mitigation policies, mitigation program development since the adoption of the previous plan, and a capabilities gap analysis. Section 5 covers the FEMA Review Crosswalk requirements under Mitigation Strategy: Hazard Mitigation Goals, State Capability Assessment, Local Capability Assessment, Mitigation Actions, Funding Sources, and Severe Repetitive Loss Strategy: Repetitive Loss Mitigation Strategy.

Section 6 – Local Planning

This section analyzes TEMA's past, current, and future planned for coordination and outreach with local governments. Specifically, it covers how TEMA's new local assistance program has performed and will be expanded, prioritization, and funding processes. Section 6 covers the FEMA Review Crosswalk requirements under Coordination of Local Mitigation Planning: Local Funding and Technical Assistance, Local Plan Integration, Prioritizing Local Assistance, and under Severe Repetitive Loss Strategy: Coordination with Repetitive Loss Jurisdictions.

Section 7 – Plan Maintenance Process
This section details the processes and procedures established for the continual improvement of this plan over the next 3 year cycle. Section 6 covers the FEMA Review Crosswalk requirements under Plan Maintenance Process: Monitoring, Evaluating, and Updating the Plan, and Monitoring Progress of Mitigation Activities.

Appendices
The appendices of this plan cover any and all supplemental information referenced in the previous sections and data tables too lengthy and unnecessary to include in the main body of the plan.

Addendum I – Hazard Event Impact History
This supplementary document contains tables which list the all National Oceanic and Atmospheric Administration (NOAA) and United State Geological Survey (USGS) recorded hazard event impacts.

Addendum II – Risk Assessment Companion
This supplementary document contains charts, tables, and indexes referenced in Section 3 and Section 4 of the HMP.

Addendum III – Local Jurisdiction Compendium
This supplementary document contains a county by county micro assessment derived from the statewide risk assessment, information about the county, and information about the county's local HMP development status.

1.2 – Plan Review Methodology

The 2010 edition of the State of Tennessee Standard Hazard Mitigation Plan was thoroughly reviewed prior to developing this plan. Each section of the 2010 plan was reviewed by multiple hazard mitigation planners from the HMPC. Based on their mitigation expertise they conducted an analysis of each section's total effectiveness detailing the pros and cons of the 2010 edition's methodology, process, and presentation. Their analysis was then cross referenced with the 2010 editions' final FEMA Crosswalk comments and suggestions.

The review analysis of the 2010 plan was paramount in updating and improving this plan to meet and exceed the State of Tennessee and FEMA's requirements and expectations. Using the same criteria, each section of this plan was, at a minimum, reviewed by at least 1 planner at TEMA and a HMPC member at BOLDplanning to maintain the high level of developmental quality. Additionally, certain hazard sections were reviewed by an appropriately experienced subject matter expert.

Plan Review Criteria

Organization & Methodology: is an analysis of the plan's writing, organization, and methodology.

- Does the text flow logically or confuse the reader?
- Does the text appear to jump from topic to topic with no clear direction or is it logically structured with each subsequent paragraph building off of the previous topic?
- Are their appropriate paragraph breaks or is the section 1 long paragraph?
- Does the section attempt to succinctly meet FEMA's requirements or does it contain superfluous amounts of information?
- Does the section logically follow FEMA's requirements or is information split up into multiple sections?

Presentation: is an analysis of the plan's ability to clearly, succinctly, and efficiently convey information.

- Are the plan's tables, charts, and graphs clear, succinct, and well organized or are they off margin, difficult to read, or poorly spaced?
- Do the plan's tables, charts, and graphs contain only relevant information or does it contain information irrelevant to the section?
- Are the plan's tables, charts, and graphs in the correct location, that is, do any tables start in the middle of the page only to be split onto the next?
- Are lists presented clearly using either a bullet point style or another method equally clear?

Data & Assessments: is an analysis of the plan's data practices and risk assessments.

- Is the data up to date or is it the best available data?
- Is the data from a legitimate source and is it cited or is it unknown?
- Do the assessments draw from the data and make logical conclusions? Or does it appear to make conclusions that aren't supported by the data?
- Do the maps and tables assist in depicting hazard risk? Or do they present unnecessary information?

Mitigation Programs: is an analysis of the plan's mitigation strategy, local and state capabilities, and its overall hazard mitigation program.

- Does the mitigation strategy address TEMA's objectives?
- Does the mitigation strategy address the identified hazards?
- Is the mitigation strategy within the means of the state and local government's capabilities?
- Is TEMA's mitigation program appropriate for its objectives, hazards, and capabilities?

1.2.1 – Plan Changes, Updates & Improvements

The State of Tennessee Hazard Mitigation Plan has undergone significant changes since its last edition. Not only has TEMA made significant efforts to improve the plan itself, but it has significantly improved and updated its hazard mitigation program. The level of analysis and detail included in this risk assessment is far greater than the previous editions of the plan. This grants the state's improved and robust hazard mitigation program a more accurate and effective base to further mold and improve its mitigation strategy.

The following table lists and details the updated plan's sections, their content as linked to the previous plan, and each section's content changes, updates, and additions.

Table 1 – Hazard Mitigation Plan Updates		
Updated Plan Section	**Previous Plan Section/s**	**Update Description**
Executive Summary	Foreword	Re-written.
Adoption Resolution	I.	N/A
Introduction to Mitigation	Introduction, II.A, II.B., II.C., III.A.	Included a more detailed description of TEMA, hazard mitigation, and DMA2000.
Section 1 – Planning Process		
1.1 – Planning Process Methodology	III.C., III.F.	Improved the descriptions of the process and cataloged the methodology in a more logical fashion. Revised the plan overview to include greater detail.
1.2 – Plan Update Overview	III.B., III.G.	Improved and more thoroughly described the review methodology for the previous plan as well as this plan. Revised to include a more organized and detailed, section by section, table of plan updates.
1.3 – Hazard Mitigation Planning Committee	III.D., III.E. III.F.	Listed in detail who participated in the plan and described their roles more thoroughly. Listed HMPC members by name and in greater detail. Placed the extensive list in an appendix while leaving the recent meetings in this section. Included more detail on ESC meetings, processes, and successes.
1.4 – Program Integration	III.B., III.G.	Separated out state and federal planning into subsections. Updated list of current state plans, scheduled HMP incorporation into these plans, and detailed how state plans were incorporated into this HMP. Added more federal programs than were mentioned in the previous plan. Updated grant information with additional years and disasters.
Section 2 – The State of Tennessee		
2.1 – Topography	II.D.	Expanded on previous plan's information, expanded the scope, and included maps with updated data.
2.2 – Climate	II.D.	Expanded on previous plan's information, expanded the scope, and included maps with updated data.
2.3 – Rivers & Watersheds	II.D.	Expanded on previous plan's information, expanded the scope, and included maps with updated data.
2.4. – Transportation Systems	II.D.	Expanded on previous plan's information, expanded the scope, and included maps with updated data.

Updated Plan Section	Previous Plan Section/s	Update Description
2.5 – Demographics	II.E.	Expanded on previous plan's information, expanded the scope, and included maps with updated data.
2.6 – Facility & Infrastructure Inventory	N/A	Incorporated the latest HAZUS-MH inventories into the state's profile.
Section 3 – Hazard Profiles		
3.1 – Methodology	IV., IV. Addendum	Broke down methods by subsection and added hazard and data source specific information.
3.2 – Hazard Identification	IV. A., IV. A. Addendum	The state's hazard list was modified and the reason for each change is included in a table.
Section 3NH – Natural Hazards		
3.3D – Droughts	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts map, vulnerability map (agricultural land use), and EMAP compliance.
3.3EQ – Earthquakes	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts map, location and extent map, and EMAP compliance.
3.3ET – Extreme Temperatures	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts map, and EMAP compliance.
3.3F – Floods	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts map, location and extents maps (FEMA NFHL), and EMAP compliance.
3.3G – Geologic Hazards	IV.A., IV.B., VIII.	Added location and extent maps (linear extensibility, landslide zones, and karst formations), and EMAP compliance.
3.3SS – Severe Storms	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts maps, and EMAP compliance.
3.3T – Tornadoes	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts maps, and EMAP compliance.
3.3WF – Wildfires	IV.A., IV.B., VIII.	Added seasonal occurrence data, yearly occurrence data, historical impacts data, a quantitative method for hazard probability, historical impacts map, location and extent maps (WUI), and EMAP compliance.
Section 3MM/T – Man Made & Technological Hazards		
3.3CD – Communicable Diseases	IV. Addendum	Updated NIH, CDC, and WHO data, revised the specific diseases assessed, increased CC burden to incorporate high growth areas.
3.3DLF – Dam & Levee Failure	IV. Addendum	Added statewide dam maps, dam inundation maps, historical incidents, a dam inventory table, and EMAP compliance.
3.3HZM – Hazardous Materials Release	IV. Addendum	Updated EPA criteria, included ATSDR materials and protocols, industrial production site list, DEA registry, and TDEC preparedness info.
3.3II – Infrastructure Incidents	IV. Addendum	Added deficient bridges list, correlated known hazard areas with high value infrastructure, updated financial exposure using new BAE data.

Section 4 – Risk Assessment		
4.1 - Risk Assessment by Local Plan Integration	IV.C., VI.A., VI.B., VI.C., VIII.J.	Added a comprehensive local risk aggregation, local exposure aggregation tables and maps, local risk vulnerability tables and maps, and total local risk aggregated tables and maps.
4.2 - Risk Assessment by Statewide Analysis	IV.C., IV.D., VI.A., VIII.J.	Added a comprehensive statewide risk assessment drawing on a GIS analysis of vulnerability, exposure, and historical occurrences displayed via maps and tables displaying identified hazard risk areas.
4.3 - Population Growth, Development Trends, & Land Use Changes	N/A	Added an economic recap of the State of Tennessee, demographic and industrial growth forecasts, and an assessment on how they will affect the state's risk.
4.4 - Potential Losses by HAZUS Simulation	N/A	Added 2 earthquake and 4 flood HAZUS simulation models complete with casualty and economic impact tables and maps.
4.5 - Vulnerability Assessment of State Property	VIII.J.	Added a map of all state owned and operated properties, applied property location to determined hazard risk areas, estimated property loss based on hazard risk areas.
Section 5 – Mitigation Strategy		
5.1 - Mitigation Goals & Objectives	IV.E., V.A., V.D.	Consolidated natural, man-made, and technological hazard strategies.
5.2 - State Capabilities	V.E.	Added agency contacts, more programs and policies,
5.3 - Changes in State Capabilities	V.E.	Analyzed and detailed new legislation, policies, federal changes, and programs since the approval of the previous HMP.
5.4 - State Capabilities Gap Analysis	N/A	New section
5.5 - Mitigation Actions	V.D., VII.C.	Added STAPLE+E assessments for each action. Added actions master list, and more details for actions.
5.6 - Local Capabilities	V.F.	Expanded details and definitions of local capabilities. Added completed local mitigation projects and actions.
Section 6 – Local Planning		
6.1 - Local Planning Integration	VI.A., VI.E.	Added more details, explanations, and process definitions.
6.2 - Local Planning Assistance	VI.A., VI.E.	Details the creation and implementation of the TMI program, TMI success, and TMI's future prospects.
6.3 - Prioritizing Local Assistance	VI.A., VI.E.	Improved the prioritization and MARS protocols.
Section 7 – Plan Maintenance Process		
7.1 - Plan Monitoring	VII.A., VII.B., VII.D.	Added visual graphics to support the process timeline. Adjusted monitoring process. Added detailed analysis of previous mitigation strategy reporting and grant process. Added details of the new mitigation tracking system.
7.2 - Plan Evaluating	VII.A.	Added visual graphics to support the process timeline. Adjusted evaluation process.
7.3 - Plan Updating	VII.A.	Added visual graphics to support the process timeline. Adjusted plan update process.

1.3 – Hazard Mitigation Planning Committee

The State of Tennessee HMPC is composed of individuals working together for the development and ongoing maintenance of this plan. The HMPC participants are grouped into 2 sub committees, the Principal HMPC, those who actively participated throughout each of the plan phases and are responsible for maintaining the plan, and the Associate HMPC, those who actively participated in at least 1 phase of plan development, provided assistance in the form of technical expertise, delivered data, or provided coordination services. Details on communication and coordination procedures can be found later in this section under subsections 1.3.2 – Agency Coordination and Section 1.3.3 – Hazard Mitigation Planning Committee Meetings.

Principal HMPC

The Principal HMPC was composed of mitigation planners and project managers from BOLDplanning, TEMA's Plans and Exercise Branch, and other state agency representatives. This committee had the primary responsibility of writing and developing the plan as well as the continued maintenance of the plan. Every member worked throughout each phase of plan development. This committee had the final say on the plan's language, maintenance procedures, risk assessment, and the state's mitigation strategy moving forward. TEMA's Plans and Exercise Branch has the responsibility of continuing maintenance of the plan after BOLDplanning's contract is complete. Additionally, TEMA served as the primary coordination entity between BOLDplanning and the Associate HMPC members. Please see Table 2 for a complete list of the Principal HMPC members.

Associate HMPC

The Associate HMPC was composed of any other individual who assisted in the development of the State of Tennessee Hazard Mitigation Plan. The Associate HMPC was largely comprised of members of the Tennessee Emergency Services Coordinator (ESC) Program. Typically, they provided hazard specific assistance, as was the case with Central United States Earthquake Consortium (CUSEC) and earthquakes, or they provided agency specific assistance, as was the case with Tennessee Department of Transportation (TDOT) and transportation networks. Members of the Associate HMPC also provided review and agency approval, as was the case with the ESCs, and in some instances they were participants in on-going collaborative mitigation projects with TEMA, as was the case with the OIR. Please see Table 2 and Table 3 for a complete list of the Associate HMPC members.

1.3.1 – Hazard Mitigation Planning Committee Members

Table 2 – Principal Hazard Mitigation Planning Committee		
Name	**Organization**	**Position**
Josh Wickham	TEMA	State Hazard Mitigation Planner
Cecil Whaley	TEMA	Plans & Exercise Branch Director
Doug Worden	TEMA	State Hazard Mitigation Officer
Tim Holden	TEMA	Natural Hazards Administrator
David Nock	TEMA	Natural Hazards Planning Supervisor
Stan Harrison	ECD	State Floodplain Coordinator
Brenda Apple	TDEC	Commissioners Office Liaison
Derial Bivens	TDOT	Emergency Coordinator
Sgt. Larry Hitchcock	THAP	Emergency Coordinator
Fulton Wold	BOLDplanning	Project Manager
Tony Gertz	BOLDplanning	Lead Mitigation Planner
Johnny Clark	BOLDplanning	Associate Mitigation Planner
Hannah Coffee	BOLDplanning	Associate Mitigation Planner
Tony Ettore	BOLDplanning	Associate Mitigation Planner
Jean-Marie Lawrence	BOLDplanning	Associate Mitigation Planner
Lydia Patritto	BOLDplanning	Associate Mitigation Planner

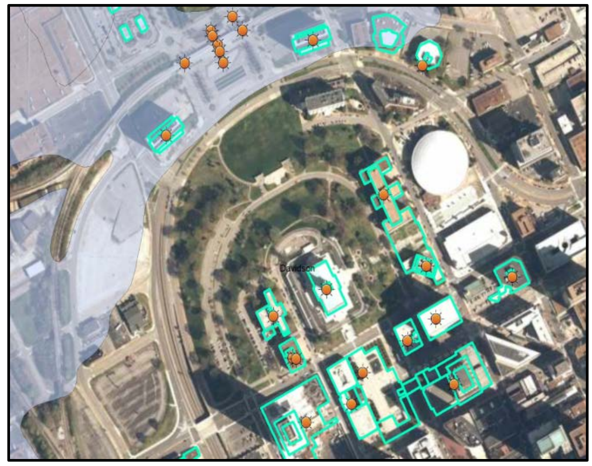
Table 3 – Tennessee Emergency Services Coordinators	
Name	**Organization**
Mark Hutchens	Alcoholic Beverage Commission
Bobby Young	American Red Cross
Rob Mynhier	American Red Cross
Annalisa Zapien-Pina	American Red Cross
Hugh Judd	AT&T
Paul Stinson	AT&T
Michael Meyer	Attorney General's Office
Benjamin A Whitehouse	Attorney General's Office
Mike Cole	Bureau of Tenn Care - Dept. of Finance and Administration
Wendy Long	Bureau of Tenn Care - Dept. of Finance and Administration
James M. Wilkinson Jr.	Central United States Earthquake Consortium (CUSEC)
Maj. Raymond Rader	Civil Air Patrol - TN Wing - USAF Auxiliary
Maj. Chris Joney	Civil Air Patrol - TN Wing - USAF Auxiliary
Lt. Col Vill Lane	Civil Air Patrol - TN Wing - USAF Auxiliary
Lt. Col Vernon Prevatt	Civil Air Patrol - TN Wing - USAF Auxiliary
Capt. Roger Everso	Civil Air Patrol - TN Wing - USAF Auxiliary
Dr. Douglas Balthaser	Dept. of Agriculture
Ronald Murphy Sr.	Dept. of Agriculture
John Kirksey	Dept. of Agriculture - Division of Forestry
Eric Henderson	Dept. of Children's Services
Daphne Billingsley	Dept. of Children's Services
Russell Robinson	Dept. of Commerce and Insurance - Bomb and Arson
Gary West	Dept. of Commerce and Insurance - Consumer Insurance Services
Chris Bainbridge	Dept. of Commerce and Insurance - Consumer Insurance Services
Dan Strickland	Dept. of Correction
Kirk Smith	Dept. of Correction
Mike Hermann	Dept. of Education
Robert E. Lea II	Dept. of Finance and Administration
David Sledge	Dept. of Finance and Administration
Jack McFadden	Dept. of Finance and Administration - Office for Information Resources (OIR)
Drew Jordan	Dept. of Finance and Administration - Office for Information Resources (OIR)
Susanne White	Dept. of Finance and Administration - Office for Information Resources (OIR) - GIS Group
James Alan Robertson	Dept. of Finance and Administration - Real Property Administration
William Bauer	Dept. of Finance and Administration - Real Property Administration
James Snell	Dept. of Finance and Administration - Resource Development and Support (Volunteer TN)
Jamie Dent	Dept. of Finance and Administration - Resource Development and Support (Volunteer TN)
Derek Church	Dept. of Financial Institutions
Bob Eddy	Dept. of Financial Institutions
Mike Perry	Dept. of General Services
John Bissell	Dept. of General Services
Terry Lindsey	Dept. of General Services
Patricia Eachus	Dept. of Health - Communicable Diseases, Chemicals, Pan Flu, Anthrax
Greg Galfano	Dept. of Health - Communicable Diseases, Chemicals, Pan Flu, Anthrax
Donna Tidwell	Dept. of Health - Emergency Medical Services

Name	Organization
Thomas Jaselskis	Dept. of Health - Radiological or Sheltering Assistance
Melanie Pafford	Dept. of Health - Radiological or Sheltering Assistance
Rick Shipkowski	Dept. of Homeland Security
James Cotter	Dept. of Homeland Security
Lisa Spencer	Dept. of Human Resources
Gary Stockton	Dept. of Human Resources
Jerry Jones	Dept. of Human Resources
Ryan Allen	Dept. of Labor and Workforce Development
Steve Hawkins	Dept. of Labor and Workforce Development
Lt. Col Ed Joyce	Dept. of Military - Tennessee Department of the Army and Airforce
Lt. Col Joseph R. Spivey	Dept. of Military - Tennessee Department of the Army and Airforce
David Remke	Dept. of Revenue
Anthony Starnes	Dept. of Revenue
Larry Hitchcock	Dept. of Safety - Tennessee Highway Patrol
Ehrin Ehlert	Dept. of Safety - Tennessee Highway Patrol
Maj. Dereck Stewart	Dept. of Safety - Tennessee Highway Patrol
Capt. Tim Dover	Dept. of Safety - Tennessee Highway Patrol
Tami Giles	Dept. of Tourist Development
Janice Rich	Dept. of Tourist Development
Derial Bivens	Dept. of Transportation
Charles King	Dept. of Transportation
Frank Horne	Dept. of Transportation
Greg Duncan	Dept. of Transportation
Alan G. Durham	Dept. of Transportation
G. Frederick Deltwiller	Dept. of Transportation - Aeronautics
Rick Beals	Dept. of Transportation - Rail and Public Transportation
Paul Davis	Dept. of Transportation - Rail and Public Transportation
Brooxie Carlton	Economic and Community Development
David G Goodman	Economic and Community Development
Robert Brawner	Environment and Conservation - Air Pollution Control
Carol Williams	Environment and Conservation - Air Pollution Control
Brenda Apple	Environment and Conservation - Commissioner's Office
Nick Fielder	Environment and Conservation - Commissioner's Office
Jeff Bagwell	Environment and Conservation - Commissioner's Office
Dale Rector	Environment and Conservation - DOE Oversight Program
Bud Yard	Environment and Conservation - DOE Oversight Program
Mike Hoyal	Environment and Conservation - Geology
Ron Zurawski	Environment and Conservation - Geology
Molly Cripps	Environment and Conservation - Office of Energy Programs
Brian Hensley	Environment and Conservation - Office of Energy Programs
Debra Shults	Environment and Conservation - Radiological Health
Bruce House	Environment and Conservation - Radiological Health
Anthony Hogan	Environment and Conservation - Radiological Health
Roger Donovan	Environment and Conservation - Solid Waste Management
Daniel Roop	Environment and Conservation - Solid Waste Management
Shane Petty	Environment and Conservation - State Park
Daniel Basham	Environment and Conservation - State Park

Name	Organization
Steve Ward	Environment and Conservation - State Park
Chase Lyles	Environment and Conservation - Water Pollution Control
Yatasha Moore	Environment and Conservation - Water Pollution Control
Wayne Muirhead	Environment and Conservation - Water Supply
Roger Hawks	Fire Prevention
Curtis Sulton	Fire Prevention
Gary Farley	Fire Prevention
Melvin Smith	Mental Health and Development - Dept. of Mental Health and Developmental Disabilities
Dennis Temple	Mental Health and Development - State of Tennessee Mental Health and Development Disabilities
Patrick Richmond	Salvation Army
Misty Ratcliff	Salvation Army
Stacy Rhodes	TARS
Rusty Williams	TARS
Jerri Powell	Tennessee Bureau of Investigation
Margie Quin	Tennessee Bureau of Investigation
Mike Cox	Tennessee Bureau of Investigation
LaVerdia McCullough	Tennessee Commission on Aging and Disability
Lauren Brown	Tennessee Commission on Aging and Disability
Mike Burton	Tennessee Department of Environment and Conservation - Oil and Gas Board, Oil well permits
Glenn Burke	Tennessee Department of Environment and Conservation - Oil and Gas Inspector for East Tennessee
Jeff Patton	Tennessee Department of Environment and Conservation - Oil/Gas Inspector
Luke Ewing	Tennessee Department of Environment and Conservation - Water Well permits Geothermal wells
Eddie Burchell	Tennessee Emergency Communication
James Barnes	Tennessee Emergency Communication
Linda Foulks	Tennessee Housing Development Agency
Robert Pack	Tennessee Housing Development Agency
Pete Hut	Tennessee Regulatory Authority - Gas Pipeline Safety Division
Scott Schriver	Tennessee Regulatory Authority - Gas Pipeline Safety Division
James Covington	Tennessee Task Force One
Tim Cornelius	Tennessee Valley Authority - ESF 12
Jim McCarny	Tennessee Valley Authority - ESF 12
Walt Lee	Tennessee Valley Authority - Nuclear
Tim Pitchford	Tennessee Valley Authority - Nuclear
Stephen Nifong	Tennessee Wildlife Resources Agency
W. Glenn Moates	Tennessee Wildlife Resources Agency
Bob Helton	U.S. Coast Guard
Debra Dyer	U.S. Dept. of Energy
Michael Knight	U.S. Dept. of Justice - Bureau of Alcohol, Tobacco, Firearms
Jacqueline Hissam	U.S. Dept. of Justice - Bureau of Alcohol, Tobacco, Firearms
Josh Bobo	U.S. Dept. of the Army - Corps of Engineers
Jerry Breznican	U.S. Dept. of the Army - Corps of Engineers
Kaye Steede	U.S. Dept. of the Army - Corps of Engineers
Kevin Gatlin	U.S. Dept. of the Army - Corps of Engineers
Don Gedge	U.S. Dept. of Transportation - Federal Highway Administration

Name	Organization
Britta Stein	U.S. Dept. of Transportation - Federal Highway Administration
Steve Spurlin	U.S. Environmental Protection Agency
Kimberly Drummer	U.S. Postal Service - Nashville Branch
John Covington	U.S. Postal Service - Nashville Branch
Mark Smith	University of Tennessee Knoxville
Brian Gard	University of Tennessee Knoxville
Michael Wooten	USDA
Thomas Green	VERIZON Wireless
Carolyn Waugh	Veteran's Affairs
Lisa Kiss	Veteran's Affairs
Mike Overcash	Volunteer Organizations Active in Disaster
Brandon Hulette	Volunteer Organizations Active in Disaster
Gary Ward	Volunteer Organizations Active in Disaster
Steve Heim	Volunteer Organizations Active in Disaster
Stephen Guillot	Volunteer Organizations Active in Disaster

1.3.2 – Agency Coordination



TEMA has built an inclusive emergency management coordination program, the ESC Program, which includes not only every state agency, but also non-profits, regional organizations, and private business. Early on in the project, the HMPC met with the ESCs to introduce them to the project and include them in its development.

Through the ESC Program and direct outreach by the HMPC, 8 federal agencies, 50 state departments, agencies, and offices, 4 major Tennessee businesses, and 6 non-profits and regional organizations assisted in the development of this plan.

From project inception to completion the ESC was notified at each of its quarterly meetings of the hazard mitigation plan's progress. Prior to the plan's submission to FEMA, the ESCs were invited to review the plan and provide input. Additionally, the ESC Program was used as a conduit to solicit section reviews as they pertained to specific agency or group; confirm accuracy of data, information, and analysis as it pertained to a specific agency or group; and solicit mitigation strategy ideas as it pertained to a specific agency or group. Where appropriate, the HMPC solicited the assistance of technical experts from various agencies and groups. Examples of this assistance were the technical expertise provided by, the Division of Forestry on wildfires, CUSEC on earthquakes, the United State Army Corps. of Engineers (USACE) and the Tennessee Valley Authority (TVA) on dams and levees, the Department of Health (TDH) on biologic hazards. When the HMPC updated and improved the plan's mitigation strategy, personnel from strategically selected agencies were interviewed to provide input on their mitigation capabilities. Table 4, located on the following page, lists information on these interviews.

Table 4 – Agency Coordination Meetings			
Contact	**Agency**	**Meeting Date**	**Meeting Format**
Dr. Shelly Phillips	USDA Animal and Plant Health Inspection Service	5/6/2013	Conference Call
Brooxie Carlton	TN Dept. Economic & Community Development	5/9/2013	Conference Call
Suzanne White	TN Office of Information Resources	5/10/2013	In Person
Dr. Douglas Balthaser	TN Dept. of Agriculture	5/14/2013	In Person
Greg Galfano	TN Dept. of Health	5/28/2013	In Person
Donna Tidwell	TN Dept. of Health	5/28/2013	In Person
Stan Harrison	TN NFIP Office	5/22/2013	Conference Call
John Kirksey	TN Division of Forestry	5/29/2013	In Person
Greg Galfano	TN Dept. of Health	5/28/2013	In Person
Donna Tidwell	TN Dept. of Health	5/28/2013	In Person
Brenda Apple	TN Dept. of Environment & Conservation	6/11/2013	In Person
Jeff Bagwell	TN Dept. of Environment & Conservation	6/11/2013	In Person
Linda Foulks	TN Housing Development Agency	6/11/2013	In Person
Cecil Whaley	TEMA, Plans & Exercises	6/12/2013	In Person
Doug Worden	TEMA, Mitigation Grants	6/12/2013	In Person
Gary Baker	TEMA, Homeland Security Grants	6/12/2013	In Person
Gary Lima	TEMA, Fixed Nuclear Facilities	6/12/2013	In Person
Mary Lynn Gillingham	TEMA, Public Assistance	6/12/2013	In Person
Andy Rose	TEMA, Hazardous Materials	6/21/2013	In Person
Jill Tokarsky	TEMA, Contracts	6/21/2013	In Person
Sean Kice	TEMA, Radiology	6/21/2013	In Person
Derial Bivens	TN Dept. of Transportation	7/25/2013	In Person

1.3.3 – Hazard Mitigation Planning Committee Meetings

The State of Tennessee HMPC held various public and interagency meetings to discuss the mitigation plan process as well as gain public support and input for the plan. These meetings provided opportunities for local governments, agencies, non-profits, and businesses to be involved in the planning process.

The HMPC notified all members of the Principal HMPC of every planning meeting. The meetings were held using established TEMA SOPs. In the event that an HMPC member was not able to attend TEMA information dissemination SOPs were implemented to maintain a common operating picture among the HMPC members. If an HMPC member was not able to attend a meeting they received an electronic summary of the meeting's agenda and summaries of any and all discussions.

The following lists include a synopsis of the HMPC meetings. Proof of meetings, sign in sheets, and notification documentation can be found in Appendix A – Planning Process Documentation. For a complete list of Tennessee hazard mitigation planning meetings held for previous Tennessee state mitigation plans, please reference Appendix B – Prior Plan Development. (III-13 to III-17)

This subsection is broken down into 2 chronological groups of meetings: *Pre Plan Development Meetings (August 2010 - February 2013)* and *Mitigation Plan Development Meetings (February 2013 - August 2013)*.

The first grouping, *Pre Plan Development Meetings*, shows what efforts TEMA has made to promote hazard mitigation planning across the state since the previous State Hazard Mitigation Plan was completed in August 2010 up until February 2013 when TEMA switched focus to the State Hazard Mitigation Plan rewriting process. The *Pre Plan Development Meetings* grouping largely focuses on local government planning outreach where the State Hazard Mitigation Planner went into communities to assist them in developing local hazard mitigation plans. While the focus of these meetings was local mitigation plans, at all of the meetings the State Hazard Mitigation Plan was spoken about and local government suggestions for new actions to incorporate into the State Mitigation Strategy were noted.

The second grouping, *Mitigation Plan Development Meetings*, shows what meetings have taken place since February to develop the 2013 State Hazard Mitigation Plan. This *Mitigation Plan Development Meetings* grouping focuses largely on Principle HMPC meetings, ESC meetings, and subject-matter expert meetings.

Pre Plan Development Meetings (Aug. 2010 – Feb 2013)

The following table documents local hazard mitigation plan outreach meetings which were facilitated by the State Hazard Mitigation Planner between August 2010 and February 2013. At each of these meetings the State Hazard Mitigation Plan was spoken about and local government suggestions for new actions to incorporate into the State Mitigation Strategy were noted.

Table 5 – Mitigation Planning Outreach to Local Governments

Jurisdiction	Date	Jurisdiction	Date	Jurisdiction	Date
Marshall Co.	8/4/2010	Dickson Co.	8/6/2010	Shelby Co.	8/16/2010
Maury Co.	8/24/2010	Sumner Co.	8/30/2010	Perry Co.	9/21/2010
Wayne Co.	9/23/2010	Shelby Co.	9/27-29/10	Rutherford Co.	10/19/2010
Clay Co.	10/23/2010	Wayne Co.	11/2/2010	Houston Co.	12/21/2010
Montgomery Co.	1/7/2011	Stewart Co.	1/7/2011	Franklin Co.	1/18/2011
Coffee Co.	1/18/2011	Humphreys Co.	1/20/2011	Houston Co.	1/24/2011
Giles Co.	2/1/2011	Stewart Co.	2/3/2011	Perry Co.	2/10/2011
Williamson Co.	2/17/2011	Putnam Co.	2/22/2011	Jefferson Co.	2/24/2011
Sevier Co.	2/24/2011	Cocke Co.	2/24/2011	Hamblen Co.	2/24/2011
Humphreys Co.	3/3/2011	Trousdale Co.	3/4/2011	Warren Co.	3/10/2011
Trousdale Co.	4/14/2011	Coffee Co.	4/19/2011	Robertson Co.	4/21/2011
Smith Co.	6/1/2011	Cumberland Co.	6/2/2011	Morgan Co.	6/2/2011
Sevier Co.	6/9/2011	Cocke Co.	6/9/2011	Hamblen Co.	6/10/2011
Jefferson Co.	6/10/2011	Williamson Co.	6/15/2011	Warren Co.	6/28/2011
Smith Co.	7/14/2011	Cumberland Co.	7/19/2011	Morgan Co.	7/19/2011
MTSU	7/27/2011	Robertson Co.	8/4/2011	Franklin Co.	8/10/2011
Lewis Co.	8/16/2011	Lawrence Co.	8/17/2011	MTSU	8/22/2011
Grainger Co.	9/1/2011	Hancock Co.	9/1/2011	Hawkins Co.	9/1/2011
Claiborne Co.	9/1/2011	Moore Co.	9/6/2011	Clay Co.	9/7/2011
Overton Co.	9/7/2011	Pickett Co.	9/12/2011	Scott Co.	9/12/2011
Fentress Co.	9/12/2011	Williamson Co.	10/3/2011	Lawrence Co.	10/5/2011
Hickman Co.	10/5/2011	McMinn Co.	10/7/2011	Monroe Co.	10/7/2011
Meigs Co.	10/7/2011	Lewis Co.	10/12/2011	Williamson Co.	10/14/2011
Overton Co.	10/27/2011	Robertson Co.	11/3/2011	Claiborne Co.	11/15/2011
Hawkins Co.	11/15/2011	Grainger Co.	11/16/2011	Hancock Co.	11/16/2011
Hickman Co.	11/30/2011	Clay Co.	12/6/2011	Fentress Co.	12/7/2011
Pickett Co.	12/7/2011	Scott Co.	12/8/2011	Moore Co.	1/5/2012
Meigs Co.	1/11/2012	McMinn Co.	1/11/2012	Loudon Co.	1/12/2012
Monroe Co.	1/12/2012	DeKalb Co.	1/20/2012	Bradley Co.	1/23/2012
Marshall Co.	1/31/2012	Rhea Co.	2/13/2012	Bledsoe Co.	2/13/2012
DeKalb Co.	3/14/2012	Rhea Co.	3/27/2012	Bledsoe Co.	3/27/2012
Maury Co.	4/11/2012	White Co.	5/8/2012	Macon Co.	5/8/2012
Lauderdale Co.	5/16/2012	Maury Co.	6/7/2012	Lauderdale Co.	6/12/2012
Macon Co.	6/14/2012	White Co.	6/14/2012	Johnson Co.	6/25/2012
Carter Co.	6/25/2012	Sullivan Co.	6/26/2012	Greene Co.	6/26/2012
Benton Co.	8/21/2012	Wilson Co.	9/19/2012	Benton Co.	10/23/2012
Wilson Co.	10/31/2012	White Co.	11/16/2012	Grundy Co.	1/24/2013
Blount Co.	2/26/2013	Hawkins Co.	2/27/2013	Wilson Co.	3/4/2013
Bedford Co.	3/5/2013	Grundy Co.	3/26/2013		

The following table documents additional outreach meetings between August 2010 and February 2013 where the State Hazard Mitigation Planner presented components of the State Hazard Mitigation Plan to regional groups, conferences, and events.

Table 6 – Mitigation Planning Outreach at Regional Events

Conference	Date
TN Association of Utility Districts Meeting	4/5/12
TEMA Grants & Contracts Section Meeting	6/28/12
TN Association of Floodplain Managers Conference	7/25/12
TN Government Finance Officers Association Conference	10/18/12
Army Corps of Engineers Meeting	11/28/12

Mitigation Plan Development Meetings (February 2013 – August 2013)

The below table documents the meetings that took place to develop the 2013 State Hazard Mitigation Plan. Following this table are descriptive narratives of each meeting.

Table 7 – Mitigation Plan Development Meetings

Meeting Title	Date
Kickoff Meeting	2/15/2013
State Facilities Risk Assessment Meeting	2/28/2013
ESC Meeting #1	3/1/2013
Hazard Identification Revision Meeting	3/14/2013
Sections 1 & 2 Review Meeting	3/27/2013
NOAA National Weather Service Meeting	4/29/2013
USDA Animal & Plant Health Inspection Service Meeting	5/6/2013
TN Dept. of Economic & Community Development Meeting	5/9/2013
TN Office of Information Resources Meeting	5/10/2013
TN Dept. of Agriculture Meeting	5/14/2013
TN NFIP Office Meeting	5/22/2013
TN Dept. of Health Meeting	5/28/2013
TN Div. of Forestry Meeting	5/29/2013
ESC Meeting #2	6/7/2013
TN Div. of Geology Meeting	6/7/2013
TN Housing Development Agency Meeting	6/11/2013
TN Dept. of Environment & Conservation Meeting	6/11/2013
Sections 3 & 4 Review Meeting	6/12/2013
FEMA Risk Assessment Preliminary Review	6/14/2013
Mitigation Goals, Objectives, & Actions Meeting	6/19/2013
Sections 5 Review Meeting	7/9/2013
TN Dept. of Transportation Meeting	7/25/2013
TN Association of Floodplain Managers Conference	7/30/2013
Sections 6 & 7 Review Meeting	8/2/2013
Final Plan Review Meeting	8/7/2013

Kickoff Meeting: State Mitigation Plan
15 February 2013

To initiate the 2013 plan development process, members of TEMA's Planning and Grant Sections, along with the director of TEMA, met with BOLDplanning Solutions representatives on February 15, 2013. At this meeting both TEMA and BOLDplanning representatives reviewed and discussed each other's expectations, objectives, and proposed timelines. Through this discussion process these 2 groups formed a singular vision for the State of Tennessee Hazard Mitigation Plan Update. This gathering was the first step toward what would become the Principal HMPC group.

It was agreed upon that the Hazard Mitigation Plan should be rewritten from scratch to better fulfill federal requirements, to improve the readability and organization of the plan, and to create a planning structure that would be easier to implement. The act of this complete rewrite would signify Tennessee's commitment to hazard mitigation which has been gaining momentum across the state since 2010.

It was decided that TEMA's State Hazard Mitigation Planner would act as BOLDplanning's primary point-of-contact throughout the project. The State Hazard Mitigation Planner's primary roles would include coordinating meetings/interviews, collecting data for the consultants to utilize, reviewing deliverables, and monitoring the overall development of the plan. BOLDplanning's primary responsibilities would include managing the project, performing data analysis, constructing the plan drafts, and making sure that both FEMA and EMAP requirements were being satisfied.

To better coordinate the development of the plan, TEMA leadership said they would establish an office space across from the State Hazard Mitigation Planner's office that BOLDplanning consultants would be able to utilize for the duration of the project. This approach proved beneficial in that the State Hazard Mitigation Planner and BOLDplanning Project Managers were able to have daily interactions and streamlined decisions throughout the plan's development.

TEMA and BOLDplanning agreed that the next few weeks would be dedicated to gathering existing datasets needed for the plan and to determine where data discrepancies may occur. To coordinate this the State Hazard Mitigation Planner would provide BOLDplanning with local mitigation plans, TEMA plan tracking charts, agency SOPs and all-hazard plans, interagency contact sheets, existing GIS shapefiles, etc.

An additional outcome of this meeting was that TEMA should consider a slight reorganization of the plan's "hazards of prime concern" list. TEMA personnel would eventually meet the next month to conduct this hazard list review.

At the conclusion of this meeting the proposed plan development timeframe was agreed upon as the following:

- Milestone 1: Pre-Planning, Planning Process Implementation, and Data Review and Gathering. ***Due Date: 4/1/13***
- Milestone 2: Hazard Analysis and Vulnerability Assessment/Risk Assessment. ***Due Date: 5/31/13***
- Milestone 3: Setting Goals, Objectives, and Strategies and Coordination of Local Mitigation Planning. ***Due Date: 6/29/13***
- Milestone 4: Finalization of the Plan. ***Due Date: 7/30/13***
- Milestone 5: Final Revisions. ***Due Date: 8/28/13***

Please see *Appendix A – Planning Process Documentation* for additional documentation.

State Facilities Risk Assessment Meeting: State Mitigation Plan
28 February 2013

After reviewing existing datasets required to update the plan, the main discrepancy identified dealt with the lack of data on the physical locations of state-owned facilities. CFR 201.4(c)(2)(ii) requires a State Hazard Mitigation Plan to describe vulnerability in terms of *"state owned critical or operated facilities located in the identified hazard areas."* Because approximately one-fourth of Tennessee's state-owned facilities database contained incorrect or unidentified addresses, this data discrepancy would prove to be a difficult obstacle to tackle when attempting to conduct a comprehensive state-owned facility risk assessment.

To assist the state in bettering the state-owned facility risk assessment, Principle HMPC members scheduled a meeting with the State Office of Information Resource's GIS Group. At this meeting the TN OIR GIS Group stated they are currently developing a data collection website to promote the creation of a singular, accurate geocoded GIS dataset of all state-owned facilities. The Principle HMPC agreed that this GIS dataset could eventually be utilized in conducting a comprehensive HAZUS-MH risk assessment model for flooding and earthquakes events.

TEMA leadership stated that the agency would support the OIR GIS Group by providing financial support, website testing and review abilities, training space and computers to teach personnel how to use the website, and by providing the OIR GIS Group a platform to present the website to all state-agencies at once during an ESC meeting. The State Hazard Mitigation Planner was selected to coordinate these activities.

Additionally TEMA leadership asked if the data collection website could include a category to enter information regarding how well a certain state facility could be used as a shelter. The OIR GIS Group said they could easily do this.

ESC Meeting #1: State Mitigation Plan
1 March 2013

In order to promote a "whole community" participation approach in developing the plan update, Principle HMPC members stated that presenting at the statewide Emergency Service Coordinators meeting would be the best way to get all stakeholders involved in the planning process from the start. The group of individuals invited to the State's ESC meeting would make up the majority of what would become the Associate HMPC.

At the ESC meeting, TEMA's State Hazard Mitigation Planner gave a 30-minute presentation on the 2013 State Hazard Mitigation Plan Update process. There were 94 persons in attendance at this presentation, which represented 44 state agencies, 3 federal agencies, 4 non-profit organizations, and 4 private businesses. Table 8 on the following page lists TEMA's ESC partners that were in attendance.

Table 8 – ESC Partners in Attendance

State Partners	
TN Department of Agriculture	TN Division of Forestry
TN Department of Children's Services	TN Department of Commerce & Insurance
TN Division of Fire Prevention	TN Bomb & Arson Investigation Section
TN Emergency Communications Board	TN Department of Correction
TN Dept. of Economic & Community Development	TN Dept. of Environment & Conservation
TN Division of Air Pollution Control	TN Division of Radiological Health
TN Division of Solid & Hazardous Waste Mgmt.	TN Division of State Parks
TN Division of Water Pollution Control	TN Division of Water Supply
TN Department of Financial Institutions	TN Department of Finance & Administration
TN Office of Information Resources	TN Division of Real Estate Administration
TN Department of General Services	TN Department of Health
TN Division of Communicable Diseases	TN Division of Emergency Medical Services
TN Department of Human Services	TN Dept. of Labor & Workforce Development
TN Department of Mental Health	TN Department of Military
TN Emergency Management Agency	TN Department of Revenue
TN Department of Safety	TN Office of Homeland Security
TN Highway Patrol	TN Department of Transportation
TN Division of Multimodal Trans. Resources	TN Department of Veteran's Affairs
TN Regulatory Authority	TN Division of Gas Pipeline Safety
TN Wildlife Resources Agency	TN Housing Development Agency
TN Commission on Aging & Disability	TN Bureau of Investigation
TN Office of Attorney General	TN Department of Tourist Development
Federal Partners	
United States Department of Transportation	Tennessee Valley Authority
United States Department of Agriculture	
Private Business Partners	
BOLDplanning Solutions	Kimley-Horn and Associates
AECOM	AT&T
Volunteer Partners	
US Air Force Auxiliary- Civil Air Patrol	American Red Cross
Salvation Army	Voluntary Organizations Active in Disasters

The ESC State Mitigation Plan presentation included topics such as:

- What is hazard mitigation?
- What are hazard mitigation plans?
- Why are hazard mitigation plans important?
- How are hazard mitigation plans tied to grant funding?
- What efforts has TEMA made to promote hazard mitigation and to assist local governments in developing hazard mitigation plans?
- What are the components of a state hazard mitigation plan?
- Who is BOLDplanning Solutions and how will they assist Tennessee in rewriting the state hazard mitigation plan?
- What are the main areas the Principle HMPC wants to put extra focus on?
- How can you and other interested stakeholders become an active part of the 2013 state mitigation planning process?

The overall perception of the state mitigation plan presentation to ESC members was very supportive. At one point in the presentation, when a 2010 map of approved local mitigation plans was shown followed by a 2013 map of approved local mitigation plans, a round of supportive applause ensued across the room. Many attendees committed that they finally understand what the term "hazard mitigation" truly means. Additionally a few attendees stated that they would like to be interviewed so their suggestions/roles could be included in the plan update. Every attendee that requested to be interviewed was later interviewed.

The Principle HMPC agrees that this meeting set the tone for later collaboration and data collection that took place throughout the plan's development.

Please see *Appendix A– Planning Process Documentation* for additional documentation.

Hazard Identification Revision Meeting: State Mitigation Plan
14 March 2013

As discussed at the State Hazard Mitigation Plan's kickoff meeting, representatives for each TEMA branch, along with the Director of TEMA, met to reorganize the state's "Hazards of Prime Concern List". This list serves multiple purposes, such as being the basis for the State Hazard Mitigation Plan, the Tennessee Emergency Management Plan, the State's Comprehensive Exercise Program, and multiple grant requirements. The old "Hazards of Prime Concern List," as seen in the 2010 State Hazard Mitigation Plan, is as follows:

The committee made the following changes to the list after detailed discussions:

- The "fire" hazard boundaries were changed to not include the particular sub-hazard "urban/house fire." The way "fire" was profiled in the 2010 State Hazard Mitigation Plan included both "urban/house fire" and "wildfire." After some discussions among committee members, it was decided that the sub-hazard "urban/house fire" should be removed and that the plan should only include "wildfire." The justification for these changes includes the following: (1) "Urban/house fire" should be in local-level risk assessments, but "house fires" typically wouldn't be considered a hazard of prime concern for a state-level risk assessment. (2) State government doesn't really have response assets for "house fires": local governments have those assets. DHS NEP guidelines require exercising all hazards of prime concern and the state doesn't need to exercise "house fires." (3) The 2010 State Hazard Mitigation Plan only had 2 paragraphs dedicated to "urban/house fires," which isn't enough to justify its existence. Over 95% of the "fire" risk assessment was dedicated to wildfires in the 2010 State Hazard Mitigation Plan. (4) In FEMA Region IV, most all other states only address "wildfire" as the fire category in their State Hazard Mitigation Plans.

- For the hazard "severe storm & severe winter storm" the committee decided to change the generic title of the hazard to "severe weather." The committee deemed the original title as being too long and wordy. Also "severe weather" is the term most often used by TEMA, therefore it seemed fitting.
- For the hazard "biologic" the committee decided to change the generic title of the hazard to "communicable disease." The committee deemed that the original title didn't seem descriptive enough for the hazard. Some committee members stated that "biologic" could also refer to "hazardous materials" or "terrorism" which is outside what the original term meant to describe. The committee agreed with the TN Department of Health's suggestion of using the title "communicable disease" instead because it better describes the hazard's original intent.
- For the hazard "hazardous material" the committee decided to add the word "release" to the end of its title. This is because hazardous materials alone aren't a threat; it is the release of hazardous materials that makes it a threat.
- Lastly, the committee decided to combine 3 2010 State Mitigation Plan hazards ("communications failure," "energy failure," and "transportation") into 1 hazard ("infrastructure incident"). The reasons for this change are as follows: (1) DHS NEP guidelines require exercising all hazards of prime concern. The committee thought it would be more advantageous to exercise all 3 of these "infrastructure" hazards at the same time under 1 category. (2) Under Tennessee's Emergency Service Function system, Transportation (ESF-1), Communications (ESF-2), and Energy (ESF-12) all fall under the "Infrastructure Section," therefore the committee saw it fitting to combine the 3 hazards under the new title "infrastructure incident."

Table 9 – Hazards of Prime Concern

2010 Tennessee Hazards of Prime Concern	
1. Drought	9. Biologic
2. Earthquake	10. Communications Failure
3. Extreme Temperature	11. Dam/Levee Failure
4. Fire	12. Energy Failure
5. Flood	13. Hazardous Materials
6. Geologic	14. Terrorism
7. Severe Storm & Severe Winter Storm	15. Transportation
8. Tornado	
2013 Tennessee Hazards of Prime Concern	
1. Drought	8. Tornado
2. Earthquake	9. Communicable Disease
3. Extreme Temperature	10. Dam/Levee Failure
4. Wildfire	11. Hazardous Material Release
5. Flood	12. Terrorism
6. Geologic	13. Infrastructure Incident
7. Severe Weather	

One additional item of discussion which took place was climate change. In recent years some states have started to address climate change as a hazard of prime concern. After various decisions, committee representatives decided not to profile climate change in this year's State Hazard Mitigation Plan Update for 2 main reasons. First, some committee members deemed climate change as more of a "condition" than a "hazard." For example, it is a condition because it amplifies the impacts and occurrences of already existing natural hazards of prime concern. Second, the committee decided that the state should wait for formal federal guidance on how to address climate change in mitigation plans before fully incorporating it. Because of continuing climate change debates and unaddressed questions, *(such as what types of climate change mitigation actions qualify for FEMA mitigation grants and how does a state conduct a state-specific cost benefit analysis (CBA) to justify climate change mitigation actions?)*, the state will wait for further federal guidance.

From this meeting the newly constructed 2013 Hazards of Prime Concern has allowed the State Hazard Mitigation Plan's Risk Assessment to be more organized and better defined.

Please see *Appendix A– Planning Process Documentation* for additional documentation.

Sections 1 & 2 Review Meeting: State Mitigation Plan
27 March 2013
On March 27, 2013 the Principle HMPC met to review the draft of Sections 1 & 2 of the State Plan as prepared by BOLDplanning. Both sections were entirely rewritten in an effort to improve the quality of the plan. Additionally, the Principle HMPC placed a renewed focus on reaching out to a "whole community" of stakeholders during the planning process which would be captured within Section 1.

Because Principle HMPC members were very active in this section's development process, the draft closely met everyone's expectations. Section 1 was based primarily around fulfilling planning process requirements and Section 2 provided an overview of the State of Tennessee, which is not a federal requirement to profile.

Because the planning process would last the entire duration of the plan's development, Section 1 was considered a shell that additional meetings would be included in as completed. Principle HMPC members suggested 3 main revisions: 1) creating a page header that represented all of Tennessee and not just TEMA, 2) a more detailed explanation of Tennessee's ESC system, and 3) a map that displays the physiographic regions of Tennessee as narrated in Section 2. BOLDplanning was able to fulfill all requests within that week.

NOAA National Weather Service Meeting: State Mitigation Plan
29 April 2013
As major strides were becoming completed within the Plan's Hazard Profile and Risk Assessment Sections, TEMA/BOLD planners solicited assistance from the National Weather Service- Nashville Office in completing the Tornado profile section. Meteorologists Tom Johnston and Mark Rose provided 8 suggestions in reviewing draft excerpts. Additionally NWS was able to explain to planners how they collect the data that is entered into the National Climatic Data Center's Storm Events Database; the most widely used database in mitigation planning.

USDA Animal & Plant Health Inspection Service Meeting: State Mitigation Plan
6 May 2013
To gather expertise needed for the Man-Made Hazards Risk Assessment sections and for the plan's Capability Assessment subsection, TEMA/BOLD planners established a conference call with Tennessee Epidemiology Officer Dr. Shelly Phillips and Emergency Coordinator Mike Wooten of the United States Department of Agriculture Animal & Plant Health Inspection Service (AEPHIS). Through this conference call USDA was able to provide planners with information regarding the National Animal Health Monitoring System, the National Surveillance Unit (NSU), and the Animal Disease Risk Assessment, Prevention, & Control Act.

TN Dept. Economic & Community Development Meeting: State Mitigation Plan
9 May 2013
In Tennessee the most used federal funding source for hazard mitigation projects that is outside of FEMA's Hazard Mitigation Grant Programs, is the U.S. Dept. of Housing and Urban Development's (HUD) Community Development Block Grant Program (CDBG) administered by the Tennessee Department of Economic & Community Development. To fully capture the importance of this funding stream in the plan's Capability Assessment subsection, TEMA/BOLD planners scheduled a conference call with TN Department of Economic and Community Development (TN ECD) Federal Programs Administrator Brooxie Carlton. Ms. Carlton explained to the planners how the CDBG program works and what steps local governments need to take to obtain funding for hazard mitigation related projects. She then explained how HUD's circumstantial CDBG "Disaster Recovery" funding stream, which Tennessee received after recent disasters, was being administered and implemented. Planners also reaffirmed with Ms. Carlton how TEMA has and will continue to promote the CDBG program within their local hazard mitigation planning outreach program.

TN Office of Information Resources Meeting: State Mitigation Plan
10 May 2013
On May 10th TEMA/BOLD planners met with Tennessee Office of Information Resources GIS Group Managers Dennis Pederson and Suzanne White to discuss how OIR developed an interactive state floodplain mapping website and to discuss what steps are being taken to promote the acquisition of Light Detection and Ranging data (LiDAR). LiDAR, a radar detection system that measures distance by illuminating a target with a laser and then by analyzing its reflected light, is the key component toward improving the state's floodplain mapping accuracy. These discussion points would later be added to the plan's Capability Assessment subsection as well as be included as mitigation actions within the plan's Mitigation Strategy section.

TN Dept. of Agriculture Meeting: State Mitigation Plan
14 May 2013
To gather expertise needed for the Man-Made Hazards Risk Assessment sections and for the plan's Capability Assessment subsection, TEMA/BOLD planners met with Tennessee Department of Agriculture's Veterinarian/Emergency Coordinator Dr. Doug Balthaser. Dr. Balthaser explained how Agriculture representatives conduct mitigation actions, how hazard vulnerabilities to livestock are profiled, and how the Disaster Animal Response Team (DART) works throughout Tennessee.

TN National Flood Insurance Program (NFIP) Office Meeting: State Mitigation Plan
22 May 2013
With flooding events being a major hazard of concern in Tennessee, TEMA/BOLD planners established a conference call with the state's NFIP manager, Stan Harrison, of Tennessee's Department of Economic & Community Development. Mr. Harrison is in regular contact with the State Hazard Mitigation Planner so this conference call was less about gathering information and more about determining what specific flood mitigation strategies/capabilities should be profiled in the plan rewrite. It

was determined that for the next few years the state should put more focus on promoting the NFIP's Community Rating System (CRS). With the development of the Biggert-Waters Flood Insurance Reform Act of 2012, some Tennesseans will be seeing increases in their flood insurance rates. The voluntary CRS program for NFIP-participating communities could reward communities that implement effective floodplain management practices by reducing flood insurance rates to their citizens.

TN Dept. of Health Meeting: State Mitigation Plan
28 May 2013
To better complete the Man-Made Hazards Risk Assessment sections and the Capability Assessment subsection of the plan, TEMA/BOLD planners established a meeting with Tennessee Department of Health Representatives Donna Tidwell *(EMS Coordinator)*, Dr. Patricia Eachus *(Public Health Emergency Preparedness Director)*, and Greg Galfano *(Communicable Diseases Planner)*. At this meeting the health representatives explained how state emergency programs worked such as: bioterrorism preparedness; hospital preparedness; the Disaster Support Network (TDSN); the Emergency Medical Awareness; Response, and Resources program; the Healthcare Resource Tracking System (HRTS); amongst other health-related topics.

TN Div. of Forestry Meeting: State Mitigation Plan
29 May 2013
On May 29th TEMA/BOLD planners met with John Kirksey *(Wildfire Operations Chief)* of Tennessee's Division of Forestry to have an hour-and-a-half discussion on wildfire threats and mitigation strategies. In March of this year, East Tennessee experienced a wildfire event that destroyed approximately 60 resort cabins and buildings, impacted approximately 160 acres, and required 150 persons to be evacuated. With this event fresh in everyone's mind, Mr. Kirksey stated that the state needs to continue guiding local communities in creating Community Wildfire Protection Plans (CWPP) and to assist communities qualify as "FireWise." TEMA/BOLD planners would later add these and other discussion points into the mitigation strategy, capability assessment, and risk assessments sections of the plan.

ESC Meeting #2: State Mitigation Plan
7 June 2013
To continually promote a "whole community" participation approach throughout the entirety of the planning process, another State Hazard Mitigation Plan Update presentation was provided at an Emergency Service Coordinator meeting on June 7th. The primary focus of this presentation was to address the main data discrepancy facing TEMA/BOLD planners in the plan rewrite process; the lack of data on physical locations of state-owned facilities needed to conduct a comprehensive state-owned facility risk assessment, as required by CFR 201.4(c)(2)(ii).

At this ESC meeting, TEMA's State Hazard Mitigation Planner introduced Suzanne White with the Tennessee Office of Information Resources GIS Group who would train attendees on how to use the newly created data collection website that allows representatives to accurately geocode their particular department's state-owned facilities.

In attendance at this presentation there were 88 persons that represented 45 state agencies, 4 federal agencies, 3 non-profit organizations, and 2 private businesses.

ESC attendees highly supported the TEMA funded and OIR developed website and how this dataset could benefit not only the State Hazard Mitigation Plan, but also future COOP Planning Initiatives, State-Supposed Sheltering Operations, and how it could even contribute to adjustments in State Government Insurance Rates.

Please see *Appendix A– Planning Process Documentation* for additional documentation.

TN Div. of Geology Meeting: State Mitigation Plan
7 June 2013

Following the ESC meeting, TEMA/BOLD planners met with State Geologist Ron Zurawski of the Tennessee Division of Geology. Mr. Zurawski provided much insight into ways to profile earthquake and geologic *(land subsidence, landslides, expansive soils)* hazards in the risk assessment section of the plan update. Additionally he provided planners with useful contacts and maps to utilize within planning efforts.

TN Housing Development Authority Meeting: State Mitigation Plan
11 June 2013

On July 11th, TEMA/BOLD planners met with Linda Foulks of the Tennessee Housing Development Authority (THDA) to gather input to incorporate into the Capability Assessment subsection of the plan. Ms. Foulks described THDA programs such as the Emergency Repair Program, the TNHousingSearch.org rental locator, and the Rebuild and Recovery Program which THDA is currently developing in coordination with TEMA. In terms of mitigation, Ms. Foulks thought the Rebuild and Recover Program would work well in the plan because this program would streamline housing assistance to areas affected by natural disasters.

TN Dept. of Environment & Conservation Meeting: State Mitigation Plan
11 June 2013

On June 11th TEMA/BOLD planners met with representatives of the Tennessee Department of Environment and Conservation (TDEC) to obtain differing perspectives to incorporate into the plan rewrite. Jeff Bagwell (Division of Water Resources) and Brenda Apple (Commissioner's Office) described initiatives their department were conducting such as emergency/mitigation planning for public water utility systems, the streamlining of environmental and historic reviews required for federal mitigation grant applications, and the monitoring of the state's dam/levee safety program. Additionally, (TDEC) expressed interest in creating a local government debris management planning program which the State Hazard Mitigation has also heard echoed by multiple local governments.

Sections 3 & 4 Review Meeting: State Mitigation Plan
12 June 2013

On June 12, 2013 the Principle HMPC met to review the draft of Sections 3 & 4 as prepared by BOLDplanning. Both sections were entirely rewritten and expanded upon in an effort to improve the quality of the plan.

Section 3 was based primarily around profiling the 13 hazards of prime concern and Section 4 provided a risk assessment for those addressed hazards. In preparing these sections TEMA/BOLD planners placed a focus on using data analysis and spatial mapping analysis to convey state specific risks and vulnerabilities. This quantitative assessment approach was very different from how previous State of Tennessee Hazard Mitigation Plans were conducted.

Because Principle HMPC members were very active in this section's development process, the draft closely met everyone's expectations. The committee suggested 3 main revisions for these sections: 1) creating a series of NFIP policy and claim maps to help identify flood mitigation gaps across the state, 2) including a portion of the state's 2012 Threat & Hazard Identification & Risk Assessment earthquake scenario into the plan's earthquake section, and 3) placing disclaimers throughout the text that identify potential limitations in the datasets being used for the analysis. All committee requests were fulfilled.

FEMA Risk Assessment Prelim Review: State Mitigation Plan
14 June 2013

To obtain advice on if the plan's development seems on track to fulfill federal regulations, the State Hazard Mitigation Planner submitted Sections 2, 3, and 4 to FEMA Region IV Mitigation Planners for a preliminary review. The FEMA Planners provided helpful insight into the state's development of the plan, especially when it came to profiling the development trends subsection.

Additionally on July 24th, TEMA/BOLD planners had a 1 hour conference call with FEMA Region IV Mitigation Planners to clarify the construction and organization of the plan. TEMA Planners were very appreciative of the assistance FEMA Region IV Mitigation Planners were able to provide throughout the development of the plan rewrite.

Mitigation Goals, Objectives, & Actions Meeting: State Mitigation Plan
19 June 2013

One of the most important parts of any planning process is to determine the goals, objectives, and actions required to guide the plan and its implementation. Since the 2010 State Hazard Mitigation Plan was approved, the State Hazard Mitigation Planner has been making notes of actions particular stakeholders would like to see incorporated into the 2013 plan. Examples of these actions include local governments requesting assistance with debris management cleanup/planning and assistance in qualifying as a NFIP CRS participant. This list of recorded suggestions was provided to the Principle HMPC as they determined the goals, objectives, and actions to be included in this year's plan.

After reviewing the 2010 State Hazard Mitigation Plan it was determined that many of the objectives and actions listed were more oriented toward preparedness/response activities than mitigation activities. Because of this factor the Principle HMPC restructured the entirety of the list.

After the final draft of the plan's goals, objectives, and actions was completed the team reviewed it 1 extra time to make sure everything addressed was obtainable and reasonable. The Principle HMPC agreed that the listing could be implemented over the coming years.

Section 5 Review Meeting: State Mitigation Plan
9 July 2013

On July 9th, the Principle HMPC met to review the draft of Section 5 as prepared by BOLDplanning. This section was entirely rewritten and expanded upon in an effort to improve the quality of the plan.

Section 5 was based primarily around profiling the state's mitigation strategy and capability assessment. In preparing this section TEMA/BOLD planners placed a focus on creating an "*implementable*" strategy that would guide planners for years to come. This required a comprehensive revaluation of all projects and capabilities listed in the 2010 State Mitigation Plan.

The draft closely met everyone expectations, because Principle HMPC members were very active in this section's development process. The committee provided minimal suggestions for this section and all were later incorporated in the final draft.

TN Dept. of Transportation Meeting: State Mitigation Plan
25 July 2013

On July 25th, TEMA planners met with Derial Bivens of the Tennessee Department of Transportation to discuss mitigation planning for transportation routes. Mr. Bivens is in regular contact with TEMA and the State Hazard Mitigation Planner. This particular conversation was focused only on determining what steps a local government should take in notifying TDOT of state routes that may require a flood mitigation project.

TN Association of Floodplain Managers Meeting: State Mitigation Plan
30 July 2013

To continually promote the 2013 HMP Update to larger audiences, TEMA's State Hazard Mitigation Planner gave a 45-minute presentation at the fourth annual Tennessee Association of Floodplain Managers Conference in Gatlinburg, Tennessee. At this conference a group of approximately 80 individuals that represented various local governments, private businesses, non-profit organizations, state departments, and federal agencies, learned about mitigation planning in Tennessee. Additionally the State Hazard Mitigation Planner brought a final draft of the plan so participants could have a chance to review the document. Tennessee's current mitigation planning methodologies received many good reviews from participates after the presentation, including positive statements from Brad Loar, the Director of FEMA Region IV Mitigation Division.

Sections 6 & 7 Review Meeting: State Mitigation Plan
2 August 2013

On August 2nd, the Principle HMPC met to review the draft of Sections 6 and 7 as prepared by BOLDplanning. Both sections were entirely rewritten and expanded upon in an effort to improve the quality of the plan.

Section 6 was based primarily around profiling local government outreach and integration and Section 7 was dedicated to plan maintenance. Both local government outreach and the tracking local projects have been significantly improved due in large to Tennessee's local mitigation outreach initiative that was started in 2010.

The draft met and exceeded everyone's expectations due to the Principle HMPC member's active participation in these sections' development. The committee provided minimal suggestions for these sections and all were later incorporated in the final draft.

Final Plan Review Meeting: State Mitigation Plan
7 August 2013

With the Principle HMPC having reviewed all sections of the plan over previous months, committee members wanted to have 1 last meeting as a group to review the plan in its entirety before it would be submitted to FEMA Region IV for review.

Committee members were very pleased with the final product and agreed that it showcases the state's commitment to protecting the life and property of Tennessee's citizens through hazard mitigation.

1.4 – Program Integration

The Hazard Mitigation Plan is an overarching document that is both comprised of, and contributes to, various other state plans. In creating this HMP, all the planning documents identified below were consulted and reviewed, often extensively. In turn, when each of these other plans is updated, they will be measured against the contents of the HMP.

Below is a general description of the state's various planning efforts and documents. While each plan can stand alone, the functional integration of the plans with the HMP will further strengthen and improve Tennessee's resilience to disasters. Following the descriptions is a matrix that identifies the most recent version of each plan and when it will be updated again. Also included is a brief narrative on how the plan was utilized and integrated into the HMP.

1.4.1 – Related State Planning

Community Wildfire Protection Plan
Led by the Division of Forestry and developed in conjunction with participating local communities, CWPPs are a prerequisite for becoming an active member of the FireWise program. The purpose of the plans is to actively reduce and implement wildfire mitigation measures and encourage local community participation and eventually become an active member of the FireWise program.

Drought Management Plan
The purpose of this plan is to provide a framework for action and cooperation in water resources management among the many local, state, and federal agencies with drought-related responsibilities. This plan outlines the resources that other state, federal and local entities can provide and the ways in which we can work together to lessen the impacts of a drought.

Emergency Management Accreditation Program Standard
The EMAP is a scalable yet rigorous national accreditation standard for state, territorial, local, and tribal government emergency management programs. TEMA accreditation was collaboratively developed in a series of working groups of emergency management stakeholders from government, business, and other sectors.

Expanding and Using Knowledge to Reduce Earthquake Losses-Strategic Plan
This serves as the strategic and operational plan for all the National Earthquake Hazards Reduction Program agencies and guides federal earthquake research, loss reduction, and mitigation efforts in the United States. It articulates the mission and goals of the National Earthquake Hazard Reduction Program (NEHRP), provides a framework for priority-setting and coordinating activities, and defines priority areas for the future. The NEHRP seeks to mitigate earthquake losses in the United States through both basic and directed research and implementation activities in the fields of earthquake science and engineering

Interim Air Quality Policy on Wildland and Prescribed Fires
The policy statement responds to plans by some federal, tribal, and state wildland owners/managers to significantly increase the use of wildland and prescribed fires to achieve resource benefits in the wildlands. The policy integrates 2 public goals; (1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility.

Mitigate Potential Terrorist Attacks Against Buildings Reference Manual
This document provides guidance to the building science community of architects and engineers, to reduce physical damage to buildings, related infrastructure, and people caused by terrorist assaults.

National Incident Management System (NIMS)
The NIMS integrates existing best practices into a consistent, nationwide approach to domestic incident management that is applicable at all jurisdictional levels and across functional disciplines in an all-hazards context.

National Fire Protection Association NFPA1600
Standard on Disaster, Emergency Management, and Business Continuity Programs – Documents codes, standards, recommended practices, and guides which were developed through a consensus standards development process approved by the American National Standards Institute.

National Response Framework (NRF)
The National Response Framework is a guide to how the nation conducts an all-hazards response. It is built upon scalable, flexible, and adaptable coordinating structures to align key roles and responsibilities across the nation, linking all levels of government, nongovernmental organizations, and the private sector. It is intended to capture specific authorities and best practices for managing incidents that range from the serious but purely local, to large-scale terrorist attacks or catastrophic natural disasters. (Incorporates Federal Response Plan, 2003/National Response Plan, 2006)

State of Tennessee Administrative Plan for Hazard Mitigation
This plan prescribes the manner in which the State of Tennessee will manage and administer the: Flood Mitigation Assistance, Repetitive Flood Claims, Severe Repetitive Loss, Hazard Mitigation Grant, Pre-Disaster Mitigation, and FEMA Unmet Needs Programs as well as the policies and procedures to be utilized.

State of Tennessee Administrative Plan for Public Assistance
This plan identifies the roles and responsibilities of the state in administering the Public Assistance Program, outlines staffing requirements as well as the policies and procedures to be utilized.

State of Tennessee Five-Year Floodplain Management Work Plan
This 5 year plan for the administration and implementation of the National Flood Insurance Program in the State of Tennessee is coordinated by the Tennessee Department of Economic and Community Development. The various state departments and agencies are directed through a Governor's Executive Order to operate in a manner that will minimize impacts on areas of identified flood hazard. Local communities in Tennessee are authorized to implement floodplain management under the general zoning enabling statutes.

State of Tennessee Hazard Assessment
This is now a supporting document and annex to the Tennessee Emergency Management Plan. The assessment highlights hazards most likely to adversely affect the physical and socio-economic environs of the state. In doing so, it promotes development of interagency, multi-hazard activities addressing all phases of the emergency management cycle. From the local and regional perspective, it assesses natural, technological, and man-made hazards likely to affect the State of Tennessee as well as discusses the process utilized to identify and evaluate the same.

State of Tennessee Recovery Plan

This plan assists in making decisions and organizing efforts relating to the methods utilized in disaster recovery. It incorporates the composite input from multiple sources of government, charitable organizations, and other private entities active in a disaster. The plan addresses the actions that should be taken starting immediately upon the occurrence of the disaster/emergency through the entire response phase and recovery phase.

State Plan for Public Health

This is the state plan to prepare for and mitigate against the impact of hazardous events in the changing environment in which Public Health may be required to function. This plan has now been transferred and merged into the Tennessee Emergency Management Plan (TEMP) under ESF-8/Disaster Operations Guide.

Strategic Plan of the Tennessee Emergency Management Program and Tennessee Emergency Management Agency

This is a strategic multi-year plan aimed at reducing the loss of life and property while protecting the state of Tennessee from all hazards, including natural disasters, acts of terrorism, and other man-made disasters. It directs and supports the state in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.

Tennessee Code Annotated

The Tennessee Code Annotated is the official compilation of the statutes, codes, and session laws of the State of Tennessee.

Tennessee Emergency Management Agency Annual Report

TEMA is empowered by state law and by the governor's executive authority to protect the public from disasters and emergencies. TEMA and the State Emergency Operations Center (SEOC) perform as the staff of the governor during a state declaration of emergency. TEMA and the SEOC are charged by law to ensure that the orders of the governor are implemented and enforced. This annual report is a narrative of all actions taken by TEMA during the previous calendar year in furtherance of these missions.

Tennessee Catastrophic Event Plan

The plan defines a coordinated operational response to a catastrophic earthquake and also helps to clarify response outcomes over a planned period of time. It increases not only the state's readiness to a New Madrid Seismic Zone catastrophic earthquake event, but improves regional and national readiness. The plan defines the answer to the question, "What will the State of Tennessee do if an earthquake should impact western regions of the state tomorrow?" It focuses on the major issues the State of Tennessee expects to encounter for an unpredicted catastrophic earthquake.

Tennessee Emergency Management Plan (TEMP)

The Tennessee Emergency Management Plan is the document that provides the foundation for all disaster and emergency response operations conducted within the State of Tennessee. Tennessee state law requires TEMA to develop this plan and update it on a periodic basis. All local emergency management plans are required to emulate the TEMP in terms of structure and purpose. All of the other plans developed by the agency make reference to the TEMP in some form or fashion. Many of the plans are tabs or sub-elements of the TEMP. Many details of emergency management involving sensitive national security issues, events involving terrorism, locations of critical facilities and references to systemic weaknesses or problems which may develop under catastrophic scenarios, are classified as confidential by state law, closely held by the agency, and not made available to the general public.

Tennessee Health Access Plan

The Tennessee Health Access Plan is published annually by the Tennessee Department of Health, Bureau of Health Services, Community Services Section. The plan assists federal, state, and local health planning officials in identifying shortage areas for primary and dental health care in Tennessee. It is generated to provide guidelines for the Health Access Incentive Grant Program, Annual Health Professional Recruitment Fair, National Health Service Corps, Graduate Medical Education – Residency Stipend Program, and J-1 Visa Waiver Programs, and to disseminate data from the annual survey of physicians, physician extenders, and dentists.

The State of Tennessee Multi-Jurisdictional Emergency Response Plans for the Sequoyah Nuclear Plant, the Watts Bar Nuclear Plant, and the United States Department of Energy Oak Ridge Reservation (MJERP)

The MJERPs were developed and are maintained by TEMA as a requirement of the Tennessee Oversight Agreement, which tasks the agency to develop a plan that protects the citizens of Tennessee from emergencies occurring at the Sequoyah Nuclear Plant, the Watts Bar Nuclear Plant, and/or on the Oak Ridge Reservation. The MJERPs meet that requirement by specifying the coordinated response among federal, state, and local organizations during an emergency event at the Sequoyah or Watts Bar Nuclear Plants or on the Oak Ridge Reservation. It also describes TEMA's responsibility to coordinate the development of state and local emergency response programs including the review, revision, and maintenance of existing documents, coordination of local emergency planning activities, development and delivery of training, and conduct of drills and exercises to verify effective offsite response capabilities.

Tennessee Threat and Hazard Identification and Risk Assessment (THIRA)

By Presidential Directive (PPD-8) all states were required to complete a Threat and Hazard Identification and Risk Assessment by 2012, as a condition to the continued receipt of EMPG and other grant funds. The THIRA produced by TEMA in 2012 is the first for the State of Tennessee and will be updated every year hereafter.

Table 10 – Planning Integration			
Plan Title	**Last Update**	**Next Update**	**Integration Description**
Community Wildfire Protection Plan	2012	2013	Tennessee's HMP has an extensive GIS driven risk assessment on wildfire risk and vulnerability. This assessment will be integrated into the Division of Forestry's future development and updates of CWPPs.
Drought Management Plan	2010	2014	Tennessee's HMP has a drought risk and vulnerability assessment section. This section will be used as the base risk and vulnerability assessment for the Drought Action Plan's update driving the state's drought response and preparedness activities.
Emergency Management Accreditation Program	2010	2013	Reviewing the standards for the conduct of emergency management professionals and their required substantive knowledge strengthened the focus of the HMP.
Expanding and Using Knowledge to Reduce Earthquake Losses-Strategic Plan	2009	2013	Given that the New Madrid fault exists on Tennessee's western boundary, the earthquake damage mitigation information contained in this plan was liberally incorporated into the HMP.
Interim Air Quality Policy on Wildland and Prescribed Fires	1998	---	The HMP utilized the information in this plan about mitigating against the effects of smoke and airborne pollutants.
Mitigate Potential Terrorist Attacks Against Buildings	2008	---	Mitigating damages caused to structures by terrorist attacks can also be effective against natural disasters.
National Incident Management System (NIMS)	2008	---	Any HMP must consider the precepts and organizational directives of NIMS to be an effective disaster mitigation and management tool.
National Fire Protection Association (NFPA) 1600	2013	2016	Determining the resistance of a community to a disaster is a critical step in developing a mitigation plan. Information ascertained through evaluating Tennessee's fire protection paradigm assisted in determining mitigation priorities.
National Response Framework (NRF)	2008	---	As with NIMS, no HMP could be constructed without a thorough understanding and incorporation of the standards and methods included within the NRF.
State of Tennessee Administrative Plan for Hazard Mitigation	2012	2013	This annually updated plan provided substantive information for several important mitigation programs, such as Flood Mitigation Assistance, Repetitive Flood Claims, Severe Repetitive Loss, Hazard Mitigation Grant, Pre-Disaster Mitigation and the FEMA Unmet Needs Programs.
State of Tennessee Administrative Plan for Public Assistance	2012	2013	Information from and about the Public Assistance program is crucial to an overall mitigation plan as it helps identify those areas that most often require relief from a disaster and thus should be the focus of mitigation projects.
State of Tennessee Five-Year Floodplain Management Work Plan	2010	2015	Flooding is a critical concern for Tennessee and thus the state's 5 year plan for lessening the impacts of floods was fully vetted and incorporated into the HMP.
State of Tennessee Hazard Assessment Guide and Hazard Identification and Risk Assessment (HIRA)	2009	2013	Tennessee hazard assessment and the HIRA are now subsumed within the state's HMP.

Plan Title	Last Update	Next Update	Integration Description
State of Tennessee Recovery Plan	2012	2017	This plan identifies how Tennessee will recover from a disaster and thus included important information on the types and amount of damage likely to be faced in the state after a disaster.
State Plan for Public Health	2010	---	This is now incorporated into the TEMP.
Strategic Plan of the Emergency Management Agency	2013	2014	Given that this document is a guidepost for Tennessee's Emergency Management Agency, it was critical in evaluating the hazards that the state will likely face and how the state intends to respond to them.
Tennessee Code Annotated	2012	2013	These are Tennessee's laws and as such determine the state's response to hazards and disasters. Since any state action must be lawful, the Tennessee Code Annotated was reviewed to ensure that the HMP was fully compliant with its requirements.
Tennessee Emergency Management Agency Annual Report	2012	2013	The annual reports provided critical information on what hazards and disasters actually have impacted Tennessee. By focusing on the actual state responses, the annual reports helped to hone the expected effectiveness of the HMP.
Tennessee Catastrophic Event Plan	2010	2015	This is an earthquake response plan that is updated every 5 years and is currently included as an annex to the TEMP.
Tennessee Emergency Management Plan (TEMP)	2011	2016	A critical document for guiding the contents of the HMP. Its body and annexes include much of the information necessary to determine the hazards that face the State of Tennessee and its citizens and how the state government intends to prepare for, respond to, recover from, and mitigate against disasters.
Tennessee Health Access Plan	2012	2013	This plan assisted in evaluating the social vulnerability of Tennessee's population in a disaster.
Tennessee Multi-Jurisdictional Radiological Emergency Response Plan for the Sequoyah Nuclear Plan	2010	2013	This is now an annex of the TEMP.
Tennessee Multi-Jurisdictional Radiological Emergency Response Plan for the Watts Bar Nuclear Plant	2010	2013	This is now an annex of the TEMP.
The State of Tennessee Multi-Jurisdictional Emergency Response Plan for The United States Department of Energy Oak Ridge Reservation	2011	2013	This is now an annex of the TEMP.
Tennessee Threat and Hazard Identification and Risk Assessment (THIRA)	2012	2013	The threats and hazards identified by the THIRA assisted in the process of determining those risks that may be able to be mitigated to lessen their severity.

1.4.2 – Related Federal Planning

A primary task in fulfilling TEMA's mission is the development and maintenance of the Tennessee Emergency Management Plan. The TEMP is an all-inclusive, strategic document, which governs the development and use of all subsequent planning documents in the State of Tennessee. The TEMP integrates all federal emergency management plans, programs, initiatives, and policies to keep the state and all state planning activities aligned with federal goals and objectives. Per these design guidelines, TEMA works with FEMA to administer federal hazard mitigation assistance programs to the State of Tennessee.

State-level mitigation is inherently integrated into a host of federal programs and initiatives. Utilizing federal grant programs the state and its local jurisdictions have accomplished numerous quality mitigation activities, negating much if not all of the adverse effects associated with hazards. Additionally, participation in some of the lesser utilized federal initiatives (CRS and FireWise) is growing in the State of Tennessee. The following information illustrates the financial impact of federal programs and the planning impact of federal initiatives on the State of Tennessee's mitigation efforts.

Hazard Mitigation Grant Program (HMGP)
Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 USC, the HMGP provides grants to states, local, and tribal governments to implement long-term hazard mitigation measures. The funds become available only after a major disaster declaration in order to reduce the loss of life and property due to hazard events and to enable the implementation of mitigation measures during the recovery period. The recipient of an HMGP grant must have a current, FEMA approved hazard mitigation plan, unless the recipient is using the grant for the development of a FEMA approved hazard mitigation plan. Since 1990 the State of Tennessee and its jurisdictions have received $146,581,729.00 in HMGP grant funding. For a list of HMGP grants received by the state per disaster, please reference Table 119 in Appendix C.

Pre-Disaster Mitigation Program (PDM)
Authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act 42 USC, the PDM program assists states, local, and tribal governments in implementing cost-effective hazard mitigation activities and projects. These activities and projects must complement a comprehensive mitigation program prior to a hazard event and disaster declaration. PDM grants are typically awarded on a competitive basis, but sometimes through legislative action. The recipient of a PDM grant must have a current, FEMA approved hazard mitigation plan, unless the recipient is using the grant for the development of a FEMA approved hazard mitigation plan. Since 2002 the State of Tennessee and its jurisdictions have received $24,317,100.72 in PDM grant funding. For a list of HMGP grants received by the state per disaster, please reference Table 120 in Appendix C.

Flood Mitigation Assistance Program (FMA)
Created under the National Flood Insurance Reform Act of 1994, 42 U.S.C. 4101, the FMA aims to reduce or eliminate claims under the National Flood Insurance Program. FEMA provides FMA grant funds to assist states and communities in implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. FMA funds are awarded on a competitive basis and can be used for flood related projects or planning. Since 1997 the State of Tennessee and its jurisdictions have received $1,253,139.27 in FMA grant funding. For a list of HMGP grants received by the state per disaster, please reference Table 121 in Appendix C.

National Flood Insurance Program (NFIP)

The NFIP is a federal program created in 1968 that allows citizens in participating communities to purchase insurance coverage for potential property damage as a result of flooding. This voluntary program for local communities is administered by the Mitigation Division of FEMA. The National Flood Insurance Program in Tennessee is administered by the Department of Economic & Community Development. The program works closely with private insurance companies to offer flood insurance to property owners and renters. In order to qualify for flood insurance, a community must join the NFIP and agree to enforce sound floodplain management standards. The 3components of the NFIP are flood insurance, floodplain management and flood hazard mapping.

In return for a local community adopting and enforcing local floodplain management regulations, flood insurance is available in the community. Currently, nearly 400 Tennessee communities participate in the NFIP. Of all natural disasters, flooding is historically responsible for the most loss of life and the greatest damage to property in the state.

Community Rating System (CRS)

FEMA's Community Rating System program is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The program incentivizes communities by offering CRS participants NFIP discounts. The goals of the CRS are to reduce flood losses, to facilitate accurate insurance rating, and to promote awareness of flood insurance.

Repetitive Flood Claims Program (RFC)

Authorized by the Bunning – Bereuter – Blumenauer Flood Insurance Reform Act of 2004, the Repetitive Flood Claims program provides funds to assist states and communities in reducing flood damages to insured properties that have had 1 or more claims to the NFIP. RFC grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula based methodologies.

Repetitive Loss & Severe Repetitive Loss Program (RL/SRL)

Authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, the Repetitive Loss and Severe Repetitive Loss program provides funding to reduce or eliminate the long-term risk of flood damage to repetitive loss and severe repetitive loss properties insured under the NFIP. Repetitive loss and severe repetitive loss properties include residential properties covered under the NFIP flood insurance policy that have had at least 4 NFIP claim payments each over $5,000 and the cumulative amount exceeding $20,000, or 2 separate claims with the cumulative amount exceeding the market value of the structure. The typical RL/SRL project uses federal funds to acquire and demolish these properties and replace them with open space areas that have little to no liability in the event of a flood. The State of Tennessee has used this program to acquire and demolish 62 RL/SRL properties.

FireWise Communities Program

Established in 2010 by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters, the FireWise Communities Program teaches communities how to mitigate against the risk of wildfire. Its aim is to facilitate the acceptance of national standards for evacuation procedures, develop local wildfire plans, instigate local mitigation activities, and educate communities. The program stresses local solutions by involving community homeowners, community leaders, planners, developers, and firefighters. Tennessee currently has 8 recognized and accredited communities and 2 more seeking accreditation.

Section 2 – The State of Tennessee

2.1 – Topography

Tennessee is a long and narrow state bordered on the east by the Appalachian Mountains and on the west by the Mississippi River. It is divided into 3 distinct geographic regions known as the Grand Divisions: East Tennessee, Middle Tennessee, and West Tennessee. East Tennessee contains the mountains and valleys of the Appalachian Mountains. The Cumberland Plateau divides East and Middle Tennessee. The Tennessee River divides Middle and West Tennessee.

Tennessee borders 8 other states: Kentucky and Virginia to the north; North Carolina to the east; Georgia, Alabama and Mississippi to the South; Arkansas and Missouri on the Mississippi River to the west. The highest point in the state is Clingmans Dome at 6,643 feet; this peak, which lies on Tennessee's eastern border, is also the highest point on the Appalachian Trail and the state line between Tennessee and North Carolina crosses the summit. The lowest point in Tennessee is the Mississippi River at the Mississippi State line. The geographical center of the state is located in Murfreesboro. Tennessee also lays claim to the most caves in the United States, with over 8,350 caves registered to date.

The lowlands of West Tennessee are bordered by the Mississippi River on the west and a portion of the Tennessee River on the east. Aside from the city of Memphis, land in West Tennessee is primarily agricultural. Nashville, the state’s capital, is located in Middle Tennessee, an area characterized by rolling hills and fertile river valleys extending eastward to the Cumberland Plateau. East Tennessee is dominated by the Appalachian Mountains and foothills, including the Cumberland Mountains, the Ridge-and-Valley area with its principal urban areas of Knoxville, Chattanooga and the Tri-Cities, and the Great Smoky Mountains that straddle the border with North Carolina.

West, Middle and East Tennessee can be further divided into 6 major physiographic regions: Blue Ridge, Appalachian Ridge and Valley Region, Appalachian Plateau, Highland Rim, Central Basin, and the Gulf Coastal Plain.

Blue Ridge Mountains

The Blue Ridge area lies on the eastern edge of Tennessee, on the border of North Carolina. This region of Tennessee is characterized by high mountains, including the Great Smoky Mountains, the Chilhowee Mountains, and the Snowbird Mountains. The average elevation of the Blue Ridge area is 5,000 feet above sea level. The Blue Ridge region, sometimes called the Unakas, constitutes the highest and most rugged surface in the state and covers an area of about 2,600 square miles. The face of the country is exceedingly rough, and the chains of mountain ridges are cut in numerous places by deep, rocky channels.

Appalachian Ridge and Valley Region

Stretching west from the Blue Ridge area for approximately 55 miles is the Appalachian Ridge and Valley Region. This area of Tennessee is covered by fertile valleys separated by wooded ridges. The western section of the Appalachian Ridge and Valley Region, where the valleys become broader and the ridges become lower, is called The Great Valley. Extending from southwestern Virginia into northern Georgia, the Great Valley is a segment of the ridge and valley province of the Appalachian Highlands, which reach from New York into Alabama. This region, consisting of long, narrow ridges with broad valleys trending from northeast to southwest between them, covers more than 9,000 square miles of Tennessee. Since the coming of the Tennessee Valley Authority in 1933, the area has been dotted with artificial lakes and dams, which supply electric power and aid in flood control.

This region has much arable land and constitutes one of the best developed and most populous agricultural districts of the state.

Cumberland Plateau

To the west of the Appalachian Ridge and Valley Region lies the Cumberland Plateau, an area covered with flat- topped mountains separated by sharp valleys. The elevation of the plateau rises from 1,500 to 1,800 feet above sea level. Lookout Mountain, southwest of Chattanooga and in the southern section of the plateau, provides views of 7 states. The Cumberland Plateau, which extends in its entirety from southern Kentucky into central Alabama, has an area of about 5,400 square miles in Middle Tennessee. The plateau is a region of contrasts, including both the Cumberland Mountains, which rise to a height of 3,500 feet, and the Sequatchie Valley, the floor of which lies about 1,000 feet below the surface of the adjoining plateau. This is the coal region of Tennessee.

Highland Rim

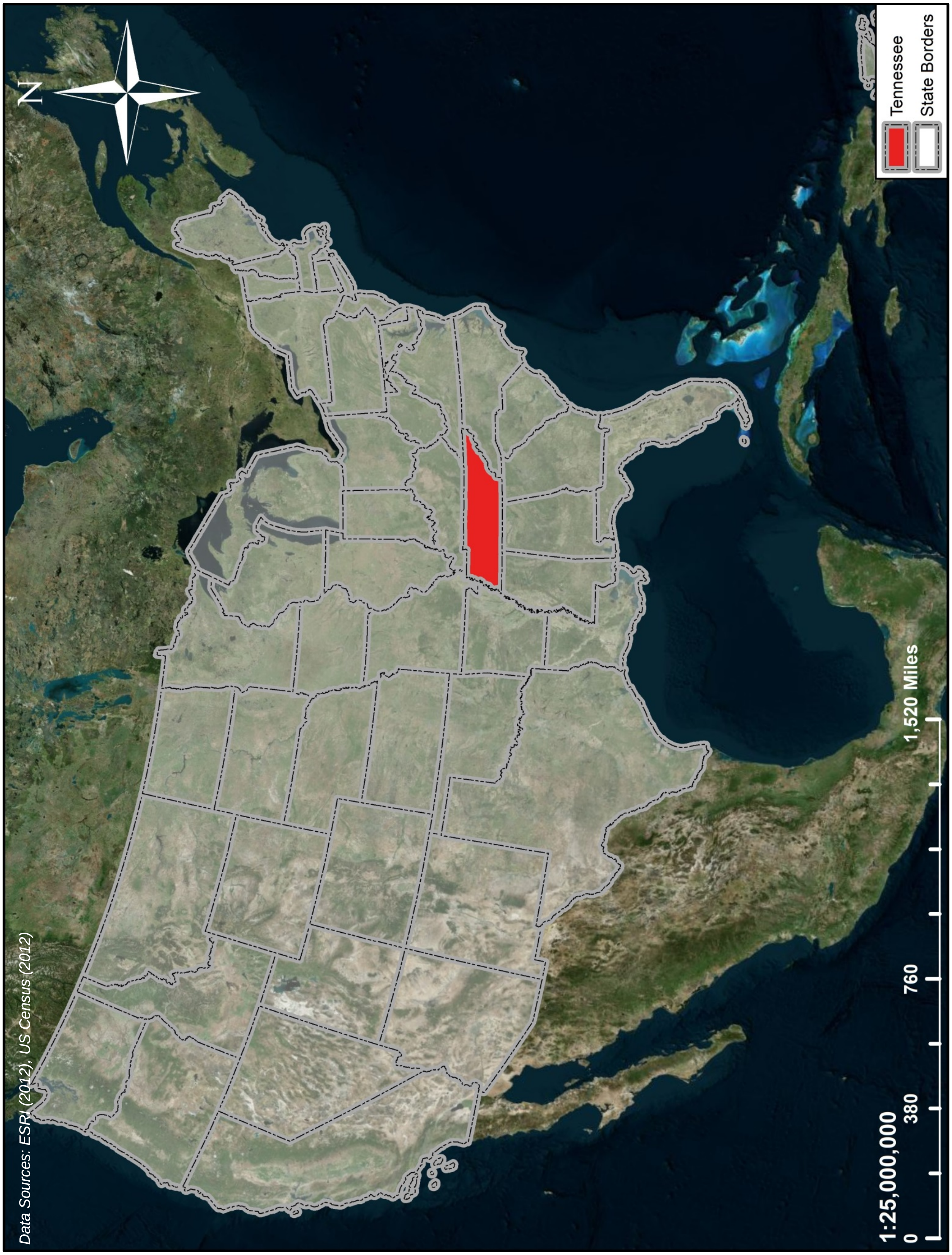
To the west of the Cumberland Plateau lies the Highland Rim, an elevated plain that surrounds the Nashville Basin. The Highland Rim is the state's largest natural region, consisting of more than 12,500 square miles. The eastern section is a gently rolling plain some 1,000 feet lower than the Cumberland Plateau. The western part has an even lower elevation and sinks gently toward the Tennessee River.

Central Basin

The Central, or Nashville, Basin is an oval depression with a gently rolling surface and has been compared to the bottom of an oval dish, of which the Highland Rim forms the broad, flat brim. With its rich soil, the region has attracted people from the earliest days of European settlement and is more densely populated than any other area in the state.

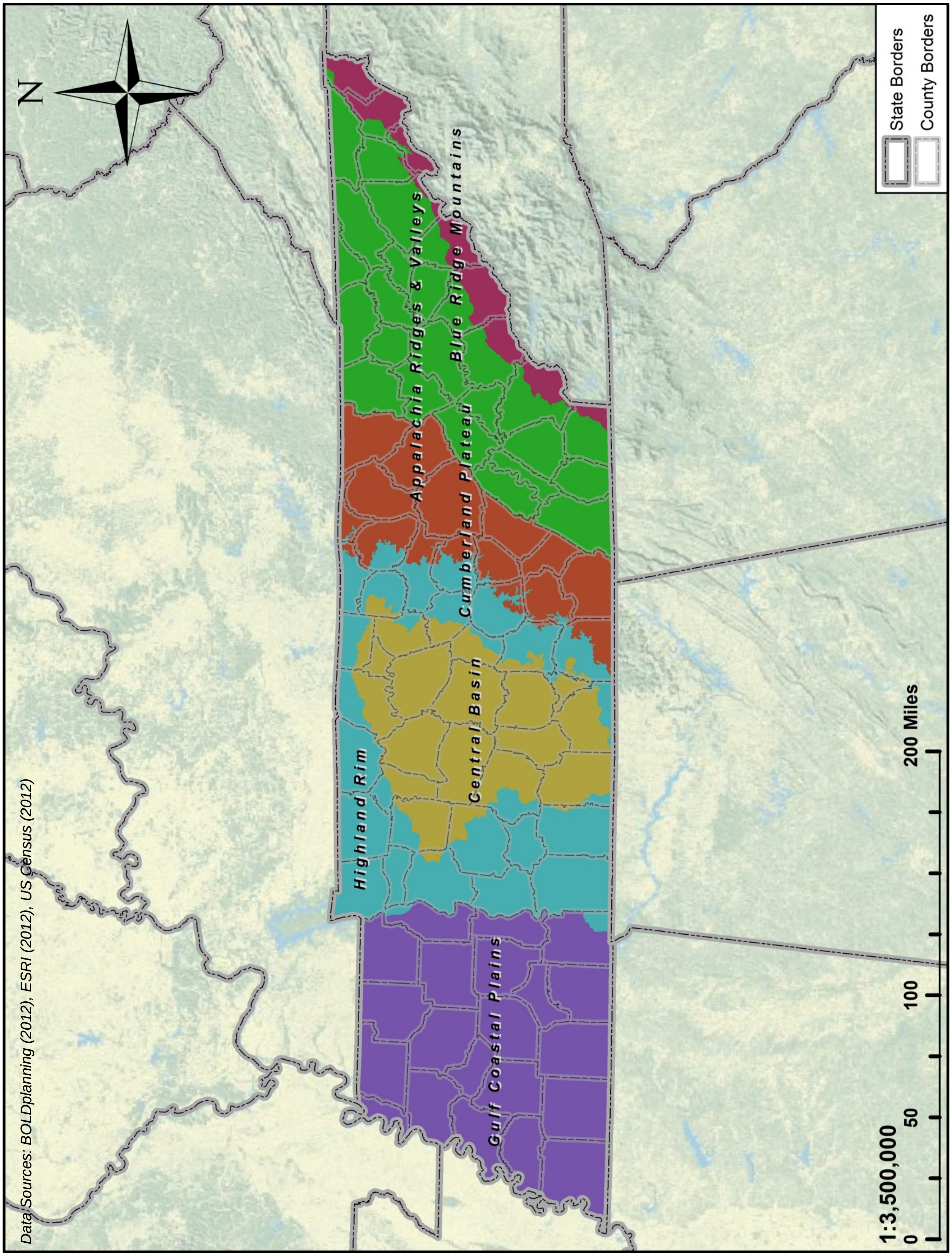
Gulf Coastal Plain

The westernmost part of the major regions is the Gulf Coastal Plain. The Gulf Coastal Plain covers an area of 9,000 square miles. It is a broad plain, sloping gradually westward until it ends abruptly at the bluffs overlooking the Mississippi flood plains and river. In the northwest corner is Reelfoot Lake, the only natural lake of significance in the state, formed by a series of earthquakes in 1811 and 1812. The plain is part of the large geographic land area that begins at the Gulf of Mexico and extends north into southern Illinois. In Tennessee, the Gulf Coastal Plain is divided into 3 sections, extending from the Tennessee River, in the east, to the Mississippi River in the west. The easternmost section or West Tennessee Uplands is approximately 10 miles wide and consists of hilly land running along the western bank of the Tennessee River. To the west of this narrow strip of land is a wide area of rolling hills and streams that stretches all the way to Memphis in western Tennessee. This is the Coastal Plain area or what is more commonly called the Tennessee Bottoms or Bottom Land.

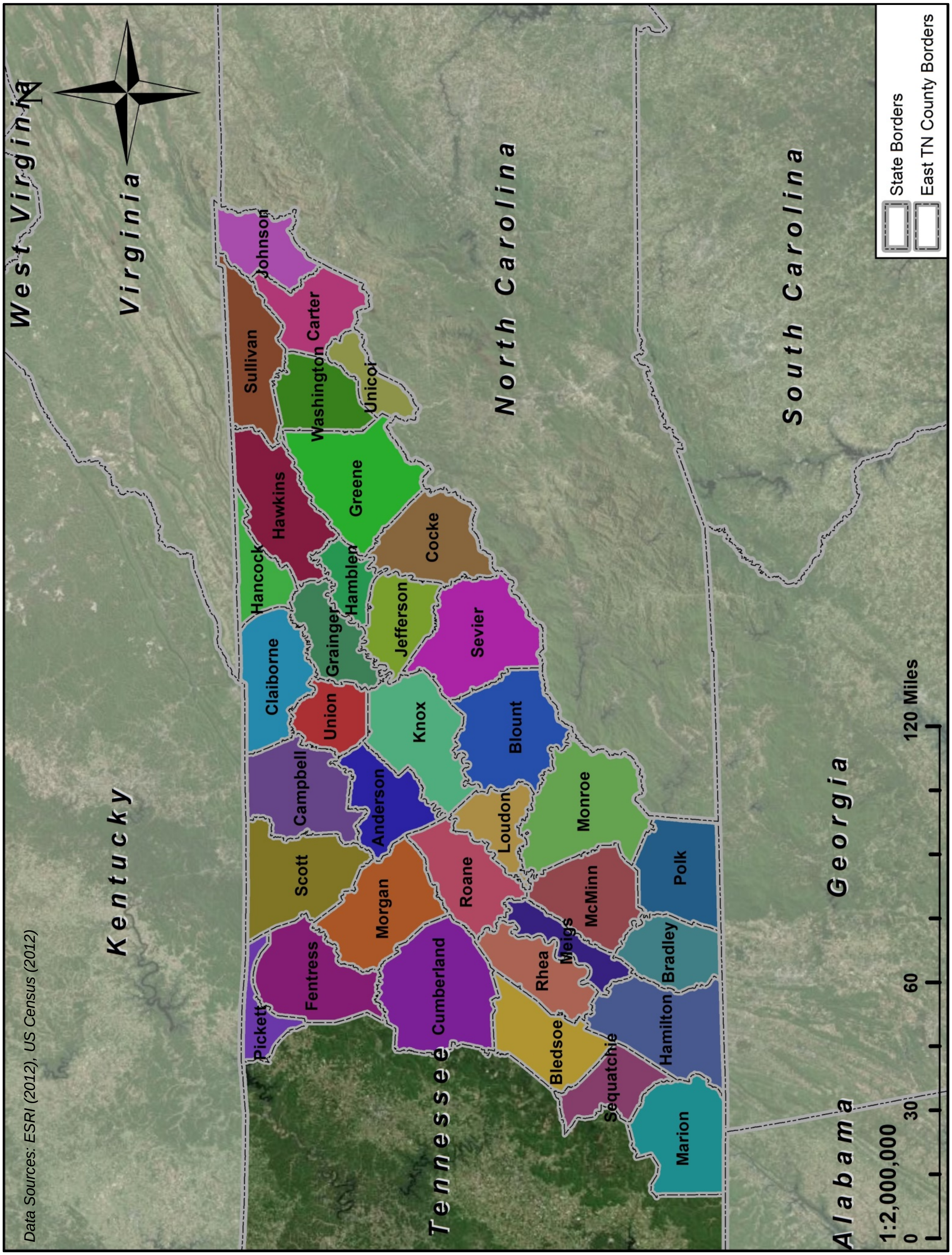


Map 1 – Tennessee Within the United States of America

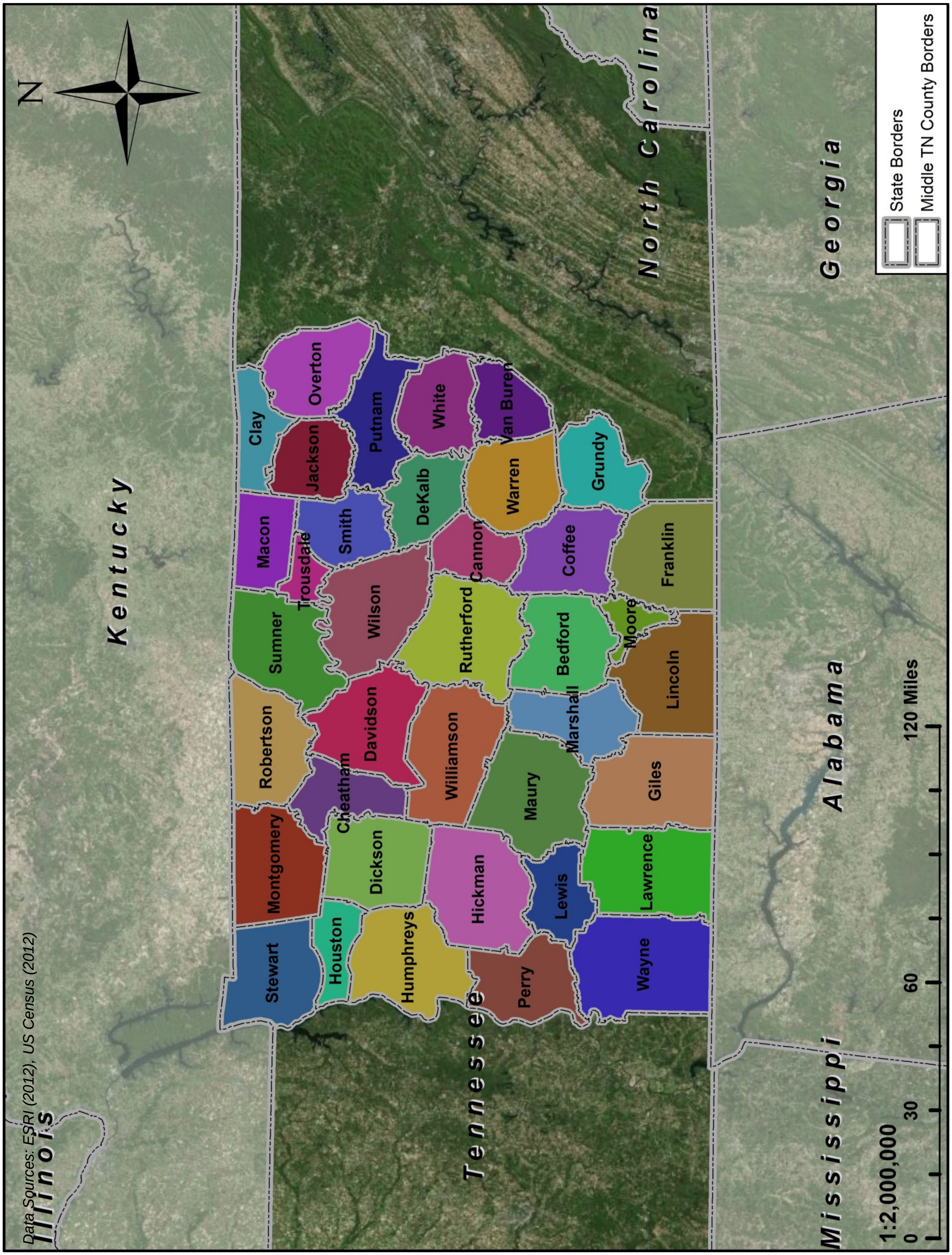
Map 2 – Physiographic Regions of Tennessee



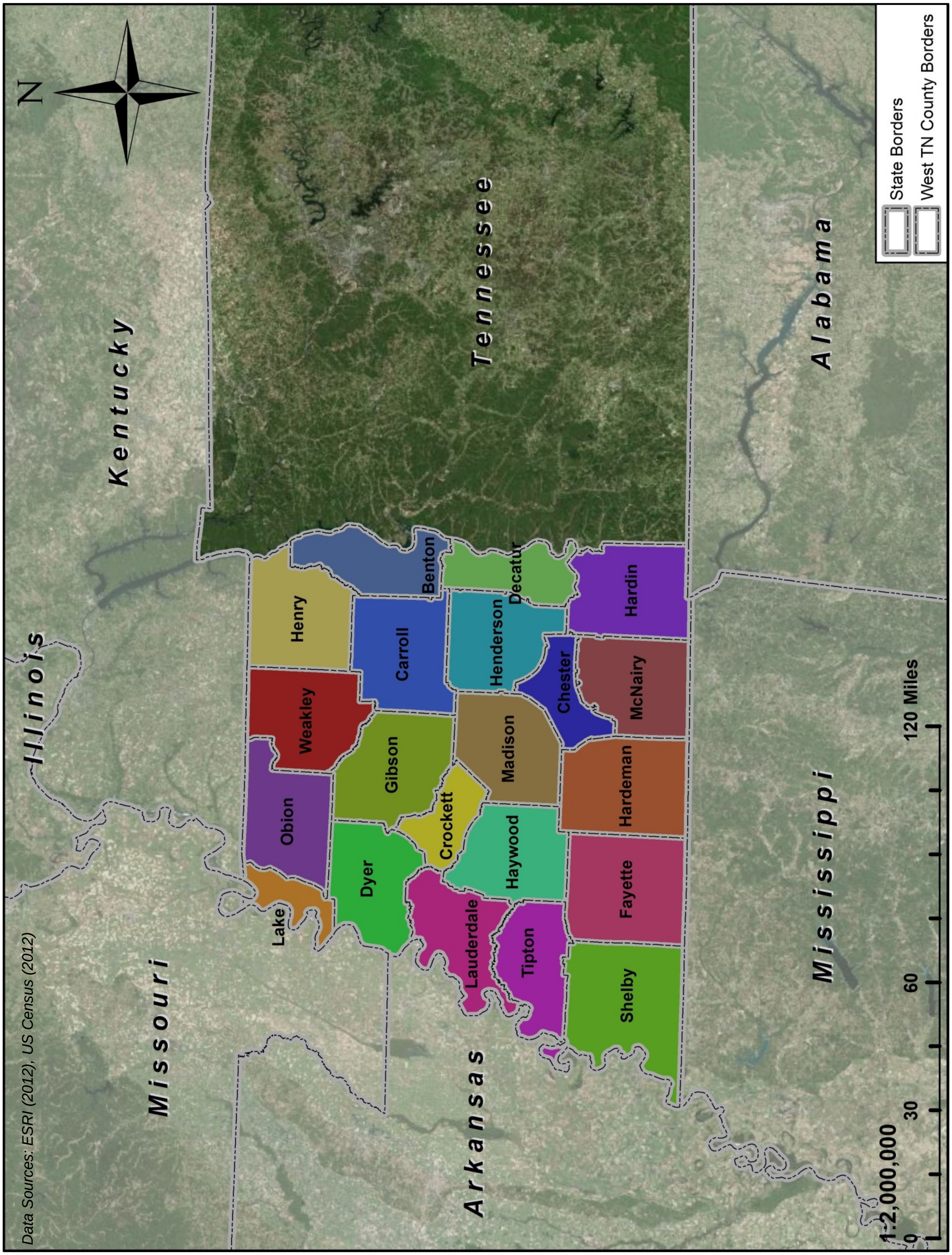
Map 3 – Counties of East Tennessee



Map 4 – Counties of Middle Tennessee



Map 5 – Counties of West Tennessee



2.2 – Climate

Most of Tennessee has a humid subtropical climate, with the higher elevations in the Appalachians classified as having a mountain temperate climate or a humid continental climate due to cooler temperatures. The Gulf of Mexico is the dominant factor in the climate of Tennessee, with moisture filled winds from the south being responsible for most of the state's annual precipitation. Generally, the state has hot summers and mild to cool winters with generous precipitation throughout the year. On average the state receives 50 inches of precipitation annually. Snowfall ranges from 5 inches in West Tennessee to over 16 inches in the higher mountains in East Tennessee, yet due to relatively mild winter temperatures, snow cover in most locations rarely persists for more than a few days.

Historically, Tennessee has an annual average temperature of 57.4 °F with an average high temperature of 68.8 °F and an average low temperature of 45.8 °F. The humidity in Tennessee varies from an average relative humidity in the morning of 83.8% to 59.2% in the afternoon/evening. The average yearly cloudiness breakdown for the state indicates 103 days of clear skies, 104 days of partly cloudy skies, and 157 annual cloudy days.

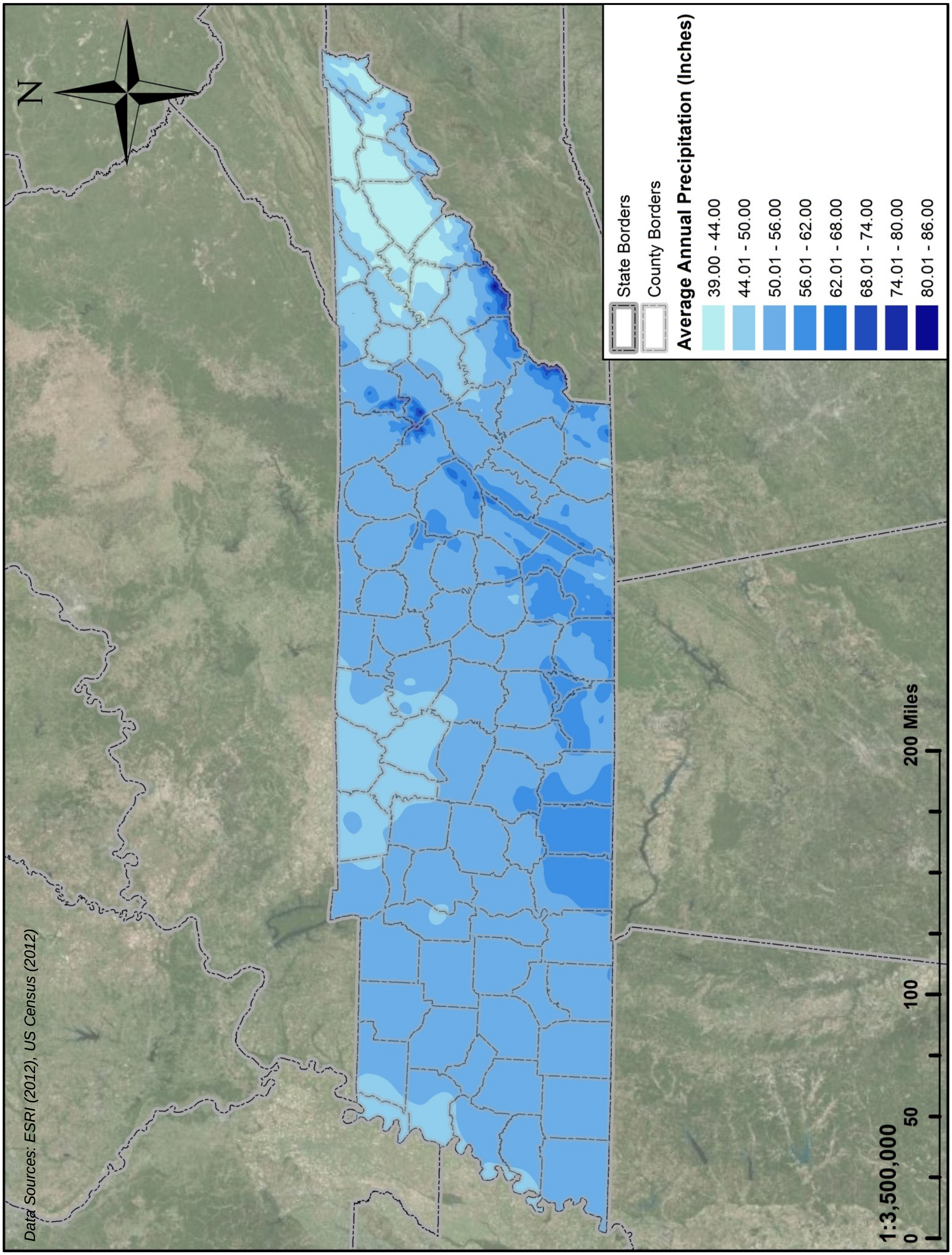
Summers in the state are mostly hot and humid, with much of the state averaging a high of around 90 °F during the season. Winters tend to be mild to cool, increasing in coolness at higher elevations. Generally, for areas outside the highest mountains, the average overnight lows in winter are near freezing for most of the state. The highest recorded temperature in the state is 113 °F at Perryville on August 9, 1930 while the lowest recorded temperature is −32 °F at Mountain City on December 30, 1917.

Tennessee’s varied topography leads to a variation in weather conditions across the state. For example, the average annual temperature varies from over 62°F in the extreme southwest to near 45°F atop the highest peaks of the east. Since Tennessee’s moist air comes primarily from the Gulf of Mexico to the south, there is a gradual decrease of average precipitation from south to north across the state.

Tennessee’s usual flood season occurs during the winter and early spring when frequent storms bring general rains of high intensity that contribute to local or more widespread flooding. Such storms can also be accompanied by damaging winds and hail and may produce tornadoes. Heavy summer thunderstorms also result in local flash flooding. Flood-producing rains are generally rare in the fall, although occasional tropical storm systems may cause serious floods as they pass through the area. Tennessee winters can be accompanied by ice storms in some areas and occasionally there are heavy snowstorms.

While the state is far enough from the coast to avoid any direct impacts from a hurricane, the location of the state makes it likely to be impacted from the remnants of tropical cyclones which weaken over land and can cause significant rainfall.

Map 6 – Average Annual Precipitation (1981 – 2010)



2.3 – Rivers & Watersheds

Tennessee contains a variety of small rivers, streams, creeks, and several major rivers with over 1,062 miles of navigable waterways. The Tennessee, Cumberland, and Mississippi Rivers are the most significant rivers in the state, with the Clinch and Duck Rivers also being of importance. Most of the state is drained by the Mississippi River and its tributaries. Waters from the 2 longest rivers—the Tennessee, with a total length of 652 miles, and the Cumberland, which is 687 miles long—flow into the Ohio River in Kentucky and join the Mississippi at Cairo, Illinois.

Formed a few miles north of Knoxville by the confluence of the Holston and French Broad Rivers, the Tennessee flows southwestward through the Great Valley into northern Alabama, then curves back into the state and flows northward into Kentucky. Other tributaries of the Tennessee are the Clinch, Duck, Elk, Hiwassee, and Sequatchie Rivers. The Cumberland River rises in southeastern Kentucky, flows across central Tennessee, and then turns northward back into Kentucky; its principal tributaries are the Harpeth, Red, Obey, Caney Fork, and Stones Rivers and Yellow Creek. In the western part of the state, the Forked Deer and Wolf Rivers are among those flowing into the Mississippi, forming the western border with Missouri and Arkansas.

Many smaller rivers transverse the state. During the early settlement periods, these rivers and streams served as the major means of transportation that allowed access to various areas of Tennessee. Cities that became major urban centers such as Knoxville, Chattanooga, Nashville, and Memphis developed alongside larger rivers. Other communities of various sizes adjacent to streams also grew and flourished, only to die as overland transportation became more accessible and reliable. Early residents located nearly all the county seats, especially those in early settled areas, near relatively substantial streams.

Thirteen of Tennessee's rivers have had sections designated as State Scenic Rivers pursuant to the state's Scenic Rivers Program established by the legislature in 1968. The Scenic Rivers Program seeks to preserve valuable selected rivers, or sections thereof, in their free-flowing natural or scenic conditions and to protect their water quality and adjacent lands. The program seeks to preserve within the scenic rivers system itself several different types and examples of river areas, including mountain streams and deep gorges of east Tennessee, the pastoral rivers of middle Tennessee, and the swamp rivers of west Tennessee.

The Ocoee River in southeastern Tennessee is rated among the top white water recreational rivers in the nation and was the site for the Olympic white water canoe/kayak competition in the 1996 Olympics.

Tennessee has more than 1,000 lakes listed in the USGS comprising over 540,000 acres. There are several major lakes including Kentucky Lake, Norris Lake, Chickamauga Lake, Cherokee Lake, and Tim's Ford Reservoir. Other lakes include Old Hickory, Percy Priest, Center Hill, Watauga, and Dale Hollow. Kentucky Lake is the largest man-made lake in the eastern United States. Reelfoot Lake in the northwest part of the state was formed after the series of New Madrid earthquakes in 1811-1812, and is the largest naturally formed lake in Tennessee. Many lakes have been formed in Tennessee by the building of dams, especially by the Tennessee Valley Authority and the Army Corps of Engineers.

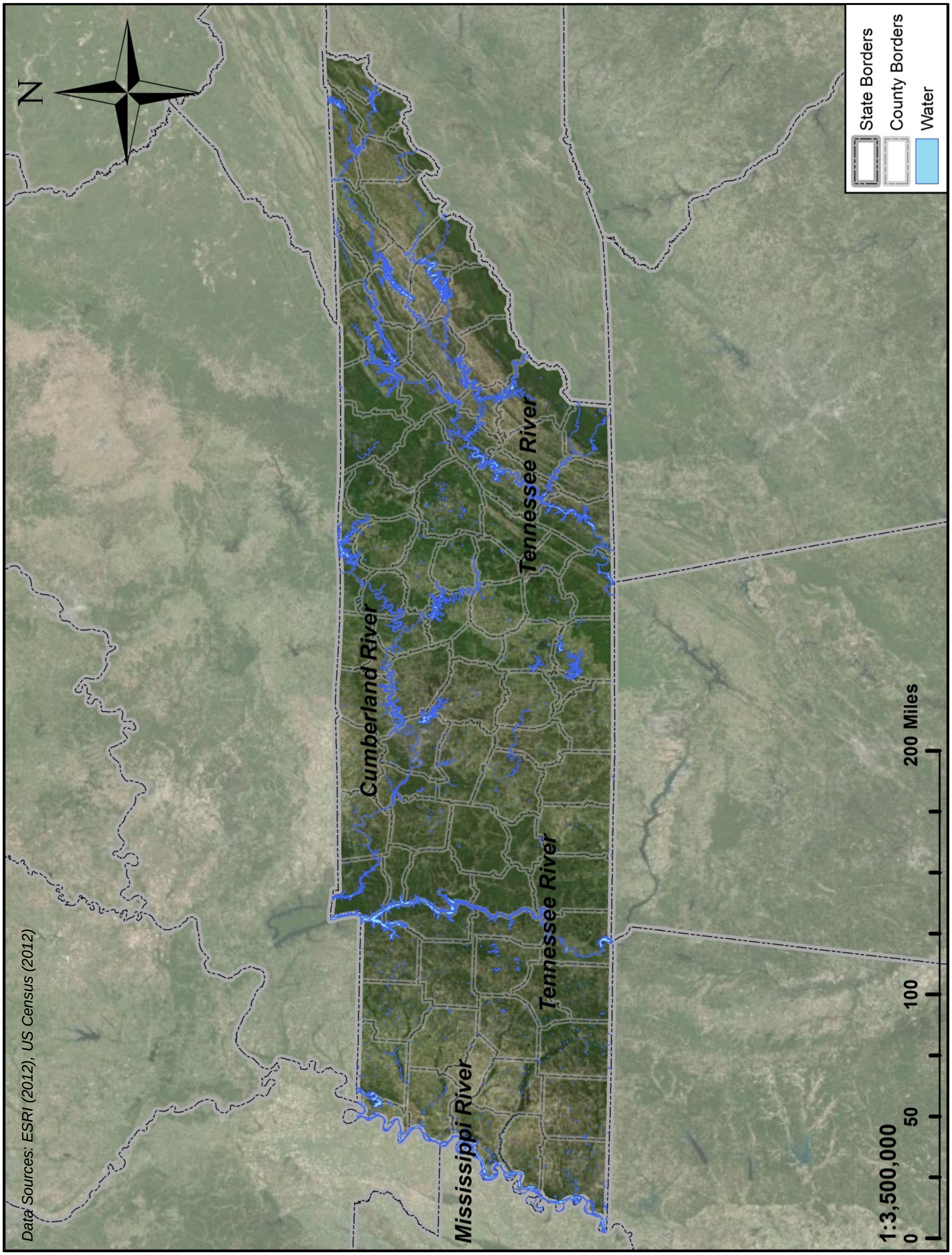
The Tennessee Valley Authority, a corporation owned by the U.S. government, provides electricity for 9 million people in parts of 7 southeastern states. The TVA, which receives no taxpayer money and makes no profits, also provides flood control, navigation, and land management for the Tennessee River system. The TVA serves virtually all of the 95 counties in Tennessee. The TVA service area in Tennessee covers about 42,038 square miles, about 49% of TVA's territory, and 99.7% of Tennessee.

This includes an electricity service area of 41,420 square miles and a watershed management area of 22,514 square miles.

A substantial portion of the power produced by the TVA comes from their 19 hydroelectric dams built across Tennessee rivers. The TVA also maintains 11 non-power dams and a total of 33 reservoirs across the state. The reservoirs have a combined surface area of about 300,000 acres and about 7,000 miles of shoreline. The TVA also owns and operates 7 locks in Tennessee (6 main locks and 1 auxiliary lock), serving about 110 Tennessee ports and terminals. About 17 million tons of cargo move through the facilities annually.

The ACOE also operates many dams and locks in Tennessee. The Corps ensures the navigability of the state's waterways and provides many recreational opportunities in and around their many reservoirs. There are 2 district offices in the state, 1 in Memphis that focuses on flood control and navigation of the Mississippi River and 1 in Nashville that is the headquarters of one of the Corps' largest districts for the miles of waterway and visitor use of facilities.

Map 7 – Rivers of Tennessee



2.4 – Transportation Systems

Tennessee has assumed a leadership position in the transportation and logistics industry with an excellent network of highways, waterways, rail lines and airports. The Volunteer State is centrally located within a day's drive of 75% of major U.S. markets. This combination of ideal location and excellent transportation resources has drawn a growing distribution and logistics industry to the state, as Tennessee is home to nearly 14,000 distribution centers, employing more than 146,000 workers.

The state has over 14,000 miles of roads in the state highway system, 80 public airports, 19,500 bridges, over 1,000 miles of navigable waterways, and over 3000 miles of rail track. The task of ensuring the safety and efficiency of the entire transit system falls on the TDOT, a multimodal agency with statewide responsibility for roads, airports, water transportation, and railroads. Memphis, Nashville, Knoxville, and Chattanooga are the focal points for all types of transportation in the state as all are located on important rivers and interstate highways, and all have airports served by the major airlines.

Airports

Tennessee has 74 general aviation airports, 6 commercial airports, over 100 private airports, and approximately 100 heliports. Tennessee's commercial airports (Memphis, Nashville, Knoxville, Tri-Cities, Chattanooga, and McKellar-Sipes at Jackson) are designed for passenger and freight movement, and are an essential part of the state's infrastructure. These commercial airports have an average runway length of 8,450 feet, and are designed to support frequent and convenient service to a variety of destinations, both domestic and international. The exception is Jackson's McKellar-Sipes airport, which has a strictly regional focus. The largest Tennessee airport, Memphis International Airport also handles the largest cargo volume of any airport in the world: 4,016,818 metric tons in 2012.

Tennessee receives the most scheduled air freight of any state in the U.S. as measured by short tons (2,000 lbs.) and the 10th most unscheduled freight in the nation. A remarkable 15.5% of all scheduled freight tonnage received nationwide arrived in the state, primarily at Memphis. Fed Ex which has its primary hub at Memphis International Airport is responsible for 200 of the airport's daily flights and 97% of the statewide air freight. With just over 10 million commercial service boarding passengers per year, Tennessee's passenger enplanements are also considerable, and 90% of commercial passenger traffic statewide is handled in Memphis and Nashville.

Highway Infrastructure

Tennessee has 1,104 miles of interstate highways including I-40 which spans the entire horizontal length of the state, going from Knoxville through Nashville to Memphis. I-24, I-65, I-75 and I-81 are all interstates that cut across different portions of the state running north and south. Tennessee has 19 interstate rest areas and 13 state border welcome areas. In addition to its 14,000 miles of state owned highways, there are about 70,000 miles of rural roads and over 17,000 miles of urban roads maintained in the state. Approximately 5,000,000 motor vehicles are registered in the state, and over 4,250,000 Tennesseans hold drivers' licenses.

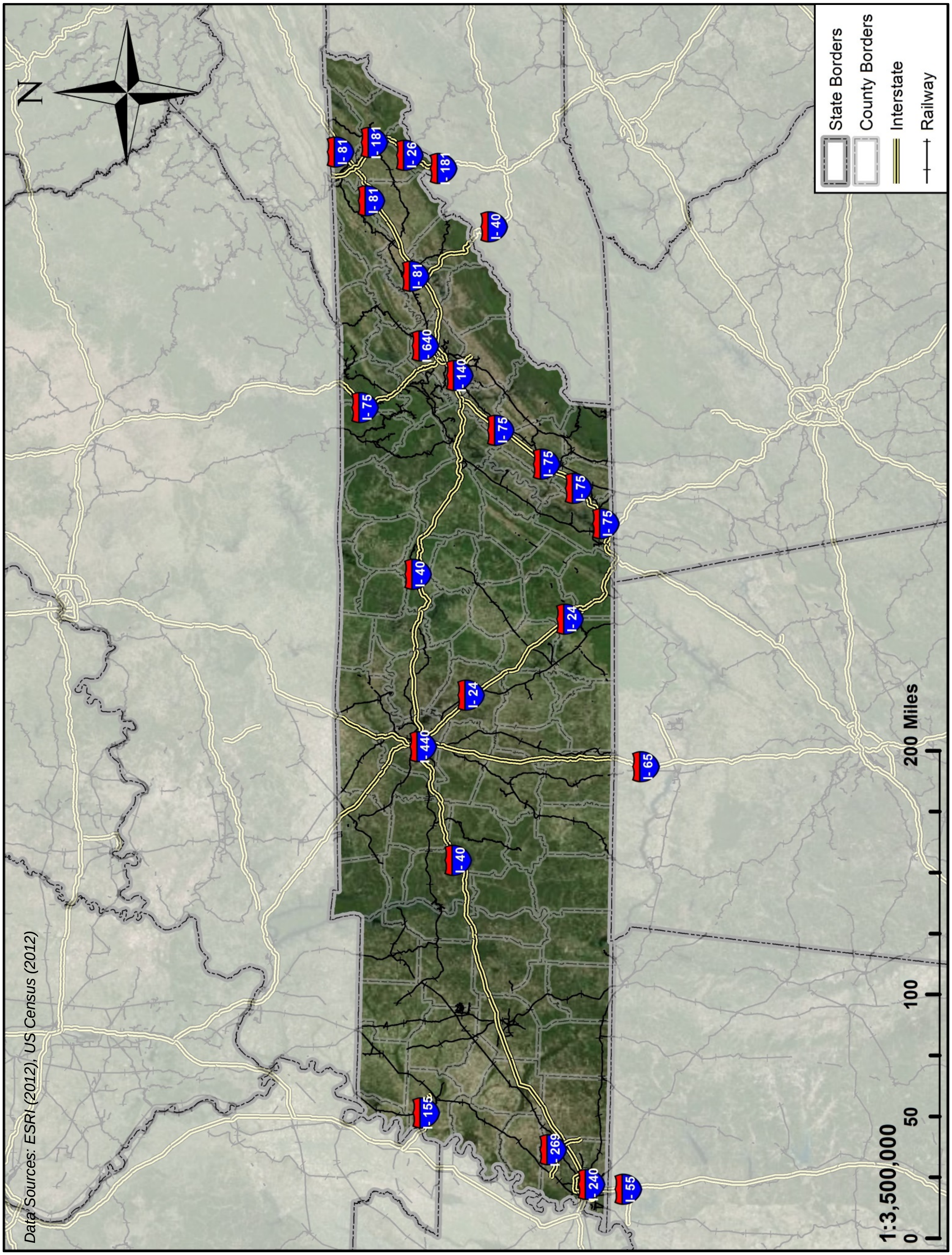
Rail

Railroad building began in Tennessee as early as the 1820s. During the 1850s, the basis for 19^{th} and 20^{th} century rail transportation was laid: the Louisville and Nashville Railroad linked Tennessee to the northern states, and the Memphis and Charleston line established ties with the East Coast. Tennessee has over 3,100 rail miles of track. Six major rail lines operate on the 2,340 miles of Class I track, and 20 different rail companies operate on the 810 miles of short-line track.

Water Based Transportation

The principal means of transportation during Tennessee's early history was water, and all the early settlements were built on or near streams. The introduction of steamboats on the Cumberland River in the early 19th century helped make Nashville the state's largest city and its foremost trading center. By mid-century, however, Memphis, on the Mississippi River, had surpassed Nashville in population and trade. The completion in 1985 of the 234 mile long Tennessee Tombigbee Waterway gave Tennessee shippers a direct north-south route for all vessels between the Tennessee River and the Gulf of Mexico via the Black Warrior River in Alabama. Although none of the waterway runs through Tennessee, the northern terminus is on the Tennessee River near the common borders of Tennessee, Alabama, and Mississippi. In 2010, the port of Memphis handled 12.1 million tons of freight, and the ports of Nashville and Chattanooga each handled about 2.0 million tons.

Map 8 – Rail & Interstates of Tennessee



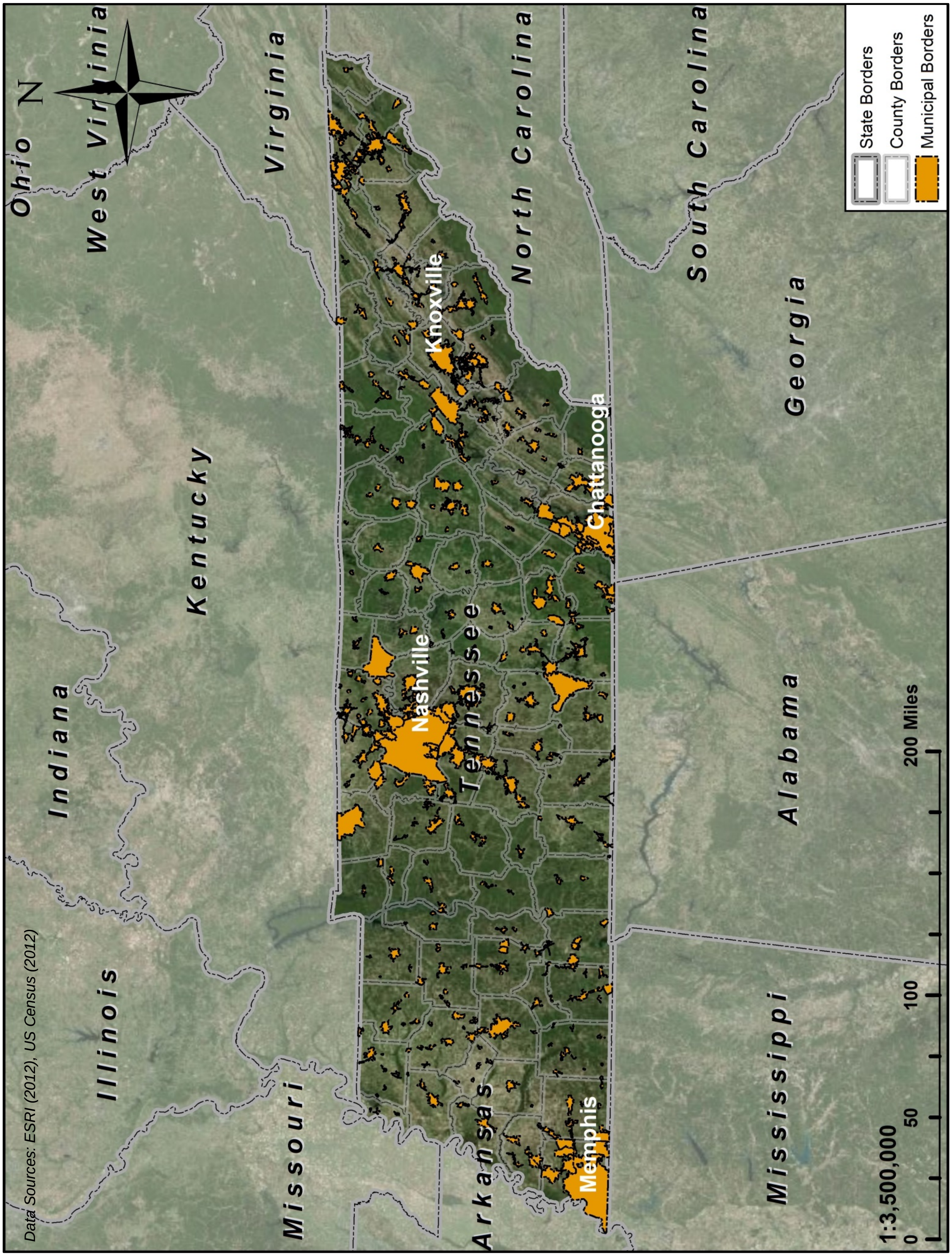
2.5 – Demographics

With approximately 6,400,000 people, Tennessee is the nation's 17th most populous state, just ahead of Maryland and Missouri. Memphis is the largest city in the state, followed closely by Nashville with both cities over 600,000 in population; the next 2 largest cities are Knoxville and Chattanooga, each with fewer than 200,000 persons. The state grew by over 700,000 persons between 2000 and 2010, and is expected to follow a similar growth pattern over the next twenty years. Tennessee's 3 largest race groups are White (75%), African American (16.66%), and Hispanic (4.57%). Compared to the United States' average, Tennessee has 4% more African Americans, almost 12% fewer Hispanics, and more than 3% fewer Asians as a percentage of its total population.

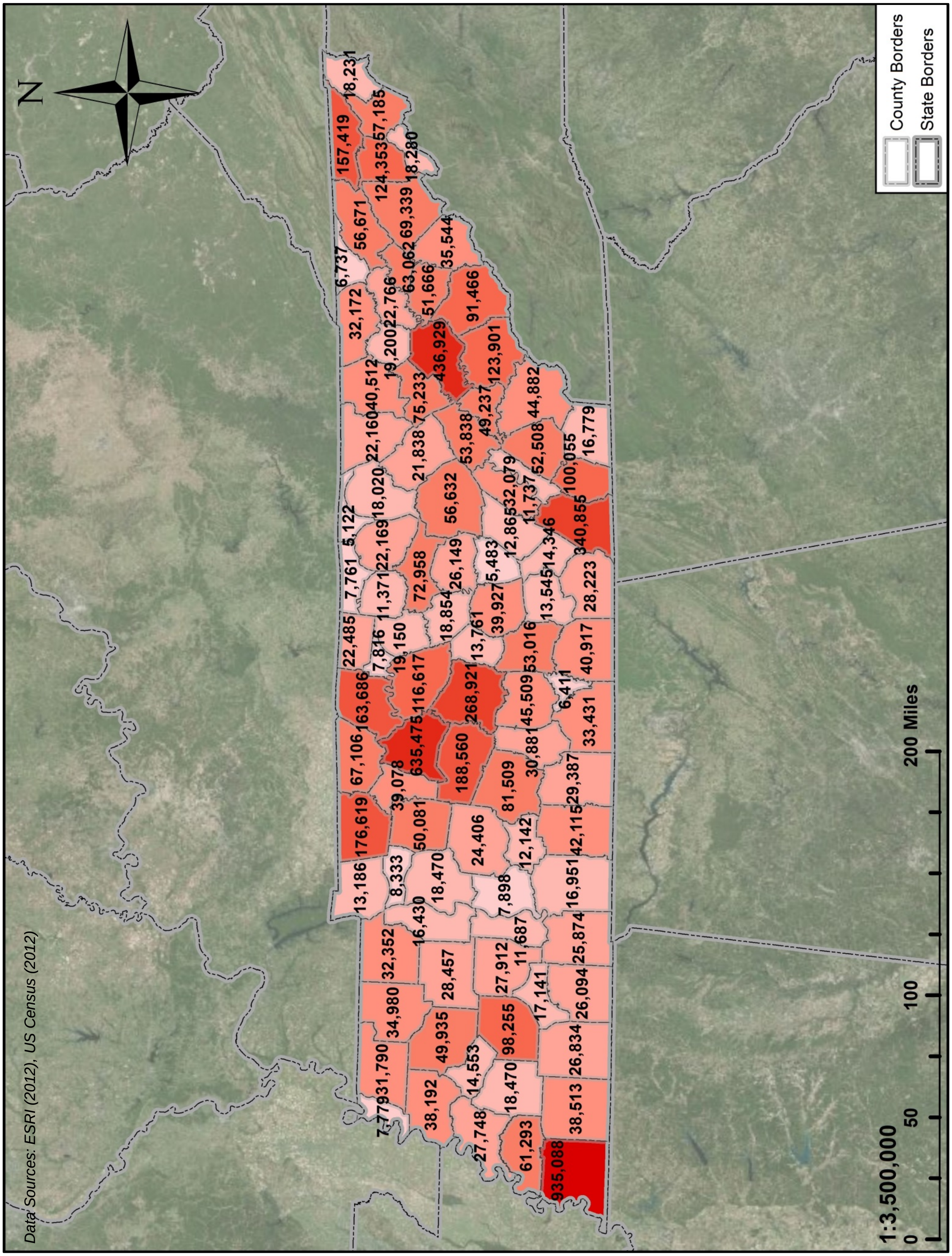
The median age of a Tennessee resident in 2010 was 38 years old, with 6.43% of the population under 5 years old, 23.57% under 18 years old, and 13.45% of the population over 65 years old. These percentages compare very closely to the overall age composition of the entire United States.

The average income of a Tennessee family in 2010 was $42,279, which is the 45th lowest family income of any state. In addition, 16.90% of Tennessee's population lives below the federally established poverty level. This places Tennessee with 2.6% more of its population living below the poverty line than the national average.

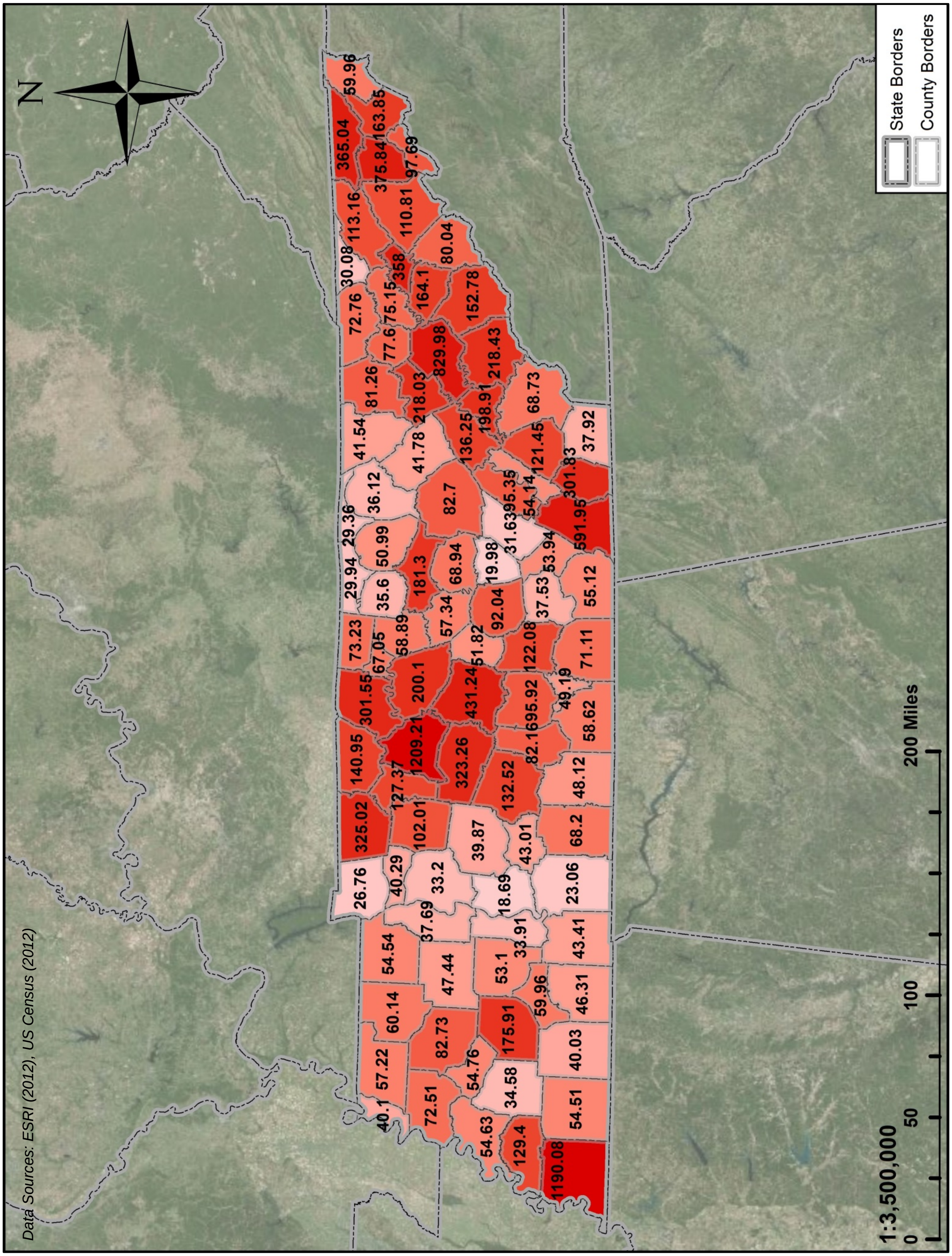
Map 9 – Cities & Towns of Tennessee



Map 10 – Total Population by County, Tennessee



Map 11 – Population Density by County, Persons Per Square Mile, Tennessee



Map 12 – Population Growth, Tennessee (2000 – 2011)

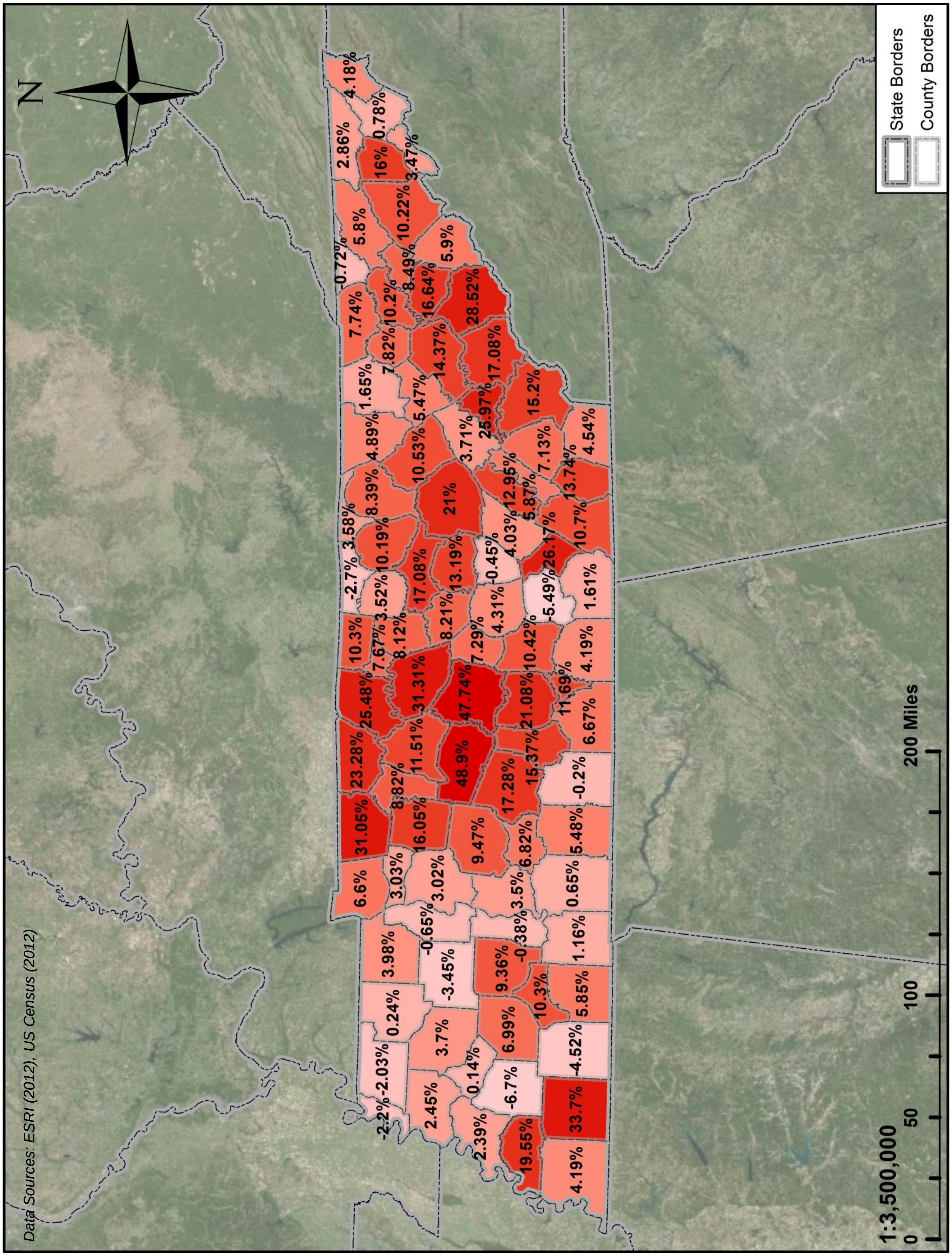


Table 11 – Tennessee Demographics

Population	Tennessee	USA
Population, 2030 Projection	7,380,634	363,584,435
Population, % Change 2010 - 2030	16.30%	17.76%
Population, % Change 2020 - 2030	8.85%	8.27%
Population, 2020 Projection	6,780,670	335,804,546
Population, % Change 2010 - 2020	6.85%	8.76%
Total Population, 2010	6,346,105	308,745,538
Age		
Persons under 5 years old, 2010	407,813	20,201,362
Persons under 5 years old, 2010, %	6.43%	6.54%
Persons under 18 years old, 2010	1,496,001	74,181,467
Persons under 18 years old, 2010, %	23.57%	24.03%
Persons 65 years old and over, 2010	853,462	40,267,954
Persons 65 years old and over, 2010, %	13.45%	13.04%
Gender		
Female Persons, 2010	3,252,601	156,964,212
Female Persons, 2010, %	51.25%	50.84%
Male persons, 2010	3,093,504	151,781,326
Male persons, 2010, %	48.75%	49.16%
Race		
Black or African American persons, 2010	1,057,315	38,929,319
Black or African American persons, 2010, %	16.66%	12.61%
American Indian and Alaska Native Persons, 2010	19,994	2,932,248
American Indian and Alaska Native Persons, 2010, %	0.32%	0.95%
Asian Persons, 2010	91,242	14,674,252
Asian Persons, 2010, %	1.44%	4.75%
Native Hawaiian and Other Pacific Islander, 2010	3,642	540,013
Native Hawaiian and Other Pacific Islander, 2010, %	0.06%	0.17%
Persons Reporting Two or More Races, 2010	110,009	9,009,073
Persons Reporting Two or More Races, 2010, %	1.73%	2.92%
Persons of Hispanic or Latino Origin, 2010	290,059	50,477,594
Persons of Hispanic or Latino Origin, 2010, %	4.57%	16.35%
Income		
Median Household Income, 2011	$42,279	$50,054
Per Capita Income, 2011	$23,722	$27,554
Persons below poverty level, 2011	1,072,492	44,150,612
Persons below poverty level, 2011, %	16.90%	14.30%

**The data are from the U.S. Census Bureau*

Table 12 – East Tennessee County Demographics			
County	**Population (2000)**	**Population (2010)**	**Population Change**
Anderson	71,330	75,129	5.33%
Bledsoe	12,367	12,876	4.12%
Blount	105,823	123,010	16.24%
Bradley	87,965	98,963	12.50%
Campbell	39,854	40,716	2.16%
Carter	56,742	57,424	1.20%
Claiborne	29,862	32,213	7.87%
Cocke	33,565	35,662	6.25%
Cumberland	46,802	56,053	19.77%
Fentress	16,625	17,959	8.02%
Grainger	20,659	22,657	9.67%
Greene	62,909	68,831	9.41%
Hamblen	58,128	62,544	7.60%
Hamilton	307,896	336,463	9.28%
Hancock	6,786	6,819	0.49%
Hawkins	53,563	56,833	6.10%
Jefferson	44,294	51,407	16.06%
Johnson	17,499	18,244	4.26%
Knox	382,032	432,226	13.14%
Loudon	39,086	48,556	24.23%
Marion	27,776	28,237	1.66%
McMinn	49,015	52,266	6.63%
Meigs	11,086	11,753	6.02%
Monroe	38,961	44,519	14.27%
Morgan	19,757	21,987	11.29%
Pickett	4,945	5,077	2.67%
Polk	16,050	16,825	4.83%
Rhea	28,400	31,809	12.00%
Roane	51,910	54,181	4.37%
Scott	21,127	22,228	5.21%
Sequatchie	11,370	14,112	24.12%
Sevier	71,170	89,889	26.30%
Sullivan	153,048	156,823	2.47%
Unicoi	17,667	18,313	3.66%
Union	17,808	19,109	7.31%
Washington	107,198	122,979	14.72%

**The data are from the U.S. Census Bureau*

Table 13 – Middle Tennessee County Demographics			
County	Population (2000)	Population (2010)	Population Change
Bedford	37,586	45,058	19.88%
Cannon	12,826	13,801	7.60%
Cheatham	35,912	39,105	8.89%
Clay	7,976	7,861	-1.44%
Coffee	48,014	52,796	9.96%
Davidson	569,891	626,681	9.97%
DeKalb	17,423	18,723	7.46%
Dickson	43,156	49,666	15.08%
Franklin	39,270	41,052	4.54%
Giles	29,447	29,485	0.13%
Grundy	14,332	13,703	-4.39%
Hickman	22,295	24,690	10.74%
Houston	8,088	8,426	4.18%
Humphreys	17,929	18,538	3.40%
Jackson	10,984	11,638	5.95%
Lawrence	39,926	41,869	4.87%
Lewis	11,367	12,161	6.99%
Lincoln	31,340	33,361	6.45%
Macon	20,386	22,248	9.13%
Marshall	26,767	30,617	14.38%
Maury	69,498	80,956	16.49%
Montgomery	134,768	172,331	27.87%
Moore	5,740	6,362	10.84%
Overton	20,118	22,083	9.77%
Perry	7,631	7,915	3.72%
Putnam	62,315	72,321	16.06%
Robertson	54,433	66,283	21.77%
Rutherford	182,023	262,604	44.27%
Smith	17,712	19,166	8.21%
Stewart	12,370	13,324	7.71%
Sumner	130,449	160,645	23.15%
Trousdale	7,259	7,870	8.42%
Van Buren	5,508	5,548	0.73%
Warren	38,276	39,839	4.08%
Wayne	16,842	17,021	1.06%
White	23,102	25,841	11.86%
Williamson	126,638	183,182	44.65%
Wilson	88,809	113,993	28.36%

**The data are from the U.S. Census Bureau*

Table 14 – West Tennessee County Demographics			
County	**Population (2000)**	**Population (2010)**	**Population Change**
Benton	16,537	16,489	-0.29%
Carroll	29,475	28,522	-3.23%
Chester	15,540	17,131	10.24%
Crockett	14,532	14,586	0.37%
Decatur	11,731	11,757	0.22%
Dyer	37,279	38,335	2.83%
Fayette	28,806	38,413	33.35%
Gibson	48,152	49,683	3.18%
Hardeman	28,105	27,253	-3.03%
Hardin	25,578	26,026	1.75%
Haywood	19,797	18,787	-5.10%
Henderson	25,522	27,769	8.80%
Henry	31,115	32,330	3.90%
Lake	7,954	7,832	-1.53%
Lauderdale	27,101	27,815	2.63%
Madison	91,837	98,294	7.03%
McNairy	24,653	26,075	5.77%
Obion	32,450	31,807	-1.98%
Shelby	897,472	927,664	3.36%
Tipton	51,271	61,081	19.13%
Weakley	34,895	35,021	0.36%

**The data are from the U.S. Census Bureau*

2.6 – Facility & Infrastructure Inventory

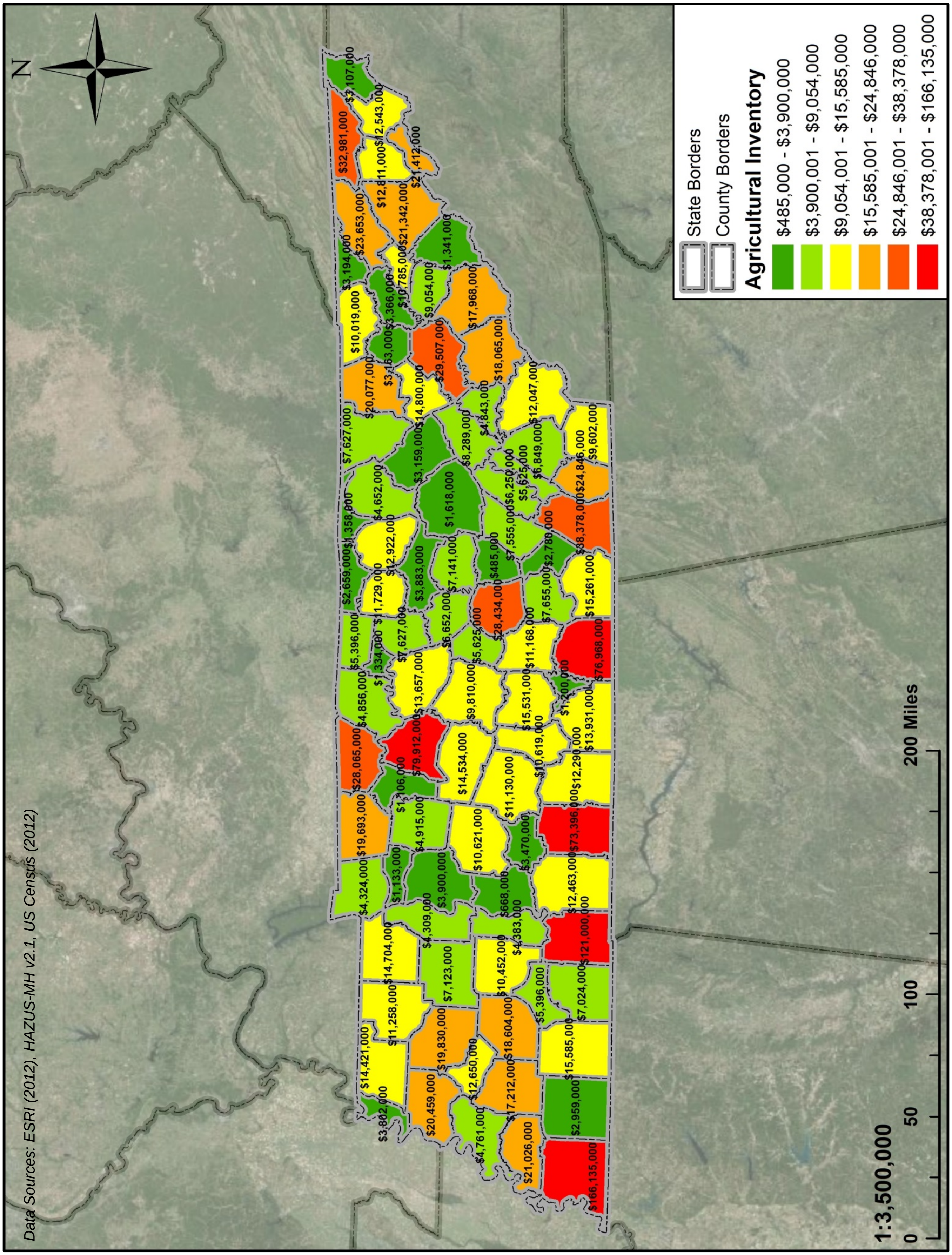
Table 15 – Structure Inventory by County, Tennessee								
Name	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Anderson	$14,800	$783,840	$57,038	$28,319	$253,890	$132,687	$3,677,007	$4,947,581
Bedford	$15,531	$250,436	$15,065	$7,419	$101,671	$38,178	$1,314,250	$1,742,550
Benton	$4,309	$132,896	$9,141	$6,327	$45,790	$32,323	$701,573	$932,359
Bledsoe	$7,555	$39,740	$8,712	$12,947	$16,447	$9,030	$412,286	$506,717
Blount	$18,065	$1,334,727	$50,374	$43,110	$339,527	$166,751	$4,157,152	$6,109,706
Bradley	$24,846	$1,053,151	$51,087	$34,286	$308,114	$175,068	$5,193,410	$6,839,962
Campbell	$20,077	$458,587	$25,247	$21,000	$201,037	$72,799	$2,188,135	$2,986,882
Cannon	$5,625	$99,715	$12,592	$7,349	$22,338	$16,581	$567,278	$731,478
Carroll	$7,123	$160,205	$19,554	$6,256	$45,347	$33,391	$958,791	$1,230,667
Carter	$12,543	$315,991	$44,070	$14,792	$96,951	$77,532	$1,935,849	$2,497,728
Cheatham	$1,106	$80,557	$12,436	$3,062	$9,067	$15,038	$465,201	$586,467
Chester	$5,396	$100,008	$8,712	$6,077	$33,060	$25,874	$657,965	$837,092
Claiborne	$10,019	$239,532	$21,299	$12,440	$148,195	$38,192	$1,277,294	$1,746,971
Clay	$2,659	$58,295	$5,267	$8,698	$11,681	$5,311	$286,064	$377,975
Cocke	$1,341	$13,819	$1,063	$759	$2,521	$2,272	$109,485	$131,260
Coffee	$11,168	$375,030	$39,899	$18,462	$168,783	$55,633	$1,669,054	$2,338,029
Crockett	$12,650	$103,869	$7,600	$5,733	$37,311	$26,970	$617,577	$811,710
Cumberland	$1,618	$81,201	$6,011	$5,299	$15,718	$11,732	$344,682	$466,261
Davidson	$79,912	$7,884,246	$758,785	$183,765	$1,551,969	$1,008,228	$26,612,617	$38,079,522
Decatur	$4,383	$104,517	$5,413	$5,363	$65,623	$17,405	$259,732	$462,436
DeKalb	$6,652	$171,510	$9,689	$6,173	$121,728	$24,872	$383,548	$724,172
Dickson	$4,915	$77,647	$3,422	$7,648	$37,248	$17,722	$884,040	$1,032,642
Dyer	$20,459	$487,317	$29,356	$13,987	$241,494	$65,168	$1,336,560	$2,194,341
Fayette	$2,959	$231,048	$20,481	$8,448	$93,178	$28,240	$805,953	$1,190,307
Fentress	$4,652	$117,277	$9,265	$3,278	$29,873	$17,000	$522,138	$703,483
Franklin	$76,968	$347,000	$31,929	$15,094	$84,978	$48,541	$1,297,931	$1,902,441
Gibson	$19,830	$507,928	$33,271	$31,353	$352,290	$107,873	$2,023,272	$3,075,817
Giles	$12,290	$312,412	$20,111	$13,669	$169,999	$50,178	$742,442	$1,321,101
Grainger	$3,366	$47,275	$9,766	$4,976	$43,518	$7,839	$472,361	$589,101
Greene	$21,342	$622,058	$39,623	$40,526	$382,171	$73,806	$2,476,329	$3,655,855
Grundy	$7,655	$85,566	$8,833	$11,512	$45,575	$12,075	$579,409	$750,625
Hamblen	$10,785	$650,428	$53,685	$21,228	$407,881	$80,570	$2,481,247	$3,705,824
Hamilton	$38,378	$4,151,269	$183,048	$144,108	$1,251,042	$447,719	$11,582,606	$17,798,170
Hancock	$3,194	$166,440	$7,626	$4,733	$47,754	$18,367	$353,472	$601,586
Hardeman	$15,585	$377,864	$19,548	$19,232	$155,795	$56,324	$1,533,979	$2,178,327
Hardin	$121,000	$261,195	$15,666	$9,075	$169,173	$37,676	$539,175	$1,044,060
Hawkins	$23,653	$946,048	$31,463	$14,662	$232,278	$98,839	$2,268,985	$3,615,928
Haywood	$17,212	$159,068	$12,202	$8,181	$176,084	$47,220	$360,812	$780,779
Henderson	$10,452	$228,169	$15,683	$11,317	$134,590	$48,046	$1,027,021	$1,475,278
Henry	$14,704	$341,354	$27,054	$12,976	$97,940	$67,342	$1,373,797	$1,935,167
Hickman	$10,621	$302,303	$14,912	$18,311	$102,934	$43,565	$1,150,012	$1,642,658

Name	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Houston	$1,133	$43,842	$4,734	$2,484	$16,404	$8,511	$353,069	$430,177
Humphreys	$3,900	$141,750	$13,155	$4,625	$55,845	$32,087	$927,907	$1,179,269
Jackson	$11,729	$201,222	$16,873	$12,736	$35,693	$27,611	$864,863	$1,170,727
Jefferson	$9,054	$234,480	$28,050	$10,909	$59,693	$42,312	$1,115,318	$1,499,816
Johnson	$3,107	$108,850	$6,616	$10,953	$20,598	$23,326	$504,123	$677,573
Knox	$29,507	$3,089,124	$139,183	$98,860	$848,331	$376,340	$9,086,399	$13,667,744
Lake	$3,802	$91,777	$11,426	$6,320	$17,928	$13,847	$428,279	$573,379
Lauderdale	$4,761	$188,188	$16,585	$11,631	$158,307	$52,864	$1,243,850	$1,676,186
Lawrence	$73,396	$157,234	$32,279	$14,534	$51,122	$36,742	$1,150,763	$1,516,070
Lewis	$3,470	$79,845	$6,017	$5,071	$14,996	$19,209	$424,951	$553,559
Lincoln	$13,931	$238,328	$16,768	$12,224	$139,798	$52,157	$1,159,486	$1,632,692
Loudon	$4,843	$216,091	$18,002	$16,334	$130,352	$30,406	$1,190,935	$1,606,963
McMinn	$6,849	$187,639	$16,770	$10,503	$50,358	$28,169	$939,020	$1,239,308
McNairy	$7,024	$235,661	$12,677	$11,477	$214,267	$42,761	$520,192	$1,044,059
Macon	$5,396	$103,757	$9,531	$6,277	$33,407	$26,123	$679,988	$864,479
Madison	$18,604	$1,592,472	$184,391	$32,434	$498,742	$227,759	$4,255,754	$6,810,156
Marion	$15,261	$1,100,028	$31,159	$3,320	$137,133	$67,917	$2,409,289	$3,764,107
Marshall	$10,619	$137,113	$9,400	$15,363	$59,485	$18,319	$1,002,422	$1,252,721
Maury	$11,130	$1,140,013	$42,537	$58,100	$194,941	$131,753	$3,394,401	$4,972,875
Meigs	$5,625	$99,715	$12,592	$7,349	$22,338	$16,581	$567,278	$731,478
Monroe	$12,047	$363,767	$28,463	$18,980	$191,595	$50,860	$687,427	$1,353,139
Montgomery	$19,693	$997,573	$59,719	$23,074	$258,099	$117,957	$4,939,527	$6,415,642
Moore	$1,200	$22,029	$4,919	$1,180	$15,304	$5,152	$139,439	$189,223
Morgan	$3,159	$75,805	$11,174	$14,901	$47,920	$23,248	$637,660	$813,867
Obion	$14,421	$483,457	$23,301	$19,783	$89,671	$76,176	$1,384,850	$2,091,659
Overton	$12,922	$369,533	$19,548	$19,232	$152,617	$54,039	$1,389,804	$2,017,695
Perry	$668	$60,498	$5,454	$2,064	$23,974	$7,572	$170,636	$270,866
Pickett	$1,358	$33,960	$3,780	$612	$25,202	$7,598	$110,999	$183,509
Polk	$9,602	$186,839	$8,620	$14,506	$73,479	$34,892	$789,162	$1,117,100
Putnam	$3,883	$1,068,028	$127,167	$13,554	$105,219	$126,938	$1,642,758	$3,087,547
Rhea	$6,250	$126,192	$9,604	$5,126	$80,617	$29,900	$715,715	$973,404
Roane	$8,289	$450,986	$71,295	$16,244	$86,659	$82,799	$2,427,402	$3,143,674
Robertson	$28,065	$322,996	$10,231	$4,433	$102,244	$36,334	$1,324,364	$1,828,667
Rutherford	$9,810	$1,275,007	$71,473	$31,576	$352,862	$116,832	$3,465,561	$5,323,121
Scott	$7,627	$208,572	$12,326	$10,025	$125,619	$41,846	$883,349	$1,289,364
Sequatchie	$2,780	$24,466	$1,444	$3,922	$8,891	$8,186	$290,211	$339,900
Sevier	$17,968	$559,145	$28,616	$16,425	$142,406	$97,540	$3,063,927	$3,926,027
Shelby	$166,135	$10,951,575	$874,533	$377,590	$2,549,543	$1,526,808	$44,748,015	$61,194,199
Smith	$7,627	$208,572	$12,326	$10,025	$125,619	$41,846	$883,349	$1,289,364
Stewart	$4,324	$100,646	$3,050	$6,499	$115,905	$26,945	$504,126	$761,495
Sullivan	$32,981	$2,259,921	$144,210	$50,982	$671,050	$303,831	$9,426,733	$12,889,708
Sumner	$4,856	$188,379	$14,694	$5,762	$58,950	$61,180	$2,009,597	$2,343,418
Tipton	$21,026	$752,801	$54,667	$11,689	$229,394	$97,067	$4,209,810	$5,376,454
Trousdale	$1,334	$125,980	$5,145	$4,450	$221,004	$16,784	$362,288	$736,985
Unicoi	$21,412	$203,353	$12,122	$8,292	$51,287	$46,501	$1,124,925	$1,467,892
Union	$3,163	$172,231	$16,267	$3,841	$71,831	$17,590	$1,148,177	$1,433,100

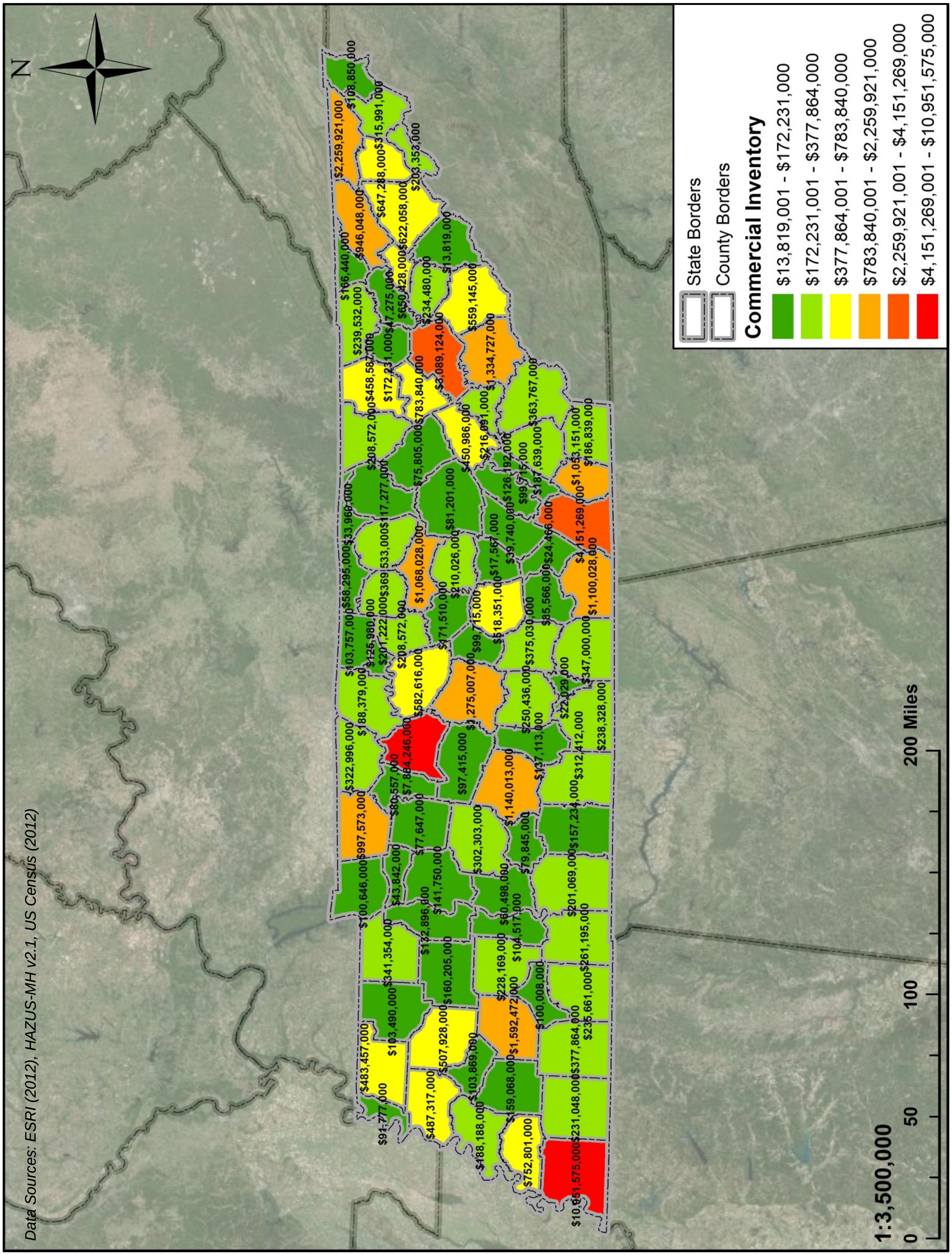
Name	Structure Classification							Total
	Agricultural	Commercial	Education	Government	Industrial	Religious	Residential	
Van Buren	$485	$17,567	$4,107	$2,960	$20,144	$4,081	$94,175	$143,519
Warren	$28,434	$518,351	$19,786	$17,004	$260,105	$62,677	$829,339	$1,735,696
Washington	$12,811	$647,288	$36,077	$38,128	$355,003	$92,268	$2,790,377	$3,971,952
Wayne	$12,463	$201,069	$11,755	$16,793	$83,141	$38,833	$1,022,069	$1,386,123
Weakley	$11,258	$103,490	$11,006	$9,855	$58,267	$29,826	$721,641	$945,343
White	$7,141	$210,026	$19,373	$11,615	$129,942	$38,424	$449,494	$866,015
Williamson	$14,534	$97,415	$14,898	$4,589	$18,301	$23,654	$654,710	$828,101
Wilson	$13,657	$582,616	$78,599	$12,970	$134,595	$111,052	$3,484,194	$4,417,683
State of Tennessee	**$309,404,704**	**$617,226,586**	**$559,607,786**	**$555,393,294**	**$553,381,159**	**$535,732,399**	**$527,640,392**	**$309,295,804**

**The data are from FEMA's HAZUS-MH v2.1.*
***The dollar values are in thousands.*

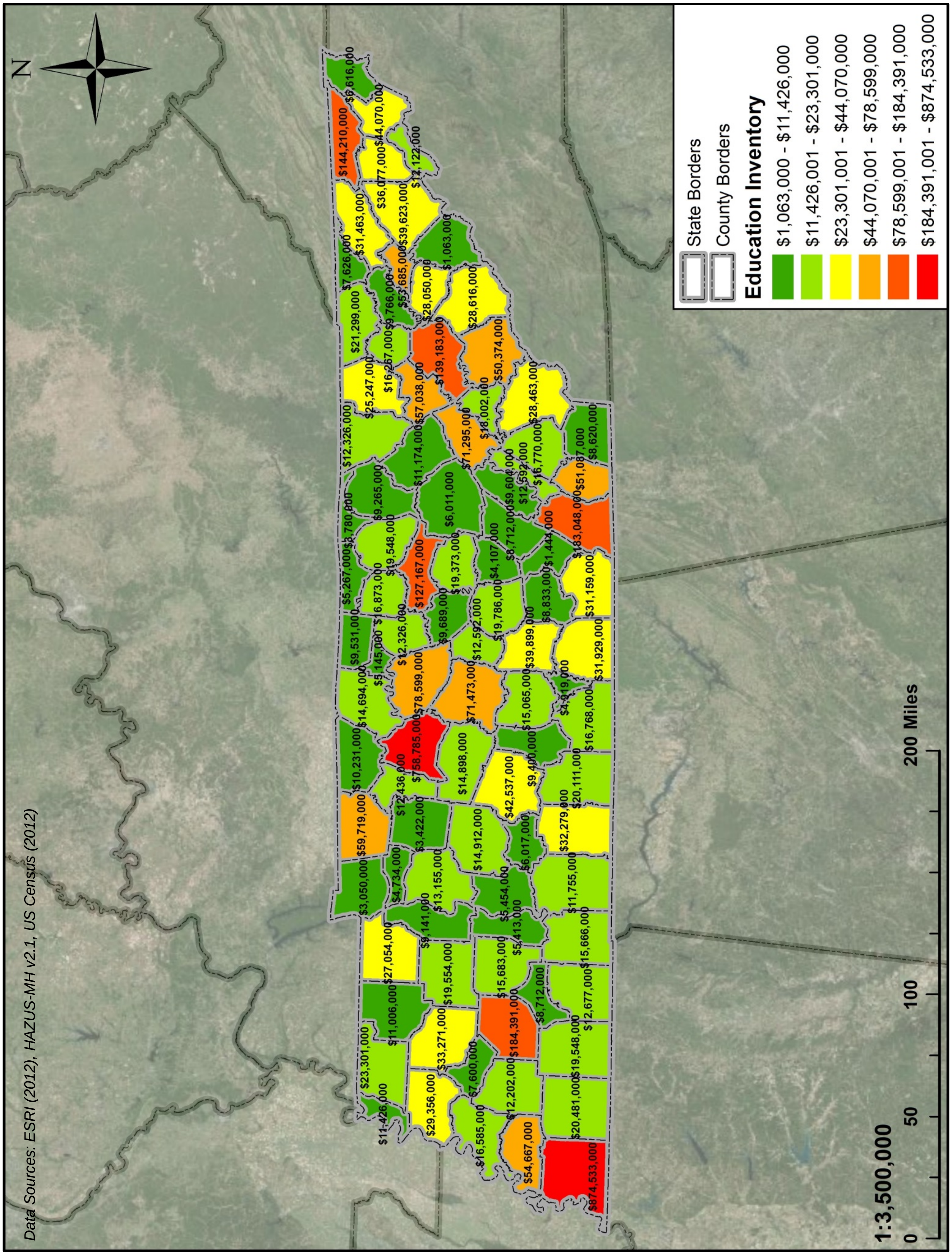
Map 13 – Agricultural Inventory, Tennessee



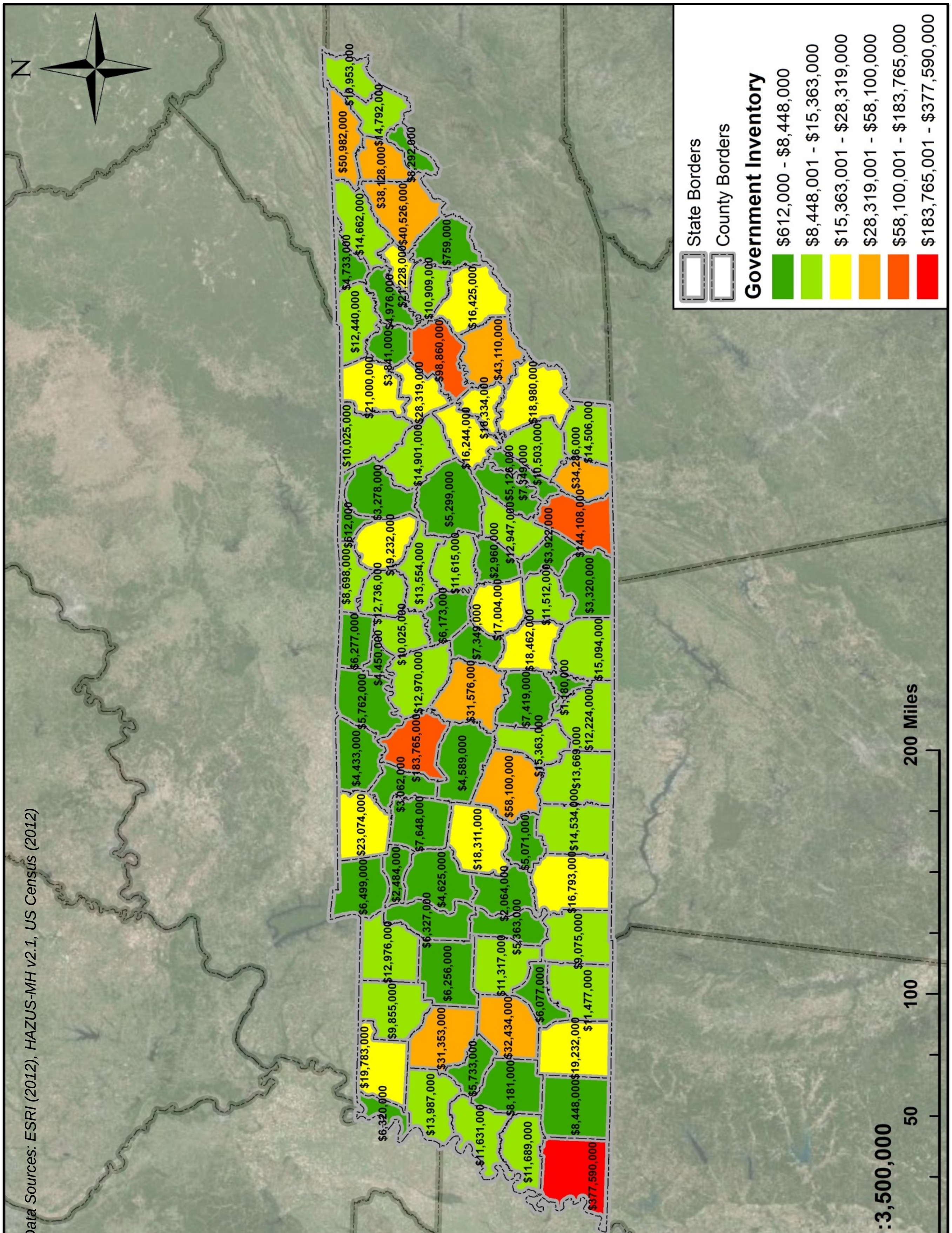
Map 14 – Commercial Inventory, Tennessee



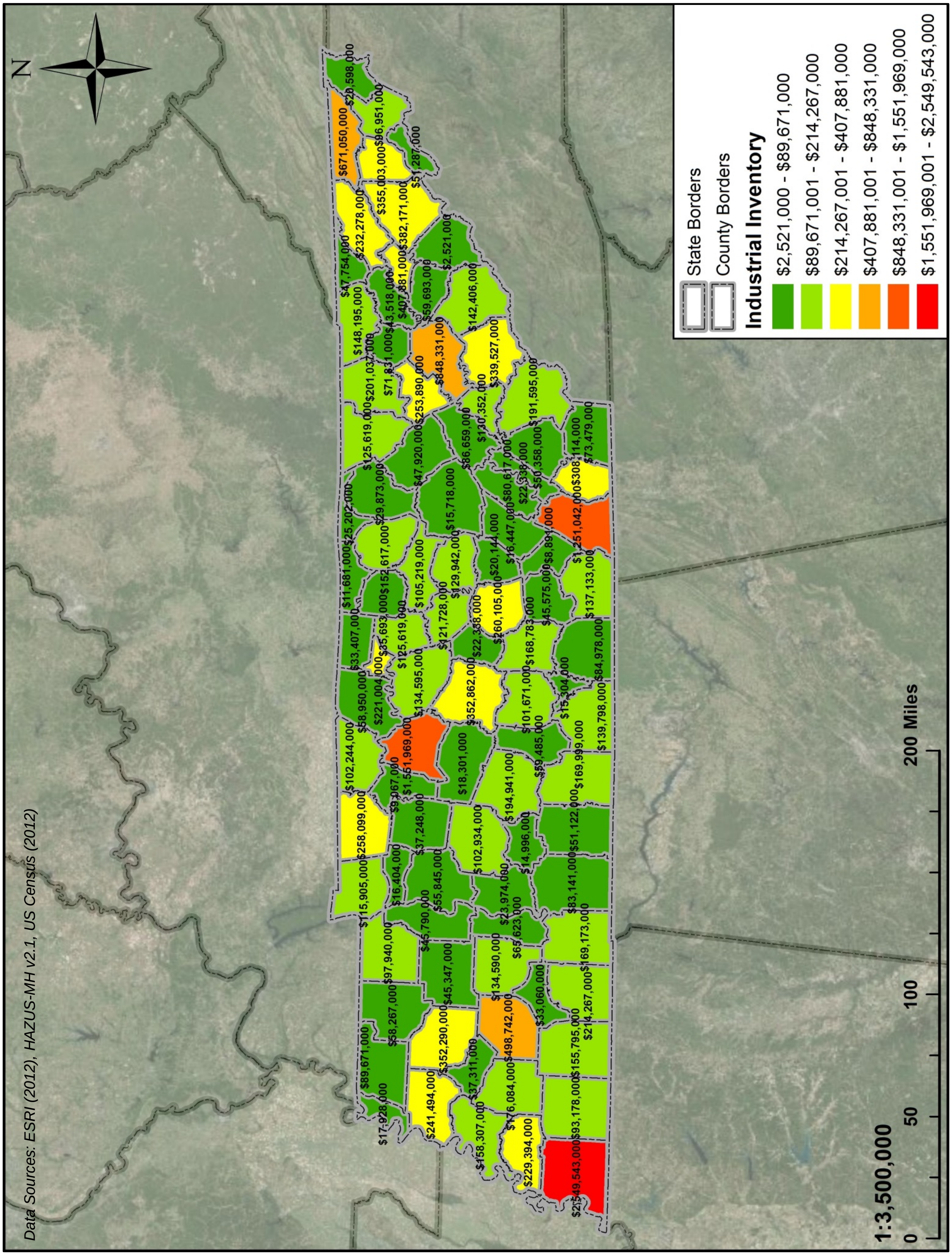
Map 15 – Education Inventory, Tennessee



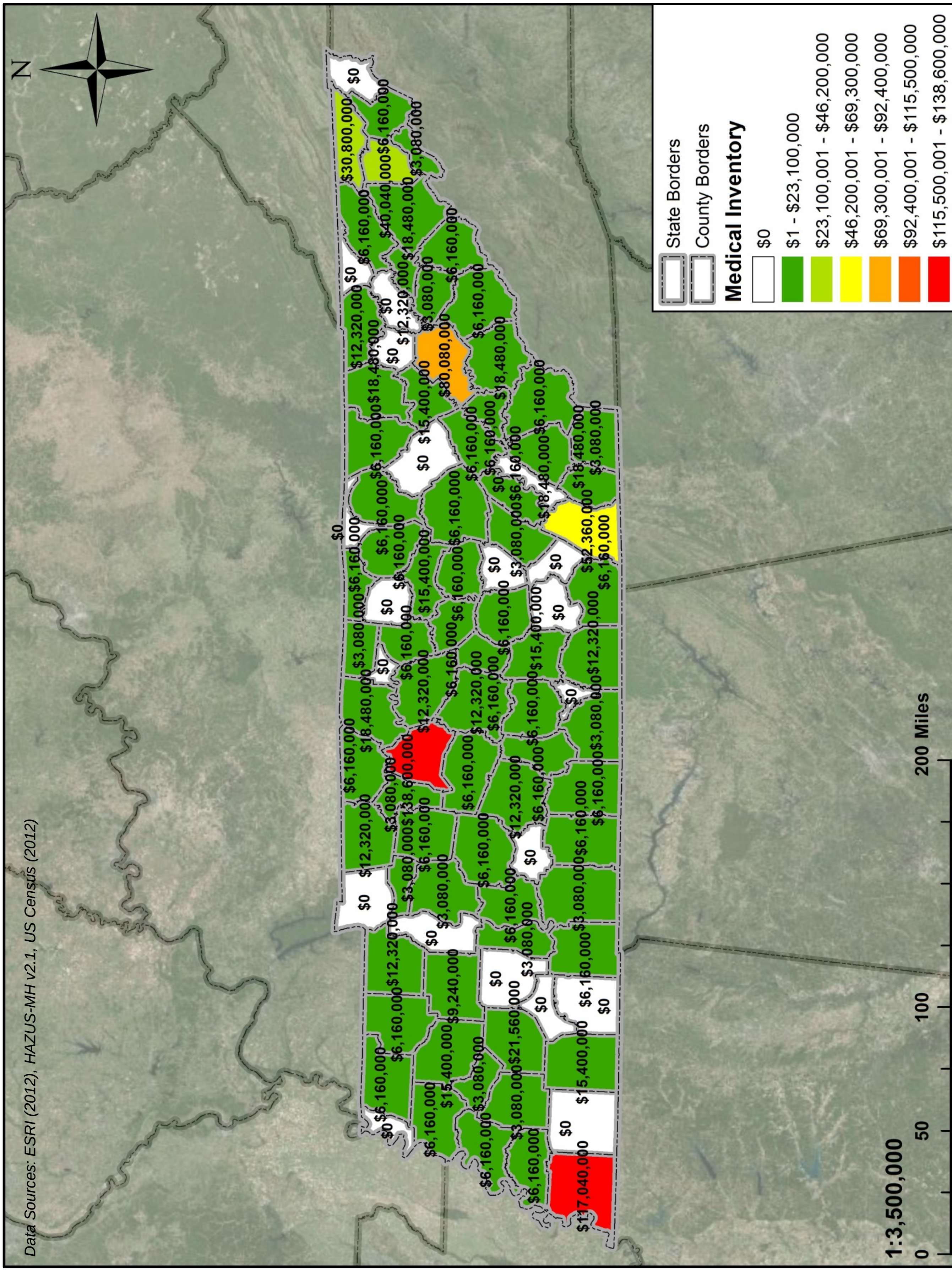
Map 16 – Government Inventory, Tennessee



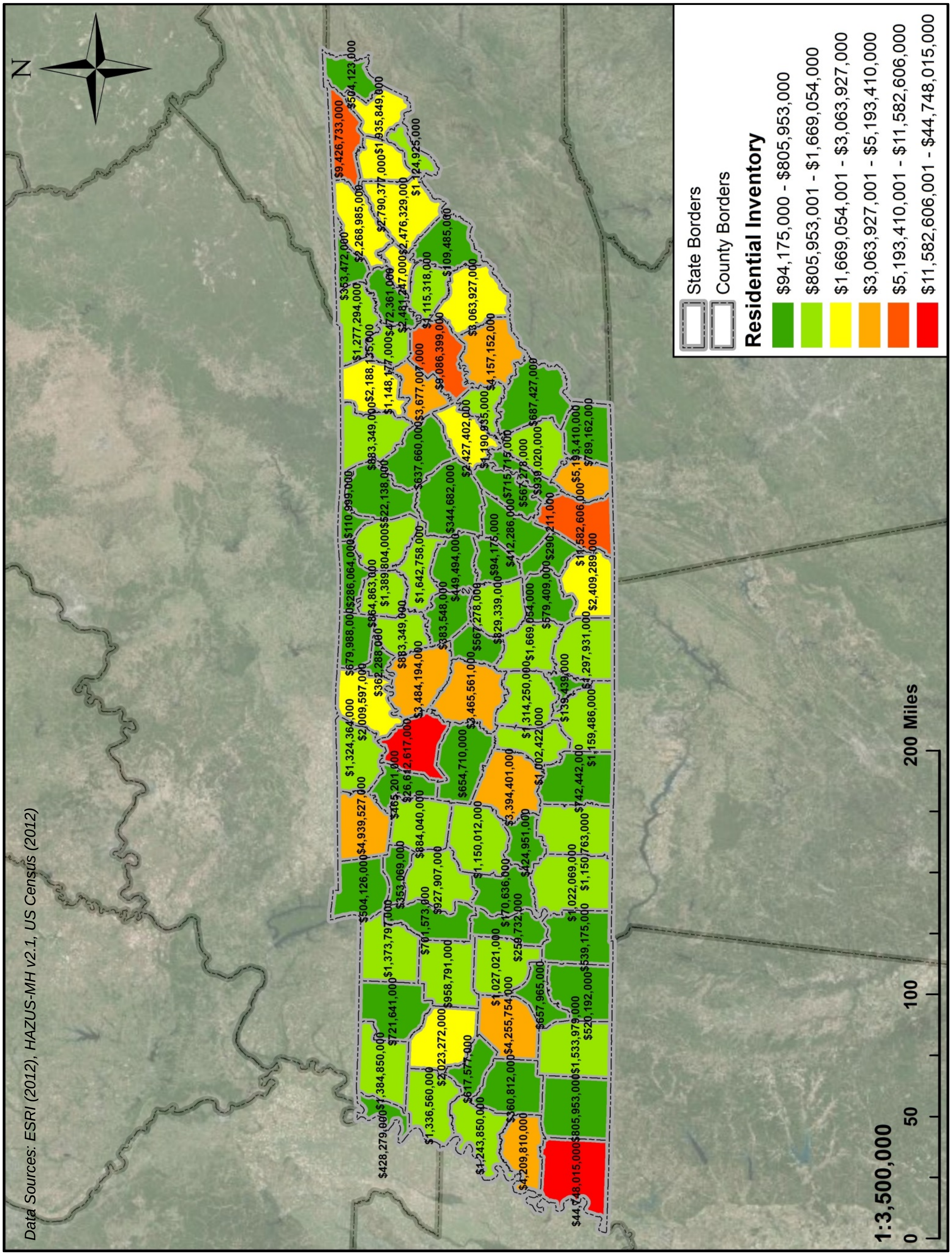
Map 17 – Industrial Inventory, Tennessee



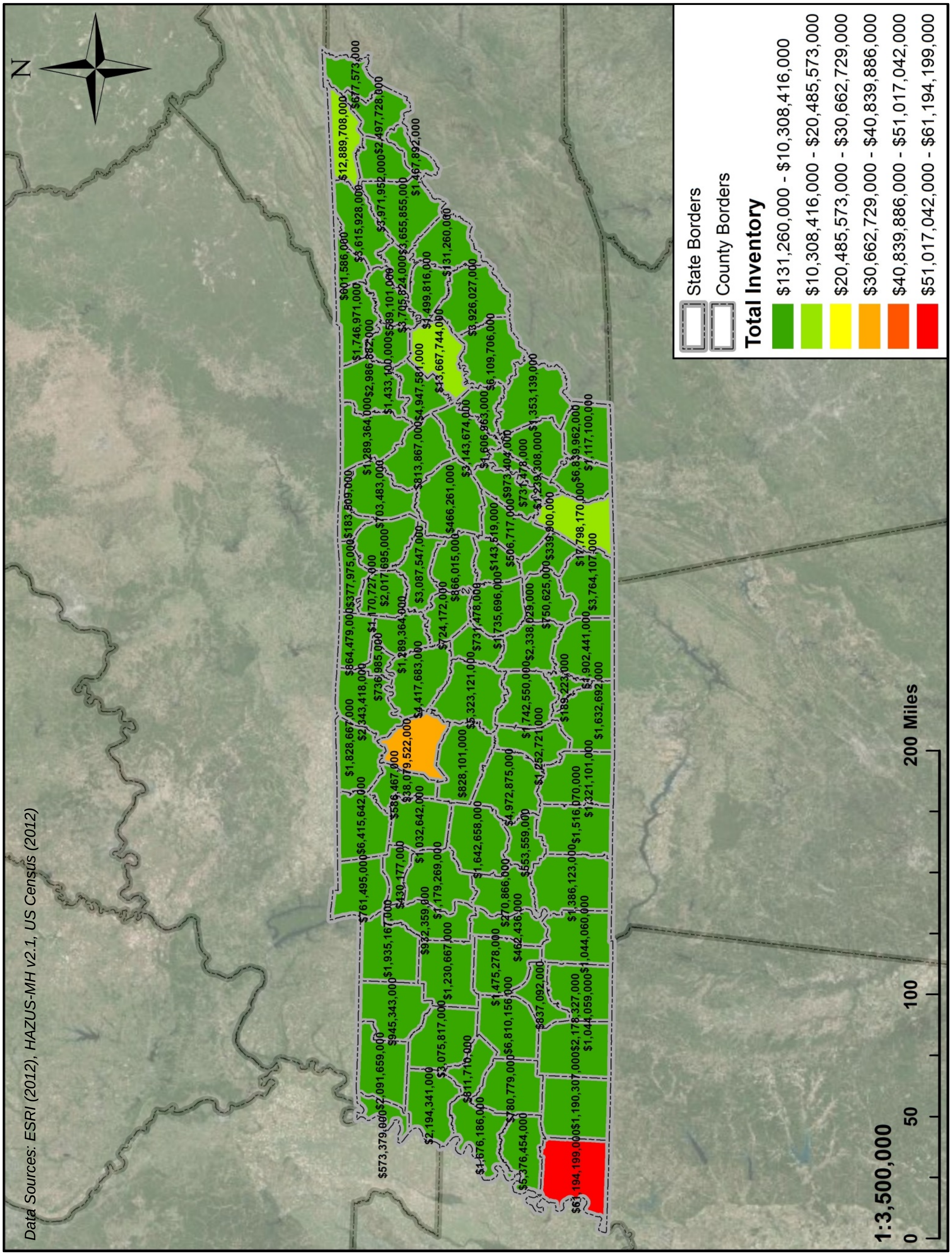
Map 18 – Medical Inventory, Tennessee



Map 19 – Residential Inventory, Tennessee



Map 20 – Total Inventory, Tennessee



Section 3 – Hazard Profiles

3.1 – Methodology

Section 3 – Hazard Profiles was developed to drive the state's risk assessment, comply with EMAP guidelines, and meet FEMA crosswalk requirements under the "Risk Assessment" categories "Identifying Hazards," "Profiling Hazards," and the "Severe Repetitive Loss Strategy." This has been accomplished through the following subsections. There descriptions, methods, and data sources are as follows.

3.3X – Hazard Name
This subsection provides a description of the hazard (natural, man-made, or technological) that has historically and potentially will continue to affect the State of Tennessee.

3.3.1 – Location & Extent
This subsection provides the geographic area and potential extent of impacts affected by each natural hazard identified as a threat in the State of Tennessee. If the hazard is measured on scale, the scale has been included and described. If geographic data exists to map the threat and/or exposure locations of the hazard, GIS maps have been included. This section was developed with data from the following sources: FEMA, NOAA, Natural Resources Conservation Service (NRCS), NWS, the University of Wisconsin's SILVIS Labs, USDA, and the USGS.

3.3.2 – Previous & Future Occurrences
This subsection details the hazards history in the State of Tennessee. If reliable data has been recorded on the previous occurrences, their summaries have been included. Additionally, this subsection, where possible, makes an attempt to predict the likelihood of a future hazard event occurring. Depending on the hazard, the prediction may come from an in-house analysis or an already existing study performed by a government agency with expertise in the hazard. This section was developed with data from the following sources: FEMA, NOAA, NRCS, NWS, USDA, and the USGS.

Well recorded and accurate hazard event information is scarce. Although this plan uses reputable and expert federal agency data sources, often the information has been recorded by impact location and not by the number of events. These sections carefully note the descriptions and summaries of these data as "impacts" or "impact events" and are in no way to be interpreted as climate or meteorological predictions. Instead they are to be taken exactly as written, descriptive summaries and collections of the historical impacts of hazard events.

Full documentation of reliable and recorded hazard histories are included in Addendum I – Hazard Event Impact History.

3.3.3 – Impact & Consequence Analysis
This subsection updates the previously approved hazard mitigation requirements for the state's EMAP accreditation. It entails an impact and consequence analysis for each natural hazard covering the: Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death); Health and Safety of Personnel Responding to the Incident; Continuity of Operations; Property, Facilities, and Infrastructure; Continued Delivery of Services; Environment; Economic Condition; Public Confidence in the Jurisdiction's Governance.

3.2 – Hazard Identification

TEMA's Hazard Mitigation Committee met to discuss the list and deliberate on any alterations. The hazards list is derived from historical hazard events and events existing with a high hazard potential. Changes were made from the previous plan's list. Only 1 hazard was removed; however, some were combined, or the hazard's name was changed to improve their profiles and the state risk assessment. Where changes occurred, TEMA's rationale is noted. For a complete list of significant hazard events please see Addendum I.

Table 16 – Tennessee Revised Hazards List

Natural Hazards	Change	Committee Rational
Drought	No Change	-
Earthquake	No Change	-
Extreme Temperature	Added Extreme Cold	Extreme cold incidents were deemed to have an existing, but unrealized risk potential.
Flood	No Change	-
Geologic	No Change	-
Severe Storms	Changed Wording from 'Severe Storm & Severe Winter Storm'	The label was deemed to lengthy and aligned with common TEMA and ESC usage.
Tornado	No Change	-
Wildfire	Removed Urban/House Fire	Urban/House Fire should be profiled at the local level, but is not considered a hazard of prime concern at the state level. State assets don't respond to Urban/House Fires. No other Region IV plans address Urban/House Fires
Man-Made Hazards	**Change**	**Committee Rational**
Communicable Diseases	Changed Wording from "Biologic"	The previous label was not correctly descriptive of the threat. Input provided by the Tennessee Dept. of Health.
Dam/Levee Failure	No Change	-
Hazardous Materials Release	Changed Wording from "Hazardous Material"	Added the word "Release" to ensure the hazard's label was correctly descriptive of the threat.
Infrastructure Incidents	Combined "Communications Failure," "Energy Failure," and "Transportation"	The hazard profiles were combined as they are interrelated under the state's ESF and DHS NEP guidelines.
Terrorism	No Change	-

Section 3NH – Natural Hazards

3.3D – Droughts

Drought is an abnormally dry period lasting months or years when an area has a deficiency of water and precipitation in its surface and/or underground water supply. The hydrological imbalance can be grouped into the following non-exclusive categories.

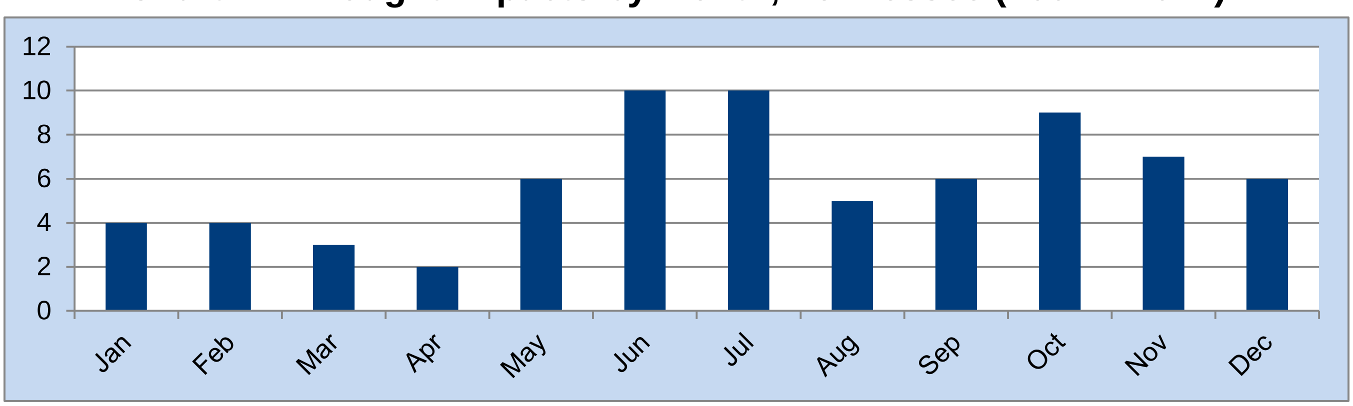
- ***Agricultural:*** When the amount of moisture in the soil no longer meets the needs of previously grown crops.
- ***Hydrological:*** When surface and subsurface water levels are significantly below their normal levels.
- ***Meteorological:*** When there is a significant departure from the normal levels of precipitation.
- ***Socio-Economic:*** When the water deficiency begins to significantly affect the population.

Droughts are regularly monitored by multiple federal agencies using a number of different indices. Typically, they are seasonal occurring in the late spring through early fall. Drought monitoring focuses on precipitation and temperature. When precipitation is less than normal, and natural water supplied begin to decease, a drought is occurring.

When below average, little or no rain falls soil can dry out and plants can die. If unusually dry weather persists and water supply problems develop. The time period is defined as a drought. Human activity such as over farming, excessive irrigation, deforestation, and poor erosion controls can exacerbate a drought's effects. It can take weeks or months before the effects of below average precipitation on bodies of water are observed. Depending on the region droughts can happen quicker, noticed sooner, or have their effects naturally mitigated. The more humid and wet an area is, the quicker the effects will be realized. A naturally dry region, which typically relies more on subsurface water will take more time to actualize its effects.

Periods of drought can have significant environmental, agricultural, health, economic, and social consequences. The effects vary depending on vulnerability and regional characteristics. Droughts can also reduce water quality through a decreased ability for natural rivers and streams to dilute pollutants and increase contamination. The most common consequences of droughts in the United States are: diminished crop yield; erosion; dust storms; ecosystem and environmental damage; wildfires; reduced electricity production from hydroelectric dams; livestock reduction. Please see the chart below for the seasonal impacts of drought in Tennessee.

Chart 1 – Drought Impacts by Month, Tennessee (2007 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

3.3.1 – Location & Extent

While extended periods without sufficient rainfall can and do occur across the state, causing damage to lawns, gardens, flora and fauna, it is most disastrous in the western half of the state where the vast majority of agricultural businesses are located. Severe drought can cause enormous economic consequences, not only in the state but in the region and nation as well. There is no set speed of onset or warning period. A drought may begin in as short of period as a week or it may take months to reach an official declared drought. Additionally, the drought can last for as little as a week to up to the entire season.

According to the Tennessee Department of Agriculture, agriculture and forestry have a profound impact on Tennessee’s economy, the health of our citizens, the beauty of our landscape as well as the quality of our lives. In hundreds of rural communities across our state, agriculture and forestry are the primary drivers of local economic activity. Agriculture and forestry’s impact is also felt throughout the manufacturing, processing, distribution and marketing sectors of our economy. The following economic impact study was developed by the University of Tennessee, Institute of Agriculture, Department of Agricultural and Resource Economics, and is presented by the Tennessee Department of Agriculture.

Major findings of note:

- In 2009, agriculture and forestry contributed $71.4 billion to Tennessee's economy.
- Agriculture and forestry accounted for 14.7% of the economic activity within the state.
- Agriculture and forestry employed more than 363,500 people, or 10.3% of the workforce.

Historically, the most severe and extreme drought conditions have occurred in the western quarter of the state and in 8 counties in southern middle Tennessee.

When a drought begins and ends is difficult to determine. Rainfall data alone won't tell if an area is in a drought, how severe the drought may be, or how long the area has been in drought. However, one can identify various indicators of drought, such as rainfall, snowpack, stream flow, and more, and track these indicators to monitor drought. Researchers have developed a number of tools to help define the onset, severity, and end of droughts. Drought indices take thousands of bits of data on rainfall, snowpack, stream flow, etc., analyze the data over various time frames, and turn the data into a comprehensible big picture. A drought index value is typically a single number, which is interpreted on a scale of abnormally wet, average, and abnormally dry. There are 3 primary drought indices that are all used to determine the onset and the severity of a drought, the Standard Precipitation Index, the Palmer Drought Severity Index, and the Crop Moisture Index.

Map 21 depicts agricultural and livestock land use throughout the State of Tennessee.

The Standard Precipitation Index (SPI)

The SPI shows the actual precipitation compared to the probability of precipitation for various time frames. The SPI is an index based on precipitation only. It can be used on a variety of time scales, which allows it to be useful for both short-term agricultural and long-term hydrological applications. A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and intensity for each month the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude."

Table 17 – Standard Precipitation Index	
Extremely Wet	2.0+
Very Wet	1.5 to 1.99
Moderately Wet	1.0 to 1.49
Near Normal	-.99 to .99
Moderately Dry	-1.0 to -1.49
Severely Dry	-1.5 to -1.99
Extremely Dry	-2 and less

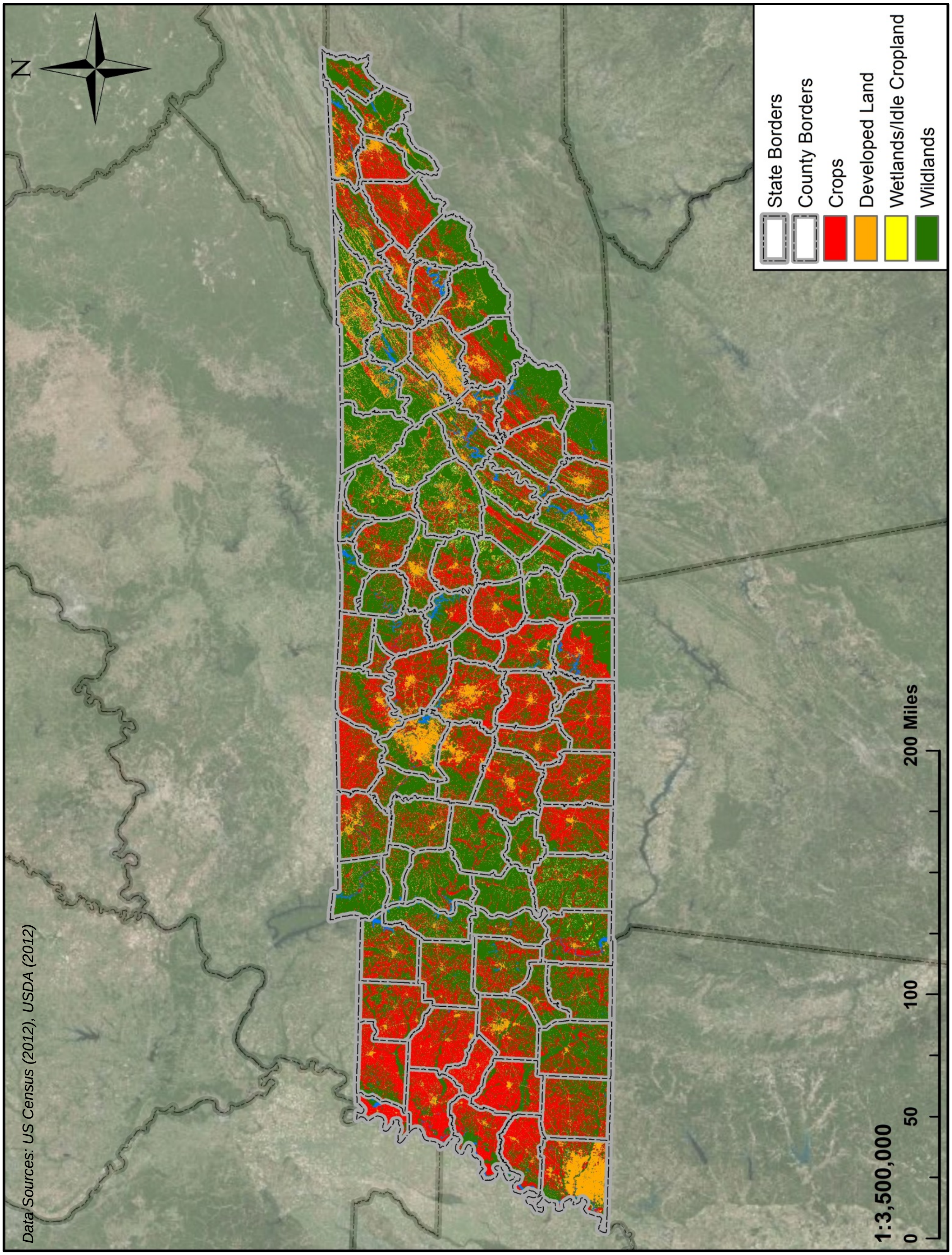
The Palmer Drought Severity Index (PDSI)

The PDSI has been used the longest for monitoring drought. The PDSI allows for a categorization of various levels of wetness and dryness that are prominent over an area. The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. Palmer values may lag emerging droughts by several months, are less well suited for mountainous land or areas of frequent climatic extremes, and are complex—have an unspecified, built-in time scale that can be misleading.

Table 18 – Palmer Drought Severity Index	
Extremely Wet	4.0 or more
Very Wet	3.0 to 3.99
Moderately Wet	2.0 to 2.99
Slightly Wet	1.0 to 1.99
Incipient Wet Spell	0.5 to 0.99
Near Normal	0.49 to -0.49
Incipient Dry Spell	-0.5 to -0.99
Mild Drought	-1.0 to -1.99
Moderate Drought	-2.0 to -2.99
Severe Drought	-3.0 to -3.99
Extreme Drought	-4.0 or less

Crop Moisture Index (CMI)

A derivative of the PDSI is the CMI. It looks at moisture supply in the short term for crop producing regions. The CMI monitors week-to-week crop conditions, whereas the PDSI monitors long-term meteorological wet and dry spells. The CMI was designed to evaluate short-term moisture conditions across major crop-producing regions. Because it is designed to monitor short-term moisture conditions affecting a developing crop, the CMI is not a good long-term drought monitoring tool. The CMI's rapid response to changing short-term conditions may provide misleading information about long-term conditions. The CMI uses the same index as the PDSI, but in its own redefined context.



Map 21 – Agricultural Land Use, Tennessee

3.3.2 – Previous & Future Occurrences

Comprehensive data on droughts, drought impacts, and drought forecasting is extremely limited and often inaccurate. Due to the complexity of drought monitoring, the complexity of agricultural and livestock market pricing, and the large areas droughts impact, the USDA and USGS have difficulty quantifying and standardizing drought data. Each of these contributing drought factors has confounding variables within them.

The USGS partners with the USDA for drought monitoring by means of ground water and aquifer measurement. Since ground water and aquifer levels are highly variable from year to year, this indicator is useful for reporting whether there is a current shortage or surplus, but is unhelpful in forecasting future events. Additionally, ground water and aquifer levels are correlates only in a lagged model to climactic conditions further compounding their usefulness in predicting future droughts.

Drought's primary impact is on agriculture and livestock. However, there are many factors it can affect: most notably livestock count, crop prices, crop losses, livestock size, and livestock by products such as milk. Absent a drought, these factors highly vary from season to season. Prices vary with international market factors influenced by conditions across the globe. Crop yields vary with other climate conditions such as too much rain during planting season or insect abundance, and even marketing campaigns developed to sell more meat from 1 type of livestock. Drought is only 1 factor in an equation of many variables.

The USDA monitors these conditions and aggregates the data to create its drought monitor. However, due to the reasons discussed, it is limited in its ability to quantify how severe a drought was over specified period of time and a specific jurisdiction.

Given NOAA's records of declared drought impacts, the state can expect a drought impact of unknown effects with a probability of 1216.67% per year or 12.1667 impacts per year.

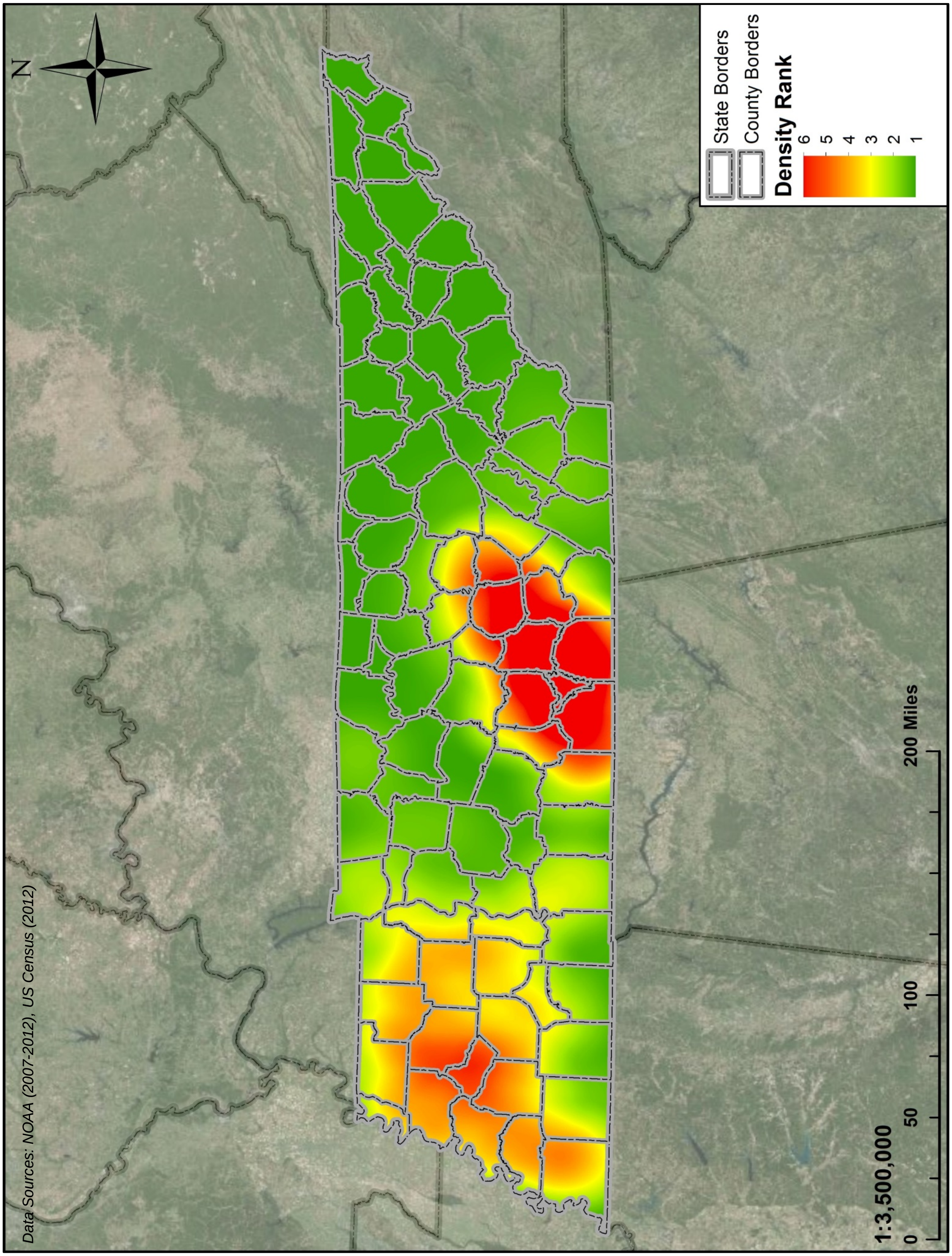
Map 22 on the following page depicts the concentrations of drought impacts throughout the State of Tennessee.

Table 19 – Impact Probability, Drought Events

Impact Year	Count of Impacts
2007	22
2008	22
2009	0
2010	12
2011	5
2012	12
Total Recorded Impacts =	73
Total Years =	6
Yearly Probability =	**1216.67%**

**The data are from the NOAA NCDC Storm Event Database.*

Map 22 – Drought Impact Density, Tennessee



Historic Hazard Incident – Drought – 1986

The dry and hot weather in the southeast United States during the first 7 months of 1986 caused a record drought. The beginning and middle of the 1986 growing season was by far the worst on record. On a hydrological standpoint, the duration was not long enough to stand out as an extreme anomaly. This drought was a significant change from the wet weather of the 1960s and 70s. The hydrological drought resulted in the lowest observed stream flows in more than half a century.

The subsequent winter months resulted in the second driest winter of the twentieth century due to the lack of Gulf Coast and East Coast winter storms. This was followed by the third driest spring in the twentieth century. Precipitation continued to be well below the norm, and temperatures were well above normal throughout the summer of 1986.

Historic Hazard Incident – Drought – 2007/2008

The drought of 2007-2008 severely affected the water supplies of the North Central Tennessee area. This was one of the worst droughts in Middle Tennessee's history. Temperatures in the Nashville area climbed to 106 degrees. For twelve consecutive days temperatures were recorded above 99 degrees. By the end of the drought many critical water supply systems neared failure. This left Tennessee to rely on mandatory and voluntary conservation measures to reduce demand on neighboring water districts to help provide additional supply. Although there are no local estimates for Tennessee alone, the USDA estimates this drought cost the affected areas of the United States $35 billion.

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

The health and safety of persons affected by drought and severe temperatures will vary greatly depending on the severity of the drought. Populations affected by drought are dependent on the amount of moisture deficiency, length of event, and the extent of the impacted area. Droughts occur over a period of days or even months and are by definition a prolonged event. Depending upon the length of the drought, those exposed have the potential to experience a myriad of health and safety concerns. During the drought of 1988, between 5,000 and 10,000 people experienced health complications. While recent drought events have not resulted in such severe impacts, their recurrence suggests a continued existing potential.

During a drought, individuals will experience moderate to severe shortages in water supply, leading to dehydration and other health risks such as muscle cramping. Severe dehydration may cause individuals to go into shock. Dehydration is most dangerous for infants, children, and older adults. Dust and poor air quality may impact respiratory systems. Prolonged droughts increase the potential for wildfires, which could further compound the risk to an individual's respiratory systems. Continued exposure to drought will increase the risk of injury and health deterioration, leading to increased fatalities. While droughts can have devastating consequences, there are methods to help prepare the public through education, and water conservation techniques. Technological advances in climate prediction and information systems developed by NOAA and the NWS assist individuals and communities by providing advanced warning and knowledge.

Health and Safety of Personnel Responding to the Incident

Although drought should pose little threat to properly equipped and trained emergency responders, TEMA and other personnel involved in an incident should observe life safety and health standards and practices. Responders are trained to the level necessary to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly address any hazards that may pose a threat. The most likely hazards encountered when responding to a drought situation are dehydration and other exposure-related illnesses.

Dehydration will likely cause increased fatigue, decreased urination, lightheadedness, low blood pressure, and other health risks. The 3 most probable illnesses related to exposure are heat cramps, heat exhaustion, and heat stroke. In extreme cases, power outages and food shortages, will make it difficult for first responders to assist communities, as well as remain cool and nourished themselves. In addition, the risk of wildfires during periods of drought is increased, which may impact the ability of emergency responders to safely and effectively provide assistance.

Continuity of Operations

During a drought, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently could be compromised. Additionally, cascading events, such as wildfires, power outages, and water shortages, may accompany droughts, putting added pressure on the state to address the needs of its citizens and facilities. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensure that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, droughts may affect the following departments: Tennessee Department of Agriculture (TDA) Division of Forestry; Department of Finance and Administration; Department of Children's Services (DCS); Department of

Environment and Conservation; Department of Health; Department of Human Services; Department of Labor and Workforce Development; and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. A drought may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises, which are conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Droughts may cause severe impacts to property, facilities, and infrastructure. Water supplies will run low and pipes may crack, making hydration from readily available, clean water difficult. The cost of new water resources can be high. As temperatures increase, so does the demand for energy. Increased energy demands can lead to power outages and higher prices, as more expensive fuels are substituted for power. Roadways and bridges may become impassable due to fractured surfaces or landslides. Transportation infrastructure will also be impacted in the waters as streams, rivers, and canals become impossible to navigate. As the number of individuals affected by the drought increases, shelters and hospitals may become overcrowded and unable to handle the influx.

The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any drought problems involving property, facilities, and infrastructure that may arise. The Tennessee Emergency Management Plan, Continuity of Operations Plan, and Memorandums of Understanding between the state and other organizations are essential tools in repairing and maintaining necessary property, facilities, and infrastructure.

Continued Delivery of Services

Drought in the State of Tennessee would probably result in only a minimal effect on public services. However, should the situation continue, some services could be more negatively impacted. Shelters may become overrun with occupants seeking refuge from the harsh climate. In addition, hospitals may become crowded with more patients suffering drought induced health problems and not enough staff to respond. Food and water may become scarce, making it difficult for meals to be delivered to those in need. The impact of the drought on water and power lines may cause other public service programs to stop functioning due to loss of electricity and running water. Under provisions in place for the Continuity of Operations, it is assumed the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. Under the Continuity of Operations, emergency personnel will assist in relocating services, activities, records, and resources wherever necessary. Backup power and potable water supplies will also assist in maintaining essential services. Coordination among various levels of government, including tribal areas and private sector organizations, is important to resume essential/critical services in a timely manner.

Environment

In the larger picture, drought may have a negligible impact on the environment. Both plants and animals depend on water to sustain life. Fish and other marine life are highly susceptible as droughts lead to increased water temperatures and decreased dissolved oxygen levels in lakes, ponds, rivers, and streams. The salt concentration and pH levels may also shift, hurting both fish and local wildlife. Crowding, stress, and even death may occur among the wildlife. Decreases in drinking water and food will negatively impact wildlife, as they begin to expand their movements, often resulting in dangerous human-wildlife encounters. Additionally, severe drought conditions will eventually lead to starvation, reductions in wildlife reproduction, and disease.

Plants face secondary hazards associated with drought, such as “tinder box” conditions. These may develop in forests, etc. resulting in scattered wildfires, which wreak havoc on surrounding communities, timber, and other resources. Polluted water and diminished soil quality may hinder the growth of plant life. Insect infestations can also increase with drought. Depending on the catalyst for the drought, severe heat may result in poorer air quality days and dangerous air quality in non-attainment zones in the state, as the level of dust and other pollutants increases.

Economic Condition

The economic and financial impacts of drought are largely based on the impacted areas and the magnitude/duration of the event. Tennessee is home to a large agricultural, swine, and cattle industry. Since agriculture is the largest consumer of water, if the industry is impacted by drought, the economic and financial repercussions would be severe. Plants are extremely susceptible to drought; lack of water and nutrients increases the likelihood of insects and disease, and reduces the survival of perennial crops. The quantity and quality of crops is also affected, resulting in increased prices to the consumer and decreased revenue for farmers. Ranchers face similar hardships, as damage to grazing lands forces them to increase supplemental feeding, lease available lands, and/or reduce the amount of livestock. When such alternatives are not available, ranchers may be forced to sell off livestock in unfavorable market conditions. Other costs and losses resulting from drought include a potential reduction in milk production, disruption of reproductive cycles, and higher livestock mortality rates.

Previous droughts have cost billions of dollars in damages and revenue losses to farmers and ranchers alike. The economic impact of drought cascades into indirect impacts beyond farms and ranches. Industries directly dependent upon agricultural production may see steep financial losses. An inability to provide water transportation may prove devastating to businesses that rely on transportation for their goods. Seasonal unemployment rates could increase, due to the lack of agricultural production.

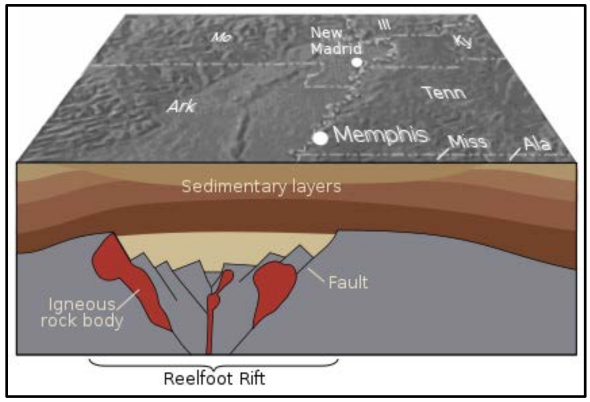
Public Confidence in the Jurisdiction’s Governance

Tennessee has both the resources and experience to address the aspects of an emergency event. The public watches the state’s conduct and effectiveness in every phase of the event. Effective planning, response, and resource coordination through mutual aid agreements, memorandums of understanding, and standby contracts can make or break the state’s ability to respond and by proxy the public’s perception of the response.

Mitigation measures also impact the public’s confidence in the state. A sound mitigation strategy reduces the consequences of and the overall risk from, specific threats. Preventive measures within the mitigation strategy can minimize the effects of drought by ensuring sufficient water and food supplies, as well as pre-designated areas of refuge from the heat that often accompanies drought events.

The manner and efficiency in which a response to a disaster is conducted could result in the loss of confidence in the program and the government’s ability to protect the citizenry. A strong and early show of the state’s resources and capabilities can strengthen the public’s trust and confidence. Rapid assessment of the situation will increase the public’s trust and confidence in the state. Following this assessment, response efforts can address the community’s immediate needs. The support services performed in the response phase can either strengthen or weaken the reputation of the program and the public’s perception of the government’s ability to provide services to people in times of need. The same is true of recovery services as the state works to return a community to normalcy. Whether or not the public approves of the state’s work will depend upon the state’s ability to address the needs of affected communities.

3.3EQ – Earthquakes



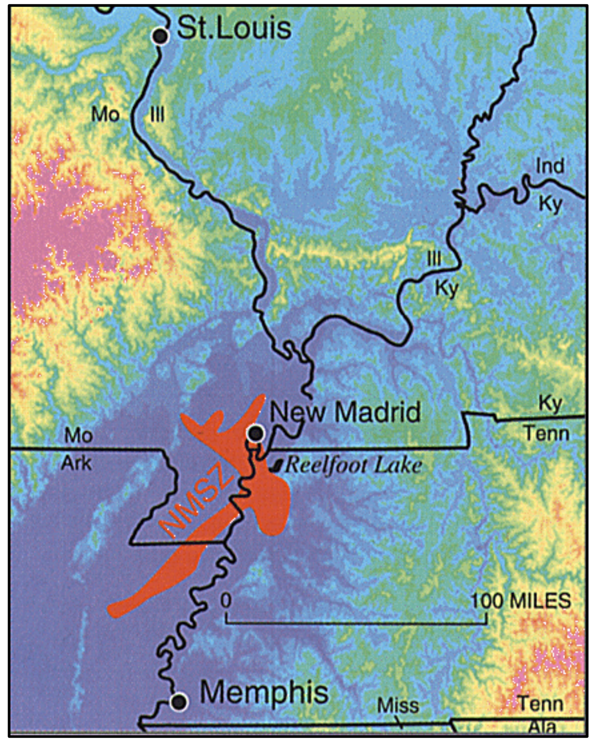
An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The energy originates from a subsurface fault. A fault is a fracture or discontinuity in a volume of rock along tectonic plates. In the most general sense, the word earthquake is used to describe any event that generates seismic waves. Earthquakes are typically caused by the rupturing of geological faults. Occasionally, they are also caused by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. The direct force of the earthquake will shake the ground and cause structures to collapse or become unstable. The shaking can also cause phenomena known as liquefaction. Liquefaction occurs when water saturated sediments are transformed by the earthquake's force into a substance that behaves like a liquid. By undermining the foundations and base courses of infrastructure, liquefaction can destroy or significantly damage a structure.

In addition to direct damage caused by an earthquake, it can cause a number of secondary hazards. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity. The shallower an earthquake, the more damage to structures it causes, all else being equal.

Seismic experts have not suggested that earthquakes occur seasonally or during a particular time of year.

3.3.1 – Location & Extent



Earthquakes strike suddenly and without warning, occur at any time of the year, and at any time of the day. A damaging earthquake occurs without definitive signals and massive earthquakes are accompanied by aftershocks. The duration of shaking can last anywhere from a second to a period of minutes. There are numerous characteristics measured when observing earthquake activity; however, its force, depth, peak ground acceleration, and the distance to the epicenter are the most influential in determining damage.

Two scales are used when referring to earthquake activity. Estimating the total force of an earthquake is the Richter scale, and the observed damage from an earthquake is, the Modified Mercalli Intensity Scale. Please see the figures on the following pages for both scales and their estimated matching equivalent index. Please see the tables on the following page for details on these scales.

Earthquakes of magnitude 5.5 or greater are considered potentially threatening to Tennessee and its jurisdictions, as this is the point at which structures can become damaged. Any earthquake felt at this magnitude or greater would cause for cessation of operations until sight inspections can take place.

While earthquake events have been recorded all across the state, the locations of the most likely occurrences in the future lie along the New Madrid Seismic Zone near the western border and the Southern Appalachian Seismic Zone near the eastern border.

In a report filed in November 2008, FEMA warned that a serious earthquake in the New Madrid Seismic Zone could result in "the highest economic losses due to a natural disaster in the United States," further predicting "widespread and catastrophic" damage across Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Mississippi, Missouri, Oklahoma, Texas, and particularly Tennessee, where a 7.7 magnitude quake or greater would cause damage to tens of thousands of structures affecting water supply, transportation/communication and other vital infrastructure. A major earthquake is expected to also result in many thousands of fatalities, with several thousand of the fatalities expected in Memphis alone.

The Southern Appalachian Seismic Zone (East Tennessee Seismic Zone) is a geographic band stretching from northeastern Alabama through eastern Tennessee into southwestern Virginia which is subject to frequent small earthquakes. This seismic zone is one-of the most active earthquake zones in the eastern United States.

Most earthquakes in the Southern Appalachian Zone are small and are detected only with instruments. A few damaging earthquakes have occurred with the largest historic earthquakes measuring 4.6 magnitude on the Richter scale, occurring in 1973 near Knoxville and April 29, 2003 near Fort Payne, Alabama. Earthquakes large enough to be felt occur approximately once a year in this zone. The USGS estimates that earthquakes as large as magnitude 7.5 are possible in the Southern Appalachian Zone which would as devastating to the region as a major quake along the New Madrid fault. See Map 23 for a geographic depiction of Tennessee's seismic zones.

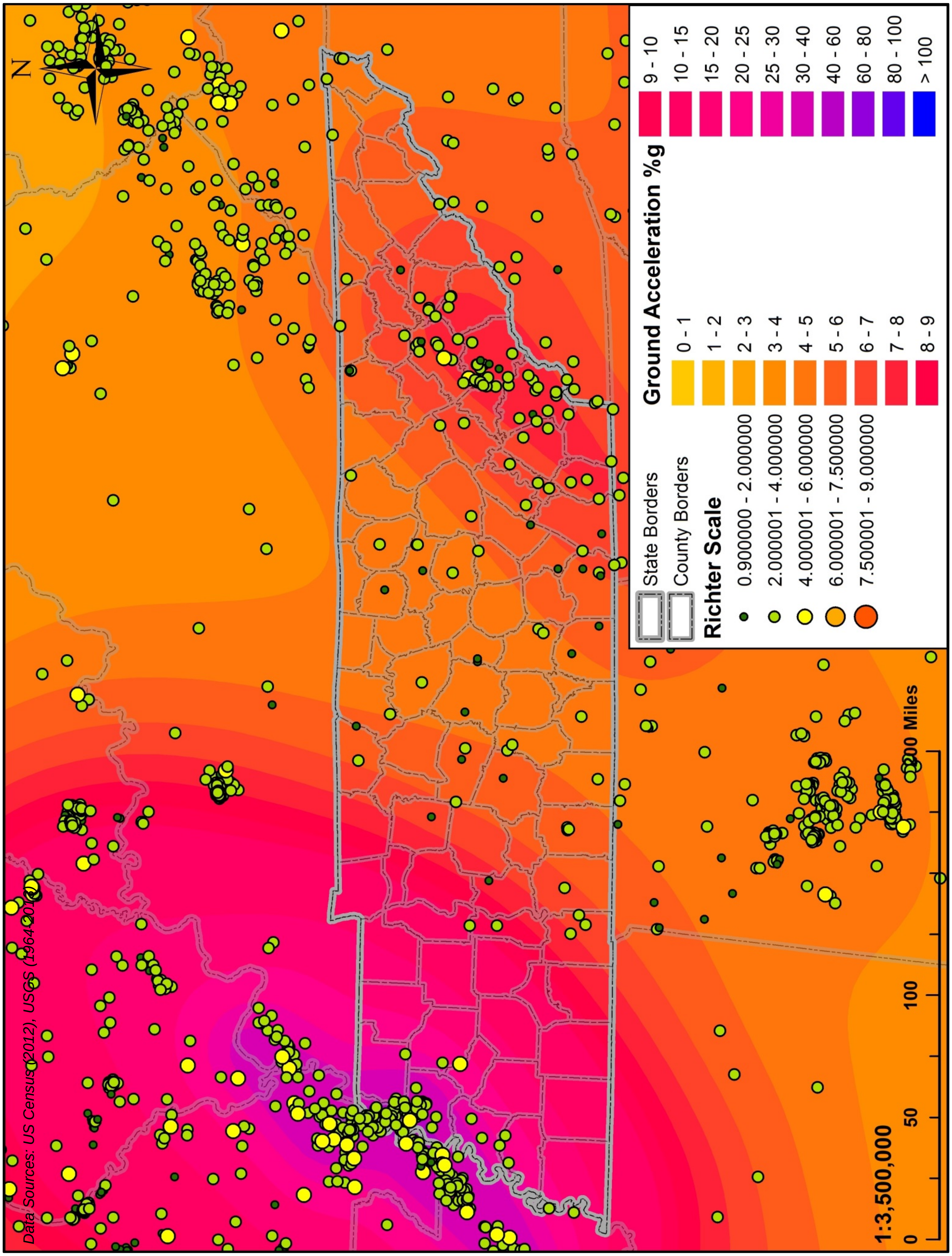
Table 20 – Modified Mercalli Scale vs. Richter Scale

Category	Effects	Richter Scale (approximate)
I. Instrumental	Not felt	1-2
II. Just perceptible	Felt by only a few people, especially on upper floors of tall buildings	3
III. Slight	Felt by people lying down, seated on a hard surface, or in the upper stories of tall buildings	3.5
IV. Perceptible	Felt indoors by many, by few outside; dishes and windows rattle	4
V. Rather strong	Generally felt by everyone; sleeping people may be awakened	4.5
VI. Strong	Trees sway, chandeliers swing, bells ring, some damage from falling objects	5
VII. Very strong	General alarm; walls and plaster crack	5.5
VIII. Destructive	Felt in moving vehicles; chimneys collapse; poorly constructed buildings seriously damaged	6
IX. Ruinous	Some houses collapse; pipes break	6.5
X. Disastrous	Obvious ground cracks; railroad tracks bent; some landslides on steep hillsides	7
XI. Very disastrous	Few buildings survive; bridges damaged or destroyed; all services interrupted (electrical, water, sewage, railroad); severe landslides	7.5
XII. Catastrophic	Total destruction; objects thrown into the air; river courses and topography altered	8

Table 21 – % Peak Ground Acceleration Vs. Mercalli & Richter Scales

Mercalli Scale Intensity	Richter Scale (Approximate)	Minimum %g	Maximum %g
I	1 - 2	0.00%	0.17%
II - III	3 - 3.5	0.17%	1.40%
IV	4	1.40%	3.90%
V	4.5	3.90%	9.20%
VI	5	9.20%	18.00%
VII	5.5	18.00%	34.00%
VIII	6	34.00%	65.00%
IX	6.5	65.00%	124.00%
X +	7 +	124.00%	-

Map 23 – Seismic Zones & Historical Earthquakes, Tennessee



3.3.2 – Previous & Future Occurrences

Since 1964, the USGS has recorded 609 earthquakes within 100 miles of Tennessee. Tennessee does not have on record any property damage, crop damage, deaths, or injuries as a result of earthquakes.

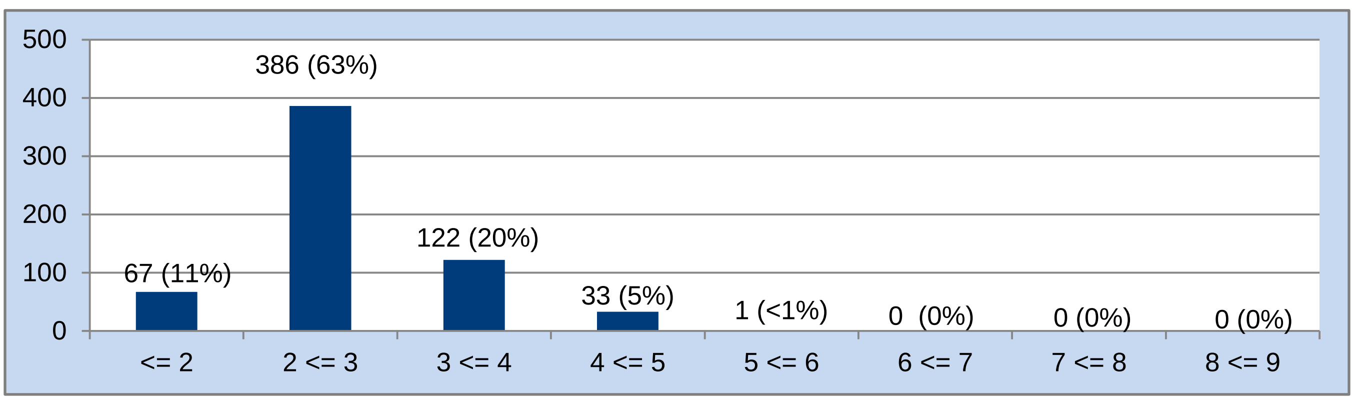
Based on the USGS's data, the average earthquake within 100 miles of Tennessee has a magnitude of 2.76 and has been as high as 5.6 on the Richter scale. The average depth of these earthquakes is 8.34 kilometers and has been just below the surface or as deep as 101.7 kilometers.

Table 22 – Earthquakes within 100 Miles of Tennessee (1964 – 2013)

Count of Events	609
Events Per Year	12.18
Average Magnitude	2.76
Magnitude Range	0.9 - 5.6
Average Depth (km)	8.34
Depth Range (km)	0 - 101.7
Total Recorded Cost	$0
Total Crop Damage	$0
Total Fatalities	0
Total Injuries	0

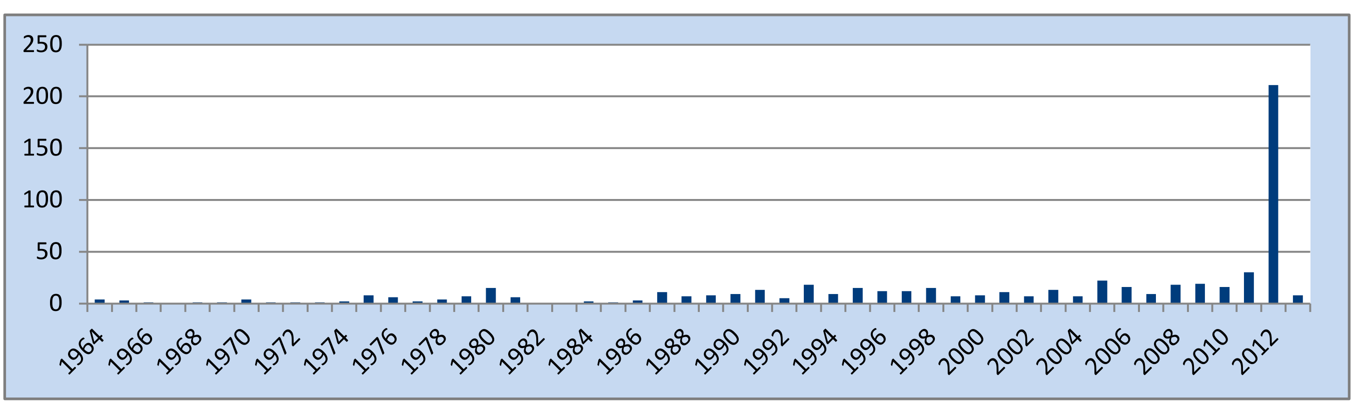
**The data are compiled from the USGS.*

Chart 2 – Earthquakes by Magnitude, 100 Mile Buffer (1964 – 2013)



**The data are from the USGS.*

Chart 3 – Earthquakes by Year, 100 Miles Buffer (1964 – 2013)



**The data are from the USGS.*

Historic Hazard Incident – Earthquakes – 1811/1812

Between 1811 and 1812 there was a series of 4 major earthquakes in the New Madrid Seismic Zone. On December 16, 1811, an earthquake occurred on the New Madrid with the epicenter located in northeast Arkansas. It resulted in only slight damages, mainly because of the sparse population in the epicenter area. Since the area was sparsely populated at the time, the exact locations of the earthquakes is unknown although it is predicted the future location of Memphis experienced seismic levels equal to IX on the Mercalli Intensity scale.

Historic Hazard Incident – Earthquake – August 1865

An earthquake with a magnitude of 5.0 and intensity of VII occurred on August 17, 1865 in Memphis affecting southwest Tennessee. Land appeared to roll and waves were created in nearby rivers. The force felled and cracked chimneys in Memphis and New Madrid.

The USGS & The New Madrid Seismic Zone (NMSZ)

In 2006 the USGS published a study on the past, present, and future state of the NMSZ. Included in this study was a scientific prediction on the future probability of a NMSZ earthquake event.

In summary, the study predicts the NMSZ will produce the following:

- A Magnitude 6 earthquake at a probability of 25% - 50% in the next 50 years.
- An earthquake sequence similar to the 1811-12 earthquakes at a probability of 7% - 10% in the next 50 years.

The USGS study on the NMSZ, found on the following pages, states:

> “It was the consensus of this broad group of scientists that (1) the evidence indicates that we can expect large earthquakes similar to the 1811–12 earthquakes to occur in the future with an average recurrence time of 500 years and that (2) magnitude 6 earthquakes, which can also cause serious damage, can be expected more frequently than the large 1811–12 shocks.

Based on this history of past earthquakes, the USGS estimates the chance of having an earthquake similar to one of the 1811–12 sequence in the next 50 years is about 7% to 10%, and the chance of having a magnitude 6 or larger earthquake in 50 years is 25% to 40%.

USGS
science for a changing world

Earthquake Hazard in the New Madrid Seismic Zone Remains a Concern

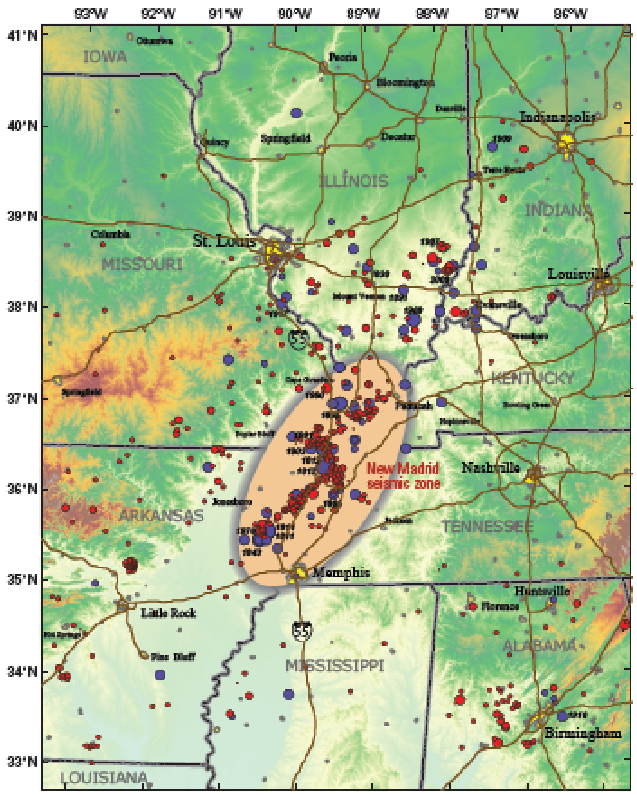
There is broad agreement in the scientific community that a continuing concern exists for a major destructive earthquake in the New Madrid seismic zone. Many structures in Memphis, Tenn., St. Louis, Mo., and other communities in the central Mississippi River Valley region are vulnerable and at risk from severe ground shaking. This assessment is based on decades of research on New Madrid earthquakes and related phenomena by dozens of Federal, university, State, and consulting earth scientists.

Considerable interest has developed recently from media reports that the New Madrid seismic zone may be shutting down. These reports stem from published research using global positioning system (GPS) instruments with results of geodetic measurements of strain in the Earth's crust. Because of a lack of measurable strain at the surface in some areas of the seismic zone over the past 14 years, arguments have been advanced that there is no buildup of stress at depth within the New Madrid seismic zone and that the zone may no longer pose a significant hazard.

As part of the consensus-building process used to develop the national seismic hazard maps, the U.S. Geological Survey (USGS) convened a workshop of experts in 2006 to evaluate the latest findings in earthquake hazards in the Eastern United States. These experts considered the GPS data from New Madrid available at that time that also showed little to no ground movement at the surface. The experts did not find the GPS data to be a convincing reason to lower the assessment of earthquake hazard in the New Madrid region, especially in light of the many other types of data that are used to construct the hazard assessment, several of which are described here.

The Geological Record

There are historical accounts of major earthquakes in the New Madrid region during 1811–12. The geologic record of pre-1811 earthquakes also reveals that the New Madrid seismic zone has repeatedly produced sequences of major earthquakes, including several of magnitude 7 to 8, over the past 4,500 years. These prehistoric earthquakes caused severe and widespread ground failures in the New Madrid region, much like those caused by the 1811–12 earthquake sequence. The key evidence for large earthquakes that occurred in the past are sand blows that formed when underground sand and water erupted to the surface as a result of violent shaking. Numerous large sand blows over a wide area were created by strong ground shaking during the 1811–12 earthquakes. Similarly large, widespread, and abundant prehistoric sand blows were produced over the same area during ground shaking from previous clusters of large earthquakes around A.D. 1450, A.D. 900, and 2350 B.C. The sizes and areal distribution of the prehistoric sand blows indicate that the older earthquakes were similar in location and magnitude to the 1811–12 shocks.



Topographic map showing earthquakes greater than magnitude 2.5 (circles) of the central United States. Red circles are earthquakes that occurred after 1972 (U.S. Geological Survey Preliminary Determination of Epicenters (PDE) catalog). Blue circles are earthquakes that occurred before 1973 (USGS PDE and historical catalog). Larger earthquakes are represented by larger circles. Yellow patches show urban areas with populations greater than 10,000.

U.S. Department of the Interior
U.S. Geological Survey

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Continuing Seismic Activity

The New Madrid seismic zone is a source of continuing small and moderate earthquakes, which attest to the high stress in the region and indicate that the processes that produced the large earthquakes over the previous 4,500 years, are still operating. It is the most seismically active area of the United States east of the Rockies. There is no sign that the rate of these smaller earthquakes is decreasing with time, as would be expected if they were aftershocks of the 1811–12 earthquakes.

GPS Measurements in the New Madrid Seismic Zone

It has been known for several years that GPS measurements made since about 1996 do not show significant deformation across part of the New Madrid seismic zone. The new results reported on recently are not substantially different from those derived from previous GPS data. These short-term observations, though important, must be tempered by the context of tectonic processes developed over many thousands to millions of years. Such long-term processes are unlikely to switch off in a few decades with an accompanying decrease in the earthquake hazard. The New Madrid region is located in the middle of the vast North American tectonic plate. In contrast to plate boundary settings like the coasts of California or Alaska where continuous deformation can be measured at the surface, some models predict that little deformation will occur during the period between large earthquakes in seismic areas within a plate.

The USGS has carried out an extensive consensus-building process in the development and updating of the national seismic hazard maps. These maps are the basis for the seismic provisions in the model-building codes adopted in almost all of the United States. Many workshops were conducted involving hundreds of scientists and engineers, and a thorough peer review process was undertaken in the development of the seismic hazard maps. Scientists at some workshops evaluated the New Madrid GPS results of the past 12 years and debated their meaning. They also considered the clear geologic evidence of large earthquakes occurring over the past 4,500 years and the continuing moderate earthquakes in the area. It was the consensus of this broad group of scientists that (1) the evidence indicates that we can expect large earthquakes similar to the 1811–12 earthquakes to occur in the future with an average recurrence time of 500 years and that (2) magnitude 6 earthquakes, which can also cause serious damage, can be expected more frequently than the large 1811–12 shocks.

Based on this history of past earthquakes, the USGS estimates the chance of having an earthquake similar to one of the 1811–12 sequence in the next 50 years is about 7 to 10 percent, and the chance of having a magnitude 6 or larger earthquake in 50 years is 25 to 40 percent.

Likely Impacts from Future Large Earthquakes

Earthquake hazards involve more than just strong ground shaking from passing seismic waves. The 1811–12 earthquakes caused many types of ground failures including landslides along the Mississippi River bluffs from Mississippi to Kentucky. Ground failures also included lateral spreading and ground subsidence by soil liquefaction across the Mississippi River flood plain and along tributaries to the Mississippi River over at least 15,000 square kilometers. Today, a repeat event could be expected to produce similar effects in northeastern Arkansas, southeastern Missouri, western Tennessee and Kentucky, and southern Illinois. Roadways in the Mississippi Valley of Arkansas and Missouri (such as Interstate 55) could become impassable because of bridge failures and fissuring of road surfaces. Venting of large quantities of water, sand, and mud as a result of liquefaction could flood fields and roads and disrupt agriculture for weeks to months. Flooding of farmland, where agricultural chemicals are stored onsite, could contaminate rivers and streams. Failure of levees, especially during high water, would contribute to flooding, and failures of riverbanks could make the Mississippi River and its tributaries difficult to navigate for many weeks.

The City of Memphis and the surrounding metropolitan area of more than one million people would be severely impacted. Memphis has an aging infrastructure, and many of its large buildings, including unreinforced schools and fire and police stations, would be particularly vulnerable when subjected to severe ground shaking. Relatively few buildings were built using building codes that have provisions for seismic-resistant design. Soil liquefaction and related ground failures are likely to occur in downtown Memphis along the Mississippi River and along the Wolf River that passes through Memphis. The older highways and railroad bridges that cross the Mississippi River, as well as older overpasses, would likely be damaged or collapse in the event of a major New Madrid earthquake. Some of the bridges and pipelines crossing the Wolf River might be damaged or destroyed. Although Memphis is likely to be the focus of major damage in the region, St. Louis, Mo., Little Rock, Ark., and many small and medium-sized cities would also sustain damage.

Continuing Preparedness Needed

The geologic record of repeated large earthquakes, the historical accounts of the 1811–12 large earthquakes, and the continuing earthquake activity in the area are compelling evidence that the New Madrid region has high earthquake hazard. The preponderance of evidence leads us to conclude that earthquakes can be expected in the future as frequently and as severely as in the past 4,500 years. Such high hazard requires prudent measures such as adequate building codes to protect public safety and ensure the social and economic resilience of the region to future earthquakes.

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The State of Tennessee Threat Hazard Identification Risk Assessment, completed and approved in 2012, summarizes a number of complex models and reports conducted on the New Madrid Seismic Zone. Tennessee's THIRA included the following reports on earthquakes:

- Mid-America Earthquake Center Level 2 Regional Impact Report: New Madrid Seismic Zone M7.7 Earthquake for the State of Tennessee
- FEMA's New Madrid Seismic Zone Catastrophic Event Planning: State of Tennessee-Direct Damaged, Economic Loss and Social Impacts Assessment
- TEMA generated HAZUS assessments

The following impacts are summarized results from the previous studies and assessments. The scenario yielding the below impacts is a 7.7 magnitude earthquake delivering catastrophic impacts across Western Tennessee during the dead of winter emanating from below Marked Tree, Arkansas.

Scope

- 20 Counties of Western Tennessee at 10,260 miles
- 1.5 million people in these 20 counties.
  - 284,000 people under the age of 5 and over the age of 65
  - 333,000 with disabilities
  - 16,000 don't speak English well
  - 289,000 currently in poverty
  - 10,300 currently in nursing homes
  - 13,100 currently in college housing
  - 18,100 currently in jail or prison

Population Impacts

- 33,000 injuries
- 1,300 deaths

Essential Facilities Impacts

- 600 schools damaged, can't provide for service
- 250 fire stations damaged, can't provide for service
- 125 police stations damaged, can't provide for service
- 55 hospitals damaged, can't provide for service

Utility Impacts

- 710,000 households without power
- 510,000 households without potable water
- 100 electric power facilities damaged
- 10 potable water facilities damaged
- 450 waste water facilities damaged
- 60 natural gas facilities damaged
- 4,000 communication facilities damaged
- Potable Water Pipeline (Local); 117,400 miles w/ 15,300 leaks & 24,000 breaks
- Waste Water Pipeline (Local); 70,500 miles w/ 12,000 leaks & 19,000 breaks
- Natural Gas Pipeline (Local); 47,000 miles w/ 12,900 leaks & 20,300 breaks
- Natural Gas Pipeline (Regional); 4,600 miles w/ 350 leaks & 1,200 breaks
- Oil Pipeline (Regional); 1,000 miles w/ 70 leaks & 230 breaks

Building Impacts

- 265,000 buildings damaged
- 107,000 buildings completely damaged (uninhabitable)
- 80% single family residences, 15% multi-family residences

Transportation Impacts

- 40 airports damaged; most not operational
- 1,000 bridges damaged; 250 completely damaged
- 80 ports damaged
- 60 railroad facilities damaged
- 2 railroad bridges damaged

Other Critical Infrastructure Impacts

- 50 dams damaged
- 7 levees damaged
- 8 registered National Historic Landmarks are within the 20 county impact zone
- 1,500 – 2,000 fixed hazardous materials facilities damaged

Debris Impacts

- 21 million tons of debris
- 850,000 truckloads (@ 25-tons per truck) to remove all debris

Direct Economic Losses

- $63 billion in total direct economic losses
- $47 billion in building losses
- $3 billion in transportation losses
- $13 billion in utility losses

Shelter/Commodity Requirements

- 400,000 people will seek shelter
- 400,000 cots; 5,000 sinks; 10,000 toilets; 800,000 blankets; 8,000 trash cans
- Over 1,000 truckloads of commodities
- 260 truckloads of water ; 150 truckloads of MREs; 315 truckloads of Ice (first 3 days)
- 23,600 people with diabetes & 42,800 with mental disorders will need to be sheltered

Search & Rescue Requirements

- 460 SAR teams of 12,700 personnel

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

The health and safety of persons will vary greatly depending on a number of earthquake conditions. Populations affected by earthquakes are dependent on the magnitude of the event, the proximity to the epicenter, soil conditions, and structure materials. Depending on these factors, earthquakes can cause no harm or can cause the death of thousands. Injuries and deaths are most often caused as a result of the falling debris, including collapsing walls and flying glass. Secondary effects can develop, such as fires and landslides. Those living in and around mountainous areas, unstable slopes, and cliffs are at risk to injuries resulting from landslides. Individuals may be at risk of carbon monoxide exposure from damaged pipes, and parasites resulting from compromised water sources. In addition to the initial earthquake, aftershocks can often follow, occurring minutes, days, weeks, and even months afterwards. In many cases, they can be of equal magnitude to the original event, and can increase injuries and death in areas already impacted. It is important that individuals expect and prepare for the occurrence of aftershocks to avoid further losses.

Although there is no way to accurately predict an earthquake event or pinpoint the epicenter, the public can be better prepared for such an event through education. Learning about potential earthquake hazards and preparedness measures can increase the chances of survival and diminish injuries and loss of life. In addition, the utilization of construction techniques with seismic considerations taken into account, can limit the amount of damage done by reducing injuries received from falling debris and collapsing structures.

Health and Safety of Personnel Responding to the Incident

Personnel responding to earthquakes have the potential to be seriously injured, facing health and safety hazards throughout the incident. The most likely hazards encountered when responding to an earthquake event would be structural instability and broken/fractured power and natural gas lines. Debris, including broken glass, will also make it difficult for emergency personnel to assist the injured and trapped. The structural instability of buildings will make it difficult to reach those trapped inside, and personnel responding may become trapped themselves. Emergency responders may injure themselves on glass, falling debris from unstable structures, electrocute themselves on broken power lines, and or become exposed to toxic chemicals and gases, causing mild to severe injuries and/or death.

While the impact of earthquakes can pose hazards to responding personnel, there are policies and procedures that guide these first responders to respond in the safest and most efficient way possible. Responders are trained to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly evaluate any hazards that may pose a threat.

Continuity of Operations

During an earthquake, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently are likely to become compromised. Additionally, cascading events, such as power outages, may accompany earthquakes, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. These plans ensure that the essential functions are continued throughout and after an earthquake.

Various departments may require activation of their COOP to remain functional. In particular, earthquakes may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Children's Services, Department of Environment and Conservation, Department of Health, Department of Human Services, Department of Labor and Workforce Development, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. An earthquake may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

The impact a building sustains is dependent upon both the magnitude of the earthquake, and the building's age and construction. Mobile homes and homes not connected to their foundations are at increased risk from earthquake damage. Buildings whose foundations are over landfills or other unstable soils are also at an increased risk of damage. Roadways may become impassable due to debris or fractured surfaces. Power lines may be down in some areas, natural gas lines may have leaks, and sewer and water lines may be damaged. An interruption in transportation, communication, and fuel supply are also possible.

The damage done to property, facilities, and infrastructure can be costly and take a long time. Although recovering from an earthquake can be costly, the State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities and infrastructure. Technological advances will allow for road crews to prepare and relocate resources, as needed. In addition, potable water, wastewater treatment, telecommunications, and reinstatement of electricity are also accounted for in the state's plan for disasters.

In an effort to reduce the impact on property, facilities, and infrastructure, there are a set of rules and standards that assist in preventing damage resulting from an earthquake. The Tennessee Code Annotated, Title 68, Chapter 120 Section 101 Statewide Building Construction Safety Standards states that

The State Fire Marshall, in accordance with the Uniform Administrative Procedures Act, promulgates rules establishing minimum statewide building construction safety standards. Such standards shall be designed to afford a reasonable degree of safety to life and property from fire and hazards incident to design, construction, alteration, and repair of buildings or structures.

It is also important to remember that not all buildings or structures fall within these standards. The minimum statewide building construction safety standards only apply to state buildings, education occupancies, and any other building or structure that requires an inspection by the State Fire Marshall for licensure. These buildings or structures must be within a jurisdiction that has adapted, in writing, a building construction safety code consisting of the International Building Code and either the International Fire Code or Uniform Fire Code.

Continued Delivery of Services

Earthquakes in the State of Tennessee may result in minimal to major effects on public service(s). Business, infrastructure, vehicles, roadways, railways, water transportation, and communications may be significantly impacted or devastated as a result. Interruptions to vehicles and roadways will make it difficult for police and fireman to respond to emergency calls. Public transportation may also be interrupted. Damage to business and communication may delay healthcare services. Depending upon the magnitude of the earthquake, public housing could face significant structural damage, requiring temporary and/or permanent relocation of residents. The capacities for both waste management and water supply could be compromised, making it difficult for residents to have access to safe drinking water.

The State of Tennessee will work diligently to maintain access to public services. Under provisions in place for the Continuity of Operations, it is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. Resumption of these services will be achieved utilizing state resources, as well as reaching out to other state governments and businesses for additional assistance.

Environment

Earthquakes may have a marginal to large impact on the environment. They have the potential to result in major geologic metamorphoses, such as the New Madrid Earthquake of 1811/12 and the creation of Reel Foot Lake. Collateral events such as hazardous material (HAZMAT) spills, ruptured product lines, and contamination of water supplies could also result in long-term impacts on the environment. Soil can become poisoned and plants damaged. Air quality may also be compromised as dust, chemical spills, and gas permeates the area.

Economic Condition

There are 4 major urban centers in the State of Tennessee: Memphis, Nashville, Chattanooga, and Knoxville. If any of these major urban areas were subjected to an earthquake, the economic and financial repercussions would be severe. Interruptions in transportation and fuel supply can cripple commerce across the state. Property damage and repairs could reach into the millions of dollars. In addition, businesses may lose revenue and face relocation from damages caused by the earthquake.

The economic impact of an earthquake can be felt in less urbanized areas as well. Harvests, livestock, and other agricultural infrastructure are at risk. Crops could be damaged or lost if irrigation systems are damaged or destroyed. These impacts on the agriculture would be financially devastating to farmers, and result in a shortage for consumers.

Public Confidence in the Jurisdiction’s Governance

Although Tennessee has the resources, there is very little experience in responding to earthquakes. State personnel and first responders are constantly in training for an earthquake. In preparing for the possibility of an earthquake, the State of Tennessee has identified the most vulnerable areas and the resources required to respond to an event. Preparedness allows the state to ensure that when an earthquake strikes, they are ready and able to respond. The effectiveness of preparedness measures, such as the EOP and MOUs, can impact the public’s confidence in the state’s ability to prepare for earthquakes before they strike. The Interstate Earthquake Compact of 1988 provides the state with immediate use of resources from other states under the mutual aid agreement. Emergency exercises test numerous areas of the state's response and recovery capabilities. Tennessee regularly exercises for earthquake events using its Tennessee Catastrophic Training Program (TNCAT). It has conducted TNCATs using earthquake scenarios in 2007, 2008, 2009, 2010, 2011, and 2012. The TNCAT in 2011 was conducted at a national level event. Lessons learned from these exercises are critical to plan revision and the improvement of local and state response capabilities. Similarly, mitigation strategies that fail to lessen the actual or potential effects of an earthquake, including the protection of emergency personnel, critical facilities, and the public's health and safety are likely to breed distrust in the public's trust.

The manner and efficiency in which the state responds to a disaster determines the public's confidence in the state. In regards to earthquakes, this refers to the state's ability to assist in the rapid assessment of the overall situation, and provide immediate response to individuals who are injured or trapped in life-threatening situations. Accurate information is critical at this stage, without which it would prove near impossible to meet the needs of citizens.

Recovering from an earthquake is incredibly difficult, given the facilities housing government, private, and non-profit services are likely to be severely damaged. The state's ability to provide its citizens with basic services and replacement shelters is necessary to maintain their confidence.

3.3ET – Extreme Temperatures

An extreme temperature event occurs when the temperature is exceptionally hotter or colder than the geographic norm and persists long enough to affect the life of the community.

Extreme Heat

Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and last for several weeks, and though the event may not be as notable as other hazards, its effects can have devastating consequences. While it is hard to quantify the exact total number of deaths that are advanced by heat wave weather, in a normal year, about 175 Americans succumb to the demands of summer heat.

The term "Heat Index" was created by the NWS to measure apparent temperature of the air as it increases with the relative humidity. This was done to help the public understand that a lower temperature with a high relative humidity can be just as dangerous as a hotter, dryer day. The Heat Index can be used to determine what effects the temperature and humidity can have on the population. It is important to know that the Heat Index (HI) values are devised for shady, light wind conditions. Exposure to full sunshine can increase HI values by up to 15 degrees. Also, strong winds, particularly with very hot, dry, air can be extremely hazardous to individuals.

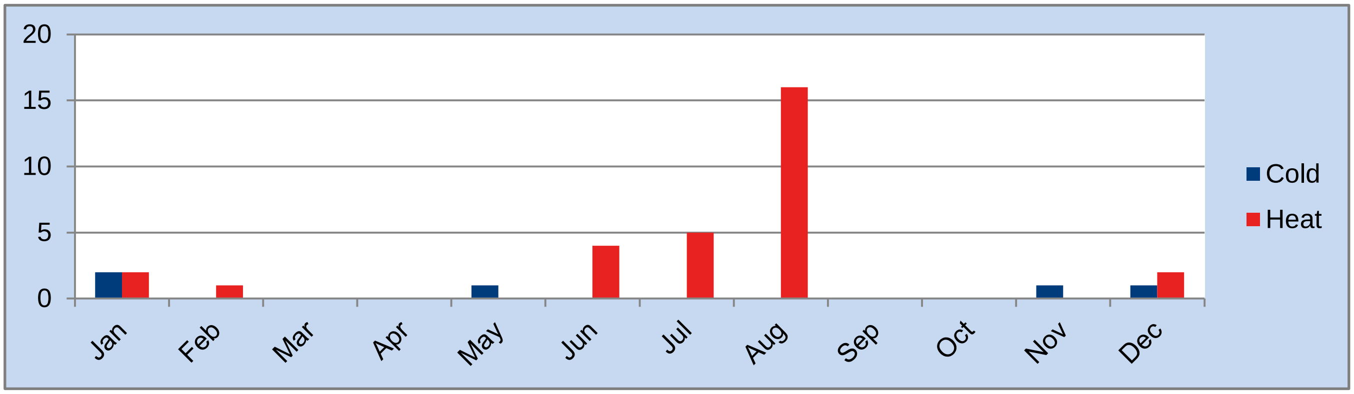
Extreme Cold

While not as clearly defined as extreme heat, extreme cold can be just as problematic and deadly for a jurisdiction that encounters this hazard. Extreme cold conditions typically accompany winter storm events but may occur on beautiful, sunny days as well. Exposure to cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible.

The term wind chill, much like the term heat index is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.

Extreme cold events are typically associated with the winter months while extreme heat is associated with the winter months. Please see the chart below depicting the seasonal differences in extreme heat and extreme cold.

Chart 4 – Extreme Temperature Impacts by Month, Tennessee (1996 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

3.3.1 – Location & Extent

Extreme heat and cold can occur in all 95 counties in Tennessee. Extreme heat is not a hazard that responds to the traditional mitigation measures of building codes or land use restrictions. Heat is the number 1 weather related killer in the United States, resulting in roughly 175 fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined.

NOAA's National Weather Service

Heat Index

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

What constitutes extreme cold varies in different parts of the country. In the southern United States, near freezing temperatures are considered extreme cold. Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. Most people judge extreme cold by the problems it causes rather than just by a temperature or a wind chill factor. In the northern areas of the country, extreme cold means temperatures well below zero.

The speed of onset of extreme temperatures, both hot and cold, is fairly slow and predictable from short and long term weather forecasts. The scale of measurement for this hazard is temperature and departure from normal temperature.

At the state level, the primary response is more careful monitoring of the statewide power grid, as extreme temperature days usually result in dramatic electric power demands. Public information campaigns are designed to remind citizens to hydrate and avoid direct exposure to the elements during the time of temperature extremes. Typical medical problems caused by extreme temperatures include the following:

- Heatstroke is a life threatening condition that requires immediate medical attention. It exists when the body's core temperature rises above 105 degrees F as a result of environmental temperatures. Patients may be delirious, stuporous, or comatose. The death-to-care ratio in reported cases in the U.S. averages about 15%.
- Heat exhaustion is much less severe than heatstroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness, or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.
- Heat syncope is typically associated with exercise by people who are not acclimated to exercise. The symptom is a sudden loss of consciousness. Consciousness returns promptly when the person lies down. The cause is primarily associated with circulatory instability because of heat. The condition typically causes little or no harm to the individual.
- Heat cramps are typically a problem for individuals who exercise outdoors but are unaccustomed to heat. Similar to heat exhaustion, it is thought to be a result of a mild imbalance of fluids and electrolytes.
- Frostbite is one of the many problems caused by exposure to extreme cold. It is damage to body tissue caused by extreme cold. A wind chill of -20 degrees Fahrenheit (F) will cause frostbite in just 30 minutes. Frostbite causes a loss of feeling and a white or pale appearance in extremities, such as fingers, toes, ear lobes or the tip of the nose.
- Hypothermia is a condition brought on when the body temperature drops to less than 95 degrees Fahrenheit (F). Hypothermia is deadly and for those who survive, there are likely to be lasting kidney, liver and pancreas problems. Warning signs include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion. Immediate critical care is essential to save the victim's life.

Historically, the highest frequency and greatest impact of extreme summer temperatures has been in the western part of Tennessee. Please see Map 24 for historic impacts of extreme temperatures.

3.3.2 – Previous & Future Occurrences

Since 1996, NOAA has recorded 35 extreme temperature impact events, 5 extreme cold, and 30 extreme heat in the State of Tennessee. Tennessee has recorded 31 deaths and 3 injuries from extreme temperature events. These events have not cost Tennesseans any dollar amount in property damage.

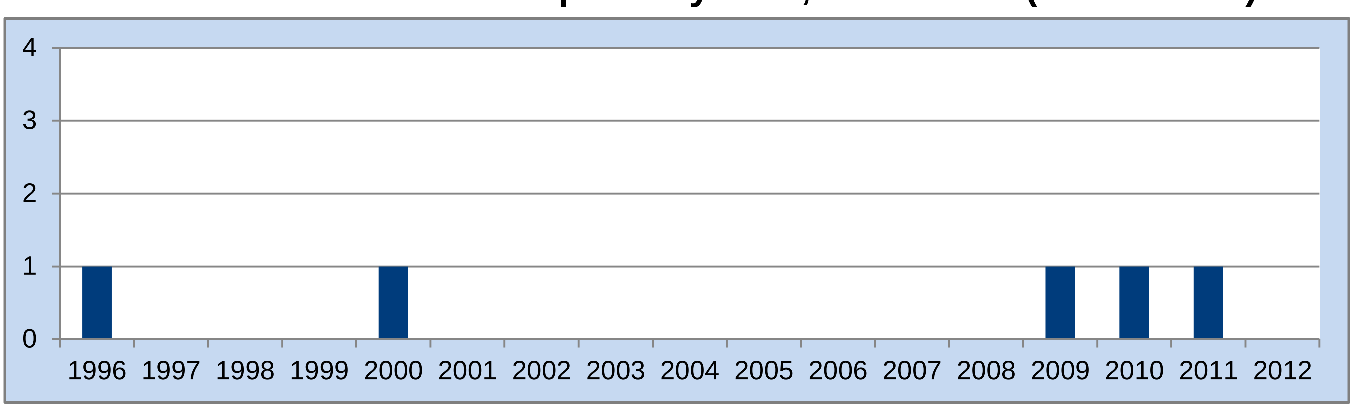
Based on NOAA's data, an extreme cold impact will cost $0 in property damage and $0 in crop damage while an extreme heat impact will cost $0 in property damage and $0 in crop damage. The average extreme cold impact will injure 0.4 people and kill 1 person while the average extreme heat event will injure 0.03 people and kill 0.87 people.

Table 23 – Historical Impacts, Extreme Cold & Heat (1996 – 2012)

	Extreme Cold	Extreme Heat
Count of Impacts	5	30
Impacts Per Year	0.29	1.76
Average Magnitude	-	-
Magnitude Range	-	-
Average Cost	0	0
Magnitude of Cost	0	0
Total Recorded Cost	0	0
Average Crop Damage	0	0
Magnitude of Crop Damage	0	0
Total Crop Damage	0	0
Average Fatalities	1	0.87
Total Fatalities	5	26
Average Injuries	0.4	0.03
Total Injuries	2	1

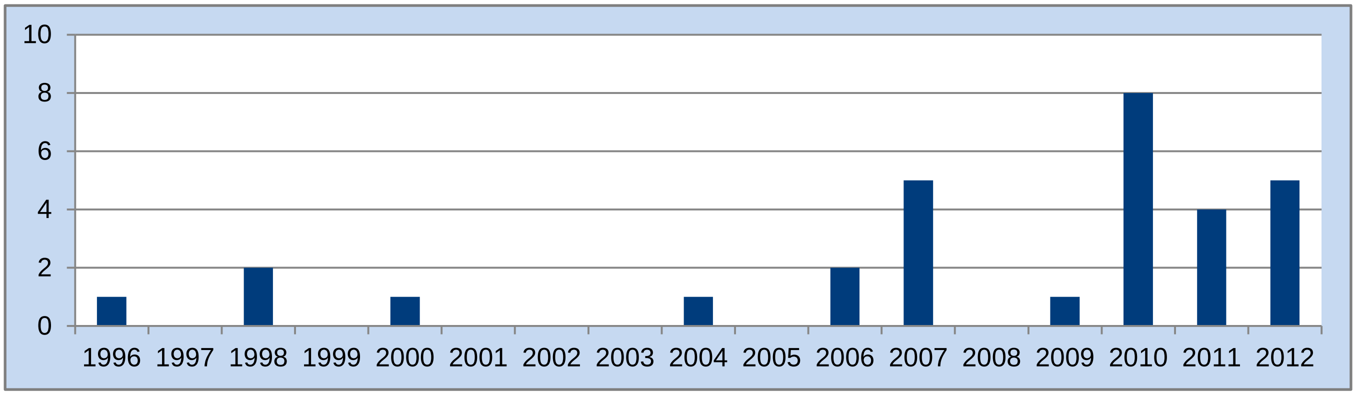
**The data are compiled from the NOAA NCDC Storm Event Database.*

Chart 5 – Extreme Cold Impacts by Year, Tennessee (1996 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 6 – Extreme Heat Impacts by Year, Tennessee (1996 – 2012)



**The data are from the NOAA NCDC Storm Event Database*

The state can expect an extreme cold impact with a probability of 29.41% per year or 0.2941 impacts per year while is can expect an extreme heat impact with a probability of 176.47% per year or 1.7647 impacts per year.

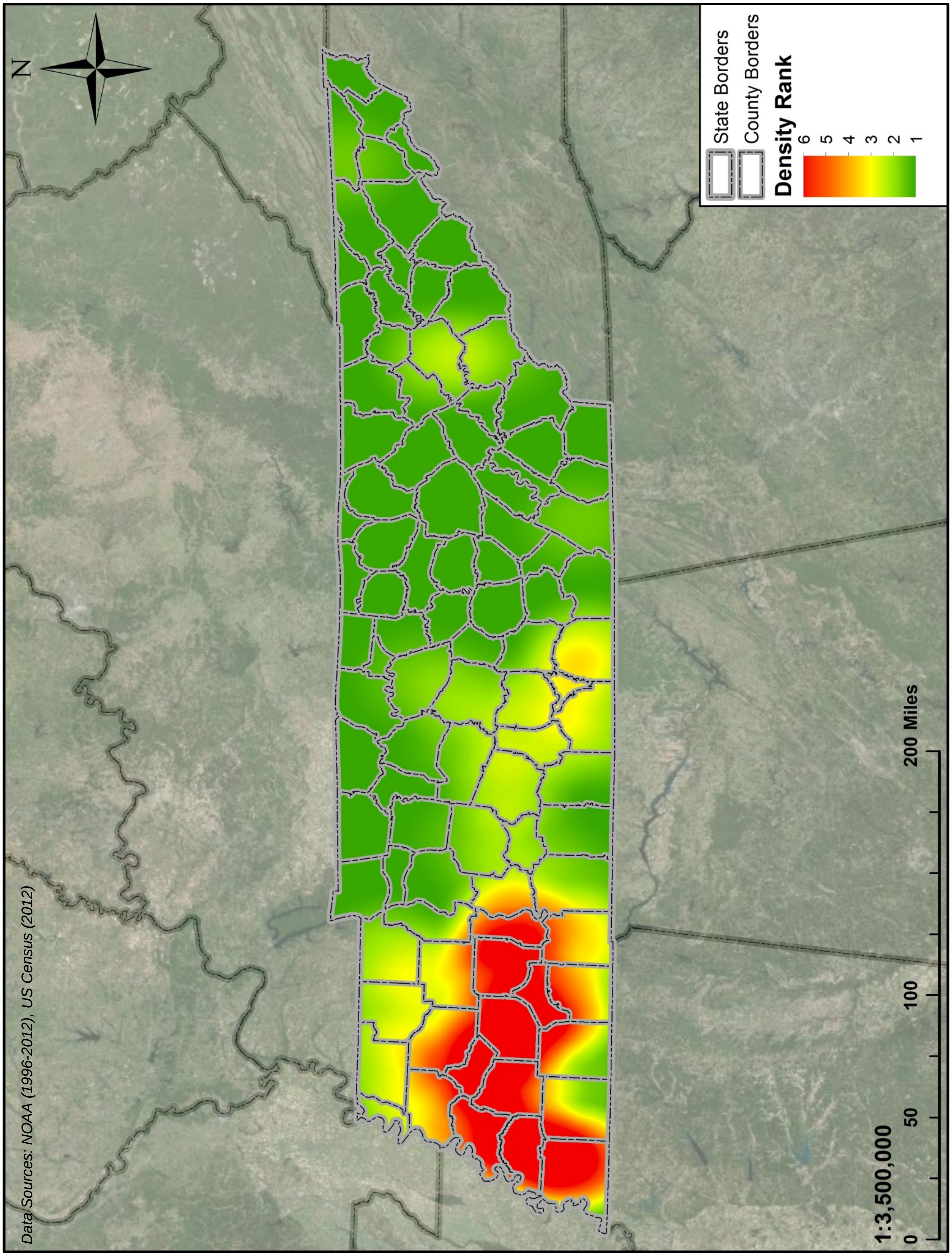
Table 24 – Impact Probability, Extreme Cold & Heat Events		
Impact Year	**Count of Impacts**	
1996	1	1
1997	0	0
1998	0	2
1999	0	0
2000	1	1
2001	0	0
2002	0	0
2003	0	0
2004	0	1
2005	0	0
2006	0	2
2007	0	5
2008	0	0
2009	1	1
2010	1	8
2011	1	4
2012	0	5
Total Recorded Impacts =	5	30
Total Years =	17	17
Yearly Probability =	**29.41%**	**176.47%**

**The data are compiled from the NOAA NCDC Storm Event Database*

Historic Hazard Event – Extreme Cold – April 1971

On April 6, 1971 a rare late-season winter weather event produced the lowest temperature on record in Nashville. The daily high was 42 degrees.

Map 24 – Extreme Temperature Impact Density, Tennessee



3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)
The health and safety of persons affected by extreme temperatures will vary, depending on the length and severity of the temperature condition. Both extreme heat and extreme cold can negatively impact individuals in the affected area. Tennessee is known to have temperatures well over 100 degrees in summer months, and as low as 20 degrees below zero in the winter. Historically, such extreme temperature events have been credited with numerous injuries and fatalities. Children, people with disabilities, and the elderly are especially susceptible to the effects of extreme temperatures.

Heat is the number 1 weather-related killer in the U.S. There are a number of health complications that can be associated with prolonged exposure to extreme heat. The stagnant atmospheric conditions and poor air quality that accompany extreme heat can put individuals at risk of developing a heat disorder, as the body becomes unable to circulate and/or sweats too much. Heat disorders can lead to serious health complications, such as heat cramps, heat exhaustion, and heat strokes. Sunburn from excessive exposure to ultraviolet radiation may also restrict the skin's ability to dispose of the heat and this may cause burns. Individuals living in urbanized areas are at a greater risk than those in rural areas due in part to the overheated asphalt and concrete.

Similarly, extreme cold can impact individuals' health and safety. Wet areas may freeze, making driving dangerous. Continued exposure to extreme cold can result in serious health complications in those unable to generate body heat, such as hypothermia, as well as carbon monoxide poisoning from the use of space heaters and fireplaces. Increased power demands for heating or cooling may result in brownout or blackout conditions, further exacerbating the situation.

Technological advances in weather predication help to prepare communities, providing updates on extreme temperature watches, warnings, and outlooks. Providing the public with education on extreme temperature safety, such as appropriate dress, dietary adjustments, and insulation, is vital to reducing the impact of an event. Encouraging individuals to put together and maintain an emergency kit for use in an extreme temperature event will help sustain them if such an incident occurs. Additionally, injuries and fatalities related to extreme temperatures can be prevented through public awareness and emergency instructions via a voluntary public service messaging system.

Health and Safety of Personnel Responding to the Incident
As with individuals in the area at the time of an incident, personnel responding to extreme temperature events face personal health and safety risks. While several risks are possible, the most likely hazards encountered when responding to an extreme temperature situation will be heat exhaustion, frostbite, and dehydration. Extreme heat can also result in heat stroke for responders assisting individuals outside or in non-air conditioned buildings. Responding to individuals impacted by extreme cold could also prove difficult if streets are iced over. Responders are trained to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly evaluate any hazards that may pose a threat.

Continuity of Operations
During extreme temperature events, it is important that critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond be maintained. These essential functions may become compromised, either from extreme temperatures, or from cascading events. Wildfires, power outages, and water shortages, may accompany extreme temperatures, placing added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations

Plans (COOP), in conjunction with the Continuity of Government Plan, ensures that essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, extreme temperatures may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Children's Services, Department of Environment and Conservation, Department of Health, Department of Human Services, Department of Labor and Workforce Development, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Extreme temperatures may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises to be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Both extreme heat and extreme cold can impact property, facilities, and infrastructure. Power outages may occur as people use more heat or air conditioning during extreme temperatures. Hospitals, nursing homes, shelters, and schools could suffer significantly if power is lost, rendering them incapable of providing necessary services. Communication systems may be impacted as well if a brownout or blackout occurs. Extreme heating of asphalt and concrete can produce what is called the "urban heat island effect". Extreme cold may freeze water pipes, reducing the availability of drinking water. Frozen roads and bridges may make travel difficult or impossible. The same is true during extreme heat, when roadways and bridges may develop fractured surfaces.

The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities, and infrastructure due to extreme temperatures. Technological advances will allow for road crews to prepare and relocate resources, as needed, while repairs are made to roadways and bridges. In addition, potable water, wastewater treatment, telecommunications, and reinstatement of electricity are accounted for in the state's plan for disasters, as well as the mutual aid agreements and MOUs between the State of Tennessee, and other states and businesses.

Continued Delivery of Services

Extreme temperatures in the State of Tennessee would likely result in only a minimal effect on public services. As the demand for heat or air conditioning increases, brownouts or blackouts are likely to occur, lasting for days or weeks. These power outages will make communication difficult, and impact the abilities of hospitals to provide for healthcare needs. Loss of power, when combined with temperature and the inability to operate medical equipment can become life threatening. Frozen or damaged roadways and bridges will make it difficult for police and fireman to respond to emergency calls. Public transportation may also be temporarily interrupted. The capacities for both waste management and water supply may be compromised, making it difficult for residents to have access to safe drinking water.

It is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. Emergency personnel will assist in relocating services, activities, records, and resources wherever necessary, as stipulated in the Continuity of Operations Plan. Backup power and potable water supplies will also assist in maintaining essential services. Depending on the resources available, this may include reaching out to other states and the federal government for assistance. Coordination among various levels of government, including tribal areas and private sector organizations, is important to resume essential/critical services in a timely manner. As essential/critical services are resumed, the impact on citizens and communities will lessen.

Environment

Extreme temperatures may have a marginal impact on the environment. Extreme heat can lead to droughts, which kills grass, trees, and disrupts wildlife; prolonged heat and the accompanying drought can also cause soil to dry and loosen, spreading across the state by windstorms, such as those during the Dust Bowl. Low dissolved oxygen levels in lakes and ponds may have devastating impacts on marine life populations. In extreme heat, dry conditions increase the risk of wildfires. Prolonged periods of extreme heat may result in days of poorer and potentially dangerous air quality in the more urbanized zones in the state.

Economic Condition

The economic and financial impacts of severe heat are largely based on the impacted areas and damage. Tennessee is home to a large agricultural, swine, and cattle industry. If this industry is impacted by prolonged temperature extremes, the economic and financial repercussions could be severe. Extreme heat will make it difficult to grow crops, as well as ensure the health and safety of swine and cattle. Damages to the state's agricultural economy can span into the millions, compromising crop yield and affecting the price of goods. Milk and cattle production decreases in extreme heat events. Damages done to transportation and energy may also impact the state's economic condition with costly repairs, relocation of services, and loss in revenue from decreased commerce. Cold temperatures can have devastating effects on trees and winter crops. Frost and freeze have the potential to impact other crops early or late in the growing season. Livestock can be impacted by prolonged cold snaps if not properly protected from severe temperatures. These hazards can weigh heavily on farmers, costing them in reduced crop yield and revenue. Specific data regarding economic impact can be found in Economic Impact Assessments.

Public Confidence in the Jurisdiction's Governance

Preparedness and mitigation are vital steps to take prior to extreme temperature events. Preparedness measures can help reduce the impact of extreme temperatures and the hazards that accompany such events. The SEOC identifies the hazards, risks, and response measures that will enable emergency personnel to become familiar with the procedures used, and more apt to act swiftly. Preparedness also provides an opportunity to reach out to the public through individualized activities and training, lessening the impact an extreme temperature may have and increasing their ability to withstand the event. The longer an extreme temperature event lasts, the more hazardous it can become. Developing a mitigation strategy provides opportunities for the state to reduce the long-term risks associated with extreme heat and cold for both people and property. A successful mitigation strategy, consisting of preventive measures, natural resource protection measures, and emergency protection measures ensures that citizens receive the necessary education and information to withstand an extreme temperature event. Both preparedness and mitigation can reduce the stress and anxiety felt by persons in the affected areas, allowing the state to continue providing appropriate assistance where and when needed.

The public will scrutinize response and recovery efforts throughout extreme temperature events. Tennessee has both the resources and experience in responding and recovering from myriad hazard events as they relate to extreme temperatures. The manner and efficiency in which a response to a disaster is conducted could result in the loss of confidence in the program and the government's ability to protect the citizenry. Responding to extreme temperatures must address the immediate needs of the health and safety of citizens, as well as the continuation of critical infrastructure where possible. The most efficient and appropriate response will put previously developed preparedness plans into action based on the rapid assessment of the event's impact. Response efforts during extreme temperatures can provide individuals with the resources necessary to wait out the event in a safe environment. Such efforts may also prevent additional hazards from developing. The support services performed in the aftermath of an event can either strengthen or weaken the reputation of the program and the public's perception of the government's ability to provide services to people in time of need.

Depending upon the length and extent of an extreme temperature event, recovery may last a few weeks, months, or years. The State of Tennessee has a large agricultural, swine, and cattle industry that will have significant difficulties recovering from extreme temperatures. Other areas of the state may take significant time as well. Recovery efforts will require government, private, and non-profit organizations to work together in rebuilding the areas affected. Such efforts should include the implementation of plans that prioritize the needs of the communities most affected, moving down to less significant services as the process unfolds. Personal lives will have been impacted by the devastating effects of extreme temperatures as well, requiring resources that focus more on the individual, such as medical supplies. Providing these resources and capabilities in a timely manner ensures as swift a recovery as possible. The faster individuals and communities can return to normalcy, the higher the public's trust and confidence in the state's abilities will be.

New and innovative mitigation/preparedness and response/recovery measures are continually explored. Mutual aid compacts, and other assisting agencies help sustain and improve emergency plans and procedures within the State of Tennessee. In seeking out federal grants, and contracts with businesses and other state governments, the State of Tennessee enhances their preparedness measures, and ensures access to resources pertinent to response and recovery efforts.

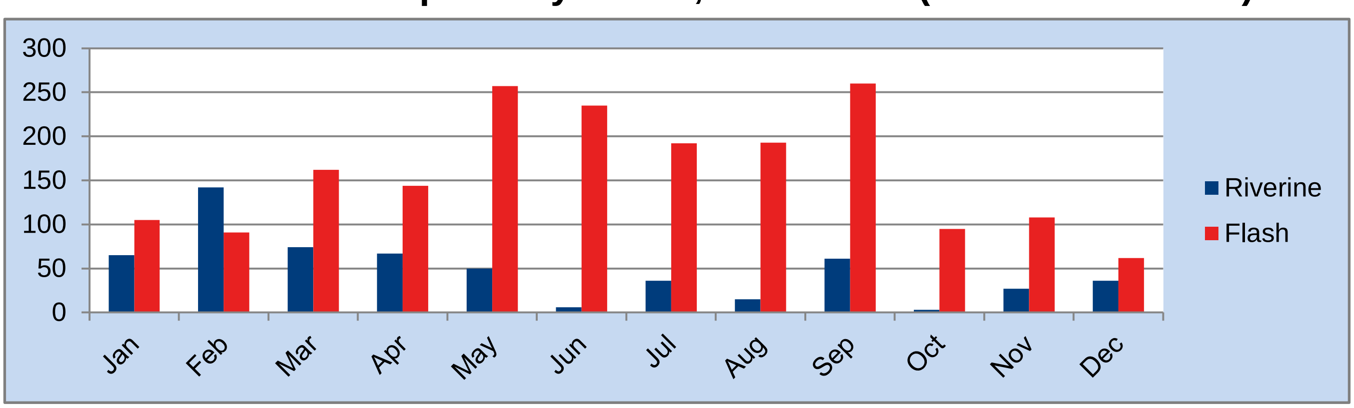
3.3F – Floods

Flooding is the most prevalent and costly disaster in the United States. Flooding occurs when water, due to dam failures, rain, or melting snows, exceeds the absorptive capacity of the soil and the flow capacity of rivers, streams or coastal areas. At this point, the water concentration hyper extends the capacity of the flood way and the water enters the floodplain. Floods are most common in seasons of rain and thunderstorms. Floods can be associated with other natural phenomena such as rainstorms, thunderstorms, hurricanes, coastal swells, earthquakes, tsunamis and rapidly melting snow.

Intense rainfall events, often accompanying the large thunderstorms that occur in Tennessee and its jurisdictions several times a year, may result in water flowing rapidly from higher elevations into valleys, collecting in, and sometimes overtopping the low lying streams. Various types of floods can happen quickly in the form of a flash flood, or accumulate seasonally over a period of weeks as is the case in a riverine flood. Flash floods often drain quickly, while riverine floods can remain for weeks. The magnitude of these floods is indeterminate and can vary, however, some areas have established a base flood elevation (BFE) to use as a determinate for construction and mitigation activities.

A variety of factors affects the type and severity of flooding within Tennessee and its jurisdictions including topography, urban development and infrastructure, and geology. Serious flooding in the mountainous or elevated areas is unusual because streams tend to be faster flowing and flood waters drain quickly. Flooding can occur anytime throughout the year, but is typically associated with the spring season. The chart below illustrates seasonal differences between riverine and flash flood impacts per month.

Chart 7 – Flood Impacts by Month, Tennessee (1993/94 – 2012/13)



**The data are from the NOAA NCDC Storm Event Database.*

3.3.1 – Location & Extent

A variety of factors affects the type and severity of flooding in Tennessee including topography, urban development and infrastructure, and geology. Serious flooding in the mountainous or elevated areas is unusual because streams tend to be faster flowing and flood waters drain quickly.

Intense flooding will cause havoc on the jurisdictions affected. Floods can cause minimal damage in the form of just inches of water to complete submersion of houses and critical facilities. Any amount of damage can render a structure unusable for as long as recovery operations would take depending on the level of damage. Intense and widespread flooding can trap people and entire communities without basic goods or services.

Flash floods tend to affect developed areas as their development has altered the natural drainage of the land. Map 34 depicts the density of flash flood impacts and corroborates their impacts occurring around developed areas.

Maps 25 through 27 on the following pages use FEMA's National Flood Hazard Layer data to depict the location of 100 and 500 year floodplains in East, Middle, and West Tennessee. No single region is left without risk to riverine floods as is shown in these maps. Below is a description of FEMA designation flood plains.

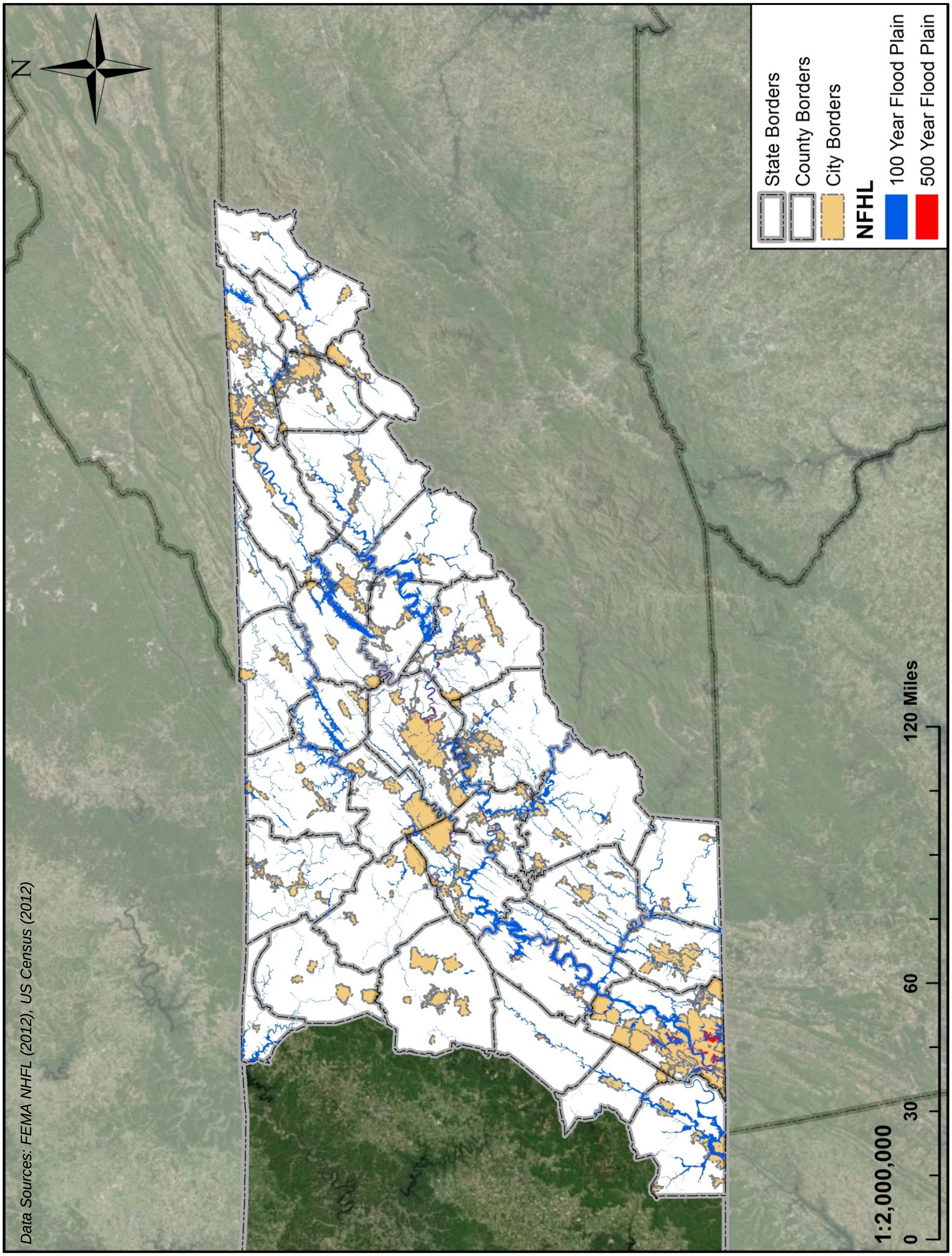
Table 25 – Primary Flood Zone Classifications in Tennessee

Zone Class	Description
A	An area inundated by 1% annual chance flooding, for which no BFEs have been determined. (100 Year Floodplain)
AE	An area inundated by 1% annual chance flooding, for which BFEs have been determined. (100 Year Floodplain)
B	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood. An area inundated by 0.2% annual chance flooding.

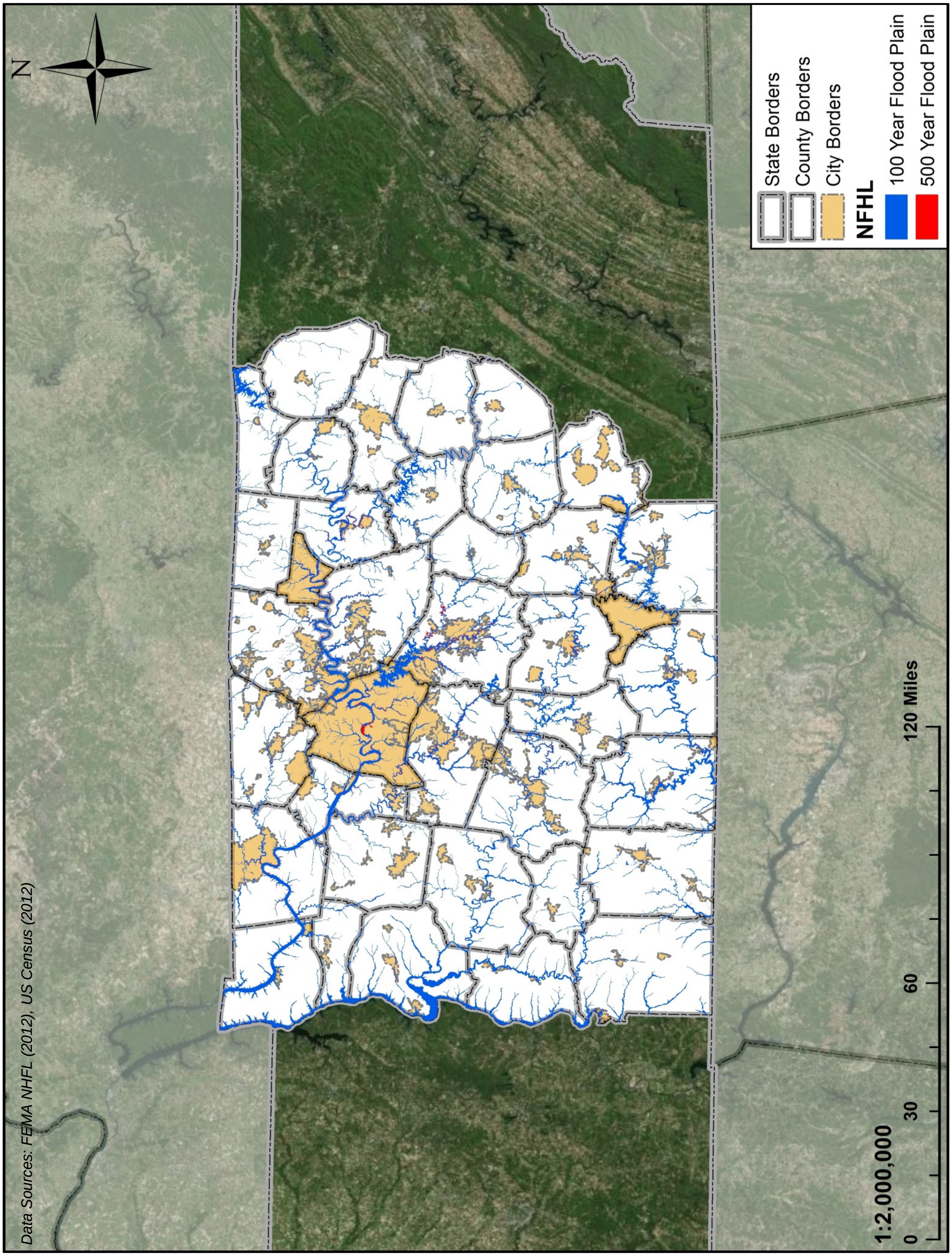
**Although FEMA designates many more floodplain classifications, these represent 99% of the flood zoning in TN. Related classifications, i.e. '100 Year protected by levee' were incorporated in classification A.*

An issue related to the hazard of flooding is Repetitive Loss and Severe Repetitive Loss properties. An RL property is a residential property which has received 2 or more flood loss claims over $1000 each. For a residential property to be classified as SRL, it must have experienced at least 4 claims over $5,000 (including building and contents payments) or at least 2 claims that cumulatively exceed the market value of the structure. For both instances, at least 2 of the referenced claims must have occurred within any 10 period and must have been more than 10 days apart. SRL properties are seen as a major burden to the National Flood Insurance Program and since they have been flooded frequently in the past, they are a high risk to be flooded again. Maps 28 through 33 depict Tennessee's RL/SRL properties and their corresponding county statistics. A complete list (without addresses) of Tennessee's RL and SRL properties can be found in Addendum II.

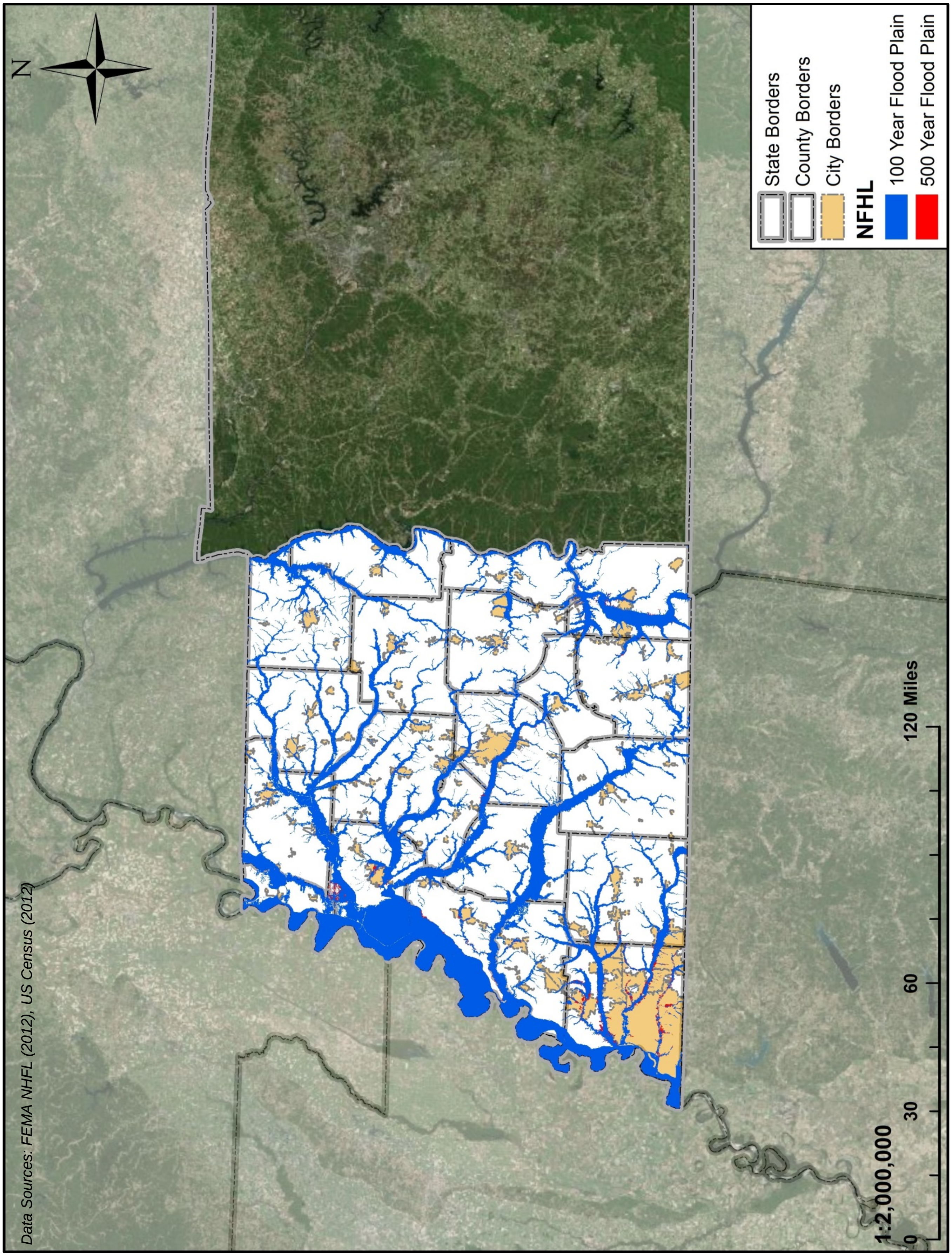
Map 25 – FEMA NFHL Floodplains, East Tennessee



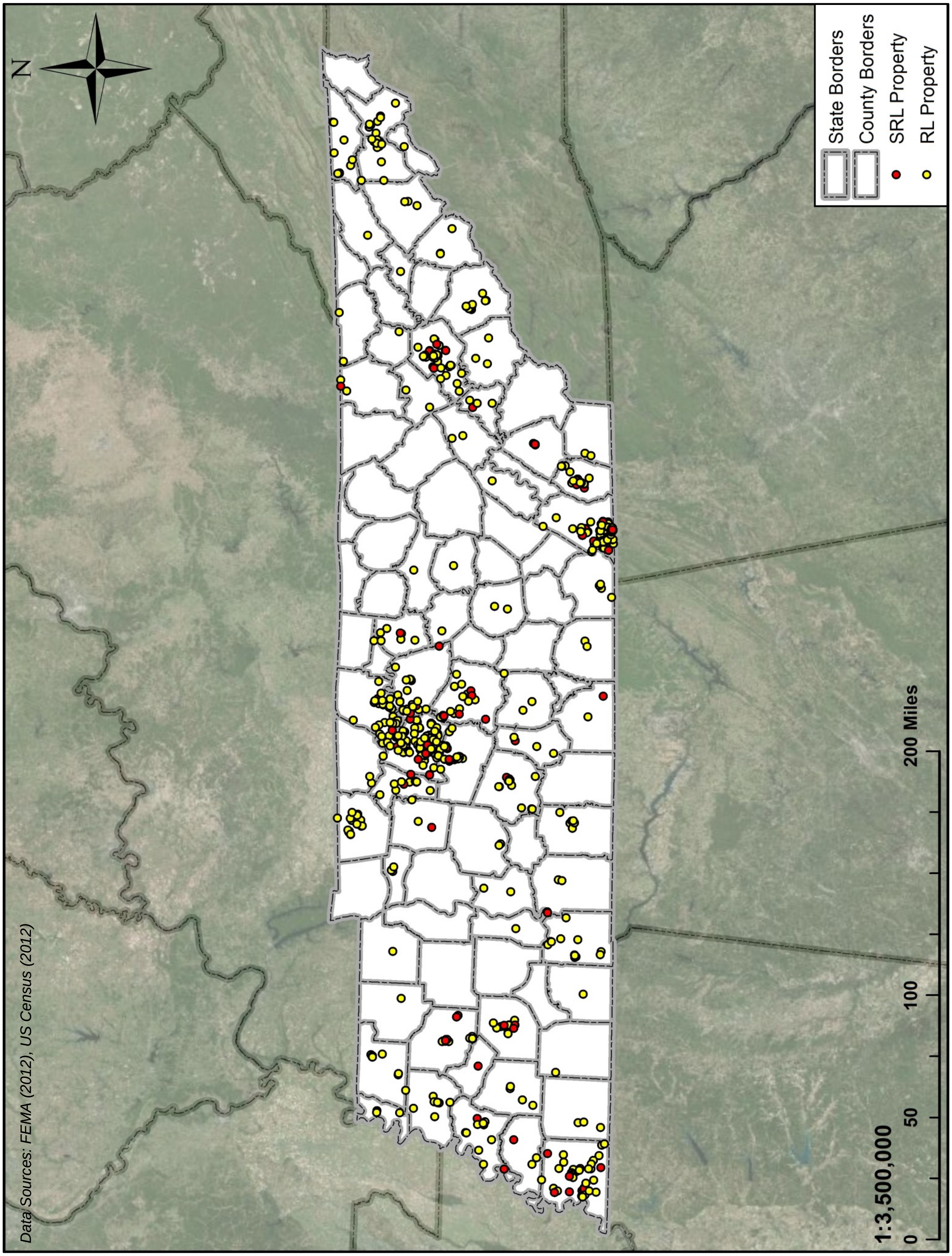
Map 26 – FEMA NFHL Floodplains, Middle Tennessee



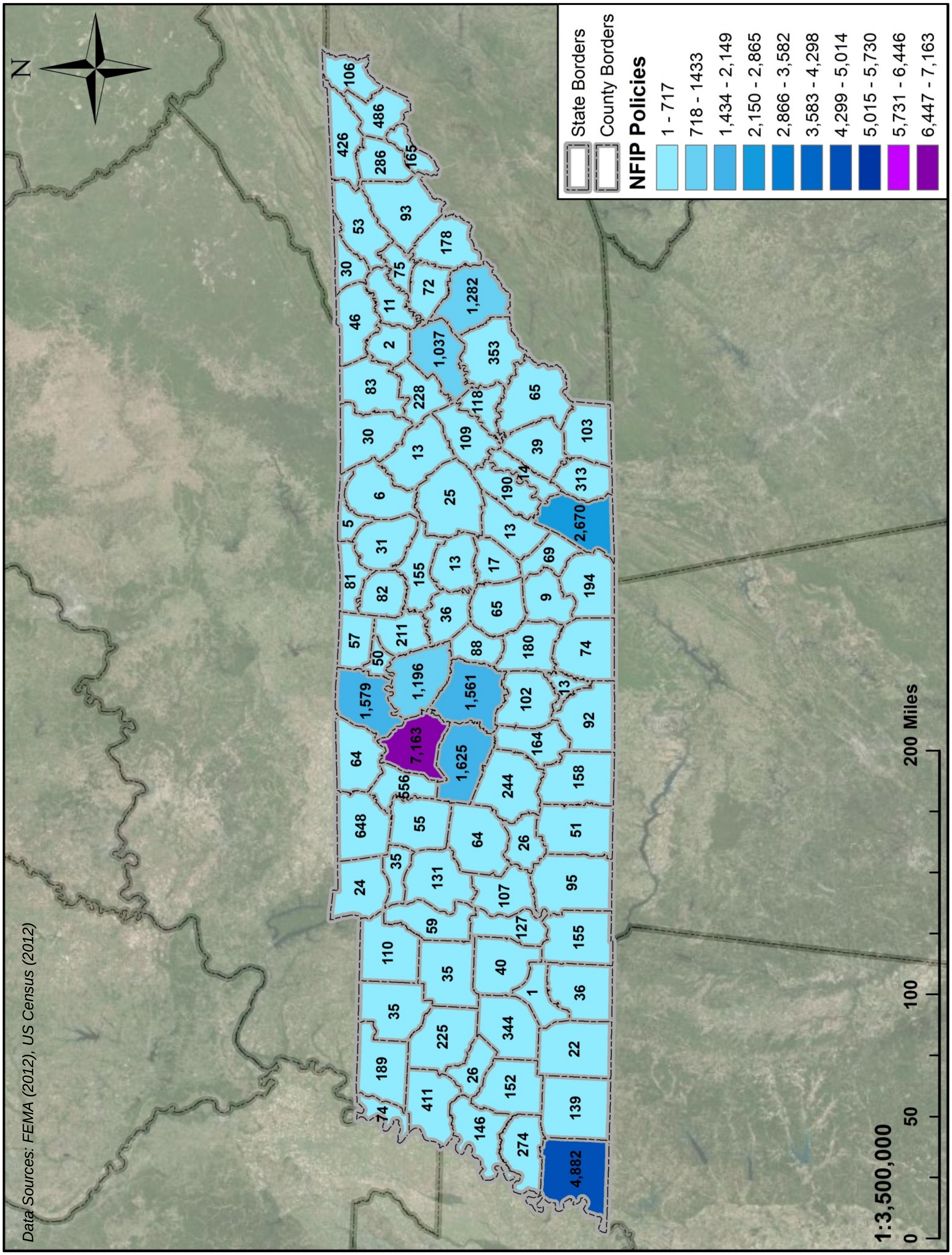
Map 27 – FEMA NFHL Floodplains, West Tennessee



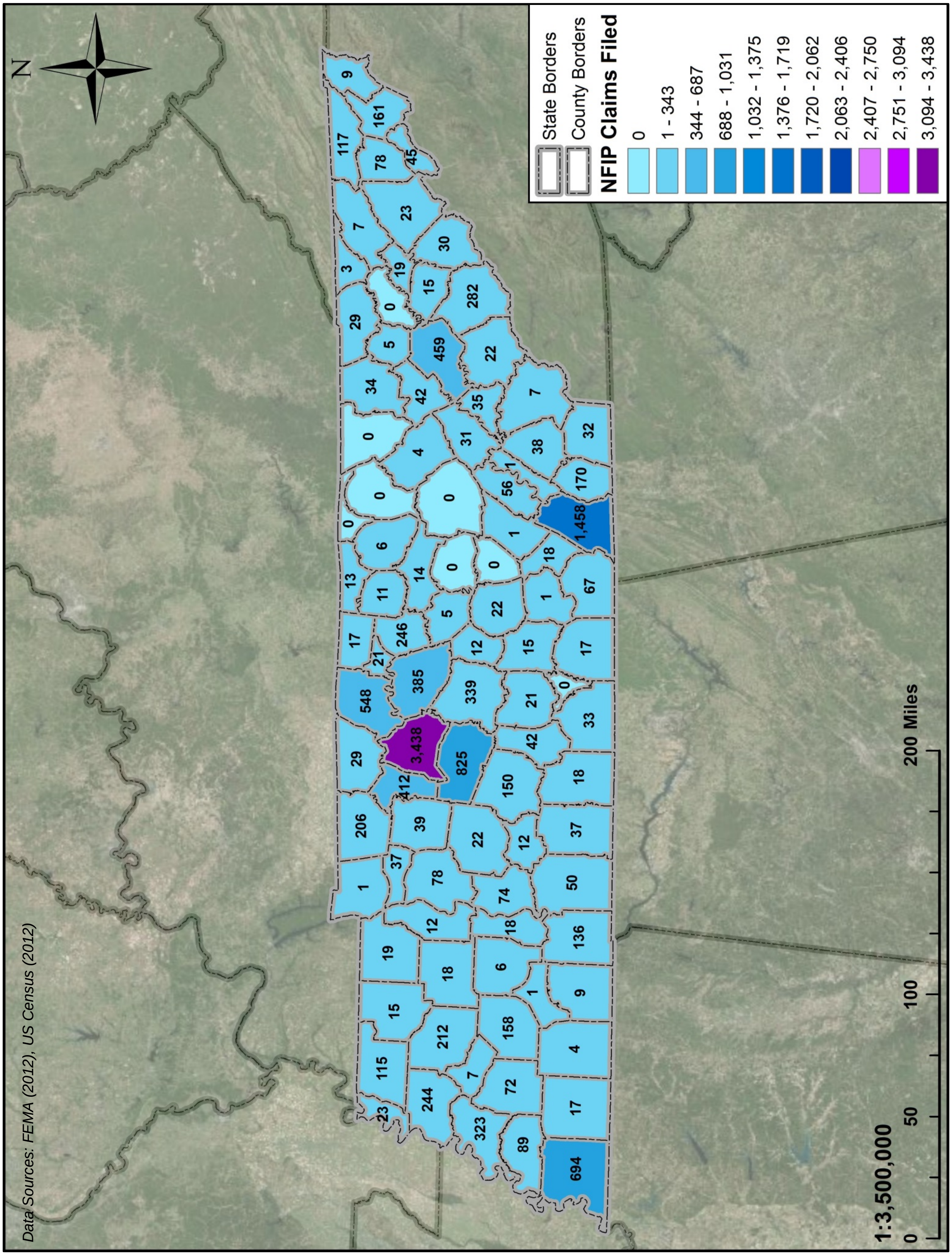
Map 28 – RL & SRL Properties, Tennessee



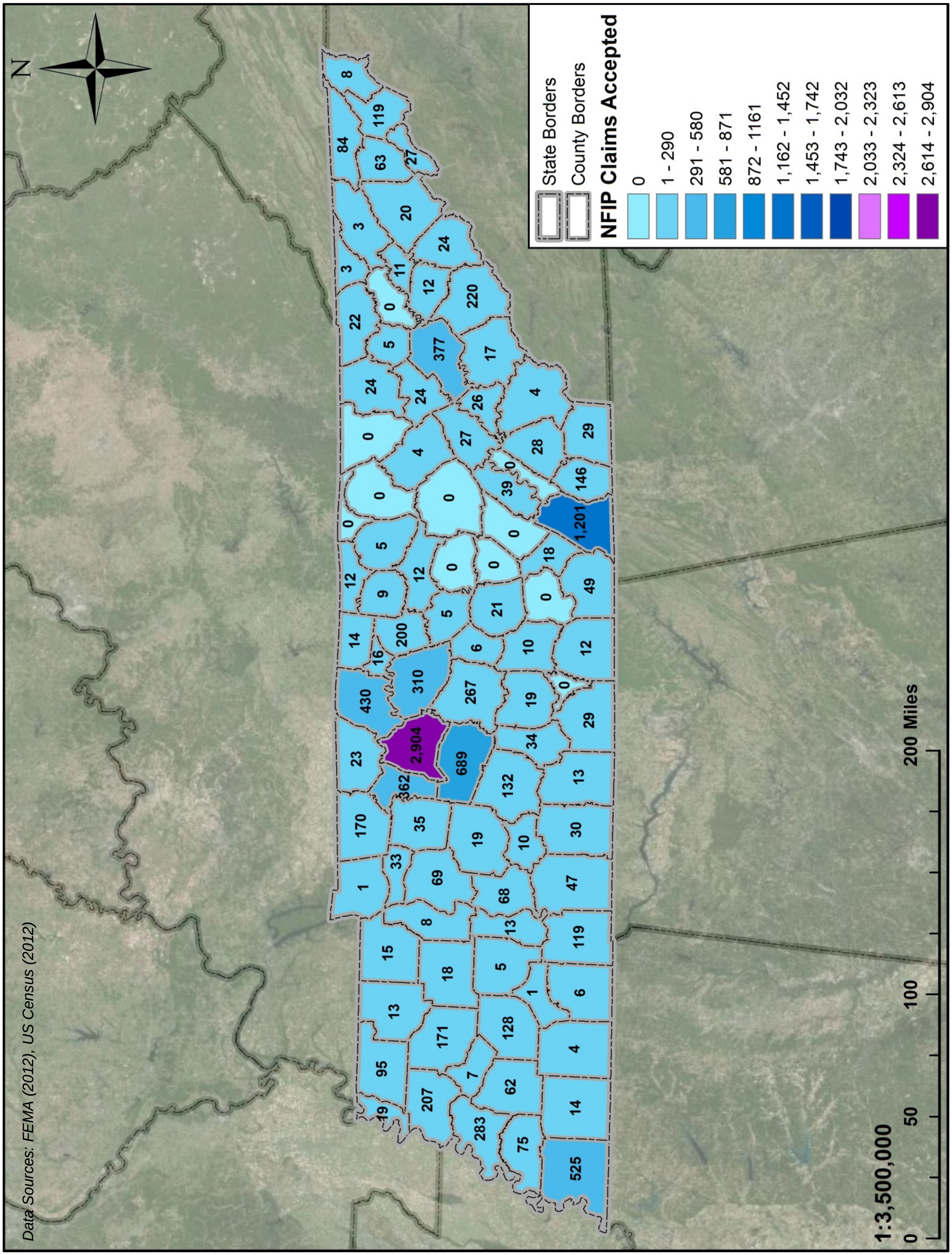
Map 29 – NFIP Policies by County, Tennessee



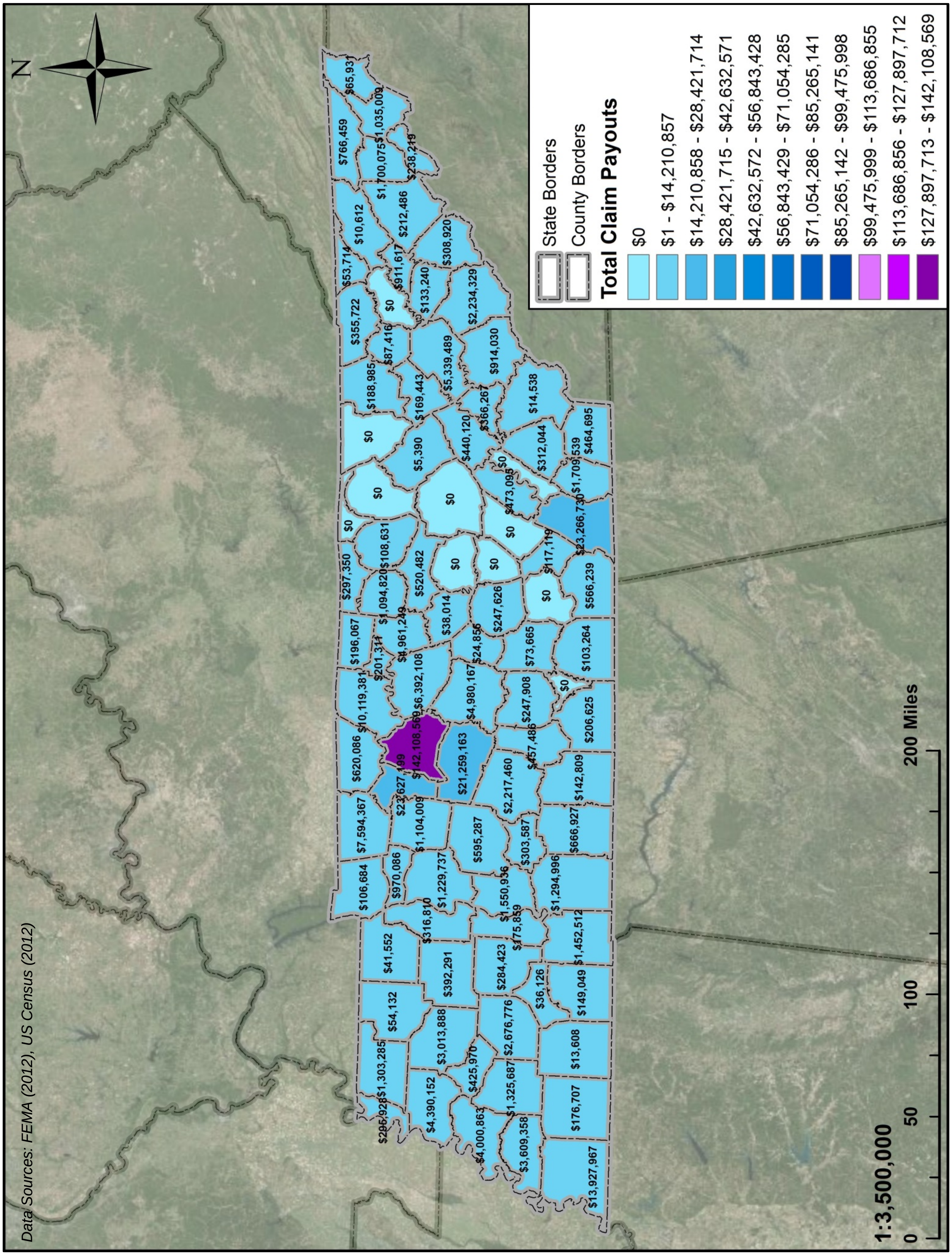
Map 30 – NFIP Claims Filed by County, Tennessee



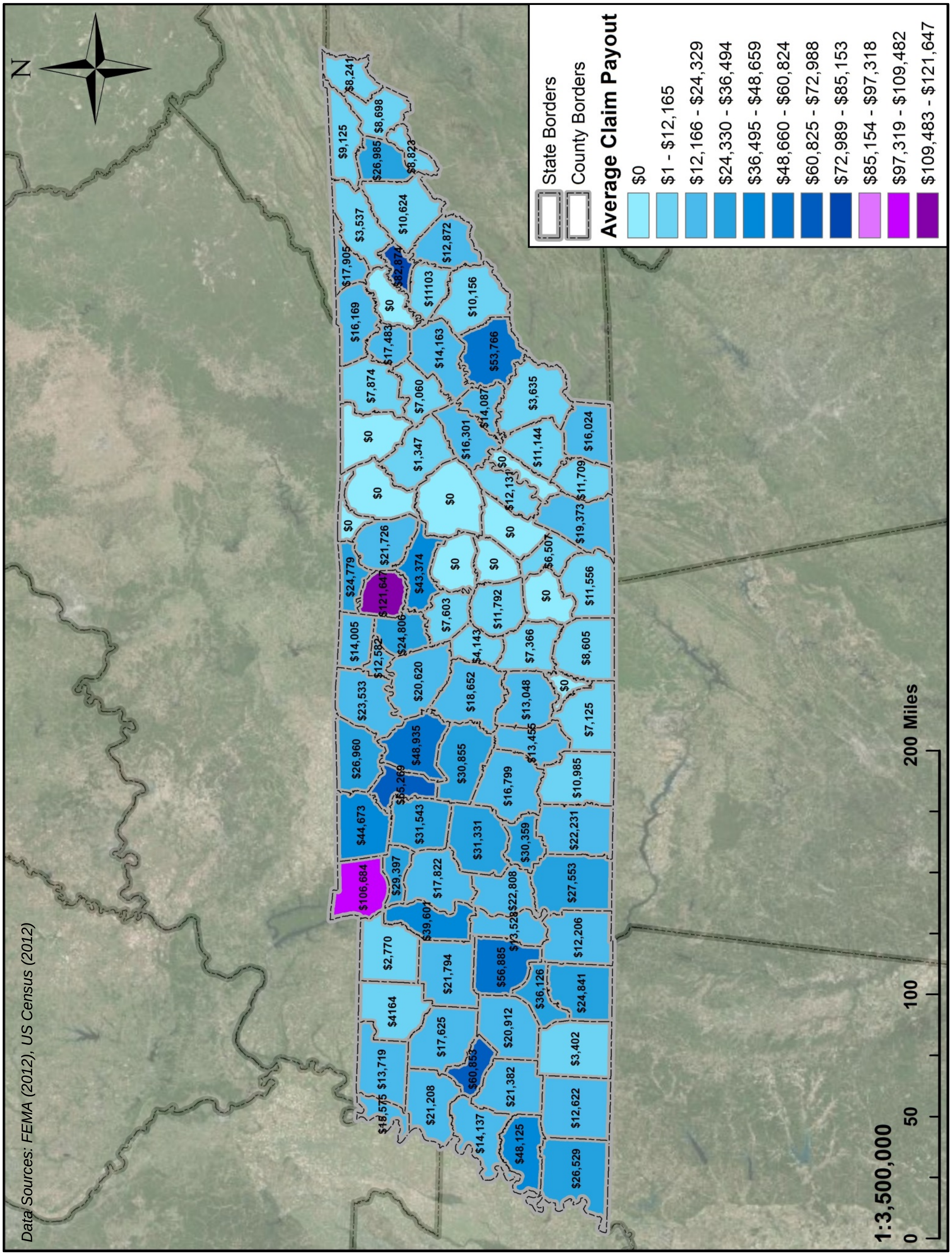
Map 31 – NFIP Claims Accepted by County, Tennessee



Map 32 – Total NFIP Claim Payouts by County, Tennessee



Map 33 – Average NFIP Claim Payouts by County, Tennessee



3.3.2 – Previous & Future Occurrences

Since 1993, NOAA has recorded 1904 flash flood impacts in the State of Tennessee. Tennessee has recorded 18 deaths and 44 injuries relating to flash flooding. These events have cost Tennesseans $386,286,970 in property damage and $466,000 in crop damage.

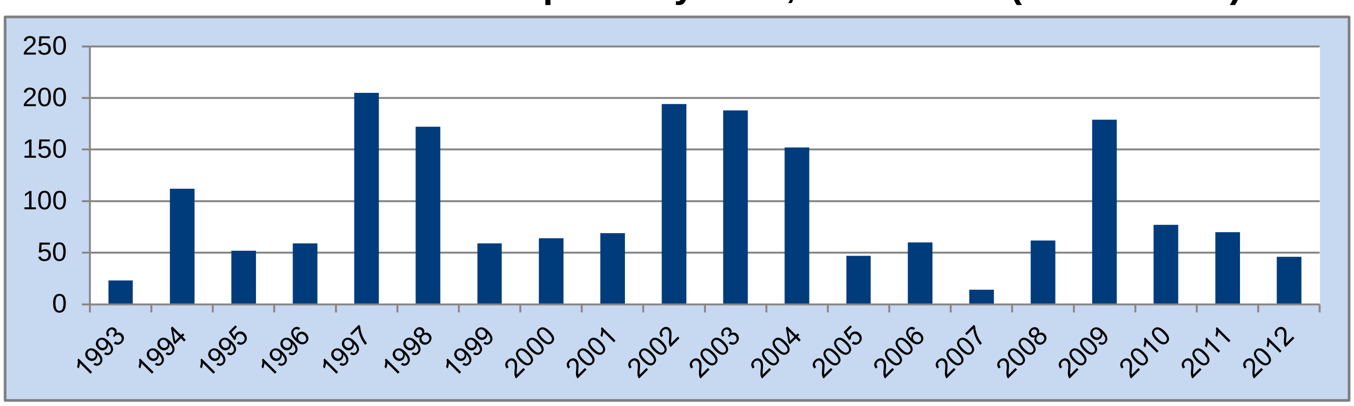
Based on NOAA's data, a flash flood impact can cost up to $50,000,000 in property damage, and $250,000 in crop damage. The average riverine flood impact will cause $202,882 in property damage, $245 in crop damage, kill 0.0095 people, and injure 0.0231 people.

Table 26 – Historical Impacts, Flash Floods (1993 – 2012)

Count of Impacts	1904
Impacts Per Year	95.2
Average Magnitude	-
Magnitude Range	-
Average Cost	$202,882
Magnitude of Cost	$0 - $50,000,000
Total Recorded Cost	$386,286,970
Average Crop Damage	$245
Magnitude of Crop Damage	$0 - $250,000
Total Crop Damage	$466,000
Average Fatalities	0.0095
Total Fatalities	18
Average Injuries	0.0231
Total Injuries	44

**The data are compiled from the NOAA NCDC Storm Event Database*

Chart 8 – Flash Flood Impacts by Year, Tennessee (1993 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

Since 1994, NOAA has recorded 582 riverine flood impacts in the State of Tennessee. Tennessee has recorded 35 deaths and 1 injury relating to riverine flooding. These events have cost Tennesseans $4,245,763,300 in property damage and $6,597,000 in crop damage.

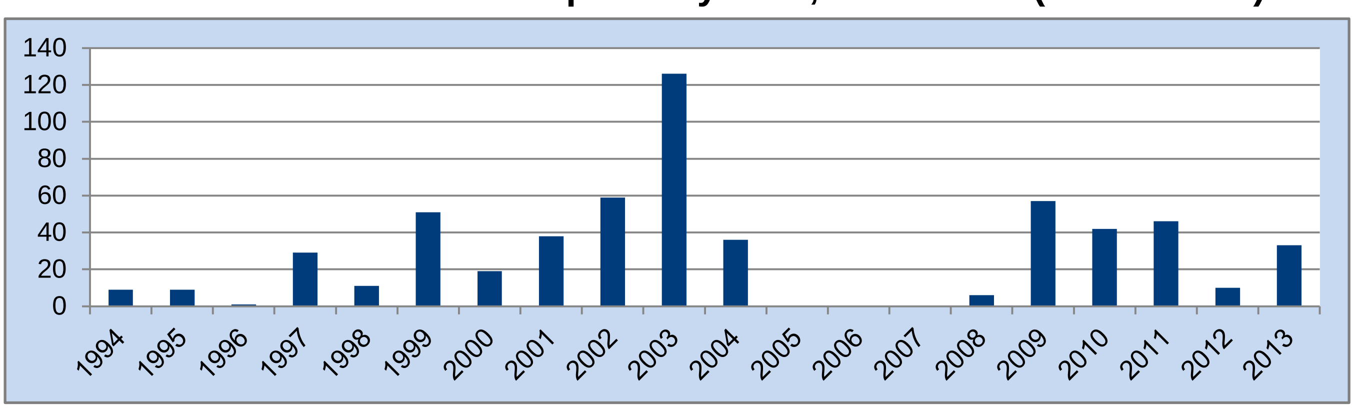
Based on NOAA's data, a riverine flood impact can cost up to $2,000,000 in property damage, and $6,597,000 in crop damage. The average riverine flood impact will cause $7,295,125.95 in property damage, $11,335 in crop damage, kill 0.0601 people, and injure 0.0017 people.

Table 27 – Historical Impacts, Riverine Floods (1994 – 2013)

Count of Impacts	582
Impacts Per Year	29.10
Average Magnitude	-
Magnitude Range	-
Average Cost	$7,295,125.95
Magnitude of Cost	$0 - $2,000,000,000
Total Recorded Cost	$4,245,763,300
Average Crop Damage	$11,335
Magnitude of Crop Damage	$0 - $2,000,000
Total Crop Damage	$6,597,000
Average Fatalities	0.0601
Total Fatalities	35
Average Injuries	0.0017
Total Injuries	1

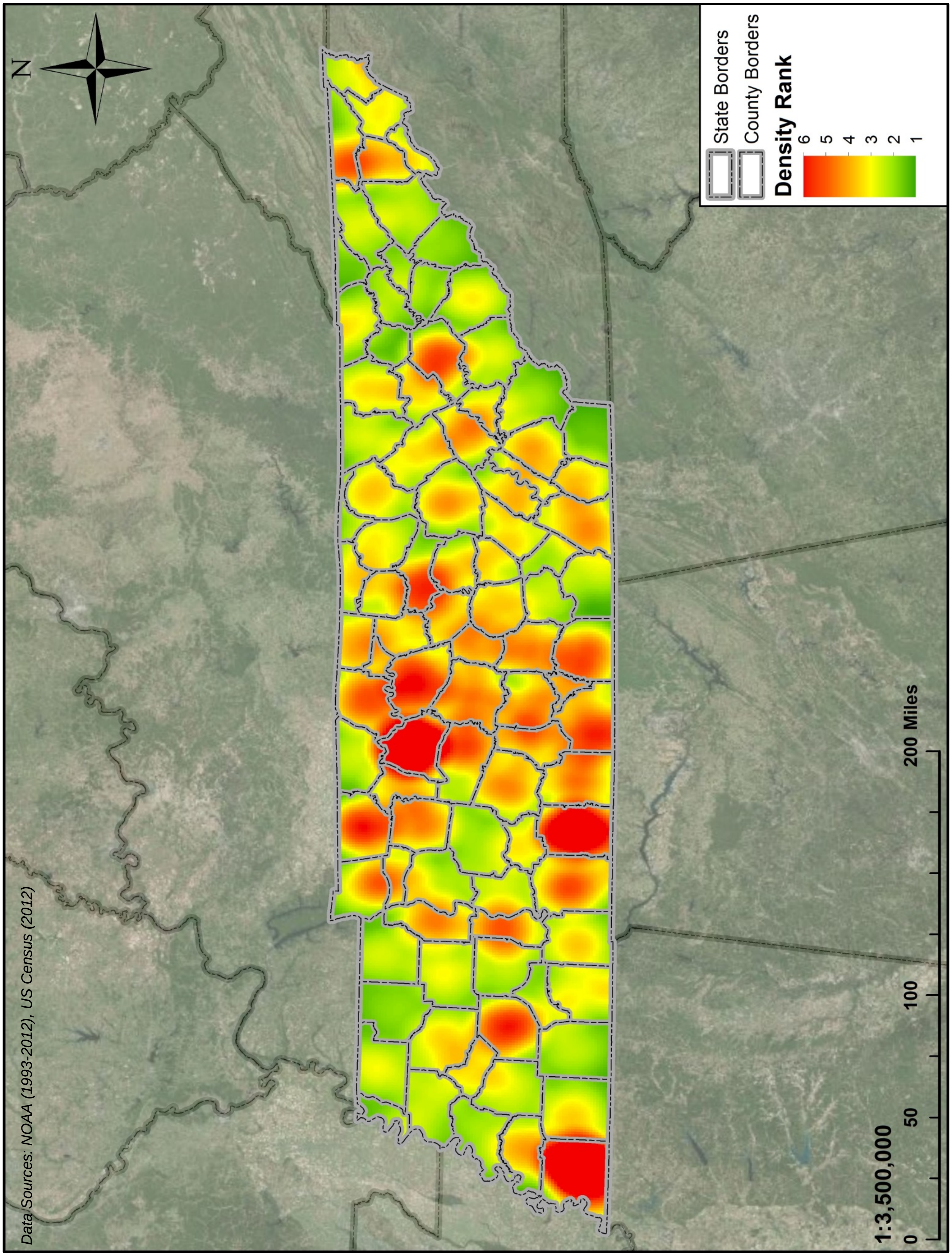
*The data are compiled from the NOAA NCDC Storm Event Database.

Chart 9 – Riverine Flood Impacts by Year, Tennessee (1994 – 2013)



The data are from the NOAA NCDC Storm Event Database.

Map 34 – Flash Flood Impact Density, Tennessee



Historic Hazard Incident – Riverine Flood – January 1927

Flooding began when the Mississippi Basin was hit with heavy rain in the summer of 1926. The Cumberland River crested at a record of 56.2', which is still the record today, even exceeding the 2010 floods. By May, the Mississippi River below Memphis reached 60 miles in width.

Historic Hazard Incident – Riverine Flood – May 2010

The May 2010 floods were the devastating outcome of a 2 day rainfall over May 1st and 2nd totaling over 19 inches. Over 30 counties (31% of Tennessee) were declared major disaster areas by the FEMA. Nashville set a new all-time record for 1 day rainfall with 7.25 inches and for a 2 day total of 13.57 inches. Rainfall intensity records for 6 hours (5.57") and 12 hours (7.20") are also set.

The Cumberland River flooded for the first time in 26 years and crested at 51.86 feet (15.81 m) in Nashville. All-time record crests were observed on the Cumberland River at Clarksville, the Duck River at Centerville and Hurricane Mills, the Buffalo River at Lobelville, the Harpeth River at Kingston Springs and Bellevue, and the Red River at Port Royal.

Twenty-one deaths were recorded in Tennessee. Almost all schools in the Middle Tennessee area were closed; some for multiple weeks. Many roads had damage from erosion including I-40, which was under construction for months. Homes and other establishments were destroyed. Flooding from the Cumberland River damaged the Grand Ole Opry House, Gaylord Opryland Resort & Convention Center, Opry Mills Mall, Bridgestone Arena, and LP Field.

Historic Hazard Incident – Riverine Flood – April 2011

Tennessee was declared a Federal Disaster Area when the Mississippi River flooded affecting Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. Over 1,300 homes were evacuated in Memphis.

The state can expect a flash flood impact with a probability of 9520.00% per year or 95.20 impacts per year while is can expect a riverine flood impact with a probability of 2910.00% per year or 29.10 impacts per year.

Table 28 – Impact Probability, Flash & Riverine Flood Events		
Impact Year	**Count of Impacts**	
	Flash Floods	**Riverine Floods**
1993	23	-
1994	112	9
1995	52	9
1996	59	1
1997	205	29
1998	172	11
1999	59	51
2000	64	19
2001	69	38
2002	194	59
2003	188	126
2004	152	36
2005	47	0
2006	60	0
2007	14	0
2008	62	6
2009	179	57
2010	77	42
2011	70	46
2012	46	10
2013	-	33
Total Recorded Impacts =	1904	582
Total Years =	20	20
Yearly Probability =	**9520.00%**	**2910.00%**

**The data are compiled from the NOAA NCDC Storm Event Database*

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)
Historical data suggests floods are the most common hazard in the United States and have the potential of causing minimal to devastating damage to large areas, as well as injuries, fatalities, and severe emotional stress. Over two-thirds of the State of Tennessee and 20-30% of the population have been and are affected by flooding. Consequently, flooding is considered a major area of concern to the state. Populations affected by floods are dependent on terrain, and the type of flood. Overall, any area is susceptible to flooding; however, low-lying and urban areas have the potential to be severely impacted. Riverine floods develop with warning, allowing individuals some time to react and minimize the physical impact on residents. Flash floods, however, come without warning, leaving little, if any, time to react. In general, floods pose extreme hazards to individuals in vehicles, who may lose control, become trapped inside, and be washed away. Additionally, lack of visibility during a flood may cause drivers to become stranded or trapped when the roadbed has been washed out under the water.

There is the potential for electrical fires and sewage backup in high-risk areas. Water sources contaminated by oils or sewage create large impacts on the community's health and availability of drinking water. Ingesting food that has come in contact with floodwater is also hazardous. Further sewage and chemical spills onto living surfaces pose serious health hazards. Damaged gas lines may cause explosions and/or exposure to harmful carbon monoxide. Mold may develop after the floodwaters recede, overwhelming individuals with compromised respiratory systems.

Floods can be prepared for by being informed of the likelihood of flooding conditions in your area, floodplain maps, and weather predictions available through the NWS. Additionally, utilizing local media sources to communicate weather threats provides communities with vital knowledge of the conditions surrounding their area.

Health and Safety of Personnel Responding to the Incident
Although TEMA and other state agency personnel responding to the incident will observe life safety and health standards and practices, flood incidents are not without risks. Personnel responding will utilize intelligence gathered from local responders, as well as watches and warning provided by the NWS, to properly address any hazards that may pose a threat.

The potential for responding personnel to be affected by an event will be hazard specific. Rushing waters from flash flooding may sweep responders and emergency vehicles away. Weakened levies may burst, sending a surge of water toward responders and compromising rescue missions. Rescue efforts may also be hindered by damaged foundations and collapsed buildings. Gas leaks may expose responders to harmful fumes and potential explosions. In an effort to minimize the impacts of a flood on personnel, all responders will be trained to the level necessary to respond in a sage and efficient manner.

Continuity of Operations
During a flood, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently may become compromised. Additionally, cascading events, such as sewage leaks and water contamination, may accompany floods, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensures that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, floods may affect the following departments: Department of Finance and Administration, Department of Tourist Development, Department of Commerce and Insurance, Department of Children's Services, Department of Human Resources, Department of Environment and Conservation, Department of Financial Institutions, Department of General Services, Department of Health, Department of Human Services, Department of Labor and Workforce Development, Department of Transportation, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Flooding may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises to be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Both riverine and flash floods can pose significant damage to property, facilities, and infrastructure. Drainage systems may become clogged during torrential rains, placing low-lying and urban areas at risk of flash floods. Damage to property, facilities, and infrastructure may also depend upon new construction and development, which can alter the natural drainage and create new flood risks. In addition, flash floods may roll boulders and tear down trees, plowing into buildings and destroying bridges. The foundations of buildings may become compromised, requiring repairs and relocation of whatever services it housed. Jurisdictions affected by the flood may face water shortages, as drinking water may have come in contact with sewage and other hazardous liquids.

Potable water, wastewater treatment, telecommunications, and reinstatement of electricity are among the items that will require immediate attention. These endeavors may prove costly in time, manpower, and finances. However, the State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise.

Continued Delivery of Services

Floods can greatly impact public services. Roadways may become impassible and dangerous to vehicles, making it difficult for personnel to respond throughout the incident. Highways and bridges may be significantly damaged, temporarily halting transportation services, including public and emergency transportation. Power outages are common, making it difficult to access documents, vital records, and logistics command and control. Such brownouts or blackouts may make a simple relocation of services impossible. Waste management and water supply could also be temporarily out of order. Floodwaters can cause damage to the waste water system, and may contaminate the general water supply. Depending on the severity of the flood, potable water may be distributed to offset this obstacle. Railways and water transports, which could be used to deliver resources for response and recovery efforts, may become incapacitated by the flooding, prolonging emergency operations. Communications may be significantly impacted; emergency personnel may find it difficult or impossible to contact incident command and others in the field. In addition, 9-1-1 centers may become overwhelmed with calls, paralyzing these critical services.

Under provisions in place for the Continuity of Operations, it is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. These services will be resumed utilizing the emergency policies and plans for the State of Tennessee, as well as any mutual aid agreements, standby contracts, and memorandums of understanding established with other public, private, and non-profit entities.

Environment

Floods may have a marginal to a devastating impact on the environment. Flooding may occur any time of the year and may leave miles of property contaminated with materials that precludes habitability. Standing water may develop, and remain after the flood recedes. Standing water is a breeding ground for mosquitos, which may carry harmful diseases. As floodwaters rise, overflowing creeks and rivers, they destroy habitats. Wild animals, including poisonous snakes, may seek refuge in homes and other buildings, risking dangerous encounters with people. Trees and other plants may become choked by the over-soaked soil and die. In addition, natural drinking water sources may become contaminated with sewage, causing wild animals to become sick and/or die off. Some of these effects can develop into long-term impacts for months or years to come.

Economic Condition

Depending upon the type and severity of the flood, there can be significant economic and financial impacts. Tennessee has numerous large industries, including nuclear power, chemical plants, livestock farms, crop farming and pipeline industries that could greatly impact the economic and financial condition of the state if destroyed. Severe flooding may drown out farmland, making it unworkable and preventing both the harvest of current crops and future planting. Without this crop yield, farmers will lose significant revenue. Floodwaters can contaminate drinking water and food for livestock, leaving them without nourishment. Over soaked grounds may pose hazardous for the nuclear power and chemical plants, as well as underground pipelines. The state's tourism may also decline for the year, resulting in revenue losses for local businesses as well. Development of proper floodplain documents greatly reduces the impact of flooding, decreasing the economic and financial impact.

Public Confidence in the Jurisdiction's Governance

The public has certain expectations regarding the government's actions related to flooding before, during, and after the event. Prior to a flood, the government is expected to identify areas of high risk and vulnerability, resources required, and a plan of response if flooding occurs. Educating citizens on how to prepare for and respond to flood warnings and watches lessens the likelihood of injury and death, increasing the public's confidence. A fully developed mitigation strategy is also necessary, as a means of prevention and protection measurements. Mitigation serves to lessen the long-term risks of flooding. The less damage done, the better public opinion will be. When a flood event occurs, additional measures of response and recovery must be taken. While Tennessee has both the resources and experience in responding and recovering from floods, the actions taken leave lasting impressions on citizens and affect confidence levels.

Response efforts must begin immediately after the event to limit loss of life, injury, and property damage. This involves putting preparedness plans into action, including any mutual aid agreements, standby contracts, etc. In seeking out and receiving assistance from surrounding governments and various organizations, such as the NWS, the State of Tennessee provides its citizens with more efficient response efforts. The manner and efficiency in which a response to a disaster is conducted, including the support services performed, have a direct impact on the level confidence in the program, and the government's ability to protect the citizenry, and its ability to provide services to people in time of need. Following response to a flood event, the recovery process helps the community return to normal operations as soon as possible. Affective recovery efforts will involve the state working alongside private, public, and non-profit organizations. The resources and capabilities that are expeditiously made available for the recovery process can maintain and strengthen the public's trust, and confidence and thus lessen the impact on citizens.

3.3G – Geologic Hazards

Geologic hazards relate to the danger involved in topography, rock formations, and soil. Included in this category are expansive soils, land subsidence/sinkholes, and landslides.

Expansive Soils

Soils and soft rock that tend to swell or shrink due to changes in moisture content are expansive soils. Changes in soil volume present a hazard primarily to structures built on top of expansive soils. The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall.

In the United States, 2 groups of rocks serve as parent materials of expansive soils. The first group is composed of aluminum silicate minerals from volcanic materials decompose to form expansive clay minerals of the smectite group. The second group consists of sedimentary rock containing high concentrations of clay minerals.

Structural damage due to expansive soils is not covered by most insurance. Recent estimates put the annual damage from expansive soils in the United States as low as $2.5 billion and as high as $7 billion.

Land Subsidence/Sinkholes

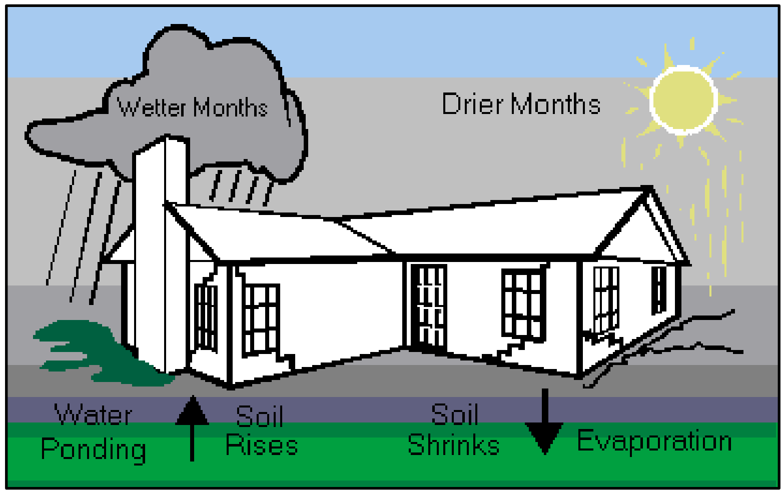
Land subsidence is the loss of surface elevation and occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rock falls in on itself. Subsidence may occur abruptly or over many years. It can occur uniformly over large areas or as localized sinkholes.

Landslides

Landslides are the downward and outward movement of slopes. Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on and over steepened slopes is the primary reason for a landslide, landslides are often prompted by the occurrence of other disasters. Other contributing factors include the following: erosion; steep slopes; rain and snow; and earthquakes.

Slope material often becomes saturated with water and may develop a debris or mudflow. If the ground is saturated, the water weakens the soil and rock by reducing cohesion and friction between particles. Cohesion, which is the tendency of soil particles to "stick" to each other, and friction affect the strength of the material in the slope and contribute to a slope's ability to resist down slope movement. Saturation also increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope. Undercutting of a slope reduces the slope's resistance to the force of gravity by removing much-needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure. The resulting slurry of rock and mud can pick up trees, houses, and cars, and block bridges and tributaries, causing flooding along its path. Additionally, removal of vegetation can leave a slope much more susceptible to superficial landslides because of the loss of the stabilizing root systems.

3.3.1 – Location & Extent



Expansive Soils

Expansive soils are slow to develop and do not usually pose a risk to public safety. The slow expansion and contraction of the clays and soils places pressure on structural foundations and subsurface dwellings. This pressure can become so great it damages foundations, cracks walls, and deforms structures. Due to the slow nature of the process it can take years before damage is observed.

The diagram located in the upper right corner of this page details the process of expansive soils over time. Expansive soils' risk is measured by quantifying the soils ability to swell and shrink from water content. The quality used to quantify the swelling capacity is called "linear extensibility." It is an expression of the length of change between water content 1/3 to 1/10 bar tension (33kPascal to 10 kPascal) and oven dryness multiplied by the thickness of the soil layer.

The NRCS uses 4 risk categories, from low to very high, measuring the change in the soils' volume expressed as a percent value of linear extensibility. Since expansive soils' risk is extremely complex to measure, current soil science techniques do not offer a known or predicted level of occurrence or impact. Please see Table 29 below for a breakdown of expansive soil threat categories. For hazard mitigation purposes a "low" rank on the scale is not considered a reasonable risk as even the most basic of structural foundations can resist this level of swelling and expansion.

Table 29 – Linear Extensibility Zones

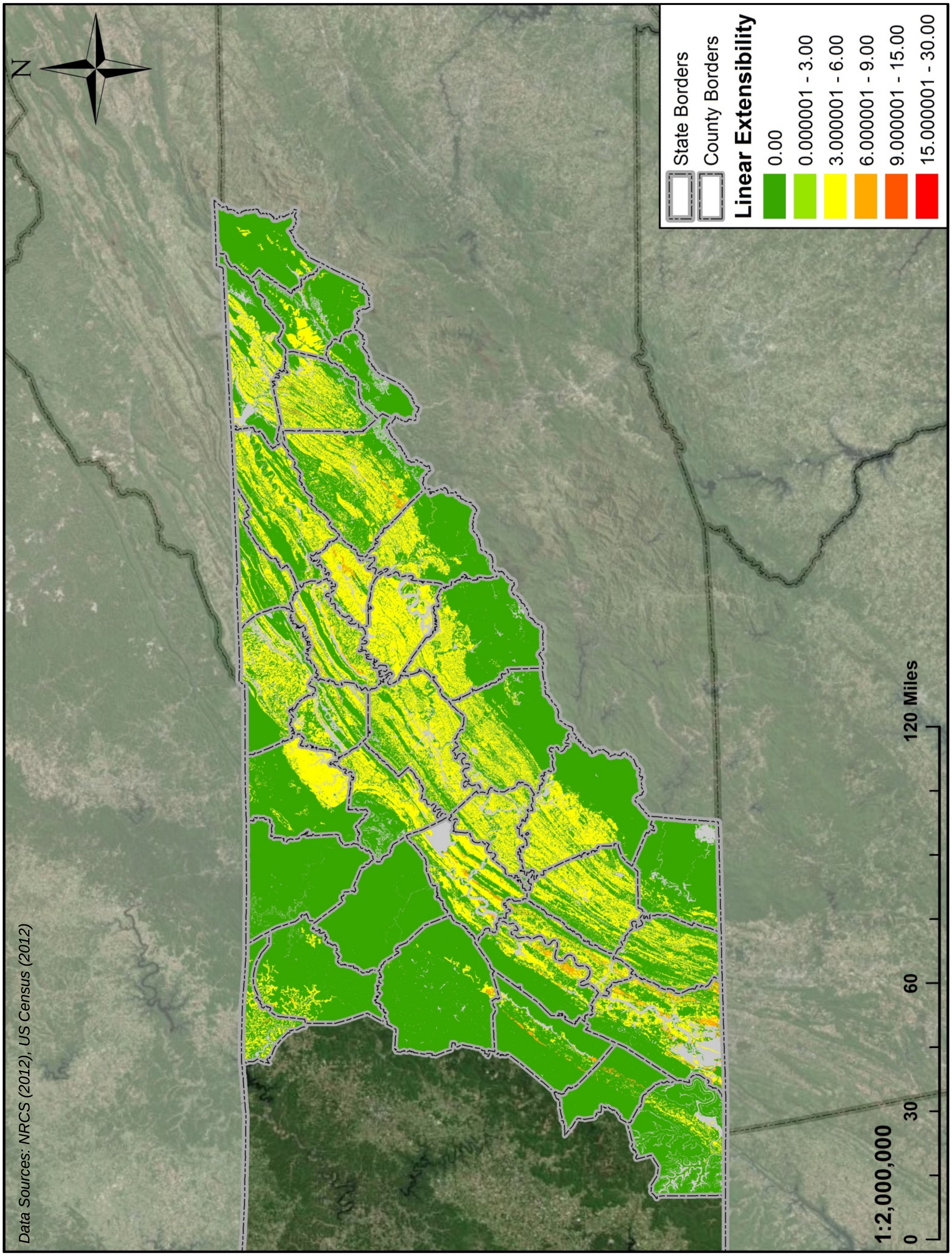
Ranking	Linear Extensibility %	Clay %
Low	0.0% - 3.0%	< 25
Moderate	3.0% - 6.0%	25 - 35
High	6.0% - 9.0%	35 - 45
Very High	> 9.0%	> 45

**The table data is from the NRCS*

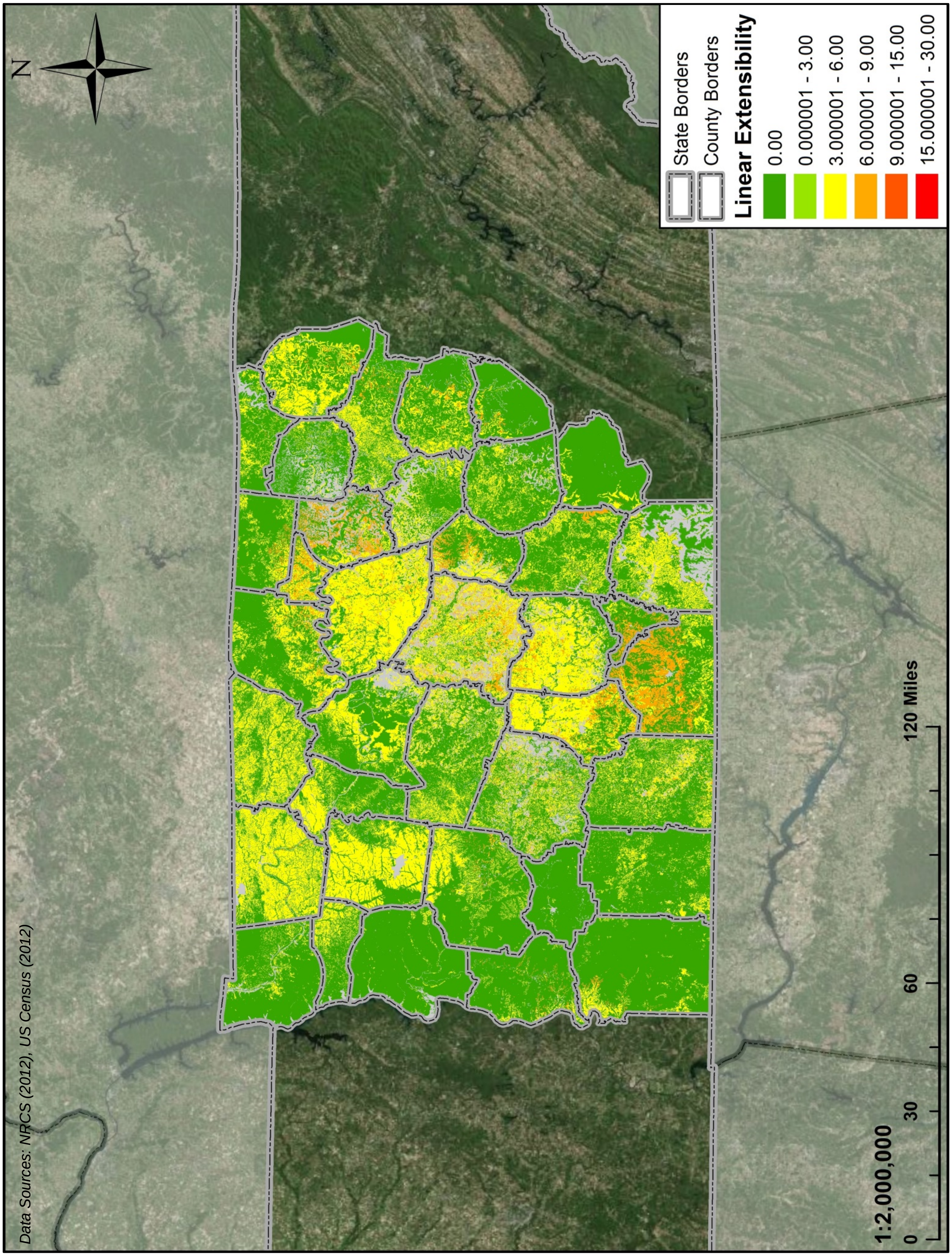
Each increase in linear extensibility increases the potential level of damage structures could incur. Ultimately, whether or not the soil swells or not is completely dependent on weather patterns. However, linear extensibility shows exactly how much swelling could occur and how bad it has the potential to be.

Maps 35 through 37 on the following pages depict the expansive soil risk throughout the State of Tennessee. The vast majority of the state is not threatened by expansive soil damage with small pockets existing throughout the state and some concentrations of high linear extensibility existing along the Mississippi River in the west.

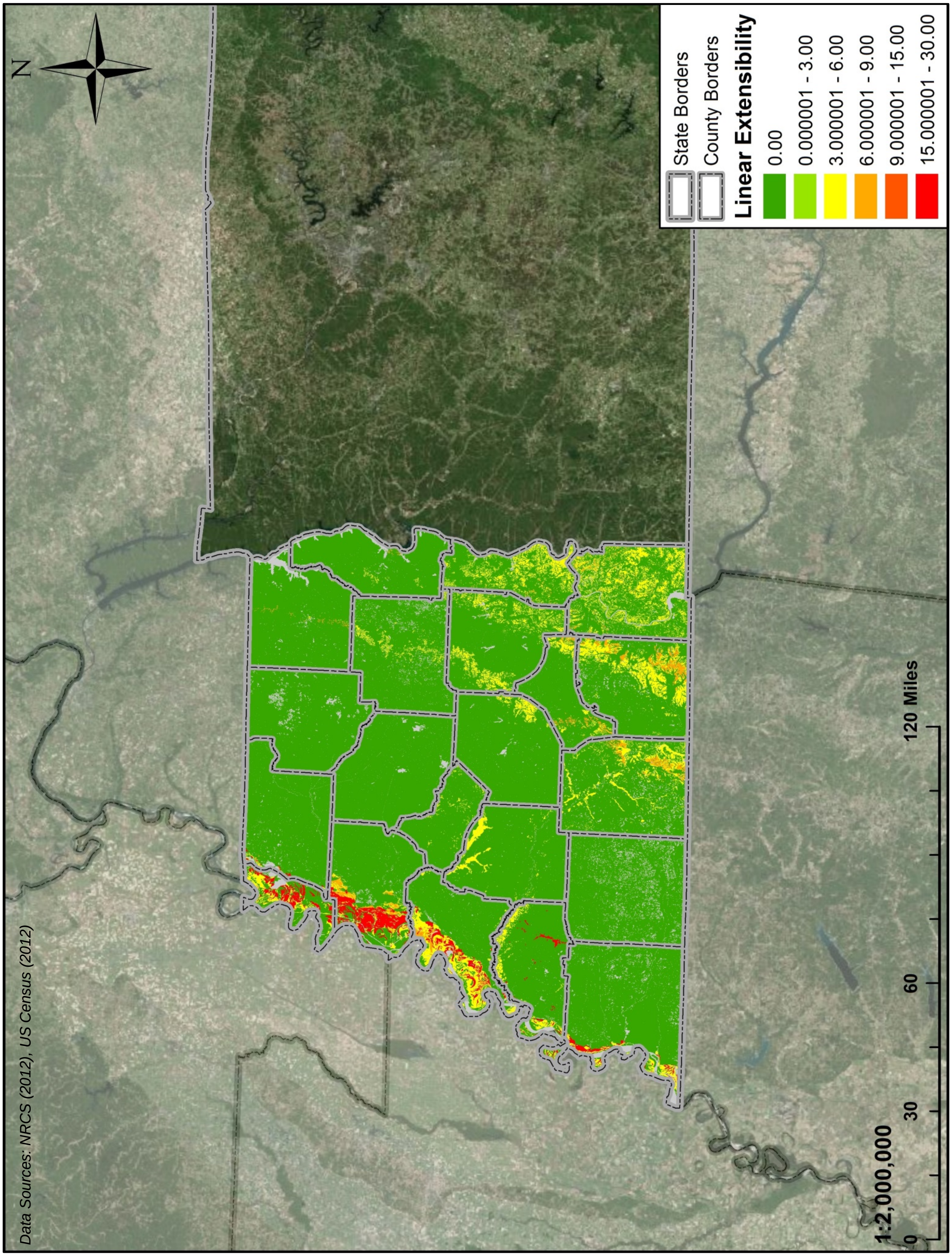
Map 35 – Linear Extensibility, East Tennessee



Map 36 – Linear Extensibility, Middle Tennessee



Map 37 – Linear Extensibility, West Tennessee



Land Subsidence/Sinkholes

Speed of onset of a landslide or sinkhole event is very rapid and unpredictable although broad areas susceptible to this type of hazard may be identified by soil samples and/or surrounding geological/riverine features. Measurement of this hazard is usually done in terms of yards of soil displaced and financial damage caused.

Land subsidence and sinkholes from human activity are results of pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydro compaction). Land subsidence occurs all over Tennessee and is usually not observable because it occurs over a large area.

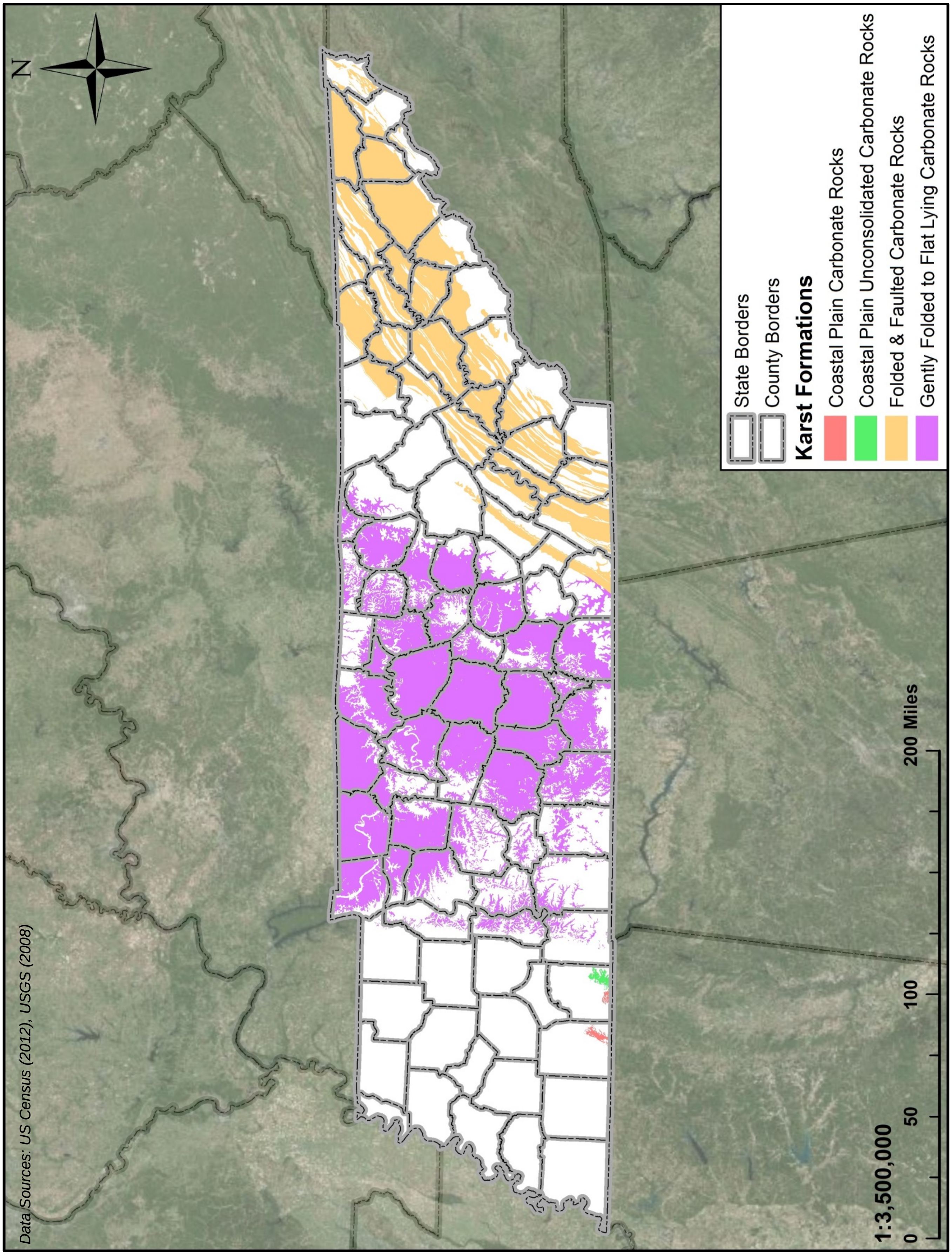
Land subsidence and sinkholes can occur naturally in parts of the country designated by rock formation as “Karst Formations.” It is difficult to accurately predict exactly where land subsidence and sinkholes will occur, but the USGS has managed to identify areas of Tennessee where there is potential, that being within the areas of Karst formations. It is extremely unlikely that a sinkhole will form in an area not considered a Karst formation.

Please see Map 38 on the following page for a depiction of Tennessee Karst Formations and the limited number of recorded land subsidence and sinkhole locations. There is no measurable difference in potential or probability among the different Karst formations. Their difference in color coding is simply to highlight other geological classifications.

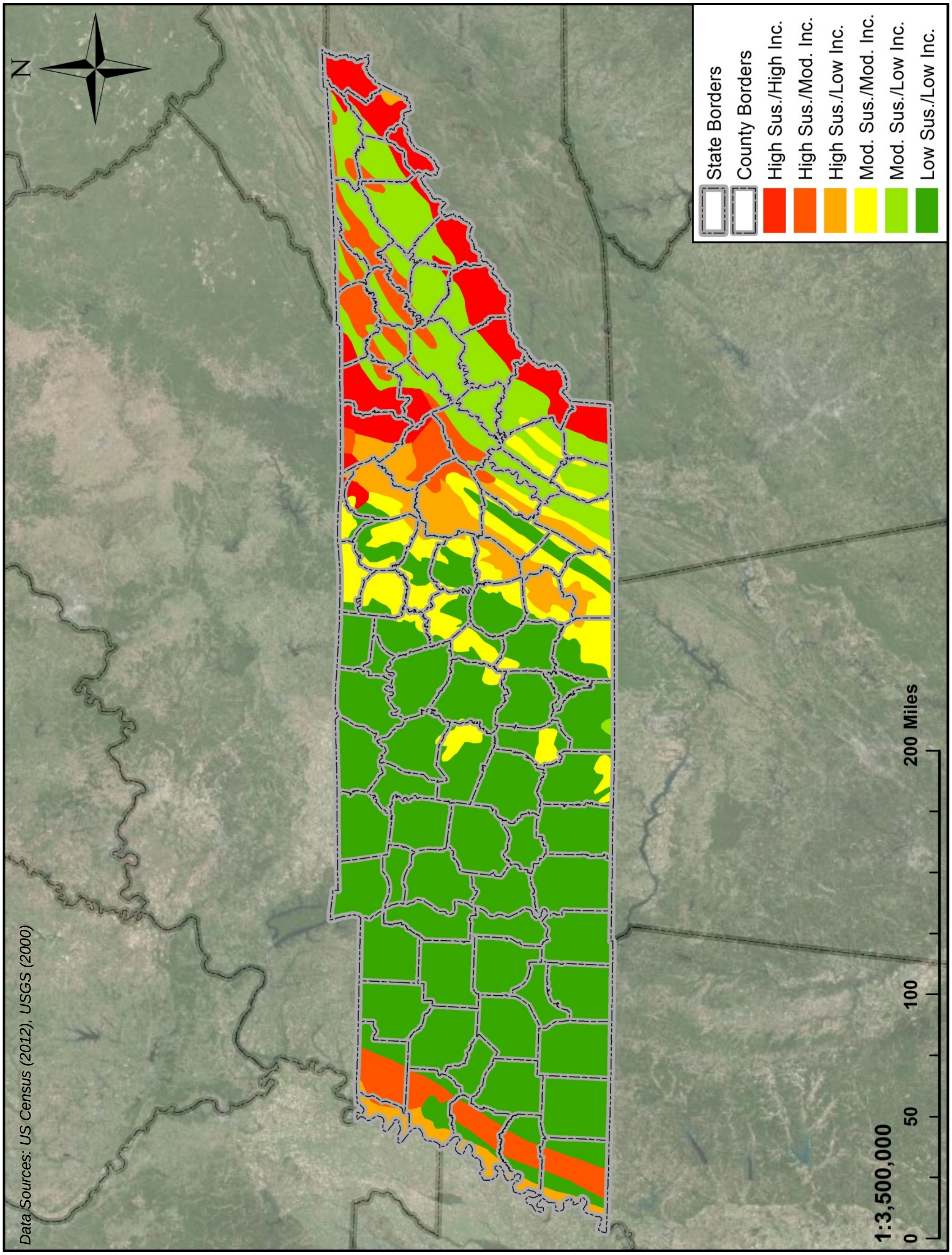
Landslides

Landslide potential varies throughout the state with Eastern Tennessee and some parts in the west along the Mississippi River having high threat areas. Landslides have the potential to destroy structures and infrastructure or block transportation in mountainous valleys. See Map 39 for a depiction of Tennessee’s landslide potential.

Map 38 – Karst Formations, Tennessee



Map 39 – Landslide Susceptibility, Tennessee



3.3.2 – Previous & Future Occurrences

At present there is no centralized and complete database containing historical records for expansive soils, land subsidence, or landslides. Where available this plan highlights historic hazard events, but does not contain a comprehensive database of these hazard events or impacts.

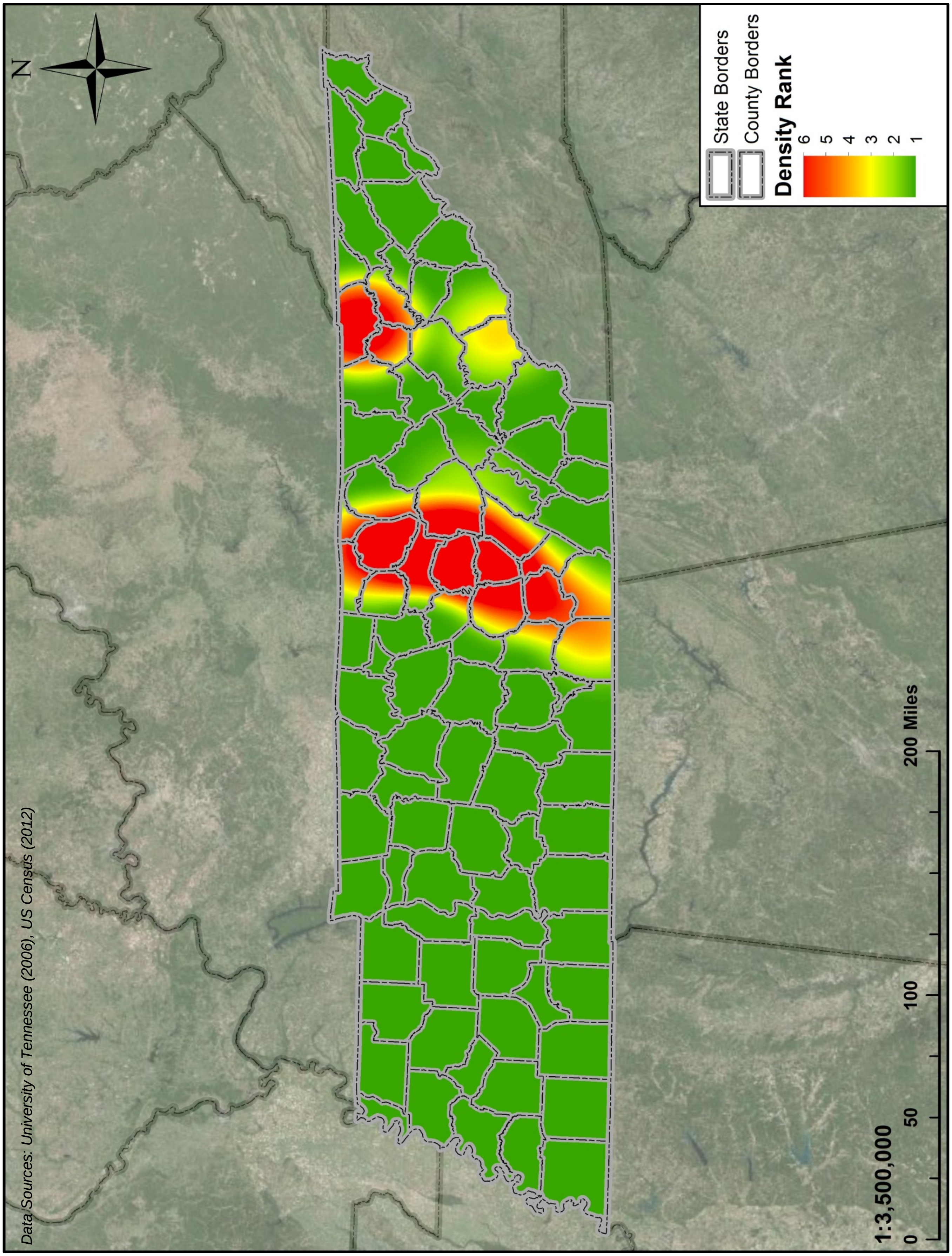
All 3 geologic hazards with the potential to affect the State of Tennessee are incredibly difficult to quantify and forecast. Instead of predicting the likelihood of an event, the hazard experts at the USGS and NRCS describe the hazards by their potential threat. Please see 3.3.1 – Location & Extent for maps depicting the geographic areas threatened by expansive soils, land subsidence, and landslides. Please see below a hazard specific description of forecasting difficulties.

Expansive Soils
Property damage caused by expansive soils is dependent on the climactic conditions of precipitation and rapid changes in temperature. Structures within an area with high swelling potential are at risk, but may never see damage from expansive soils.

Land Subsidence
Land subsidence and sinkholes form deep underground without knowledge or geologists or environmental engineers. Over time, based on empirical evidence, experts have isolated the geologic formations most likely to form land subsidence and sinkholes, but are unable to accurately predict specific formations. Further compounding the problem of depth, their formation begins with erosion on a micro scale. Map 40 on the following page depicts a limited dataset of only some of the few known land subsidence and sinkhole locations in Tennessee.

Landslides
Landslides occur on their own, but often occur as a secondary hazard. Incidents of heavy rain, melting snow, earthquakes, and land subsidence are their primary cause. Hence, their future occurrences are highly dependent on the likelihood of the mentioned hazards. There are identified high risk areas, as shown in 3.3.1 – Location & Extent, which take into account rock type, rock formation, and slope.

Map 40 – Land Subsidence & Sinkhole Impact Density, Tennessee



Historic Hazard Incident – Land Subsidence/Sinkhole – February 1999

A sinkhole caused a Colonial owned pipeline to rupture on February 9, 1999 in Knoxville, Tennessee. Roughly 53,550 gallons of diesel fuel, high sulfur, 86 Grade was released into the environment causing $7 million in damage. The leading edge of the oil slick on the Tennessee River advanced 6 miles downstream from Goose Creek within the first 24 hours. There were 44,016 gallons recovered from the river. About 18,000 tons of contaminated soil was excavated at the leak site during March and April.

Historic Hazard Incident – Landslide – December 2011

In December of 2011 a major rockslide blocked I-40 westbound in Cocke County between mile markers 450 and 451 near the North Carolina border. Another occurred in January of 2012 in the same location. A 53-mile detour was created to make up for the I-40 stretch. Eastbound traffic was not affected. Along with anchors and large bolts that bolster the stability of the mountainside, blankets of metal mesh were put in place to prevent smaller debris. The 2 rockslide repairs along I-40 cost more than $2.6 million.

Historic Hazard Incident – Landslide – January 2013

On January 17, 2013, a landslide measured at about 150 feet wide and extending 800 to 900 feet down the mountainside took place in Graham County, North Carolina, about a half mile from the Tennessee border. After heavy rain the landslide occurred closing the Cherohala Skyway. The western end of the roadway extended into southeast Knoxville and closed down the border. There were nearly 50 more slope failures on state-maintained roads extending into western North Carolina.

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

There are several different geological threats that may impact the health and safety of Tennessee residents. Sinkholes or caves, for example, may develop at any time, threatening lives and trapping people within the holes. While infrequent, landslides are more likely to occur, and bring with them their own hazards. Because they may happen without warning, landslides may kill and/or trap people suddenly. They may also damage utility lines and gas mains, putting residents at risk of electrical fires, carbon monoxide poisoning, and explosions.

Geologic events vary in degree of severity. Regarding sinkholes, once an incident has occurred, barring any injury or death that requires intervention, the known collapse site is avoided. Landslides, however, may require a different approach, as both the potential and risk for injury and/or death is greater. Educating the public on these hazards, including potential warning signs may limit the devastation. In addition, such education will provide individuals with an understanding of how to respond once a sinkhole or landslide has occurred.

Health and Safety of Personnel Responding to the Incident

The hazards faced by personnel will depend on the event they are responding to. The most likely hazards encountered when responding to a geologic event would be sub-surface or sub-strata instability. Sinkholes may continue to grow in both depth and circumference after the initial collapse, threatening the safety of those responding. Roadways may become blocked by landslides, making it difficult for first responders to reach the injured and trapped. Personnel responding to the incident may become injured themselves on any debris found in the area. In addition, any chemicals that may have leaked and/or gas pipes that may have broken can produce toxic fumes and possible explosions.

Although emergency personnel face health and safety risks when responding to various geological events, the State of Tennessee has policies and procedures in place to minimize the risks. Standard Incident Command System procedures require the incident commander to establish safe zones and staging areas for all personnel and assist essential personnel/contractors in and out of the cordoned area. A designated safety officer monitors the health of all responders during response activities. Any injured responders are immediately treated on site or evacuated to area clinics or hospitals, as the need requires. TEMA and other state agency personnel responding to the incident shall observe life safety and health standards and practices. Responders will be trained to the level necessary to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly address any hazards that may pose a threat.

Continuity of Operations

During a geologic event, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently may become compromised. Additionally, cascading events, such as power outages and water shortages, may develop, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensure that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, geologic events may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Commerce and Insurance, Department of Human Resources, Department of Environment and Conservation, Department of Financial Institutions, Department of

General Services, Department of Health, Department of Human Services, Department of Labor and Workforce Development, Department of Transportation, Department of Veterans Affairs, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Geologic hazards may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises to be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Geologic events may pose a threat to property, facilities, and infrastructure within the State of Tennessee. Sinkholes may occur beneath property, demolishing all or part of the building; they may also appear in the middle of a roadway, cutting off transportation routes. Karst topography poses a threat specifically to the state's infrastructure, creating the potential for weakened dams. Landslides are more likely to occur that sinkholes and Karst topography. They may be caused by human modifications of land, and can cause significant damage to roadways. The foundation of buildings may weaken. In addition, water may become contaminated, gas may leak, and power lines may break.

Expansive soils may over time damage the foundations and weaken the overall stability of a structure. Expansive soils, almost exclusively clay formations, exist sparingly throughout the state, but not in large areas. It takes many years or even decades for expansive soils to damage a structure to the point where it is not safe to inhabit. Additionally, when such a situation occurs the damage is physically obvious and easily identifiable.

The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities, and infrastructure due to geologic events. Roads are maintained through an annual system of scheduled surveys and preventive maintenance to not only monitor sub-strata activity, but also to prevent damage from landslides/subsidence. Proper land-use zoning and inspections can minimize the likelihood of geologic events. Potable water, wastewater treatment, telecommunications, and reinstatement of electricity are also accounted for in the state's plan for disasters.

Continued Delivery of Services

Historically, geologic events, such as landslides, and land subsidence, have not caused any services to be shut down for a large span of time. Most often, geologic events have resulted in alternate routing or the succession of state provided services. It is possible that geologic events may cause damage to water, sewage, and gas lines. Such damage would make it difficult to provide individuals with safe drinking water. Power lines might also be damaged, temporarily putting communities without power and making it difficult to maintain public services. Given the scope and magnitude of an event, provisions are in place for the continuity of operations. It is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours.

Environment

Geologic events can result in profound impacts, both lasting and temporary, on the environment. Landslides can alter the paths of rivers and streams creating serious impacts on water tables. They may grow in size as they travel, pulling down trees and boulders along the way. Collateral impacts are also possible as was the case in the Moccasin Bend oil pipeline disaster. Damaged ground and land erosion can alter the topography in such a way that flood plains are altered. Karst topography may produce significant changes in soil and rock formations, leading to the development of sinkholes and other geological events. As in many instances, the scope and magnitude of any geologic event will dictate the degree of impact on the environment.

Economic Condition

The economic and financial impacts of geologic events are largely based on the conditions of the impacted area and the magnitude of the event. While geologic events rarely create an economic strain for the State of Tennessee, a major event on Interstate 40 could have tremendous financial repercussions. East and west bound traffic would have to divert to alternate routing, substantially increasing delivery times and costs which would ultimately be passed on to the consumer. Costly damage, such as cracked or destroyed foundations may also be done to business establishments and private homes. Costly repairs to utility lines and power lines may also impact the state. Certain economic and financial impacts may diminish with the implementation of professional inspections and construction designs. Specific data regarding economic impact can be found in Economic Impact Assessments.

Public Confidence in the Jurisdiction's Governance

Improving the TEMP, identifying resources, and providing opportunities for educational and preparedness training serves to reassure the public of the State of Tennessee's abilities during a geologic event. In addition, the development of private, public, and non-profit partnerships/mutual aid agreements provides the state with immediate access to resources during response and recovery. In an effort to lessen the long-term impact on residents and property, mitigation strategies are developed. These strategies help determine the risks, reducing the potential consequences. The effectiveness of preparedness and mitigation activities helps determine the public's confidence in the state's ability to keep its residents safe,

Response and recovery efforts are the most visible part of emergency operations. The manner and efficiency in which a response to a disaster is conducted could result in the loss of confidence in the program and the government's ability to protect the citizenry. The faster personnel respond to the needs of citizens, the better the confidence level. The support services performed in the aftermath of an event can either strengthen or weaken the reputation of the program and the public's perception of the government's ability to provide services to people in time of need. Resources utilized at this time are also crucial, during both response and recovery. The state resources and capabilities that are expeditiously made available for the recovery process can maintain and strengthen the public's trust and confidence, lessening the impact on citizens.

3.3SS – Severe Storms

Severe storms comprise the hazardous and damaging weather effects often found in violent storm fronts. They can occur together or separate; they are common and usually not hazardous, but on occasion they can pose a threat to life and property.

This plan defines Severe Storms as a combination of the following severe weather events as defined by NOAA and the NWS.

Hail: Showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud.

High/Strong Wind: Sustained wind speeds of 40 miles per hour or greater lasting for 1 hour or longer, or winds of 58 miles per hour or greater for any duration. Often referred to as straight line winds to differentiate from rotating or tornado associated wind.

Lightning: A visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud.

Thunderstorm Winds: The same classification as high or strong winds, but accompanies a thunderstorm. It is also referred to as a straight line wind to differentiate it from rotating or tornado associated wind.

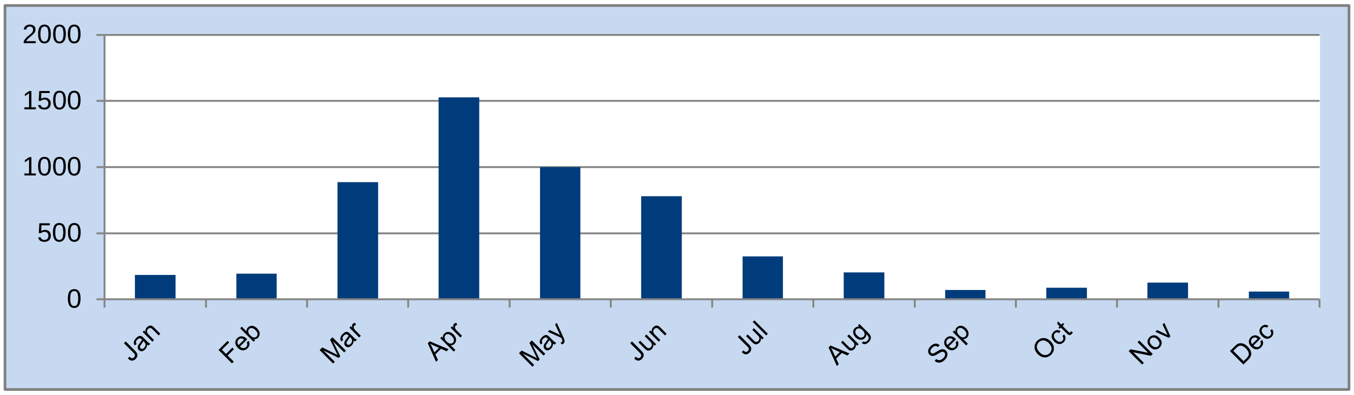
Winter Storm: Hazardous winter weather in the form of heavy snow, ice storms, heavy freezing rain, or heavy sleet. May also include extremely low temperatures and increased wind.

> ***Ice Storm:*** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater.
>
> ***Heavy Snow:*** This generally means snowfall accumulating to 4" or more in depth in 12 hours or less; or snowfall accumulating to 6" or more in depth in 24 hours or less. In forecasts, snowfall amounts are expressed as a range of values, e.g., "8 to 12 inches." However, in heavy snow situations where there is considerable uncertainty concerning the range of values, more appropriate phrases are used, such as "...up to 12 inches..." or alternatively "...8 inches or more."

Severe storms have been so consistent throughout modern history that much of the vulnerability is mitigated. However this section is not concerned with everyday wind, lightning in the sky, or mild precipitation. This section is concerned with common storm elements when they behave such that they pose a threat to property and life. This is what is classified as “severe.”

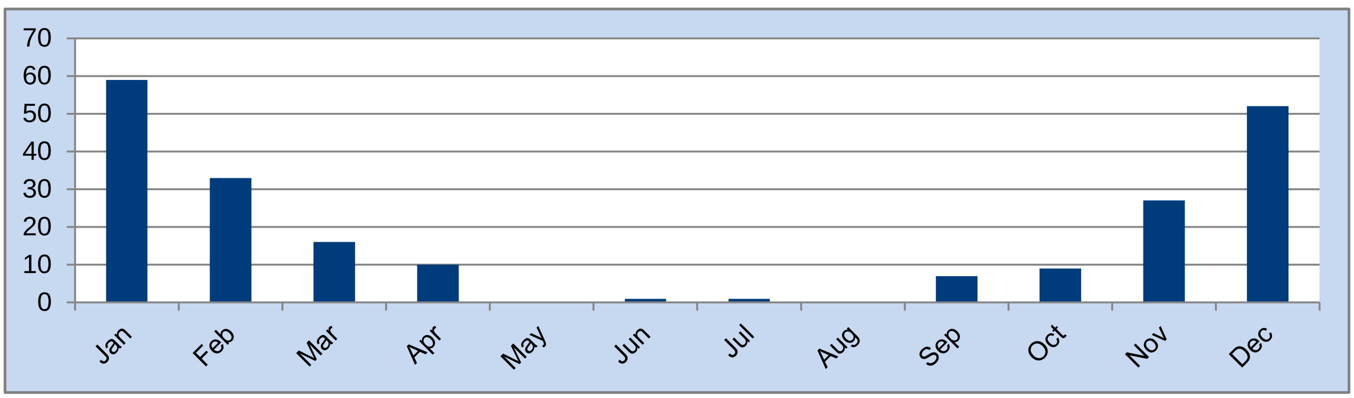
Charts 10 – 15 on the following 2 pages depict the seasonal tendencies of each type of severe storm.

Chart 10 – Hail Impacts by Month, Tennessee (1955 – 2012)



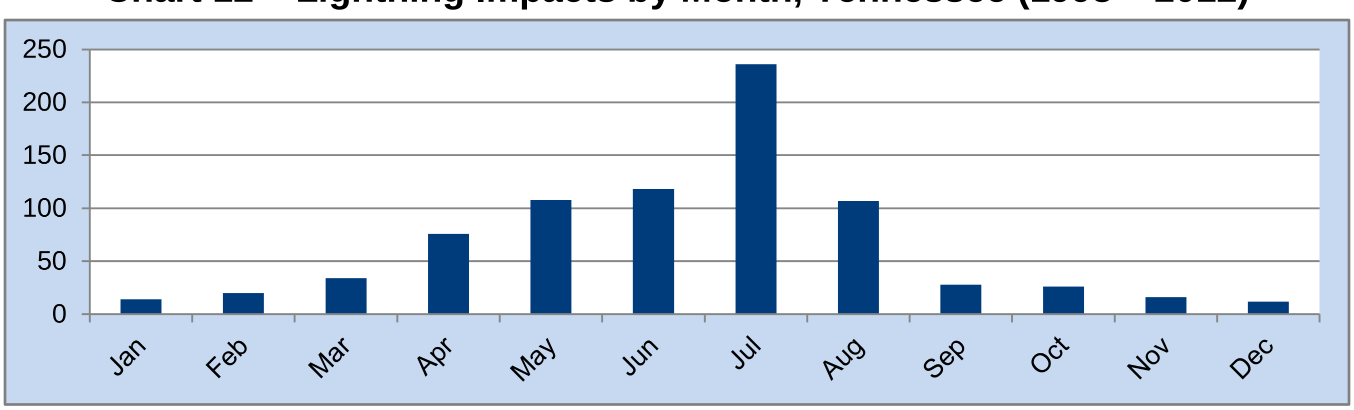
**The data are from the NOAA NCDC Storm Event Database.*

Chart 11 – High Wind Impacts by Month, Tennessee (1993 – 2012)



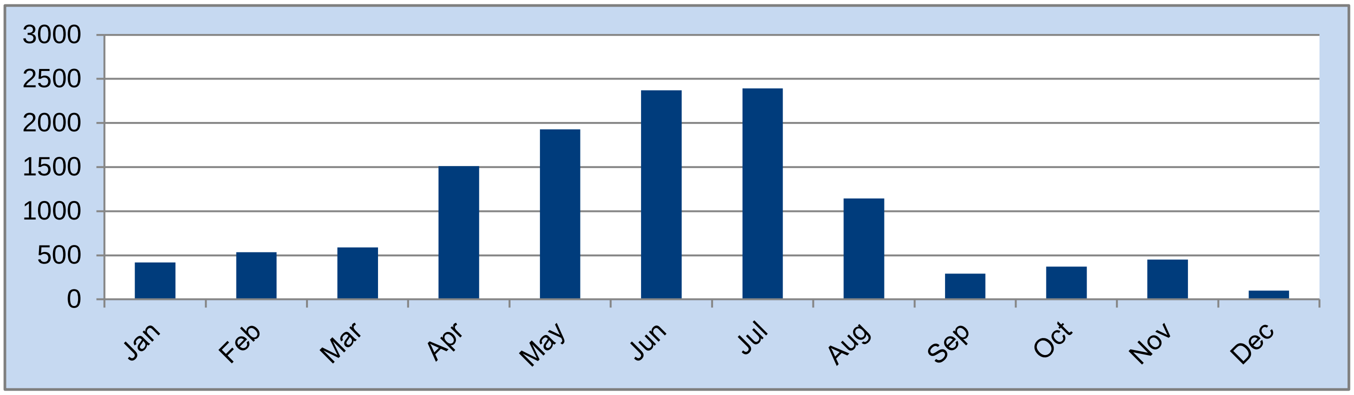
**The data are from the NOAA NCDC Storm Event Database.*

Chart 12 – Lightning Impacts by Month, Tennessee (1993 – 2012)



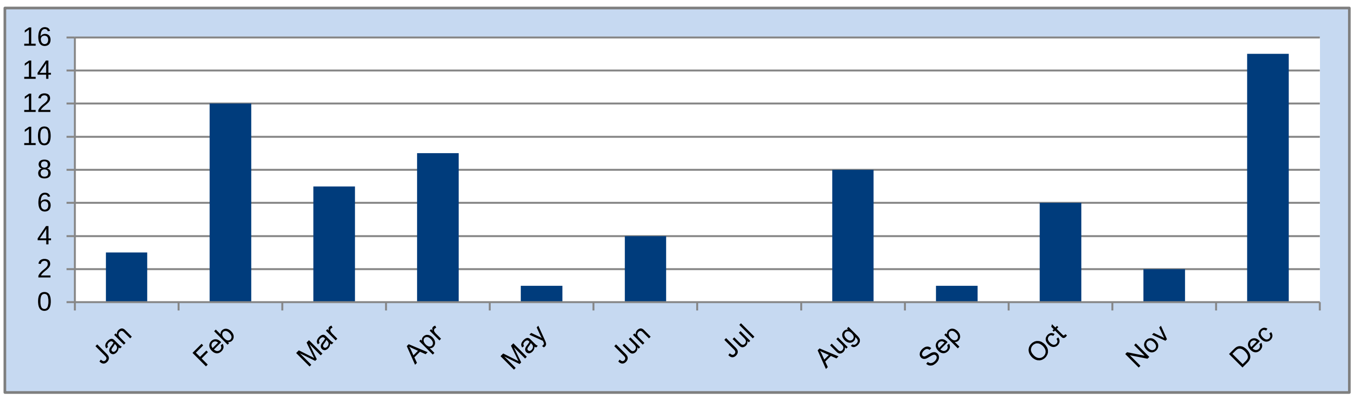
**The data are from the NOAA NCDC Storm Event Database.*

Chart 13 – Thunderstorm Wind Impacts by Month, Tennessee (1955 – 2012)



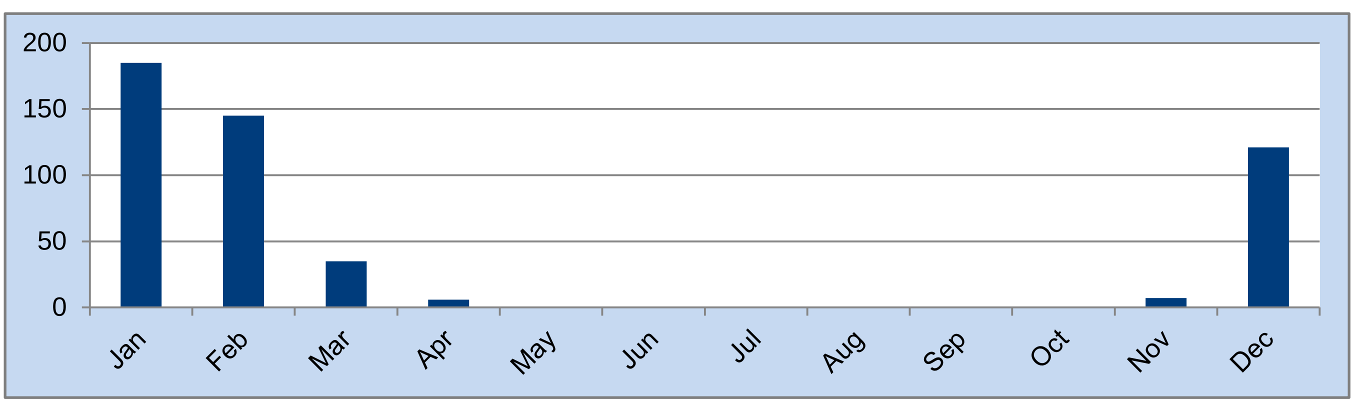
**The data are from the NOAA NCDC Storm Event Database.*

Chart 14 – Strong Wind Impacts by Month, Tennessee (1993 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 15 – Winter Storm Impacts by Month, Tennessee (1993 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

3.3.1 – Location & Extent

Severe storms can rapidly descend on an area but in many cases are predictable. Most weather forecasts focus on more than just temperature but on quickly changing conditions that may lead to the onset of severe storms.

The entire state is susceptible to severe weather as Tennessee is located in a temperate climate zone. Snow and ice can occur in Memphis and wind events can occur in the eastern, more mountainous sections. However, the greatest number of occurrences of winter storms occurs in the eastern half of the state as the elevation steadily increases from Nashville to the eastern border with North Carolina. Winter storms, while always dangerous, range from being a nuisance for transportation in the middle part of the state to being life threatening in the eastern part of the state.

Lightning strikes occur far more time than they are reported to NOAA and the NWS and as such their impact density centers on highly populated areas.

Severe storm wind events more commonly impact the eastern part of the state as the topography begins to affect the wind speed accompanying severe storms. These storms can quite frequently be threatening to life and property and are very dangerous as many occur at night after the area has been heated all day. Additionally, the state sits in a position where cold northern air and warm, moist air from the Gulf of Mexico collide frequently.

To measure wind speed and its correlating potential for damage, experts use the Beaufort scale as shown on the following page. Neither lightning nor winter storms have a measurement unto their own. Snow accumulation from winter storms is measured in inches while NOAA has developed the hailstorm intensity index, shown in Table 31, to match hail size and their likely damage impacts.

Table 30 – Beaufort Scale

Beaufort Scale

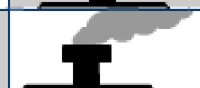
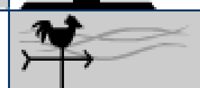
Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Table 31 – Modified NOAA/TORRO Hailstorm Intensity Scale				
Code	**Intensity Category**	**Diameter (Inches)**	**Approximate Size**	**Typical Damage Impacts**
H0	Hard Hail	0 - 0.33	Pea	No damage
H1	Potentially Damaging	0.33 - 0.60	Marble/Mothball	Slight damage to crops
H2	Potentially Damaging	0.60 - 0.80	Dime/Grape	Significant damage to crops
H3	Severe	0.80 - 1.20	Nickel to Quarter	Severe damage to crops, damage to glass and plastic, paint and wood scored
H4	Severe	1.20 - 1.60	Half Dollar	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.60 - 2.00	Silver Dollar to Golf Ball	Damage to tiled roofs, significant risk of personal injury.
H6	Destructive	2.00 - 2.40	Egg	Aircraft bodywork dented, brick walls pitted
H7	Very Destructive	2.40 - 3.00	Tennis Ball	Severe roof damage, risk of serious injuries to persons not protected
H8	Very Destructive	3.00 - 3.50	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.50 - 4.00	Grapefruit	Extensive structural damage, risk of severe injury or fatal injuries to persons not protected
H10	Super Hailstorms	4.00 +	Softball and up	Extensive structural damage, risk of severe injury or fatal injuries to persons not protected

3.3.2 – Previous & Future Occurrences

Since 1955, NOAA has recorded 5,443 hail impacts and 12,104 thunderstorm wind impacts in the State of Tennessee. Tennessee has experienced 0 deaths and 0 injuries relating to hail activity while it has experienced 17 deaths and 264 injuries relating to thunderstorm wind activity. Hail events have cost Tennesseans $15,425,600 in property damage and $888,000 in crop damage. Thunderstorm wind events have cost Tennesseans $201,775,630 in property damage and $9,789,500 in crop damage.

Based on NOAA's data, hail in Tennessee can be anywhere from 0.75 to 4.0 inches in diameter, cost up to $5,000,000 in property damage and $400,000 in crop damage in 1 impact. The average hail impact will yield hail 1.52 inches in diameter, cause $2,834 in property damage, cause $164 in crop damage, kill 0 people, and injure 0 people.

Based on NOAA's data, thunderstorm winds in Tennessee can blow anywhere from 45 to 85 miles per hour, cost up to $40,000,000 in property damage, $80,000 in crop damage in 1 impact. The average thunderstorm wind event will blow at 54.96 miles per hour, cause $16,666 in property damage, $809 in crop damage, kill 0.001 people, and injure 0.022 people.

Table 32 – Historical Impacts, Hail & Thunderstorm Winds (1955 – 2012)

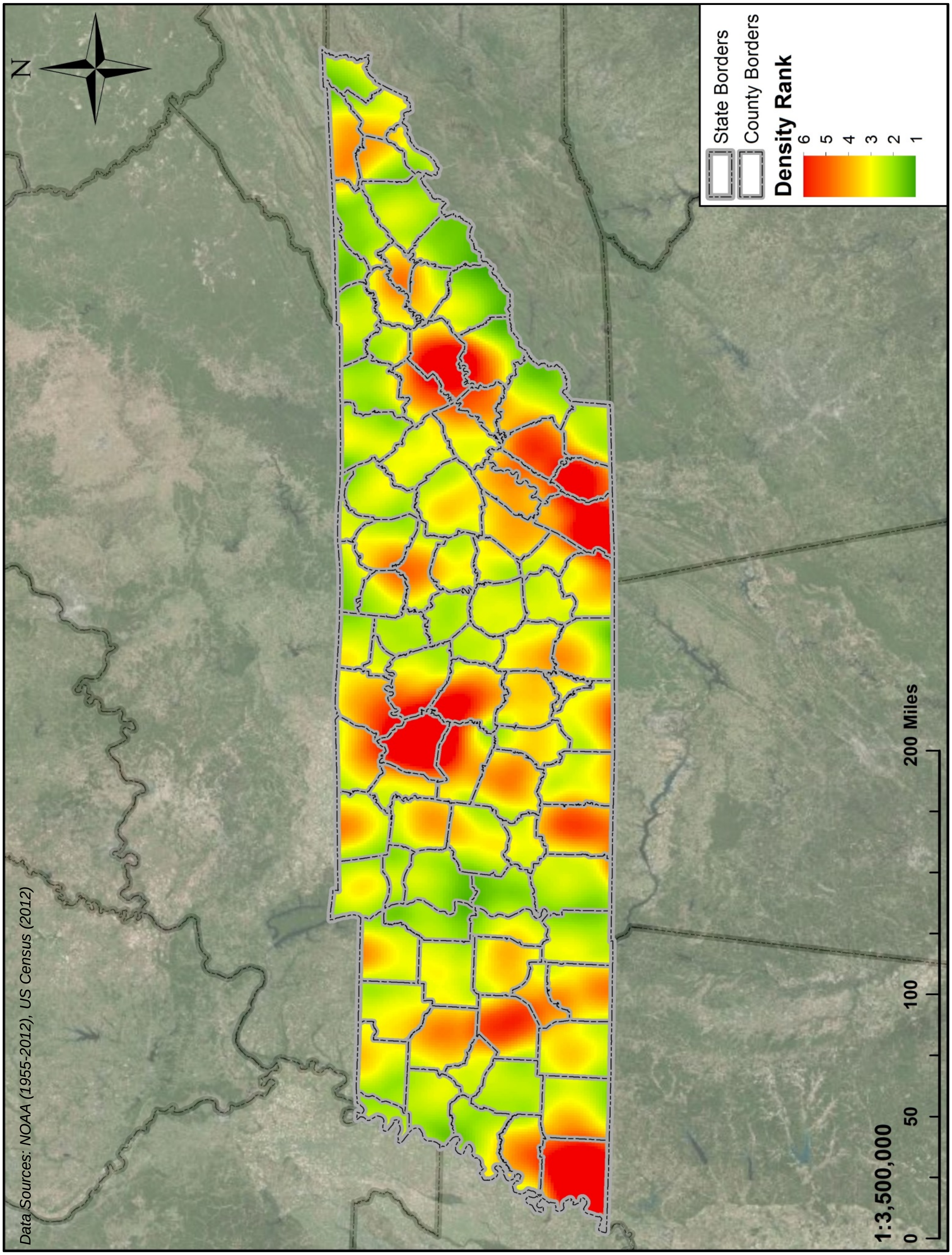
	Hail	Thunderstorm Winds
Count of Impacts	5443	12,104
Impacts Per Year	95.49	208.74
Average Magnitude (Inches/MpH)	1.52	54.96
Magnitude Range (Inches/MpH)	0.75 - 4.0	45 - 85
Average Cost	$2,834	$16,666
Magnitude of Cost	$0 - $5,000,000	$0 - $40,000,000
Total Recorded Cost	$15,425,600	$201,775,630
Average Crop Damage	$163	$809
Magnitude of Crop Damage	$0 - $400,000	$0 - $80,000
Total Crop Damage	$888,000	$9,789,500
Average Fatalities	0	0.001
Total Fatalities	0	17
Average Injuries	0	0.022
Total Injuries	0	264

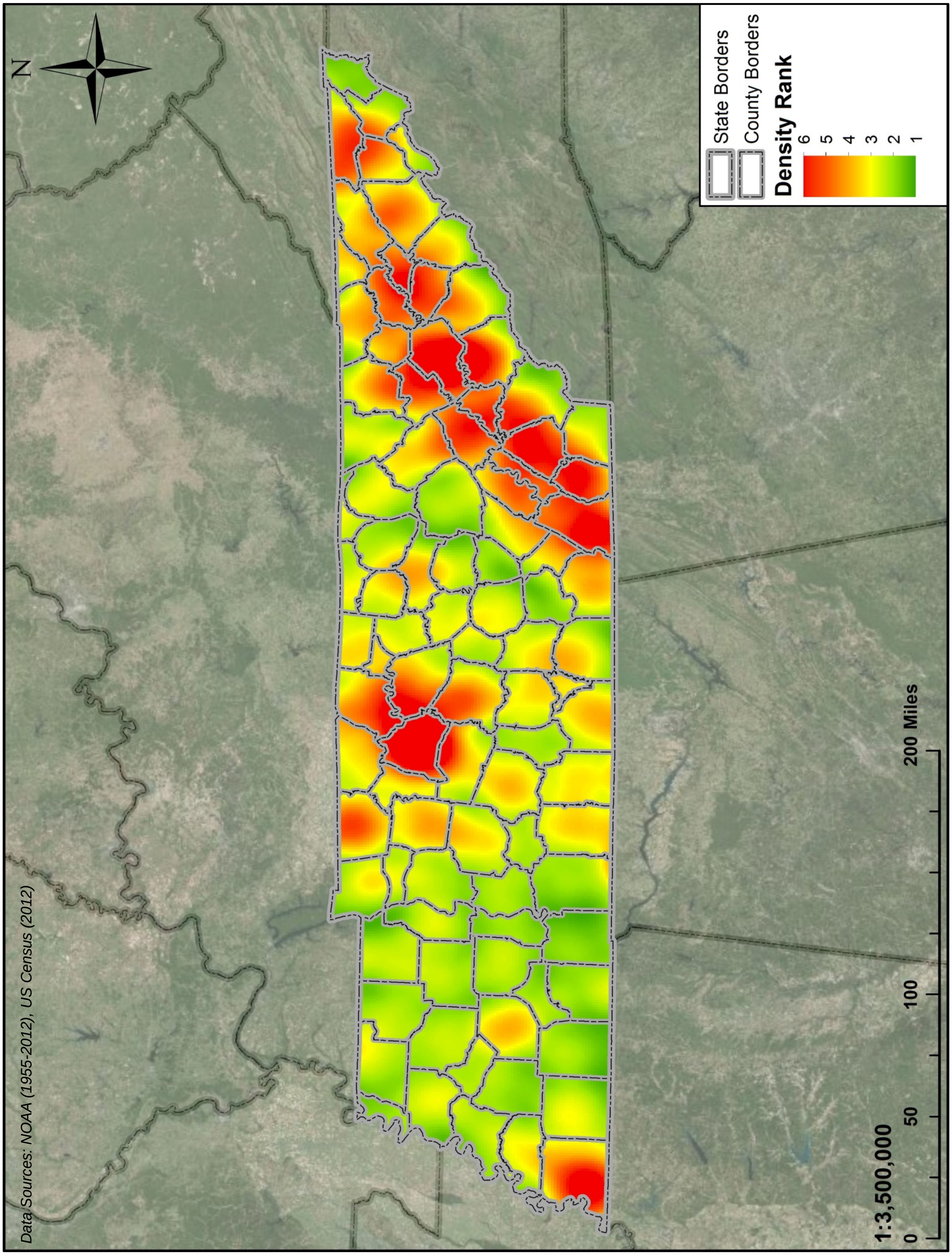
**The data are compiled from the NOAA NCDC Storm Event Database.*

Data Deficiency

NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.

Map 41 – Hail Impact Density, Tennessee





Map 42 – Thunderstorm Wind Impact Density, Tennessee

Since 1993 (for high winds) and 2003 (for strong winds), NOAA has recorded 215 high wind impacts and 68 strong wind impacts in the State of Tennessee. Tennessee has experienced 0 deaths and 0 injuries relating to high wind activity while it has experienced 4 deaths and 3 injuries relating to strong wind activity. High wind events have cost Tennesseans $22,266,250 in property damage and $0 in crop damage. Strong wind events have cost Tennesseans $907,000 in property damage and $25,000 in crop damage.

Based on NOAA's data, high winds in Tennessee can blow anywhere from 35 to 83 miles per hour, cost up to $2,000,000 in property damage, $0 in crop damage in 1 impact. The average high wind event will blow at 45.73 miles per hour, cause $103,564 in property damage, $0 in crop damage, kill 0 people, and injure 0 people.

Based on NOAA's data, strong winds in Tennessee can blow anywhere from 31 to 65 miles per hour, cost up to $70,000 in property damage, $20,000 in crop damage in 1 impact. The average strong wind event will blow at 41.83 miles per hour, cause $13,338 in property damage, $368 in crop damage, kill 0.06 people, and injure 0.04 people.

Table 33 – Historical Impacts, High & Strong Winds (1993/2003 - 2012)

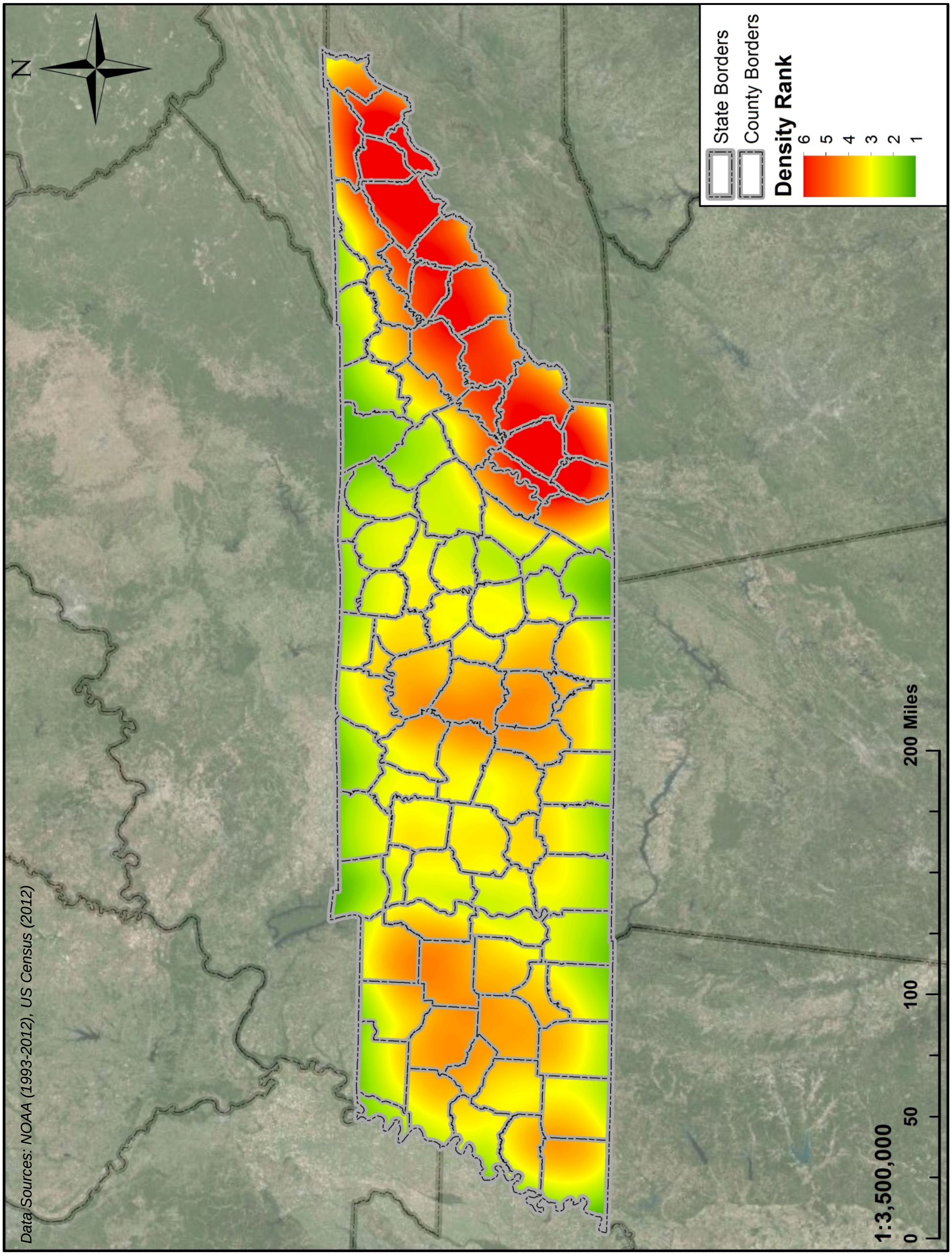
	High Winds	Strong Winds
Count of Impacts	215	68
Impacts Per Year	10.75	6.8
Average Magnitude (MpH)	45.73	41.83
Magnitude Range (MpH)	35 - 83	31 - 65
Average Cost	$103,564	$13,338
Magnitude of Cost	$0 - $2,000,000	$0 - $70,000
Total Recorded Cost	$22,266,250	$907,000
Average Crop Damage	$0	$368
Magnitude of Crop Damage	$0 - $0	$0 - $20,000
Total Crop Damage	$0	$25,000
Average Fatalities	0	0.06
Total Fatalities	0	4
Average Injuries	0	0.04
Total Injuries	0	3

**The data are compiled from the NOAA NCDC Storm Event Database.*

Data Deficiency

NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.

Map 43 – High & Strong Wind Impact Density, Tennessee



Since 1993, NOAA has recorded 795 lightning impacts and 499 winter storm impacts in the State of Tennessee. Tennessee has experienced 38 deaths and 214 injuries relating to lightning activity while it has experienced 5 deaths and 20 injuries relating to winter storm activity. Lightning events have cost Tennesseans $48,165,240 in property damage and $92,000 in crop damage. Winter storm events have cost Tennesseans $11,338,350 in property damage and $5,000,000 in crop damage.

Based on NOAA's data, lightning in Tennessee can cost up to $6,000,000 in property damage and $30,000 in crop damage in 1 impact. The average lightning impact cause $60,585 in property damage, cause $116 in crop damage, kill 0.0478 people, and injure 0.2692 people.

Based on NOAA's data, winter storms in Tennessee can cost up to $5,000,000 in property damage, and $5,000,000 in crop damage in 1 impact. The average winter storm event will cause $22,722 in property damage, $10,020 in crop damage, kill 0.01 people, and injure 0.04 people.

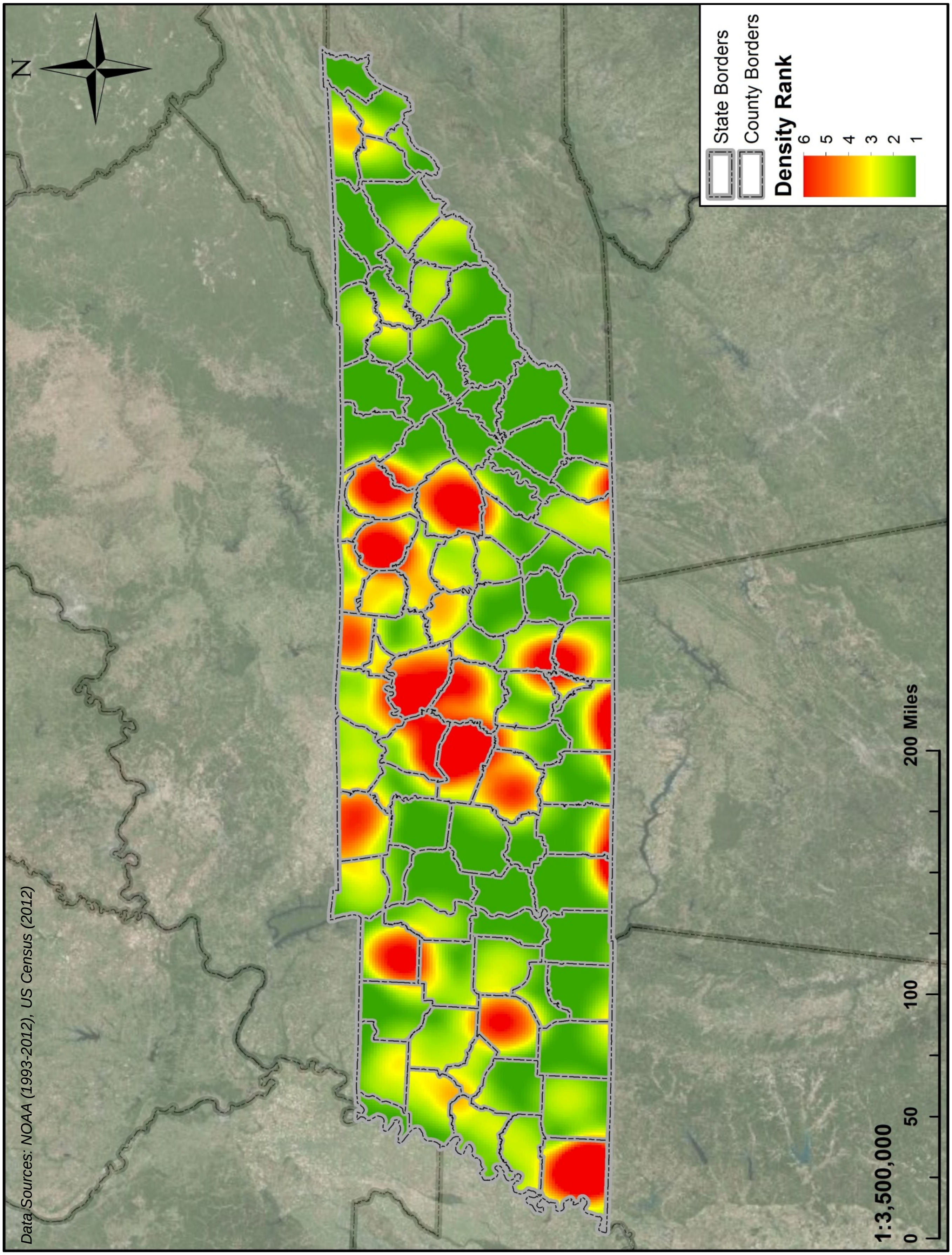
Table 34 – Historical Impacts, Lightning & Winter Storms (1993 – 2012)

	Lightning	Winter Storms
Count of Events	795	499
Events Per Year	39.75	24.95
Average Magnitude	-	-
Magnitude Range	-	-
Average Cost	$60,585	$22,722
Magnitude of Cost	$0 - $6,000,000	$0 - $5,000,000
Total Recorded Cost	$48,165,240	$11,338,350
Average Crop Damage	$116	$10,020
Magnitude of Crop Damage	$0 - $30,000	$0 - $5,000,000
Total Crop Damage	$92,000	$5,000,000
Average Fatalities	0.0478	0.01
Total Fatalities	38	5
Average Injuries	0.2692	0.04
Total Injuries	214	20

**The data are from the NOAA NCDC Storm Event Database*

Data Deficiency

NOAA's methodologies and recording practices have changed over the period of some of the following datasets. For instance, one may notice a sharp increase in the recorded impacts for hail and thunderstorm winds in the middle 1990s. This is not due to an increase in hail or thunderstorm wind impacts, but instead is a result of a change of policy for NOAA. During this time period they altered their recording process from county based to city and town based. This does not skew the number of fatalities, injuries, recorded magnitudes, or damage numbers as these would have simply been aggregated at the county level.



Map 44 – Lightning Impact Density, Tennessee

Map 45 – Winter Storm Impact Density, Tennessee

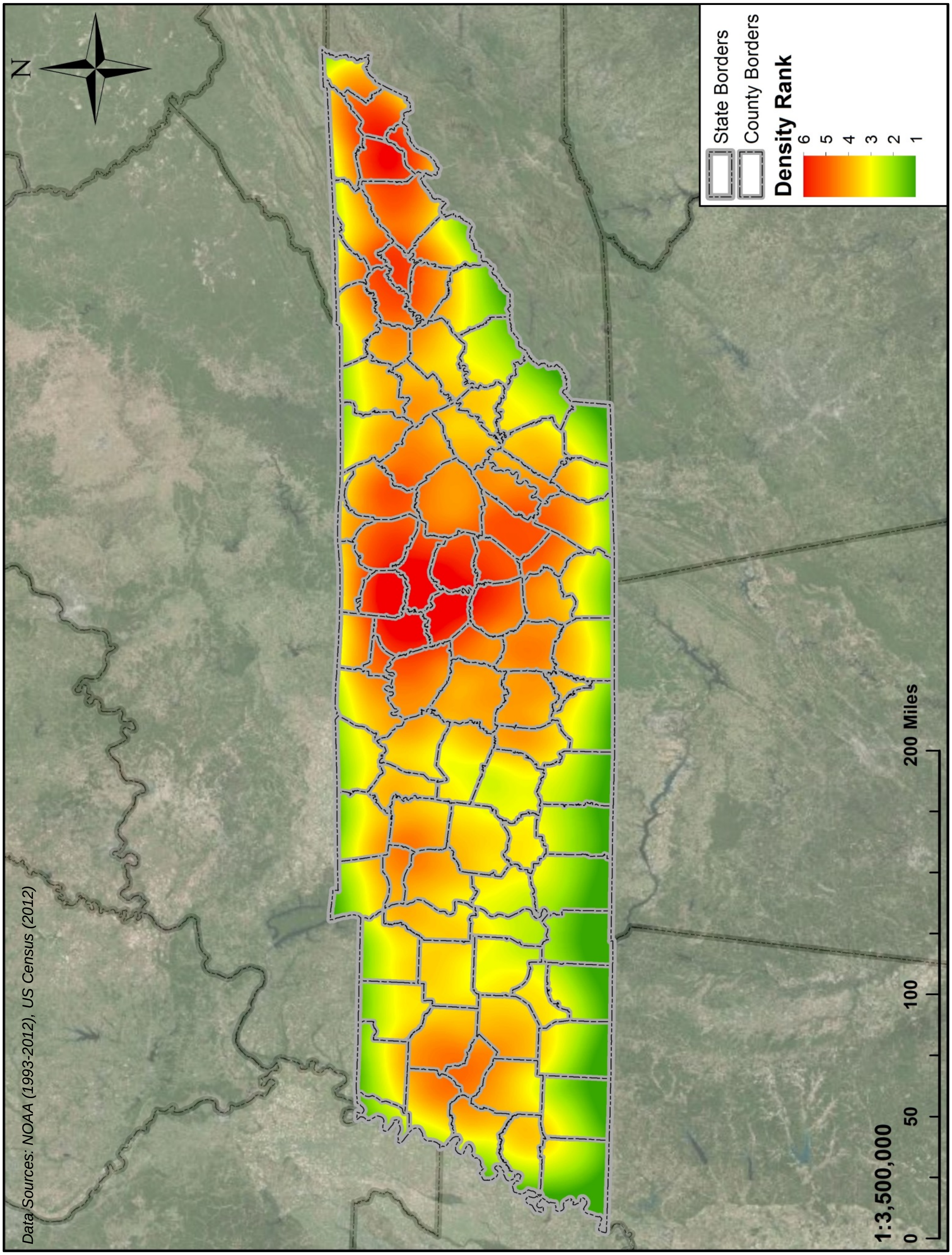
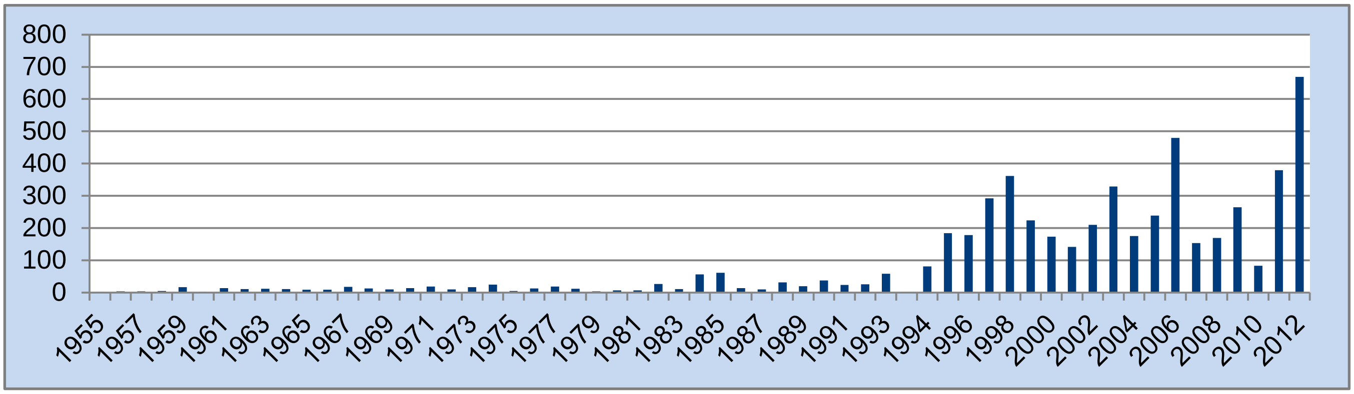
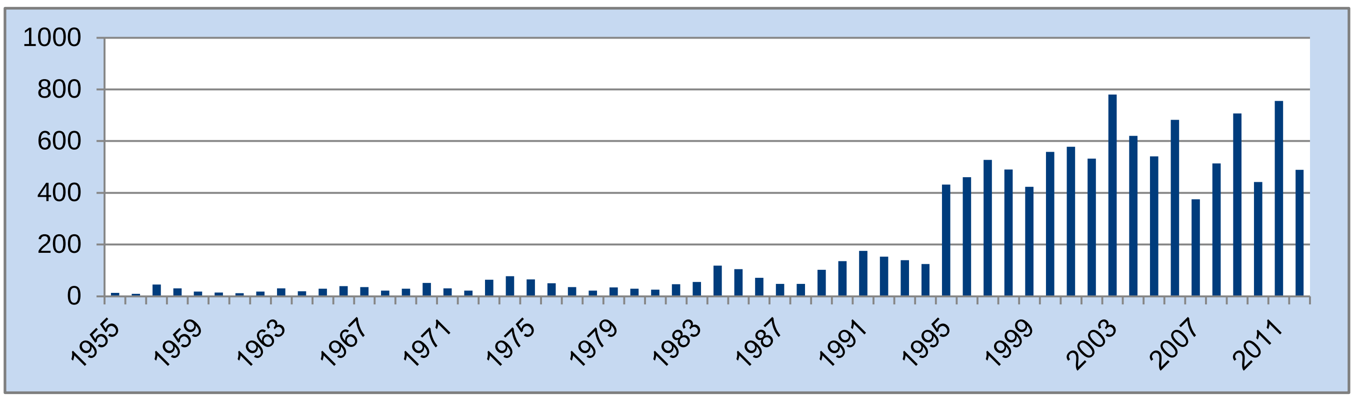


Chart 16 – Hail Impacts by Year, Tennessee (1955 – 2012)



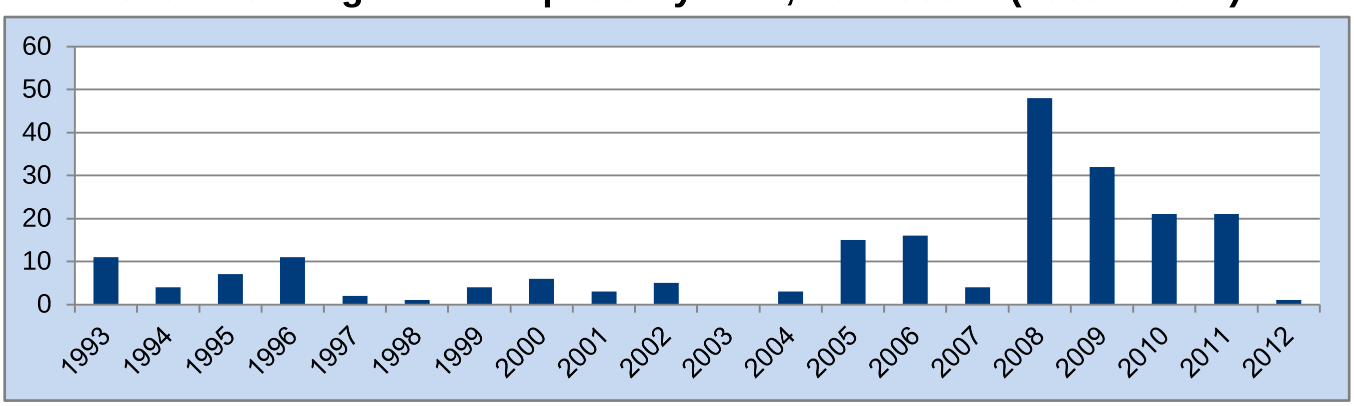
**The data are from the NOAA NCDC Storm Event Database.*

Chart 17 – Thunderstorm Wind Impacts by Year, Tennessee (1955 – 2012)



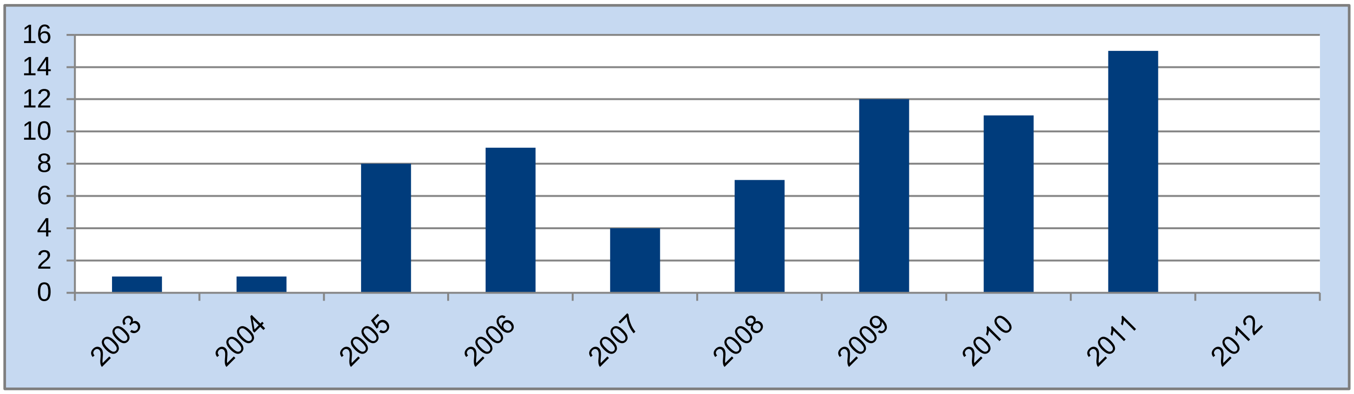
**The data are from the NOAA NCDC Storm Event Database.*

Chart 18 – High Wind Impacts by Year, Tennessee (1955 – 2012)



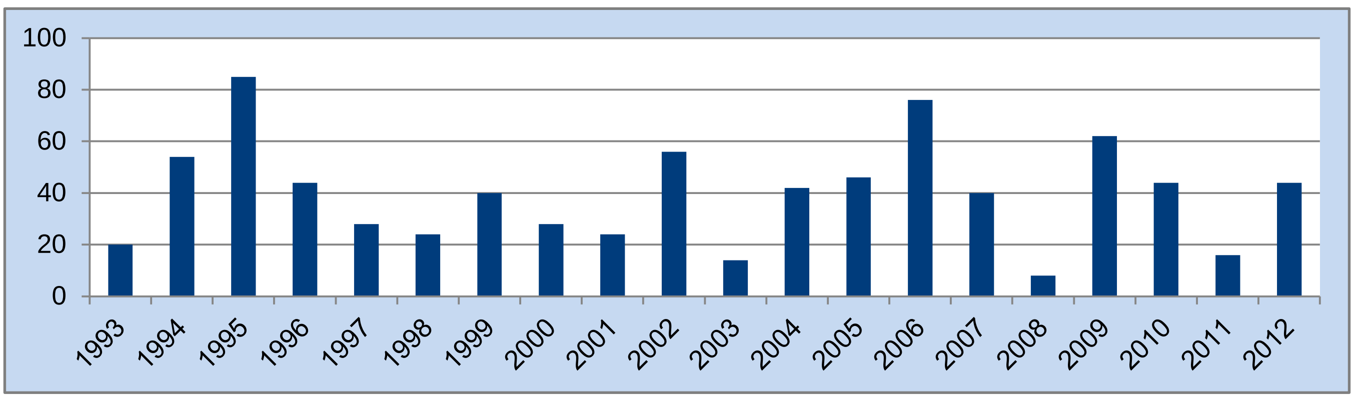
**The data are from the NOAA NCDC Storm Event Database.*

Chart 19 – Strong Wind Impacts by Year, Tennessee (1955 – 2012)



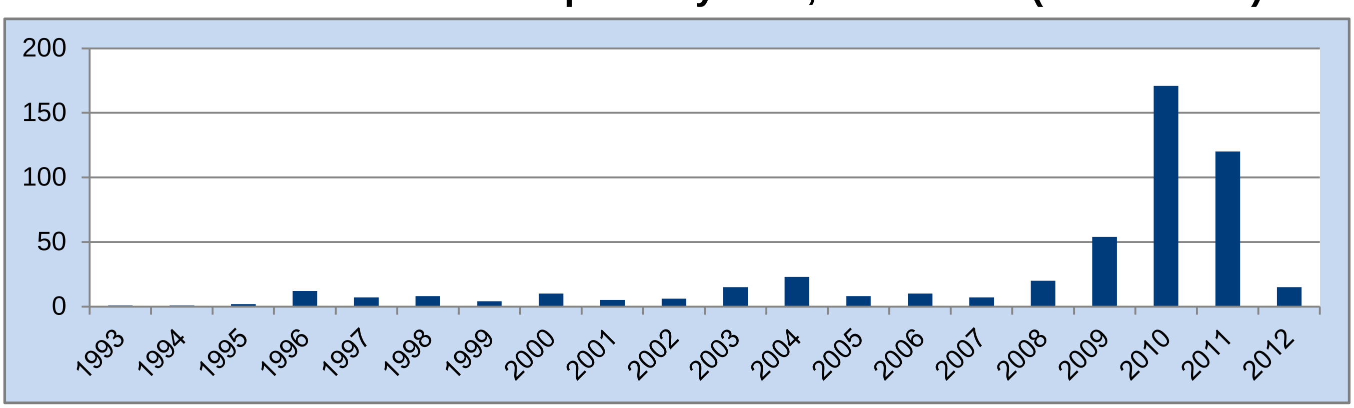
**The data are from the NOAA NCDC Storm Event Database.*

Chart 20 – Lightning Impacts by Year, Tennessee (1955 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

Chart 21 – Winter Storm Impacts by Year, Tennessee (1993 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

Historic Hazard Event – Winter Storm – January 1951

The worst ice storm in the history of Nashville, Tennessee occurred on January 29, 1951 and ended February 1, 1951. To this day it is known as the "Great Blizzard." A strong cold front moved through Nashville on the 28th causing temperatures to drop below freezing. On February 2nd the temperature dropped to negative 10 degrees Fahrenheit. The storm caused a complete shutdown of transportation for 2 days. By the end of it Nashville was buried under 8 inches of ice and snow.

Power failures affected the entire area. Over 16,000 homes and 80,000 residents were without electricity, and over 2,000 telephones were out. Transportation and communication systems alone were more than $2 million in damages. There were 2 fatalities in weather-related car crashes and dozens of other injuries. Roofs collapsed from the weight of snow and ice, hundreds of automobiles were abandoned, and thousands of trees had to be cleared from the roads. Not 1 business was open for 3 days. Eastern Air Lines canceled flights for 3 days, and Louisville & Nashville Railroad trains were up to 2 days behind schedule.

When the storm cleared, thousands of residents took to the streets creating what is still considered the worst traffic jam in Nashville's history. Some of these traffic jams were up to 5 miles long and clogged the main streets leading downtown. The ice and snow did not completely melt until February 12th.

Historic Hazard Incident – Winter Storm – January 1963

On New Year's Eve of 1963 a winter storm swept through most of the southern United States. The storm formed when a surface low-pressure system moved northward through the eastern Gulf of Mexico, leading to a snowstorm from the central Gulf Coast northward into Tennessee. The storm resulted in 3 fatalities. Travel was severely restricted for multiple days following the storm. Central and eastern sections of the state recorded over 6 inches of snow, with up to 16 inches in south-central Tennessee at Lawrenceburg. Several boats and docks were sunk, power and telephone lines collapsed overloaded with snow.

Historic Hazard Incident – Winter Storm – March 1993

One of the largest and intense winter storms in a century hit the south on March 12-14, 1993. Severe cold following the storm preserved much of the snow, prolonging road closures. High wind and heavy, wet snow brought down thousands of miles of power lines leaving millions of people without power for up to a week for some. Wind gusts were measured as high as 99 mph. Along with heavy snow fall, Tennessee and Ohio Valleys were hit by a tornado outbreak. Florida received the worst of the outbreak with 27 tornadoes touching down resulting in 4 fatalities.

The state can expect a hail impact with a probability of 9522.81% per year or 95.2281 impacts per year while it can expect a lightning impact with a probability of 3553.55% per year or 35.5455 impacts per year and it can expect a winter storm impact with a probability of 2495.00% per year or 24.95 impacts per year.

Table 35 – Impact Probability, Hail, Lightning, & Winter Storms

Impact Year	Count of Impacts		
	Hail	Lightning	Winter Storms
1955 - 1959	31	-	-
1960 - 1969	108	-	-
1970 - 1979	133	-	-
1980 - 1989	241	-	-
1990 - 1999	1,462	294	44
2000	172	27	9
2001	140	23	5
2002	209	55	6
2003	328	13	14
2004	174	41	25
2005	238	45	8
2006	481	75	10
2007	152	39	7
2008	168	8	19
2009	263	61	53
2010	82	43	170
2011	378	15	119
2012	668	43	1
Total Years =	57	22	20
Total Recorded Impacts =	5428	782	499
Yearly Probability =	**9522.81%**	**3554.55%**	**2495.00%**

**The data are compiled from the NOAA NCDC Storm Event Database*

The state can expect a high wind impact with a probability of 1075.00% per year or 10.7500 impacts per year while it can expect a strong wind impact with a probability of 680.00% per year or 6.8000 impacts per year and it can expect a thunderstorm wind impact with a probability of 20868.97% per year or 208.6897 impacts per year.

Table 36 – Impact Probability, High, Strong & Thunderstorm Winds

Impact Year	Count of Impacts		
	High Wind	Strong Wind	Thunderstorm Wind
1955 - 1959	-	-	117
1960 - 1969	-	-	248
1970 - 1979	-	-	453
1980 - 1989	-	-	650
1990 - 1999	40	-	3061
2000	6	-	559
2001	3	-	578
2002	5	-	532
2003	0	1	780
2004	3	1	621
2005	15	8	541
2006	16	9	682
2007	4	4	375
2008	48	7	514
2009	32	12	707
2010	21	11	442
2011	21	15	755
2012	1	0	489
Total Years =	20	10	58
Total Recorded Impacts =	215	68	12104
Yearly Probability =	**1075.00%**	**680.00%**	**20868.97%**

**The data are compiled from the NOAA NCDC Storm Event Database*

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

The health and safety of persons affected by severe storms will vary. Historical data suggests that severe storms have the potential of causing minimal to devastating damage to an area, as well as hundreds of injuries and even death. Populations affected by severe storms are dependent on its mass and strength at the time of impact. Severe storms can bring heavy rain, strong winds, hail, lightning, heavy snow accumulation, ice, ice storms, and flash flooding. Gas leaks, water and sewage leaks, and broken power lines are also hazards associated with severe storms, causing the potential for carbon monoxide poisoning, electric shock, fires, explosions, and contaminated water supplies. Education, awareness, and drills can prepare residents for severe storms before they strike.

Health and Safety of Personnel Responding to the Incident

In an effort to minimize injury and loss of life, TEMA and other state agency personnel responding to the incident shall observe life safety/health standards and practices. Personnel responding will utilize intelligence gathered from local responders to properly address any hazards that may pose a threat. Depending on the size of the geologic event, responders may face various hazards. Physical hazards include debris covered areas, streets, and roadways, as well as construction hardware. Responders may be shocked by downed power lines that may still be active but not visible. In the event of a winter storm, transportation is likely to become hazardous making reaching victims a risk of its own.

Responders are trained to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly evaluate any hazards that may pose a threat. Standard Incident Command System procedures require the incident commander to establish safe zones and staging areas for all personnel. A designated safety officer monitors the health of all responders during response activities. Any injured responders are immediately treated on site or evacuated to area clinics or hospitals, as the need requires.

Continuity of Operations

During severe storms, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently may become compromised. Additionally, cascading events, such as gas leaks, power outages, and water shortages, may accompany severe storms, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensures that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, severe storms may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Commerce and Insurance, Department of Human Resources, Department of Environment and Conservation, Department of General Services, Department of Health, Department of Human Services, Department of Labor and Workforce Development, Department of Transportation, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Severe storms may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities and infrastructure due to severe storms. Roadways may become impassable due to debris, heavy rainfall, etc. High winds can blow down utility poles causing brownouts and or blackouts to develop throughout the affected areas. In addition, hail may cause windows to shatter, spreading glass everywhere. Although damage to property, facilities, and infrastructure can be severe, there are plans to minimize and recover from the impact. Technological advances will allow for road crews to prepare and relocate resources, as needed. The availability of potable water, and repairs to wastewater treatment, telecommunications, and electricity are also accounted for in the state's plan for disasters. Emergency Support Function 3 (Infrastructure) plays a major role in determining the status of man-made vertical and horizontal structures. The status of property, facilities and infrastructure is determined by teams of damage assessors in concert with codes enforcement, federal teams and insurers.

Continued Delivery of Services

Severe storms may greatly impact public service(s). Business, infrastructure, vehicles, roadways, railways, water transportation, and communications may be significantly degraded or devastated as a result. Damage done to these areas may affect the delivery of services in several ways. As transportation routes become impassable, alternate routing will be necessary for the movement of resources and services, including emergency responders. Depending upon the severity of the storm, such a route may not be immediately available. In addition, if a severe storm produces flooding, water transportation may be completely halted. It is possible that severe storm events may cause damage to water, sewage, and gas lines. Such damage would make it difficult to provide individuals with safe drinking water and food. Power lines might also be damaged, temporarily putting communities without power and making it difficult to maintain public services, including communication with emergency personnel. According to the Continuity of Operations Plan, it is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. If necessary, the State of Tennessee may utilize agreements and contracts made with other public, private, and non-profit organizations to ensure resources are available.

Environment

Depending on the type and magnitude, severe storms may have a marginal to a devastating impact on the environment. Ice storms for instance, may envelop square miles of area and result in major damage to trees and foliage. The lightning from severe storms has the potential to start fires, which compromise the air quality and may have a lasting effect on surrounding trees, plants, and local wild life. High winds may also bring devastation to wooded areas, bringing down large trees. Tennessee also has numerous chemical industries or storage locations; the repercussions from one being destroyed could, and probably would, be environmentally devastating for both the immediate area and surroundings.

Economic Condition
The economic and financial impacts of severe storms vary based on the affected areas and magnitude of the event. Tennessee has many large industries, including nuclear power, chemical plants, livestock farms, and pipeline infrastructure that would greatly impact the economic and financial condition of the state if destroyed. Nuclear power and chemical plants could pose significant economic threats to large areas if damaged. Pipelines would prove costly to repair, especially if tap water has been contaminated. Hail can be especially damaging to crops, destroying crop yield and resulting in little to no revenue. Other businesses may also face economic and financial impacts, if storms damage building structures, resulting in expensive repairs.

Public Confidence in the Jurisdiction's Governance
The public's confidence in the jurisdiction's governance depends upon the states actions before, during, and after a severe storm event. The State of Tennessee has experienced several severe storms throughout the years. As such, the government possesses both the resources and experience necessary to address these events. Preparedness and mitigation efforts prior to severe storms protect the state and its residents as much as possible, lessening the impacts of such an event. The development of plans, mutual aid agreements, and interagency cooperation seek to prepare the state and its residents for severe weather. Additional prevention and protection measures are in place to take the necessary actions that serve to minimize the impact prior to severe storms. Should the State of Tennessee be hit by severe weather, these pre-storm measures can be utilized to ensure efficient and effective response and recovery efforts.

Response efforts begin immediately after the event to understand the initial impact and address the needs of the citizens. The support services performed in the aftermath of an event are crucial to response efforts. The manner and efficiency in which a response to a disaster is conducted, including the expeditious deployment of resources and capabilities that are expeditiously used for the recovery process can maintain and strengthen the public's trust and confidence lessening the impact on citizens. Recovery efforts to return citizens to a state of normalcy can be long lasting and include various public, private, and non-profit resources. To improve upon preparedness, mitigation, response, and recover efforts, the State of Tennessee is continually seeking out new and innovative measures for the public, including technological advancements, mutual aid contracts, and other assisting agencies.

3.3T – Tornadoes

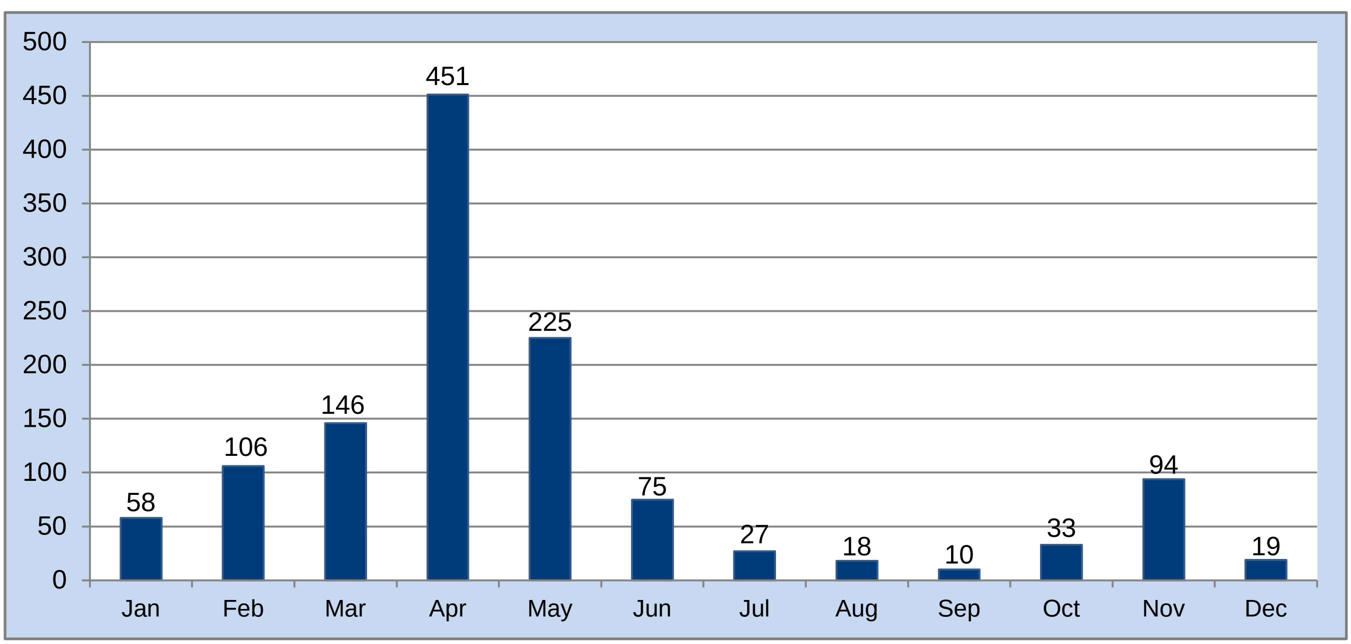
A tornado is a violently rotating column of air in contact with the ground. Often referred to as a twister or a cyclone, they can strike anywhere and with little warning. Tornadoes come in many shapes and sizes, but are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust.

Statistically, tornadoes are seasonal, but the season varies from area to area throughout North America. Tennessee's tornado season lasts from February through May with a small spike of activity in November. Please see Chart 22 below for details.

Tornadoes can cause several kinds of damage to buildings. Tornadoes have been known to lift and move objects weighing more than 3 tons, toss homes more than 300 feet from their foundations, and siphon millions of tons of water. However, less spectacular damage is much more common.

Tornadoes can also generate a tremendous amount of flying debris. If wind speeds are high enough, airborne debris can be thrown at buildings with enough force to penetrate windows, roofs, and walls.

Chart 22 – Tornado Impacts by Month, Tennessee (1950 – 2012)



**The data are from the NOAA NCDC Storm Event Database*

3.3.1 – Location & Extent

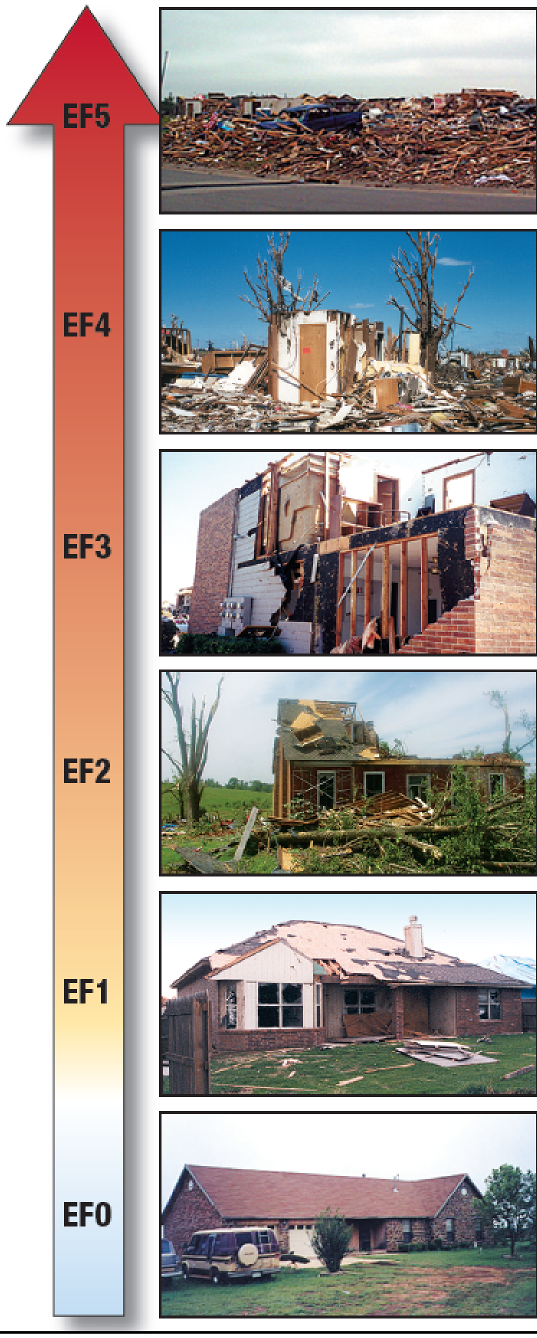
Tornadoes can strike anywhere in the State of Tennessee, placing the entire planning area at risk. Many tornadoes only exist for a few seconds in the form of a touchdown. The most extreme tornadoes can attain wind speeds of more than 200 miles per hour, stretch more than 2 miles across, and travel dozens of miles.

A tornado may arrive with a squall line or cold front and touch down quickly. Smaller tornadoes can strike without warning. Other times tornado watches and sirens will alert communities of high potential tornado producing weather or an already formed tornado and its likely path.

Until 2007, the Fujita Tornado Scale ranked the severity of tornadoes. The Fujita Scale assigned a numerical F value, F0 through F5, based on the wind speeds and estimated damage. Since 2007 the U.S. switched over to the Enhanced Fujita Scale. The altered scale adjusted the wind speed values per F level and introduced a rubric for estimating damage. Please see the chart below for a comparison between the Fujita and Enhanced Fujita Scales.

An EF0 or EF1 tornado could lightly damage structures where they would be unsafe to use until repaired. An EF3 or larger tornado could destroy the entire neighborhood, town, or city, or damage any number of structures to the point where they would be unusable or unsafe. Please see the chart on the following page for a description of the typical amount of damage for each level on the Enhanced Fujita Scale.

Fujita Scale		EF Scale	
Fujita Scale	3-Second Gust Speed (mph)	EF Scale	3-Second Gust Speed (mph)
F0	45-78	EF0	65-85
F1	79-117	EF1	86-109
F2	118-161	EF2	110-137
F3	162-209	EF3	138-167
F4	210-261	EF4	168-199
F5	262-317	EF5	200-234



Incredible: Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized missiles become airborne, trees are completely debarked.

Devastating: Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars are blown some distance, large debris becomes airborne.

Severe: Roofs and some walls are torn from structures, some small buildings are destroyed, non-reinforced masonry buildings are destroyed, most trees in forest are uprooted.

Considerable: Roof structures are damaged, mobile homes are destroyed, debris becomes airborne (missiles are generated), large trees are snapped or uprooted.

Moderate: Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored mobile homes are overturned, attached garages may be destroyed.

Light: Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.

3.3.2 – Previous & Future Occurrences

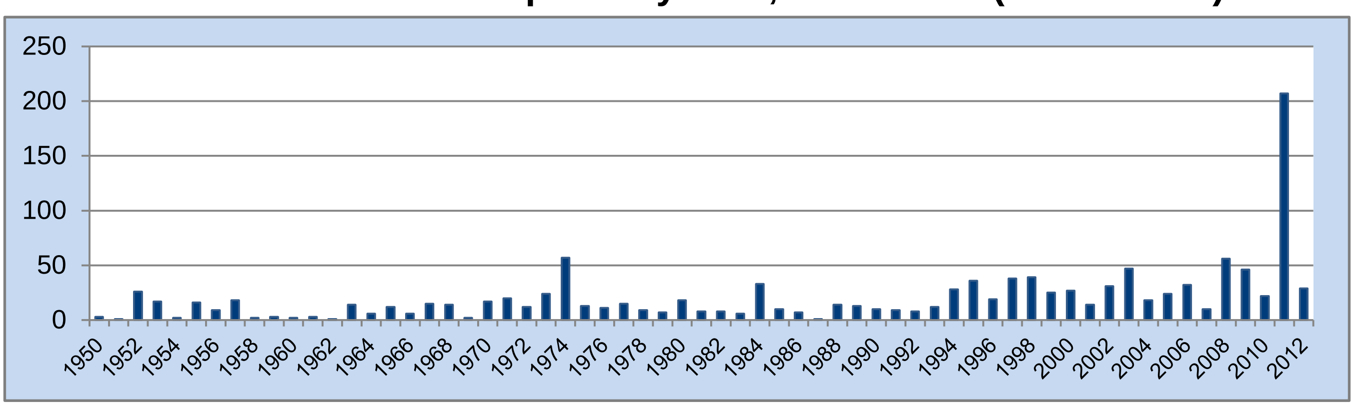
Since 1950, NOAA has recorded 1,262 tornado impacts in the State of Tennessee. Tennessee has experienced 370 deaths and 4,816 injuries relating to tornado activity. These events have cost Tennesseans $1,578,235,890 in property damage and $2,883,000 in crop damage.

Based on NOAA's data, a tornado in Tennessee can be anywhere from an EF0 to EF5 in magnitude, cost up to $100,000,000 in property damage, and $1,000,000 in crop damage. The average tornado impacts will be an EF1 or EF2 in magnitude, cause $1,250,584 in property damage, cause $2,284 in crop damage, kill 0.29 people, and injure 3.82 people.

Table 37 – Historical Impacts, Tornadoes (1950 - 2012)	
Count of Impacts	1262
Impacts Per Year	20.03
Average Magnitude (EF)	1.27
Magnitude Range (EF)	0 - 5
Average Cost	$1,250,584
Magnitude of Cost	$0 - $100,000,000
Total Recorded Cost	$1,578,235,890
Average Crop Damage	$2,284
Magnitude of Crop Damage	$0 - $1,000,000
Total Crop Damage	$2,883,000
Average Fatalities	0.29
Total Fatalities	370
Average Injuries	3.82
Total Injuries	4,816

The data are compiled from the NOAA NCDC Storm Event Database

Chart 23 – Tornado Impacts by Year, Tennessee (1950 – 2012)



The data are from the NOAA NCDC Storm Event Database.

Historic Hazard Incident – Tornadoes – April 1998

On April 15-16, 1998, a 2 day tornado outbreak occurred in the Midwestern United States, Mississippi and Tennessee Valleys. The worst of the outbreak occurred on the second day when 13 tornadoes swept through Middle Tennessee. 2 of these tornadoes touched down in Nashville, causing of damage to the downtown and East Nashville areas. This made Nashville the first major city in almost 20 years to have an EF2 or larger tornado make a direct hit in the downtown area.

The outbreak also produced several other tornadoes. A total of 10 tornadoes were reported throughout the breakout. One was an EF5 tornado. There were 7 fatalities and 105 injuries throughout Middle Tennessee.

Historic Hazard Incident – Tornadoes – February 2008 (Super Tuesday Outbreak)

The 2008 Super Tuesday tornado outbreak affected the Southern United States and the lower Ohio Valley. The event began on Super Tuesday, while 24 U.S. states were holding primary elections and caucuses to select the presidential candidates for the upcoming presidential election.

87 tornadoes occurred over the 15 hour outbreak. Many of these destructive tornadoes hit heavily populated areas, including the Memphis metropolitan area, Jackson, Tennessee, and the Nashville metropolitan area. 57 people were killed across 4 states and 18 counties, with hundreds of others injured. Damage from the tornadoes was estimated at over $500 million. The weather system caused significant straight-line wind damage, hail as large as softballs – 4.5 inches in diameter, major flooding, significant freezing rain, and heavy snow. The total damage from the entire weather system exceeded $1 billion.

In Memphis, an EF-2 tornado swept through destroying the Hickory Ridge Mall, parts of Germantown, and the International Airport. 4 people in the metropolitan area were killed, 36 others were injured in Shelby County by tornadoes, and there was 1 additional death southeast of Hebron, Tennessee from an EF-3 tornado.

Northeast, near Jackson, TN, a tornado touchdown overturned several cars and at least 15 tractor trailers along Interstate 40. The Sharon Baptist Church in Savannah, TN lost its $7 million facilities to the tornado. 31 buildings on the Union University campus received damage. 12 students were trapped in the damaged buildings, but all were rescued. Over 60 people in the Jackson area were treated for injuries. There were no fatalities caused by the Jackson tornado, however there were 2 fatalities in the Huntersville community, located west of Jackson, from another EF-3 tornado. The tornadoes caused about $47 million worth of damages in Madison County, with $40 million of that total occurring at Union University alone.

In the Nashville metropolitan area, a supercell moved through forming funnel clouds, but there was never a touch-down; after passing through an EF-3 tornado touched down in Castalian Springs and Westmoreland. The tornado path was 51 miles long and up to 0.75 miles wide. There were 22 fatalities. The tornado caused a major fire at a natural gas plant near Green Grove. The area was evacuated and no one was injured. In total, about 260 houses in the 3 counties were destroyed. Damages were around $78 million in Macon County alone. Debris from the Lafayette area was found as far as 70 miles to the northeast. Sixteen thousand TVA electricity customers in Macon and Trousdale Counties lost power.

Historic Hazard Incident – Tornadoes – April 2011

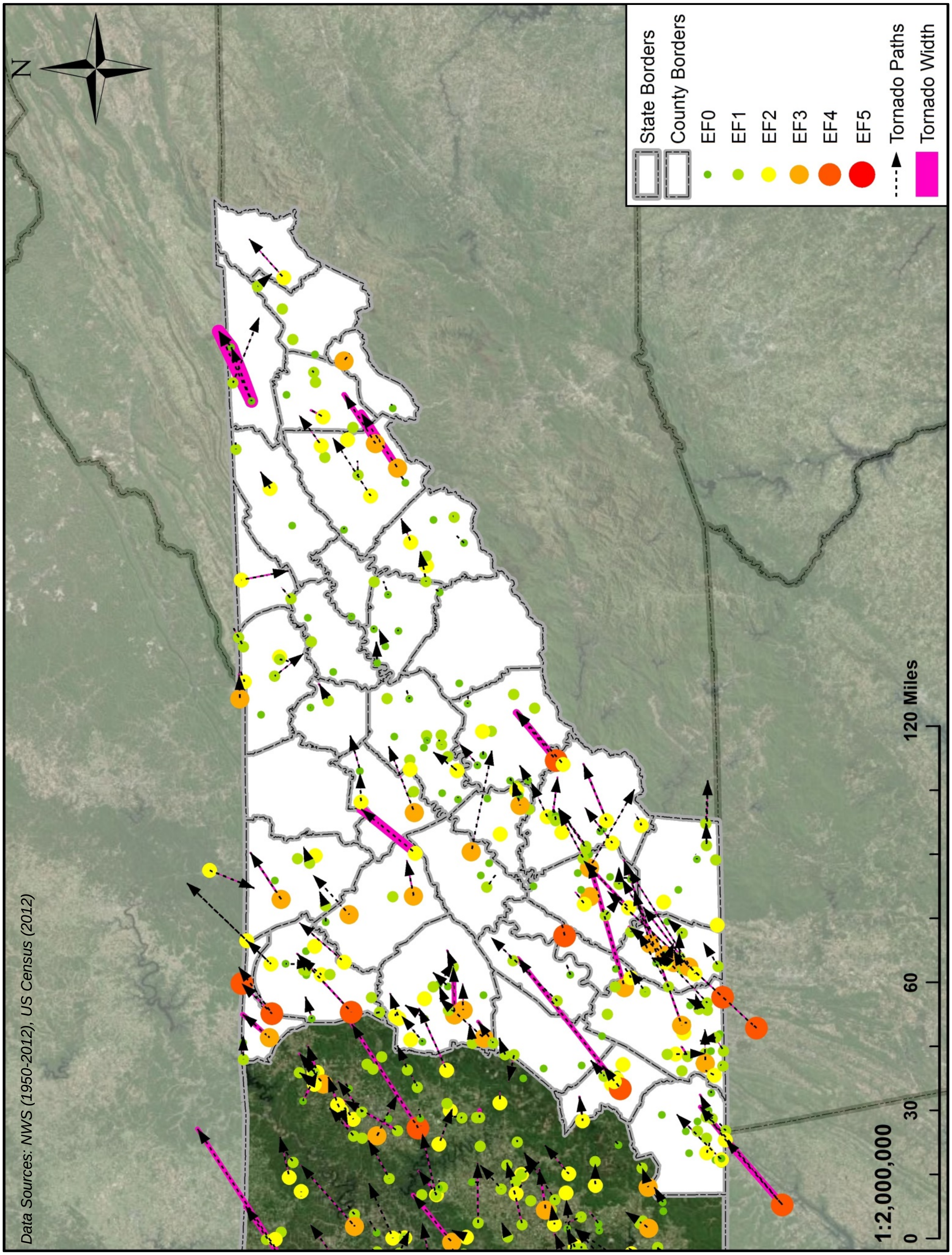
The largest tornado outbreak ever recorded in the United States occurred on April 25-28, 2011. Southern, Midwestern, and northeastern United States were all affected leaving catastrophic destruction in its path. The outbreak totaled 358 tornadoes in 21 states.

A series of intense storm cells produced multiple tornadoes, damaging hail, and lightning across East Tennessee. Two tornadoes struck near Cleveland, Tennessee, including an EF-2, which injured 1 person and destroyed 3 mobile homes and an EF-1, also landed about a mile west of Cleveland. A third touchdown was reported, but unconfirmed, near Etowah in McMinn County. Golf ball- and baseball-sized hail fell throughout the area. 6,900 Knoxville Utilities Board customers were left without power, and 22,000 customers were affected by the outages across Knox County.

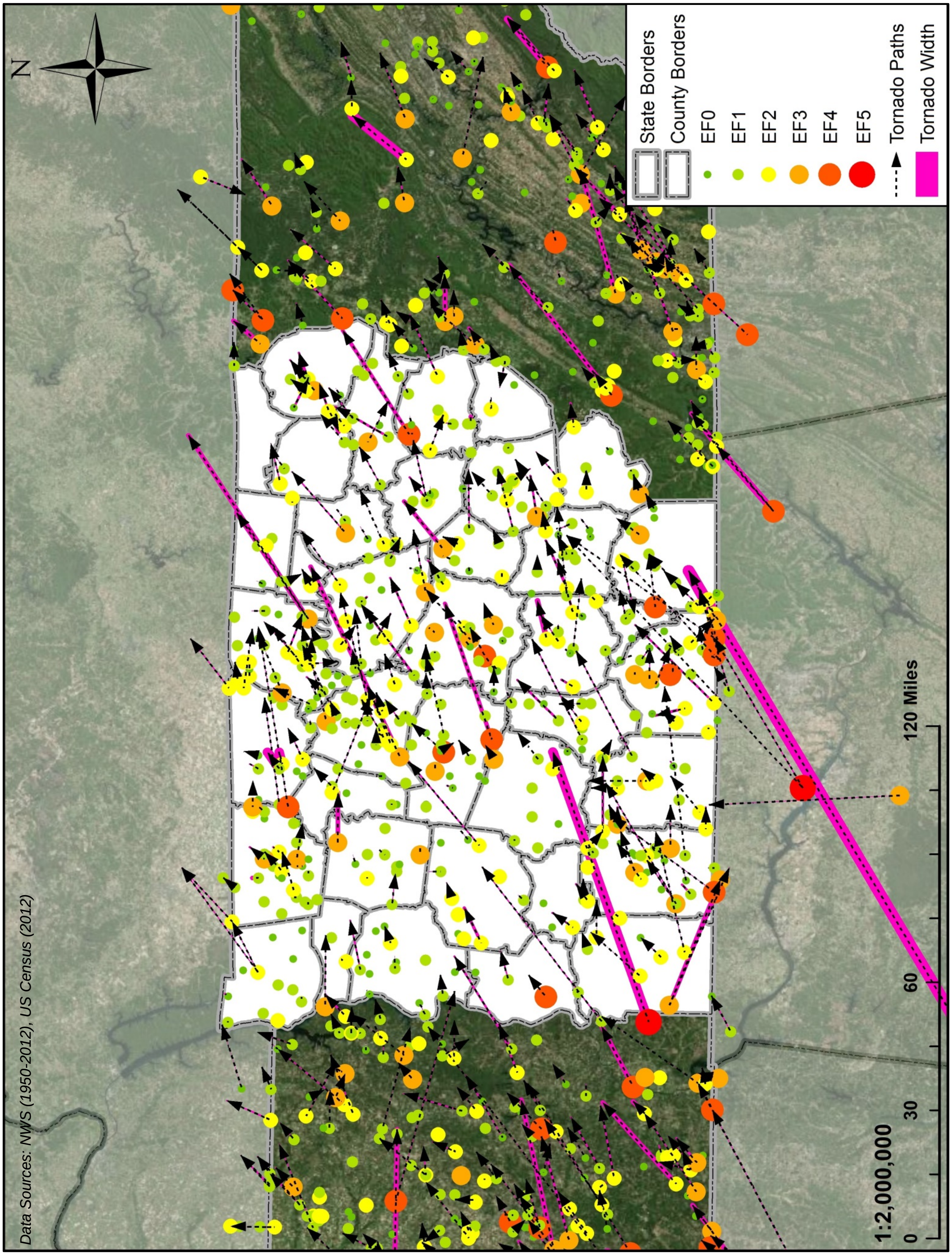
Historic Hazard Incident – Tornadoes – January 2013

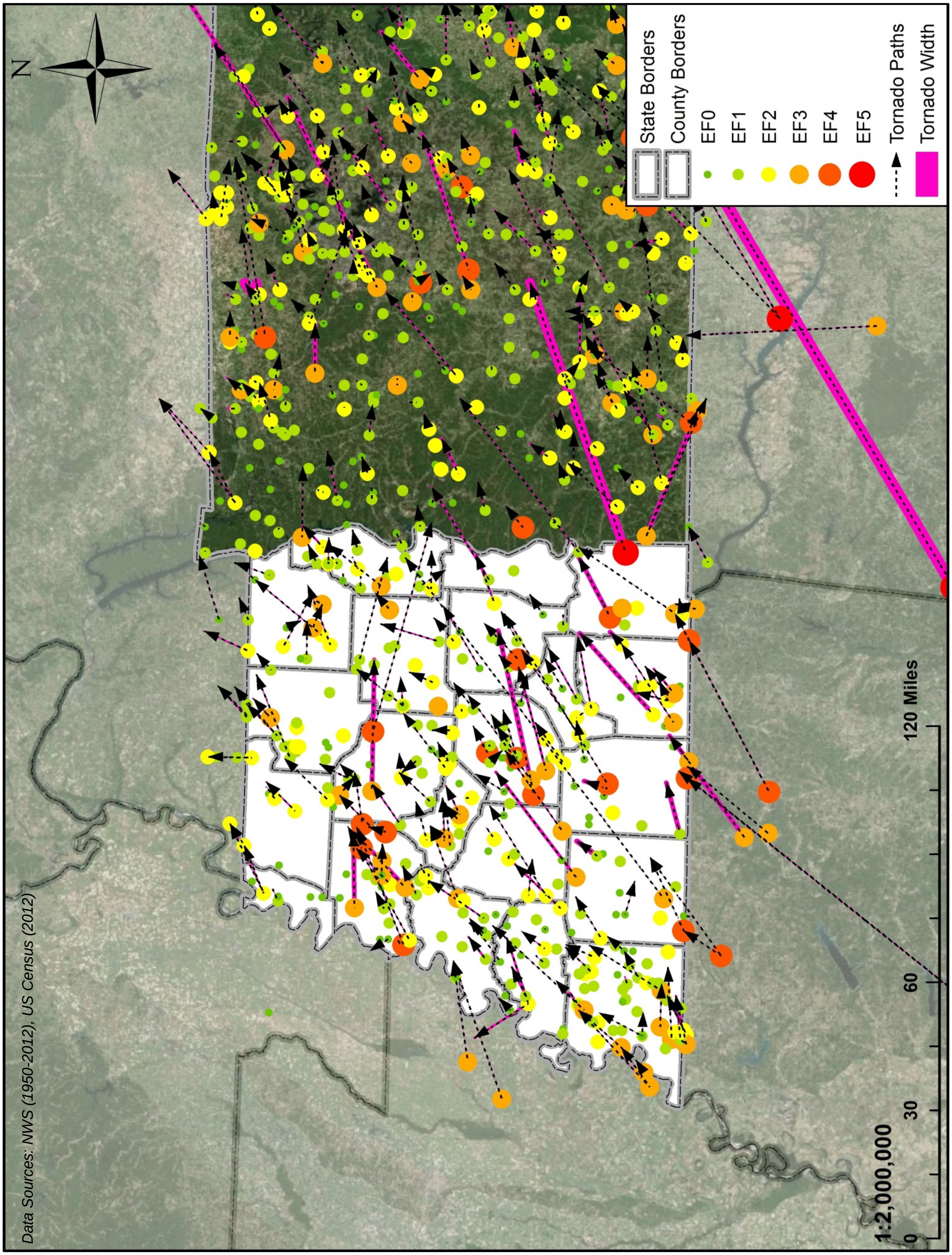
On January 29-30, 2013, a powerful upper level trough moved across the United States containing strong winds with speeds of 80 mph just 2,500 feet above the surface and 150 mph at 20,000 feet. A record warm air mass with temperatures in the 60s and 70s spread northward ahead of the system as a powerful cold front moved eastward across the state during the early morning. This created a line of showers and thunderstorms known as a Quasi-Linear Convective System producing numerous tornadoes and widespread wind damage. There was 1 fatality and at least 3 injuries across the state. 24 tornadoes were confirmed making this event the largest January tornado outbreak and the second largest outbreak of tornadoes for any month in Tennessee history.

Map 46 – Historical Tornado Impacts, East Tennessee



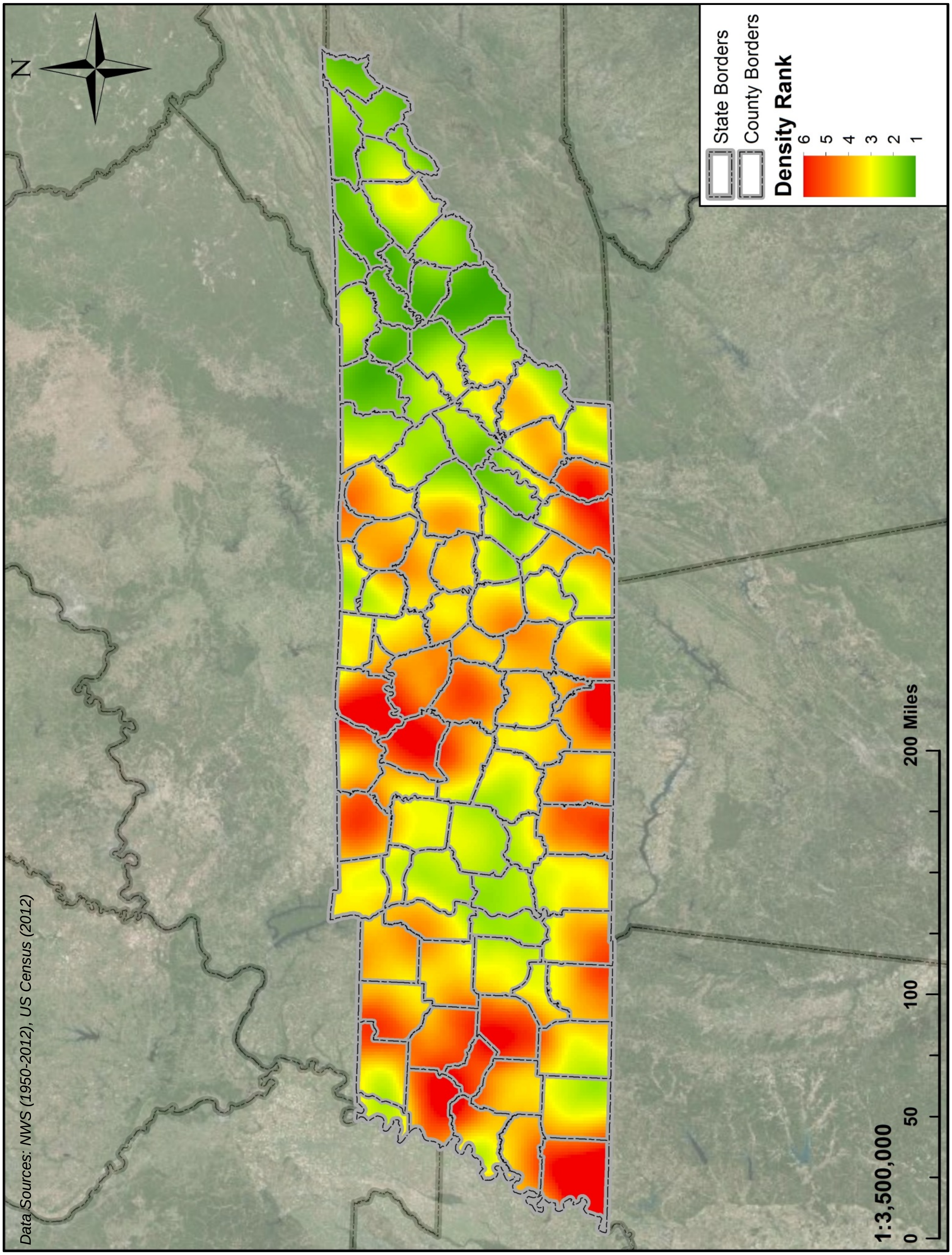
Map 47 – Historical Tornado Impacts, Middle Tennessee





Map 48 – Historical Tornado Impacts, West Tennessee

Map 49 – Tornado Impact Density, Tennessee



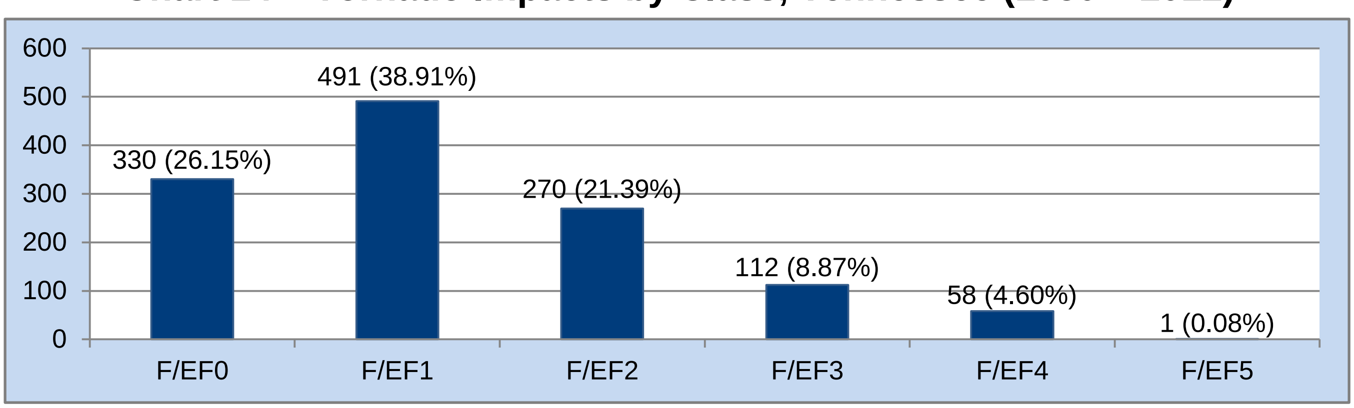
The state can expect a tornado impact with a probability of 2035.48% per year or 20.3548 tornado impacts per year. Of the total probability; there is a 532.26% probability of an EF0 impact or 5.3226 EF0 impacts per year; 791.94% probability of an EF1 impact or 7.91.94 EF1 impacts per year; 435.48% probability of an EF2 impact or 4.35.48 EF2 impacts per year; 180.65% probability of an EF3 impact or 1.8065 EF3 impacts per year; 93.55% probability of an EF4 impact or .9355 EF4 impacts per year; 1.61% probability of an EF5 impact or .0161 EF5 impacts per year.

Table 38 – Impact Probability, Tornadoes

Impact Year	Count of Impacts by Fujita Scale					
	F/EF0	F/EF1	F/EF2	F/EF3	F/EF4	F/EF5
1950 - 1959	0	33	40	12	12	0
1960 - 1969	0	37	28	10	0	0
1970 - 1979	27	82	35	23	18	0
1980 - 1989	23	57	27	10	1	0
1990 - 1999	79	62	48	25	8	1
2000	7	17	2	1	0	0
2001	9	2	2	1	0	0
2002	9	9	10	3	0	0
2003	14	22	3	6	2	0
2004	5	13	0	0	0	0
2005	10	8	6	0	0	0
2006	10	10	4	8	0	0
2007	3	6	1	0	0	0
2008	16	20	12	6	2	0
2009	18	24	3	0	1	0
2010	11	9	2	0	0	0
2011	78	70	39	6	14	0
2012	11	10	8	1	0	0
Total Years =	62					
Total Recorded Events =	330	491	270	112	58	1
Total Tornadoes =	1262					
Probability By Class =	532.26%	791.94%	435.48%	180.65%	93.55%	1.61%
Yearly Probability =	**2035.48%**					

**The data are compiled from the NOAA NCDC Storm Event Database*

Chart 24 – Tornado Impacts by Class, Tennessee (1950 – 2012)



**The data are from the NOAA NCDC Storm Event Database.*

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

Populations affected by severe storms are dependent on several factors. These include the tornado's mass and strength at the time of impact, location of impact, and ability to respond to warnings. Tornadoes may strike quickly, with little to no warning, and can bring heavy rain and hail. Historical data suggests that tornadoes have the potential of causing minimal to devastating damage to an area, as well as hundreds of injuries, and even death. In April 2011, the State of Tennessee saw a total of 857 injuries and 62 fatalities. Most fatalities and injuries associated with tornadoes are caused by flying debris. Those in the affected area may also become trapped by a collapsing structure. Tornadoes may also damage power lines and cause gas leaks, making individuals susceptible to fires, electrocution, explosions, and exposure to harmful gases. It is also important to remember that tornadoes often accompany severe storms, and bring with them additional dangers of lightning and flash floods.

Tornadoes can be prepared for in advance by awareness, drills, and by utilizing the technological advances in weather prediction available through the NWS. Providing resources and opportunities for communities to learn the difference between tornado watches and warnings, as well as what to do before, during, and after tornadoes will increase an individual's ability to prepare, and further minimize loss of life and injuries.

Health and Safety of Personnel Responding to the Incident

Personnel responding will utilize intelligence gathered from local responders to properly address any hazards that may pose a threat. The potential for responding personnel to be affected by the event will be hazard specific. Rescue attempts, clean-up efforts, as well as other response and recovery activities can lead to injuries. The health and safety of responding personnel can be impacted based on a number of potential hazards. Responders may be injured or impeded by debris-covered areas, including streets and roadways. Downed power lines that may still be active and not visible to the responder may result in shock and or small fires. Gas leaks may disperse harmful and odorless carbon monoxide or other gases into the area. Any hazardous chemicals that may have leaked can also pose a risk to responders. Basements, unstable structures, and multilevel buildings will make search and rescue difficult.

Responders are trained to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly evaluate any hazards that may pose a threat. Standard Incident Command System procedures require the incident commander to establish safe zones and staging areas for all personnel. A designated safety officer monitors the health of all responders during response activities. Any injured responders are immediately treated on site or evacuated to area clinics or hospitals, as the need requires.

Continuity of Operations

During a tornado, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently may become compromised. Additionally, cascading events, such as floods, power outages, and water shortages, may accompany tornadoes, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensures that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, tornadoes may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Tourist Development, Department of Commerce and Insurance, Department of Human Resources, Department of Environment and Conservation, Department of Financial Institutions, Department of General Services, Department of Health, Department of Human Services, Department of Labor and Workforce Development, Department of Transportation, Department of Veteran's Affairs, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Tornadoes may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failure may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises to be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Property, facilities, and infrastructure can be severely damaged as a result of tornadoes. Buildings may collapse or become structurally compromised. There may be large power outages, as power lines may be down in areas in and around the impact zone. Gas lines and water mains may also sustain damage. Roadways have the potential to become impassable due to debris, making it difficult for emergency personnel to respond to injuries. The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities and infrastructure due to tornadoes.

Emergency Support Function 3 (Infrastructure) plays a major role in determining the status of man-made vertical and horizontal structures. The status of property, facilities, and infrastructure is determined by teams of damage assessors in concert with codes enforcement, federal teams, and insurers. In addition, potable water, wastewater treatment, telecommunications, and reinstatement of electricity are also accounted for in the state's plan for disasters. However, recovery efforts can be costly, with the potential damage ranging in the millions.

Continued Delivery of Services

Tornadoes could greatly impact public services at the local level. Business may have difficulties remaining open and or providing services to customers depending upon the damages done to both the buildings used and merchandise offered. Infrastructure, including transportation and communication, may break down temporarily. This can affect services provided to individuals, such as public transit. Damages to the transportation infrastructure may limit emergency responder efforts to reach individuals; blocked roadways, railways, and water routes may also make it difficult for relocation efforts, as well as providing sanitary food and water. Communication failures, including brownouts and or blackouts, will make it difficult for individuals to request assistance, hinder responders' efforts, and slow the state's ability to access information and provide response and recovery resources/efforts. Under provisions in place for the Continuity of Operations, it is assumed that the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours.

Environment

Tornadoes could have a marginal to a significant impact on the environment, uprooting trees and destroying vegetation. Wildlife habitats and food sources may be completely demolished, leaving the animals weak and vulnerable. However, the collateral events associated with tornadoes may cause the larger impact. Tennessee has a large chemical industry. Damages to such facilities could be environmentally devastating for both the immediate vicinity and for several miles around them. Air quality may also be affected by such damages, putting individuals at risk of respiratory problems. Lightning from the storm may start fires, which could spread out of control. Flooding from heavy rains accompanying tornadoes, may significantly alter the landscape and produce additional dangers to individuals, buildings, and infrastructure.

Economic Condition

The economic and financial impacts of tornadoes are largely based on the affected areas and the level of damage. Tennessee has many large industries, such as, nuclear power, chemical plants, livestock farms, and pipeline infrastructure that would greatly impact the economic and financial condition of the state if destroyed. Agricultural crops could be severely damaged or completely destroyed by a tornado. High winds and/or a tornado could severely damage or destroy nuclear power and chemical plants, causing massive power failures and placing nearby communities at risk of radiation and exposure to harmful chemicals. The water supply may also become compromised, especially if pipelines are cracked. Private businesses may be hurt as well if buildings and merchandise are damaged, resulting in some degree of revenue loss. Although repairs to such industries may be costly, technological advancements will allow for quick recovery to normal operations.

Public Confidence in the Jurisdiction's Governance

Hazardous events have multiple stages, all of which are scrutinized by the public. Tennessee is well equipped with the resources and experience to manage any event with efficiency, maintaining public morale and trust. The TEMP, mutual aid agreements, memoranda of understanding, and standby contracts, as well as relationships across the public, private, and non-profit sector keep the State of Tennessee well prepared for any event and the risks that may accompany it. Preventive measures, and both natural resource and emergency protective measures that make up the mitigation strategy help ensure the state has taken the steps available to minimize damage to both life and property. When tornadoes occur, the preparedness and mitigation measures set in place will be utilized throughout the response and recovery phases to ensure appropriate and efficient actions are taken.

In addition to the services provided before an incident, the state is prepared for, and capable of, response and recovery efforts in the event of a tornado. The support services performed in the aftermath of an event can either strengthen or weaken the public's perception and reputation of the program. When immediate actions are taken to respond to those affected by the event, further injuries and loss of life are minimized. Additionally, the affected communities feel safer and more confident in the responders and the state's ability to address the needs of its citizens. Recovery efforts must immediately follow to address the needs of the community in returning to normalcy as quickly as possible. The state resources and capabilities that are expeditiously made available for the recovery process can maintain and strengthen the public's trust and confidence and thus lessen the impact on citizens.

3.3WF – Wildfires

The NWS defines a wildfire as: Any free burning uncontainable wildland fire not prescribed *for the area which consumes the natural fuels and spreads in response to its environment.* They can occur naturally, by human accident, and on rare occasions by human action. Typically their point of origin is far from human development with the exception of roads, power lines, and similar infrastructure. There is a constant threat to hikers, campers, and other people engaging in outdoor activities. Significant danger to life and property occurs when human development meets and becomes intertwined with the wildland's vegetation. The threat of wildfire increases in areas prone to intermittent drought, or are generally arid and or dry.

Rampant destruction can be mitigated by fire services regularly engaging in preventive burns and land use measures to minimize the spread of wildfire events. Both of these practices are used in Tennessee to minimize the threat of wildfires.

Population de-concentration in the U.S. has resulted in rapid development in the outlying fringe of metropolitan areas and in rural areas with attractive recreational and aesthetic amenities, especially forests. This demographic change is increasing the size of the wildland-urban interface, defined as the area where structures and other human development meet or intermingle with undeveloped wildland. Its expansion has increased the likelihood that wildfires will threaten life and property.

The expansion of the WUI in recent decades has significant implications for wildfire management and its impact. The WUI creates an environment in which fire can move readily between structural and vegetation fuels. Two types of WUI are mapped: intermixed and interface. Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of dense, contiguous wildland vegetation.

3.3.1 – Location & Extent

In Tennessee, as in most places, the WUI is at its most vulnerable the larger the population-bases are that interface or intermix. In western parts of the state, the largest interface/intermix is situated near Memphis. The other interface/intermix areas are scattered fairly evenly north to south in the eastern part of western Tennessee. In Middle Tennessee, the largest areas of WUI are concentrated in Cheatham, Dickson, Davidson, Montgomery and Williamson Counties with the remaining areas even distributed north to south in middle Tennessee.

Since there are more forest lands and a substantial population in the eastern third of the state, it is no surprise that the largest concentration of WU interface/intermix occurs there. The largest area is near Knoxville with the eastern half of East Tennessee having the most frequent occurrence of population with interface/intermix.

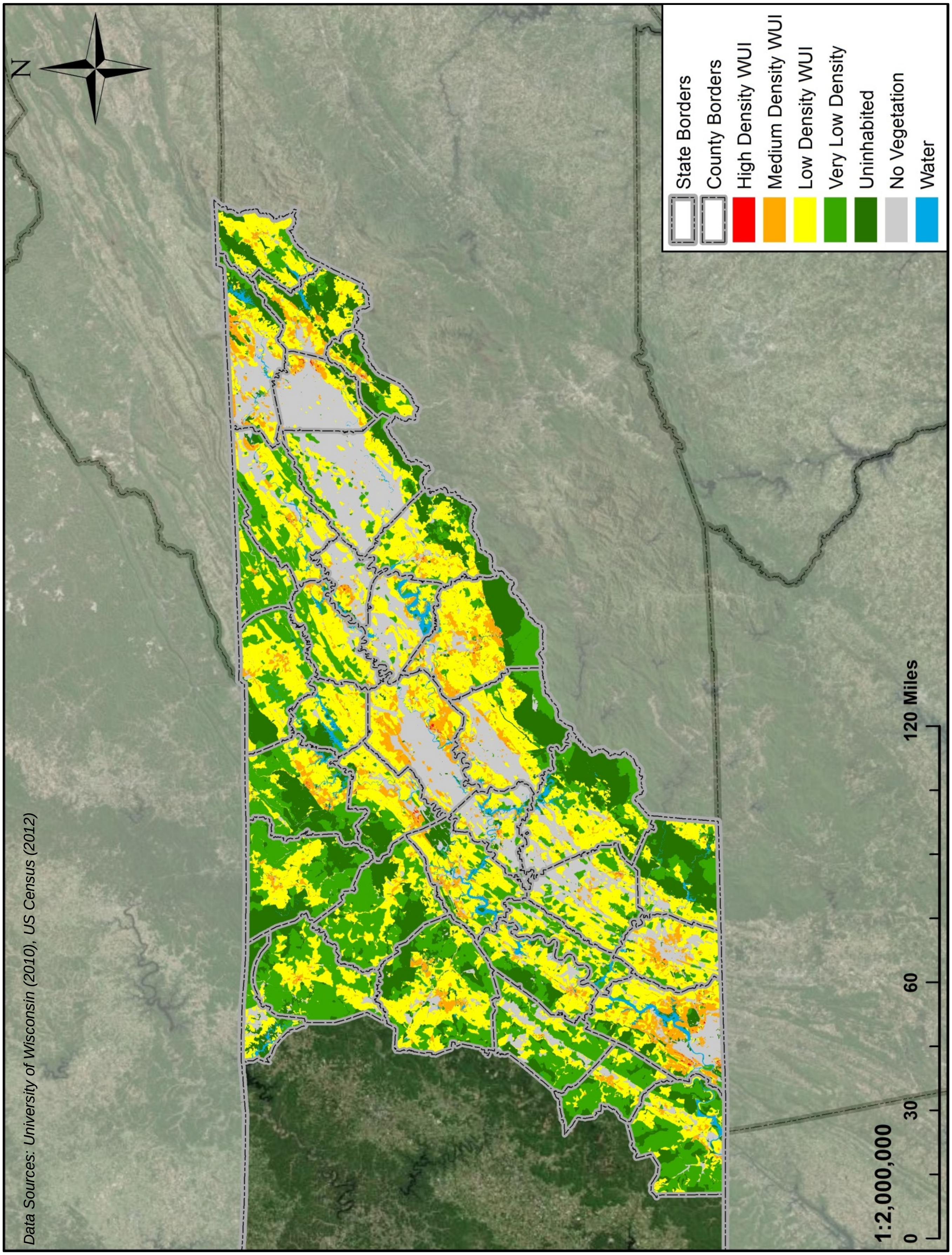
The duration of a wildfire depends on the weather conditions, how dry it is, the availability of fuel to spread, and the ability of responders to contain and extinguish the fire. Historically, some wildfires have lasted only hours while other fires have continued to spread and grow for an entire season. They spread quickly and often begin unnoticed until they have grown large enough to signal by dense smoke. If fuel is available, and the high wind speeds hit, a wildfire can spread over a large area in a very short amount of time. These factors make the difference between small upstart fires easily controlled by local fire services to fires destroying thousands of acres requiring multiple state and federal assets for containment and suppression.

Maps 50 through 52 on the following pages depict the WUI in East, Middle, and West Tennessee.

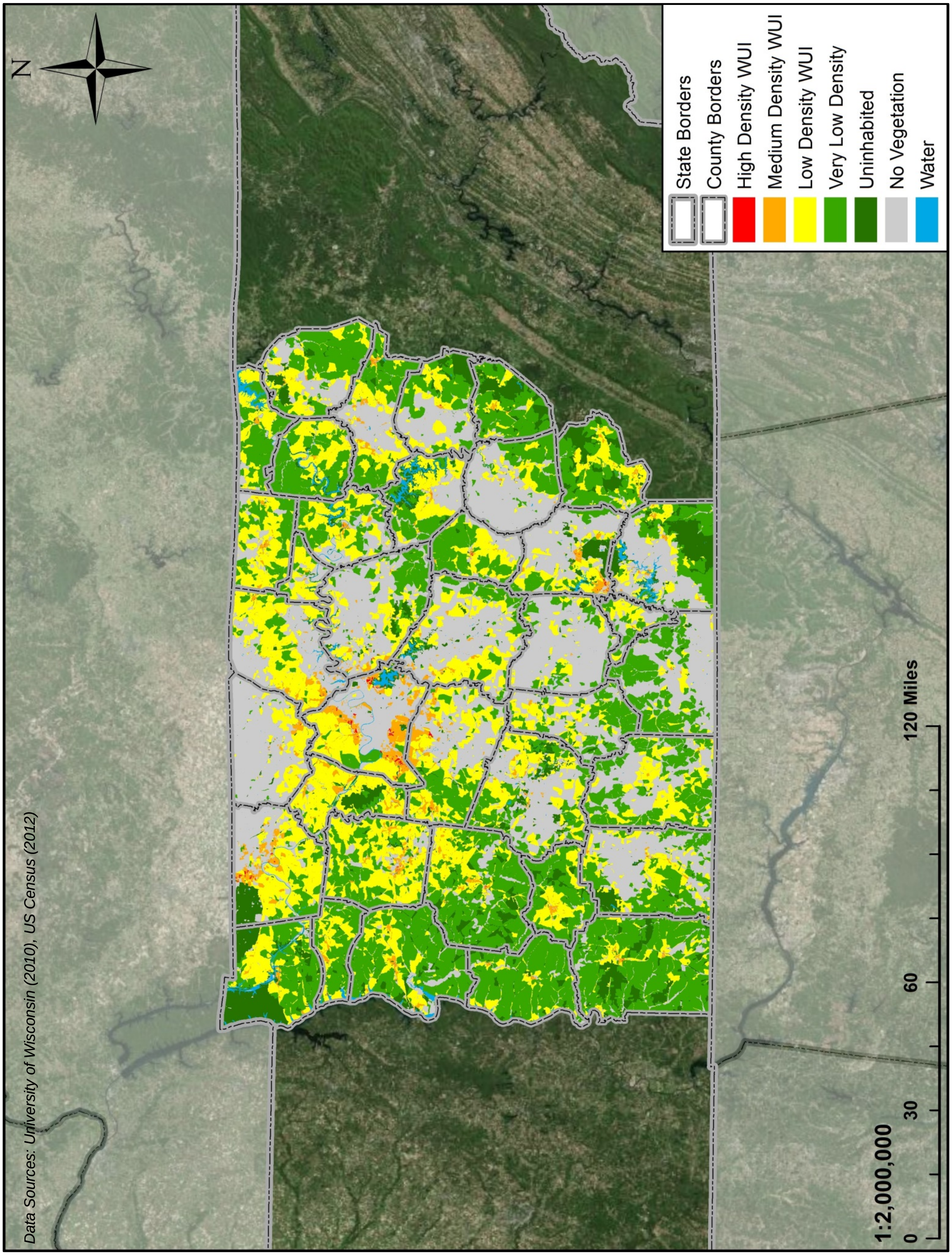
Table 39 shown below, details ranges of wildfire damages. The severity of the wildfire depends on a number of quickly changing environmental factors. It is impossible to strategically estimate the severity of a wildfire as the quickly changing factors, drought conditions and wind speed, have such a great influence on the wildfire conditions.

Table 39 – Burn Severity Index

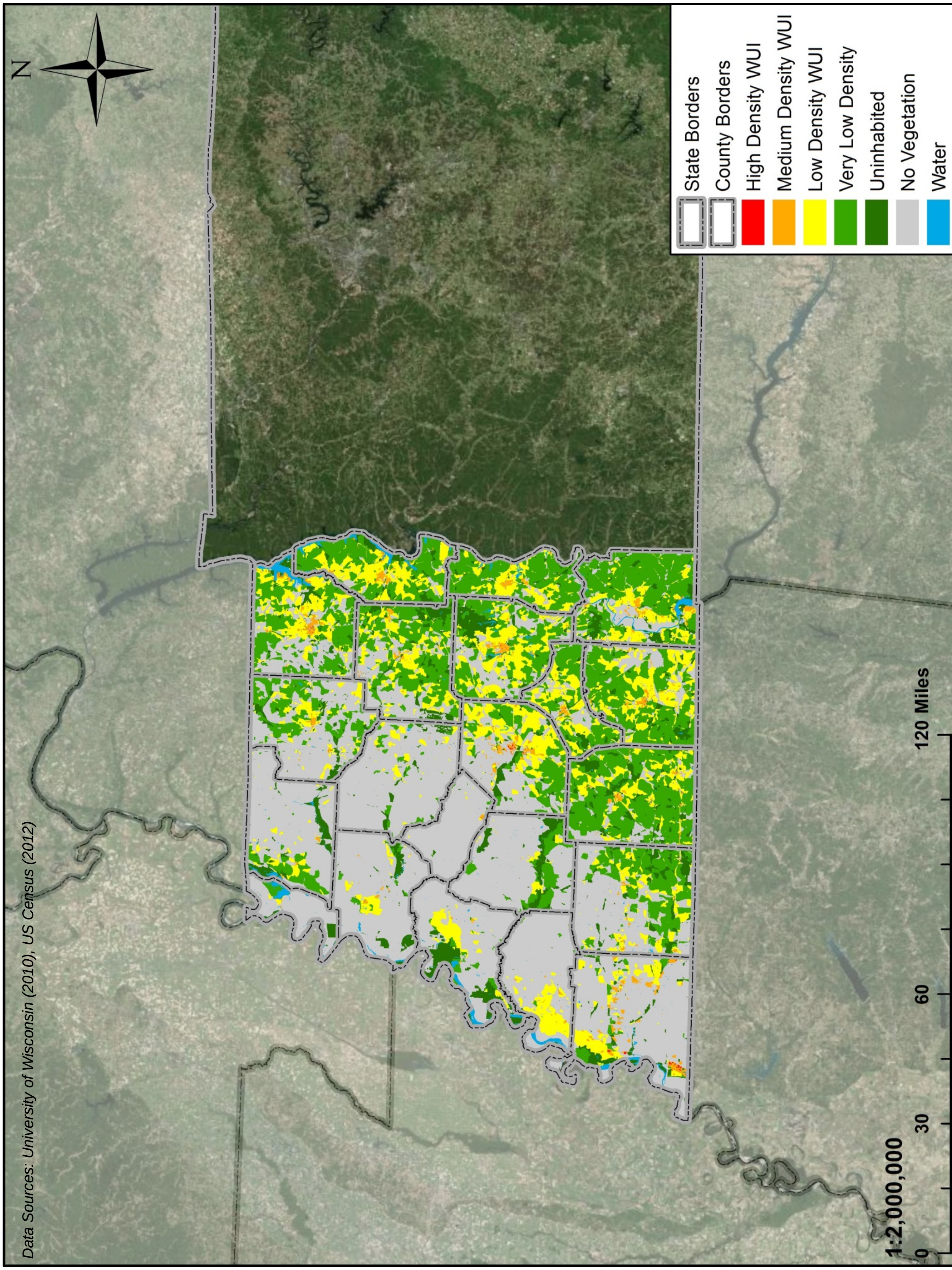
Rank	Burn Severity	Description	Characteristics
0	Unburned	Fire extinguished before reaching microsite	• Leaf litter from previous years intact and uncharred • No evidence of char around base of trees and shrubs • Pre-burn seedlings and herbaceous vegetation present.
1	Low Severity Burn	Surface fire which consumes litter yet has little effect on trees and understory vegetation.	• Burned with partially consumed litter present • Evidence of low flame heights around base of trees and shrubs (<0.5 m) • No significant decreases in overstory & understory basal area, diversity or species richness from pre-burn assessments • Usually burning below 80 ° C
2	Medium-Low Severity Burn	No significant differences in overstory density and basal area, & no significant differences in species richness. However, understory density, basal area, and species richness declined.	• No litter present and 100% of the area covered by duff • Flame lengths < 2 m • Understory mortality present, little or no overstory mortality
3	Medium-High Severity Burn	Flames that were slightly taller than those of Medium-low intensity fires, but these fires had occasional hot spots that killed large trees, With significant reduction in the understory	• Soil exposure on l-50% of the area • Flame lengths <6m • High understory mortality with some overstory trees affected
4	High Severity Burn	Crown fires, usually a stand replacing burn with relatively high overstory mortality	• Soil exposure >50% • Flame lengths >6m • Higher overstory mortality >20% • Usually burning above 800 ° C



Map 50 – Wildland Urban Interface, East Tennessee



Map 51 – Wildland Urban Interface, Middle Tennessee



Map 52 – Wildland Urban Interface, West Tennessee

3.3.2 – Previous & Future Occurrences

Since 1950, the Tennessee Division of Forestry has recorded 194,269 wildfires burning 3,209,681 acres in the State of Tennessee. They do not have a complete record of property damage or total environmental damage.

Based on the Division of Forestry's data, Tennessee wildfires burn 17 acres per wildfire and 50,947 acres per year.

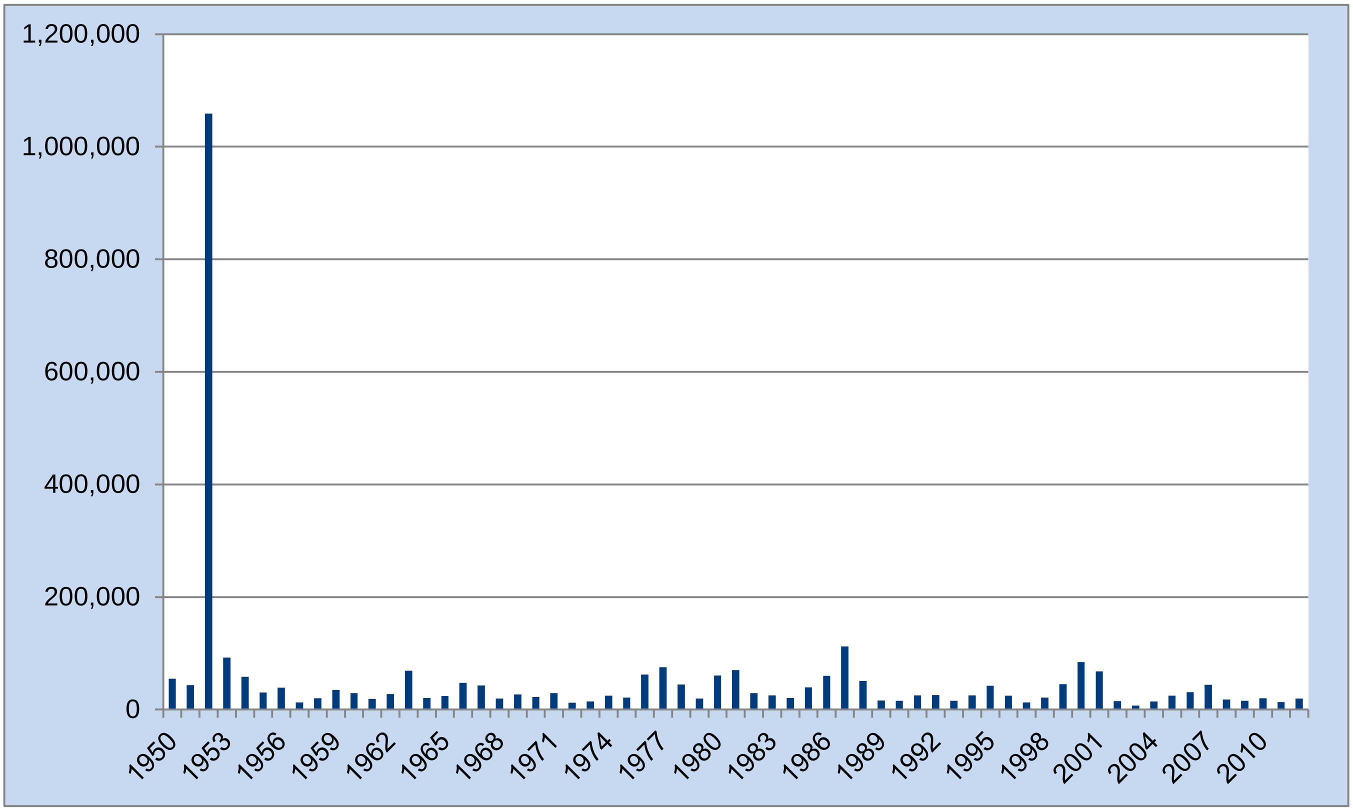
The state can expect a wildfire with a probability of 3,084% or 3,084 wildfires per year.

Table 40 – Historical Impacts, Wildfires (1950 - 2012)	
Total Fires	194,269
Fires Per Year	3084
Fire Probability	3084%
Total Acres	3,209,681
Acres Per Year	50947
Acres Per Wildfire	17

**The data are from the Tennessee Division of Forestry*

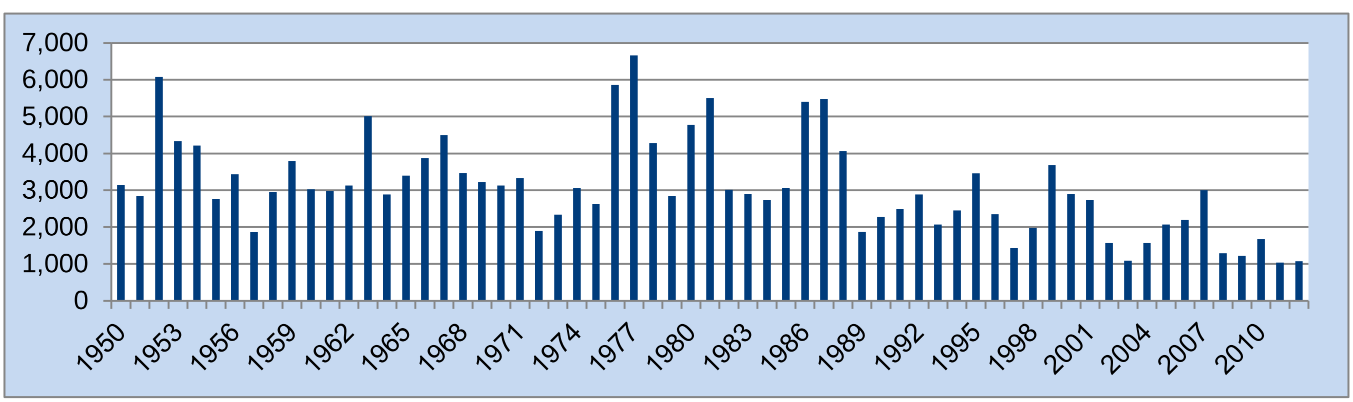
Historic Hazard Event – Wildfire – Summer 1953
Forest and brush fires were severe statewide. This is the worst recorded fire season in the state's history burning over 1,000,000 acres of land.

Chart 25 – Acres Burned by Year, Tennessee (1950 – 2012)



**The data are from the Tennessee Division of Forestry*

Chart 26 – Wildfires by Year, Tennessee (1950 – 2012)



**The data are from the Tennessee Division of Forestry*

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

Wildfire situations can emanate from myriad sources, but more often than not they are technological or human-caused events. Home wildfires, wildfires, and forest wildfires can impact large populations if intensified. The specific impacts they have can vary, but there are some similarities. Individuals may be exposed to smoke inhalation. In home wildfires, smoke may fill a room quickly, making it difficult for an individual to breathe and find a safe exit. The smoke from wildfires and forest wildfires can affect overall air quality in the area, proving especially dangerous for those with asthma or other lung related health concerns. Food may become exposed to heat, smoke, or soot, putting individuals at risk for food poisoning. In addition, each type of event may impact an individual's general safety, placing them at risk for burns and carbon monoxide poisoning.

Wildfires may cause entire communities to go without power, making it difficult for individuals to stay cool and compromising the food supply. Water can become contaminated, and unable to be used without risking sickness. Wildfires produce an extreme amount of heat, which can severely burn an individual's hands and feet even after the blaze is extinguished, and may also reignite the flames. The wildfire may also have caused chemicals to explode or leak, placing those exposed to the potential health risks of hazardous materials. Wildfires may result in cascading events, such as future flooding, which may further impact citizens. Rapid response to wildfires is necessary to prevent them from developing into forest wildfires. Although forest wildfires typically occur in heavily forested areas, more people have begun to populate these areas. The increase in population leads to an increase in the possibility of impact from forest wildfires on citizens.

For wildfires requiring state assistance, TEMA will activate appropriate levels of emergency support coordination for a state response to local jurisdictions. Depending on the magnitude of the event, evacuation routes and roadblocks will be established through coordination with the TN DoT and the TN DPS. While these actions will help during the event, the state may also take preparedness and mitigation actions to lessen the impact on its citizens. Wildfire safety and education will not only prepare individuals, but it may also prove to help prevent future events.

Health and Safety of Personnel Responding to the Incident

Although TEMA and other state agency personnel responding to the incident will observe life safety and health standards and practices, wildfire incidents are not without risks. Changes in the speed and direction of the wildfire and smoke may threaten responders' ability to control the blaze as well as remain at a safe distance. The most likely hazards encountered when responding to a wildfire situation could be heat exhaustion, smoke inhalation, structural instability, as well as other exposure-related illnesses. Chemicals and other combustible material may have leaked, and fuel sources may be open, increasing the potential for explosions and exposure to poisonous gases. Downed power lines may expose responders to live electricity. Emergency personnel may have difficulties responding to some residents, as not all roads may be accessible to wildfire vehicles. Unstable trees may ignite or fall upon already damaged structures, making rescue more difficult and potentially trapping emergency personnel.

Responders are trained to respond in a safe and efficient manner with scene safety being the number 1 priority. Personnel responding will utilize intelligence gathered from local responders to properly evaluate any hazards that may pose a threat including federal information systems such as 'Red Flag

Warnings' and 'Wildfire Weather Watches provided by the NWS. In addition, a meteorologist from the NWS specifically trained for wildfires provides additional support, giving weather briefings and forecasts to incident responders and command staff. Standard Incident Command System procedures require the incident commander to establish safe zones and staging areas for all personnel. A designated safety officer monitors the health of all responders during response activities. Any injured responders are immediately treated on site or evacuated to area clinics or hospitals, as the need requires.

Continuity of Operations

During a wildfire, critical infrastructure, essential functions, and other areas necessary for the state and its various departments to function and respond efficiently may become compromised. Additionally, cascading events, such as power outages and water shortages, may accompany wildfires, putting added pressure on the state to address the needs of its citizens. The State of Tennessee has several plans and procedures in place to efficiently and effectively respond to any problems that may temporarily interrupt the state's operations and response. Continuity of Operations Plans, in conjunction with the Continuity of Government Plan, ensure that the essential functions are continued throughout or immediately after the event.

Various departments may require activation of their COOP to remain functional. In particular, wildfires may affect the following departments: TDA Division of Forestry, Department of Finance and Administration, Department of Tourism Development, Alcoholic Beverage Commission, Department of Commerce and Insurance, Department of Mental Health, Department of Children's Services, Department of Human Resources, Department of Environment and Conservation, Department of Health, Department of Human Services, Department of Labor and Workforce Development, and TEMA. These departments perform various functions, from maintaining the state's environmental safety, to providing for the health and safety needs of adults and children. Wildfires may impact the health and safety of senior officials and others in authority, requiring orders of succession and delegations of authority to maintain effective operations. Cascading events may further hinder continuity of other essential functions, such as communication and access to vital records. Power failures may make it impossible to retrieve necessary information. Activation of COOP plans helps to alleviate these obstacles by activating appropriate personnel, performing only essential tasks, and relocating activities, records, and resources. Continuity is further maintained by ensuring any necessary emergency needs for the department are accounted for prior to the disaster. Ensuring successful continuity of operations requires testing, training, and exercises to be conducted yearly to prepare personnel for operating in emergency conditions.

Property, Facilities, and Infrastructure

Wildfires spread quickly, and pose a threat to any homes and buildings in the vicinity. Residential areas can ignite and spread wildfires quickly, especially if they are surrounded by brush and trees, or have woodpiles and furniture nearby. Power lines left covered in branches or ivy may ignite, and/or fall, causing blackouts. Wildfires result in massive structural damage to residential, commercial, and industrial buildings, often rendering them destroyed. Property and facilities may remain at risk from hot spots, even after the wildfires are extinguished. Drinking water can become contaminated, hindering the state's ability to provide safe water. The State of Tennessee has plans and procedures in place to efficiently and effectively respond to any problems that may arise in property, facilities and infrastructure due to wildfires. Potable water, wastewater treatment, telecommunications, and reinstatement of electricity are also accounted for in the state's plan for disasters

The best building codes and safety standards cannot prevent damage or total loss of property, facilities and infrastructure. However, over the years, Tennessee has significantly reduced the impacts of wildfires through a variety of methods. Encouraging strong local codes enforcement, and increased public awareness, such as appropriate chimney upkeep and safety zones, has increased the public's preparedness and ability to respond. Enhancing local wildfire planning and response capabilities, and developing higher standards for wildfire fighter training has resulted in a more resilient and affective group of personnel able to quickly and efficiently combat wildfires.

Continued Delivery of Services

Historically, wildfires in the State of Tennessee have not affected the long term delivery of services to any impacted area. However, given the scope and magnitude of an event, it is possible that public services may be compromised. While urban wildfires would probably impact little, if any, of these services, the same cannot be said for wildfires and forest wildfires. With a majority of the manpower fighting the blazes, few will be left to assist with less severe emergencies. Wildfires of any category can cause blackouts, taking days or weeks for full power to be restored. This can pose a serious threat to hospitals treating patients. The public housing department may become overwhelmed attempting to provide shelter to individuals forced out of their homes, and/or with no home to return to.

Should a wildfire event impact the continued delivery of services, provisions are in place to maintain Continuity of Operations. It is assumed the State of Tennessee will begin the resumption of essential/critical services within 24-48 hours. Under the Continuity of Operations, emergency personnel will assist in relocating services, activities, records, and resources damaged by the wildfire. Backup power and potable water supplies will also help maintain essential services. Essential/critical services must be resumed in a timely manner; coordination among various levels of government, including tribal areas and private sector organizations, achieves this need in an efficient manner. As essential/critical services are resumed, the impact on citizens and communities will lessen.

Environment

Depending on the magnitude, wildfires have a marginal to devastating impact on the environment. Wildfires in urban areas will most likely have little to no permanent impact on the physical environment. In the case of wildfires however, hundreds to thousands of acres could be charred resulting in possible disruptions to the delicate ecosystem. Wildfires and forest wildfires result in barren soils, unable to absorb water and maintain vegetation. These conditions may last up to 5 years following a wildfire and create conditions perfect for flash floods and mud slides, resulting in further damage to the surrounding wildlife and ecosystem. Wildfires must be contained quickly to lessen the effect on the ecosystem. The Forestry Division of the Tennessee Department of Environment and Conservation is the first line of defense in fighting forest wildfires, lessening the long-term impact.

Economic Condition

The economic and financial impacts of wildfires are largely based on the impacted areas and the magnitude of the event. Wildfires in Tennessee are generally restricted to relatively small woodland or grassland areas. The impact of such wildfire events is negligible to the economy and financial institutions. However the Wildland/Urban Interface continues to expand in rural areas, dramatically increasing the potential values lost to wildfires. In some cases, crops can be partially or wholly damaged, impacting crop yield, revenue, and consumer prices. The tourism industry in Eastern Tennessee is located in areas where wildfires are more common placing the industry at risk.

Public Confidence in the Jurisdiction's Governance

Tennessee has both the resources and experience in responding and recovering from wildfires. Preparedness actions, such as education the public and maintaining strict wildfire safety guidelines allows residents to shoulder some of the responsibility for their health and safety, while decreasing the likelihood of injury or death. Continued public outreach ensures individuals know about local defensible space requirements and chimney wildfire safety, such as the NFPA 211 standards; this furthers residents' confidence in the state and its ability to educate citizens. In addition to these preparedness steps, mitigation is essential to preventing additional damages and/or loss of life.

Community inclusive mitigation measures should be developed into a mitigation strategy, providing opportunities for the state to minimize the long-term risks associated with wildfires for both individuals and the environment. Tennessee actively supports the expansion of its communities engaging in the FireWise program further increasing the public's confidence. A successful mitigation strategy, consisting of both prevention and protection measures, ensures that citizens receive the necessary education and information to withstand any wildfire event. A mitigation strategy can assist with ensuring access to clean water, food, and shelter for those affected by wildfires. Other measures ensure emergency personnel and vital services are protected; without these resources, the state would not be able to respond to the needs of its citizens. However, should the mitigation strategy fail to protect emergency personnel, critical facilities, and the public's health and safety from the potential effects of a wildfire, distrust is likely to develop regarding the jurisdiction's abilities.

During a wildfire event, response efforts must address the immediate needs of the health and safety of citizens, as well as the continuation of critical infrastructure. Previously developed preparedness plans will assist responders, rapidly assessing the event's impact. Such efforts may also prevent secondary hazards from developing. These response services performed in the aftermath of an event can either strengthen or weaken the reputation of the program and the public's perception of the government's ability to provide services to people in time of need. Furthermore, the state resources and capabilities that are expeditiously made available for the recovery process can maintain and strengthen the public's trust and confidence, lessening the impact on citizens. The State of Tennessee utilizes mutual aid compacts, other assisting agencies, etc. in recovery efforts. The Emergency Management Assistance Compact is 1 such example of a network of emergency management between states, assisting in providing rapid resources to fight wildfires. The state is continually seeking new and innovative response and protective measures for the public, in hopes of reducing the likelihood of injury and/or loss of life throughout the incident, and into the recovery stages.

Section 3MM/T – Man Made & Technological Hazards

While natural disaster and hazard mitigation employs the methodology described in standard publications such as FEMA 386-2 “Understanding Your Risks – Identifying Hazards and Estimating Losses,” man-made risk assessment requires the integration of more complex economic impact models, and other publications including, but not limited to FEMA publication 386-7 “Integrating Human-Caused Hazards Into Mitigation Planning” and the Emergency Management Accreditation Program Standards. Man-made risks, technological hazards, and biologic threat modeling often require greater extrapolation from related data, as their historic incidence may not be as frequent, or have yet occurred for newer technologies. Succinctly put, the mechanics of man-made disasters requires inferential, rather than empirical determination.

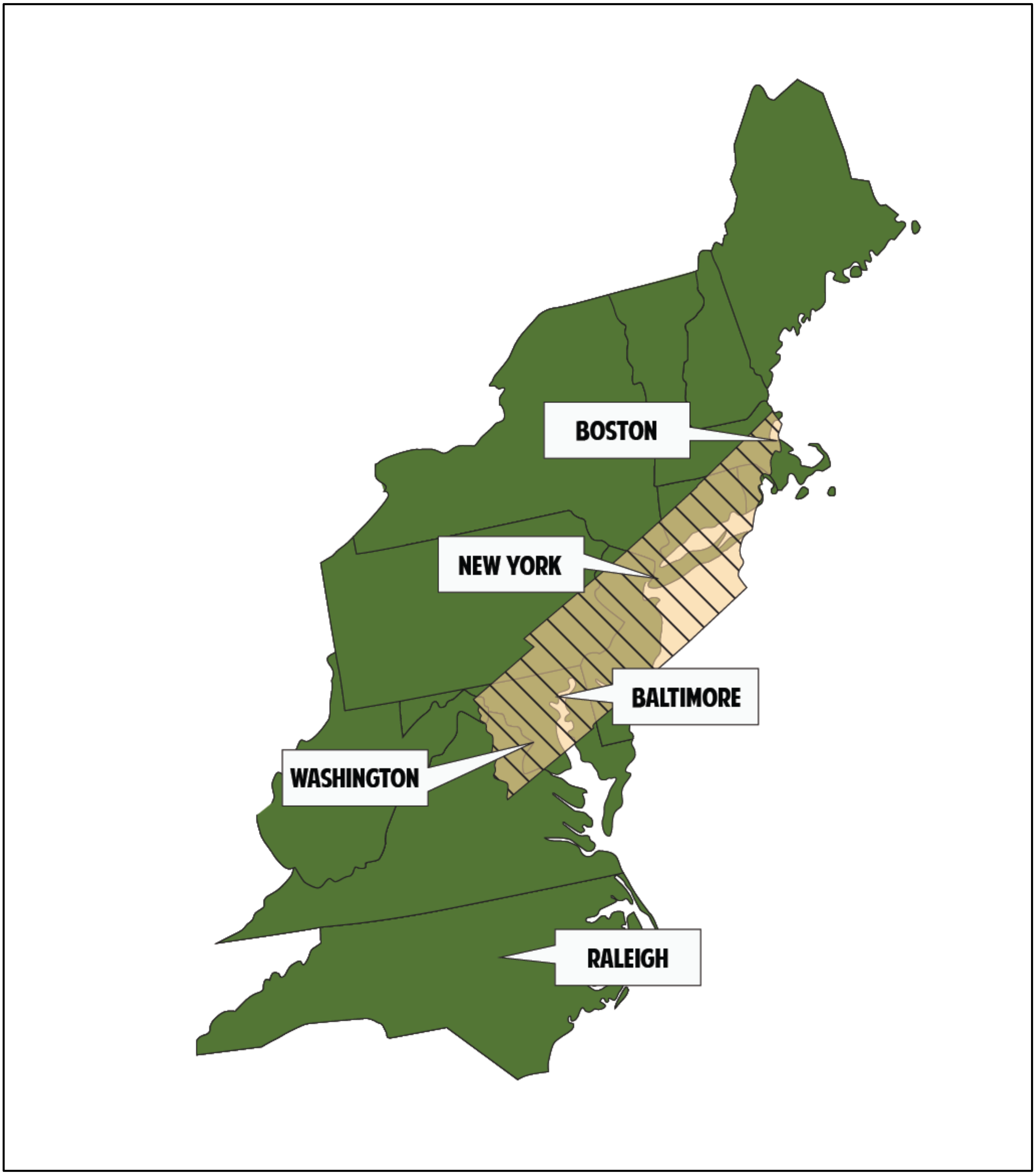
Methodology

There is no quantity more variable or subject to change than the human-factor: it increases the difficulty in prediction, and the necessity for flexibility in modeling. To this end, the following statistical sources have been consulted to provide economic impact scenarios and reference points, and then to correlate by region expressing that region’s particular exposures and liabilities:

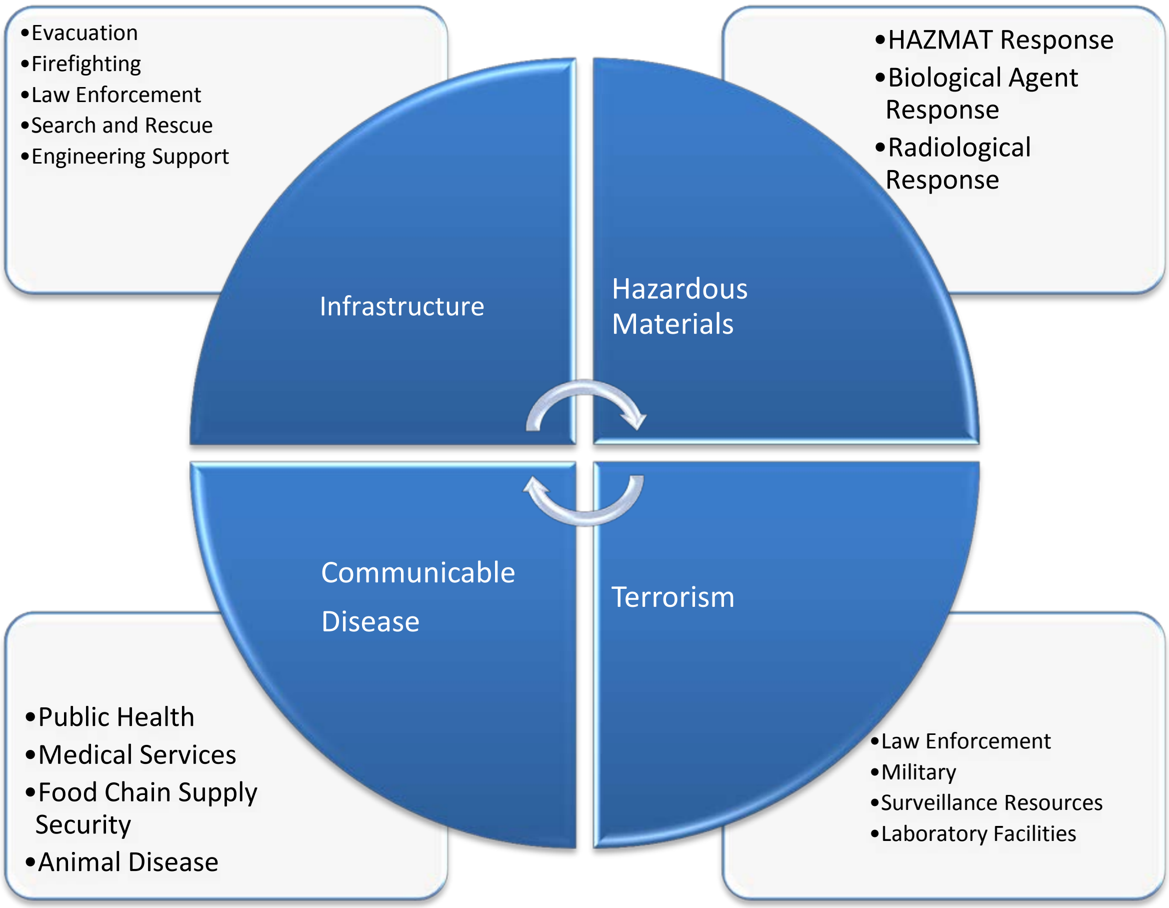
- US Census Bureau
- US Department of Commerce: Bureau Economic Analysis (BEA): RIM II
- The US Critical Infrastructure Assurance Office (CIAO) Site List
- Housing and Urban Development (HUD)
- NAIC (National Association of Insurance Commissioners) SAP (Statutory Accounting Principles)
- Tennessee Department of Transportation (TDOT)
- Tennessee Department of Commerce and Insurance (TDCI)
- RAMCAP Plus®

Tennessee, by its physical nature, creates a markedly wide exposure platform. Map 53 below demonstrates the proportional geographic and metropolitan risks when compared to the more localized and manageable areas on the Eastern seaboard.

Map 53 – Proportional Geographic Risk



Intra-agency dependency constitutes both an asset and a liability; understanding workflows determines how effectively these agencies can share or delegate their responsibilities. The constituent needs in 4 of the Man Made and Technical Hazards and the work flow they depend on can be best visualized in the graph below.



3.3CD – Communicable Diseases

3.3.1 – Description

Communicable diseases encompass a wide variety of pathogens along with multiple mediums for transmission, and pose one of the most flexible and rapidly evolving public health threats in Tennessee and FEMA Region IV at large. The scope of these threats, and the multiple agencies often required to respond to even singular incidents make protocols and timely dissemination of public health information of particular importance. Further, communicable diseases that are not generalized public health threats can spread quickly in close quarters or through contaminated public resources immediately following an emergency and relocation of large populations. Protocols must be in place for proper sanitation, timely triaging, and reporting of cases when overcrowding due to displacement is present in temporary housing, shelters, or residential facilities. The Emergency Provider Infection Control Manual must also be referenced during the course of emergencies to institute protocols that prevent patient to provider transmission of infectious diseases.

Tennessee maintains an extensive array of communicable disease personnel both inside and ancillary to the Department of Communicable and Environmental Disease (CEDC). Communicable and Environmental Disease Services is 1 of the 13 divisions of the Bureau of Health Services; it is assigned the responsibility of detecting, preventing, and controlling infectious and environmentally-related illnesses of public health significance. Emergency management personnel are more frequently including pandemic and communicable disease drills in their exercise dockets at locations across the nation. The Centers for Disease Control and Prevention (CDC) conducted 4 pandemic exercises between 2007 and 2008 simulating national, as well as state and local responses to H1N1 or other influenza variants at epidemic levels.

Communicable diseases fall into 2 broad categories: Human or Zoonotic. While the purview of the human to human pathogens remains fairly well delineated at both the state and federal level, zoonotic responses will often require the assistance of Tennessee Department of Agriculture, Tennessee Wildlife Management Agencies, CDC, FDA, USDA Wildlife Services, or local Fish and Game officials. Of those diseases that are classified by the state as 1A level incidents, requiring the immediate filing by the observing individual of a telephone incident report, 12 are communicable.

3.3.2 – Scope of Threat Management

A Communicable Disease Emergency occurs when urgent or extensive public health or medical interventions are necessary because the risk of disease outbreak or biologic threat carries the potential for morbidity and mortality in Tennessee, a specific region, at county or municipal levels or nationally. The CEDC participates in the Emerging Infections Program (EIP) in conjunction with *Tennessee Department of Health, Vanderbilt University School of Medicine, Department of Preventive Medicine,* and the *CDC. This program allows for the combined resources of these entities* to assess the public health impact of emerging infections and to evaluate methods for their prevention and control. The EIP operates in conjunction with 9 other states: California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, and Oregon. The EIP was established by the CDC, but is operated at the state level to facilitate: surveillance, prevention, and control of emerging infectious diseases. EIP activities go beyond the routine functions of health departments by:

- Addressing the most important issues in infectious diseases and selecting projects that the EIP network is particularly suited to investigate
- Maintaining sufficient flexibility for emergency response and addressing new problems as they arise
- Developing and evaluating public health interventions and ultimately transferring what is learned to public health agencies
- Incorporating training as a key function of EIP activities
- Giving high priority to projects that lead directly to the prevention of disease

3.3.3 – Governing and Coordinating Agencies

The following agencies are primarily responsible for any public health threat via communicable disease, though cooperating agencies may not be limited to those listed below.

State Coordinating Agency

- Tennessee Department of Health

State Cooperating Agency

- Communicable and Environmental Diseases Services

Federal Coordinating Agency:

- Department of Health and Human Services

Federal Cooperating Agencies

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Homeland Security
- Department of the Interior
- Department of Justice
- Department of Labor
- Department of State
- Department of Transportation
- Department of Veterans Affairs
- Environmental Protection Agency
- General Services Administration
- U.S. Agency for International Development
- U.S. Postal Service
- U.S. Customs and Border Patrol
- American Red Cross

3.3.4 – Locations

A biologic or communicable disease threat can occur anywhere, or anytime. Concentrated efforts must be made at surveillance in the following arenas:

Healthcare

Tennessee health care institutions serve as the front lines to communicable disease response and also as potential disease reservoir populations and points of cross contamination. Tennessee maintains excellent hospital and in-patient coverage in all 3 of its primary regions, with Level I trauma facilities. All Tennessee hospitals and healthcare facilities are required to report specific Healthcare Acquired Infections to the NHSN, the National Healthcare Safety Network. The NHSN is a web-based data reporting and submission program, which includes validation routines for many data elements, thus reducing common data entry errors. Hospitals can view, edit, and analyze their data at any time. TDH staff download, analyze, and validate NHSN data monthly.

Education Facilities and Dormitories

The State of Tennessee mandates a vaccination series for all incoming resident students at educational facilities, consisting of measles, mumps, rubella, meningococcal meningitis, and varicella vaccines. In spite of these vaccine series, dormitory housing at colleges and universities have historically been susceptible to outbreaks of viral meningitis. In September of 2012, 2 students died from bacterial meningitis at Middle Tennessee State University and Mt. Juliet High School. An outbreak at Oak View Elementary in October of 2012 necessitated the closure of the school and decontamination of the premises and school buses. Vaccination, along with immediate quarantine procedures should be adhered to with particular care in the academic setting where institutional controls are the primary mitigation technique with proven effectiveness.

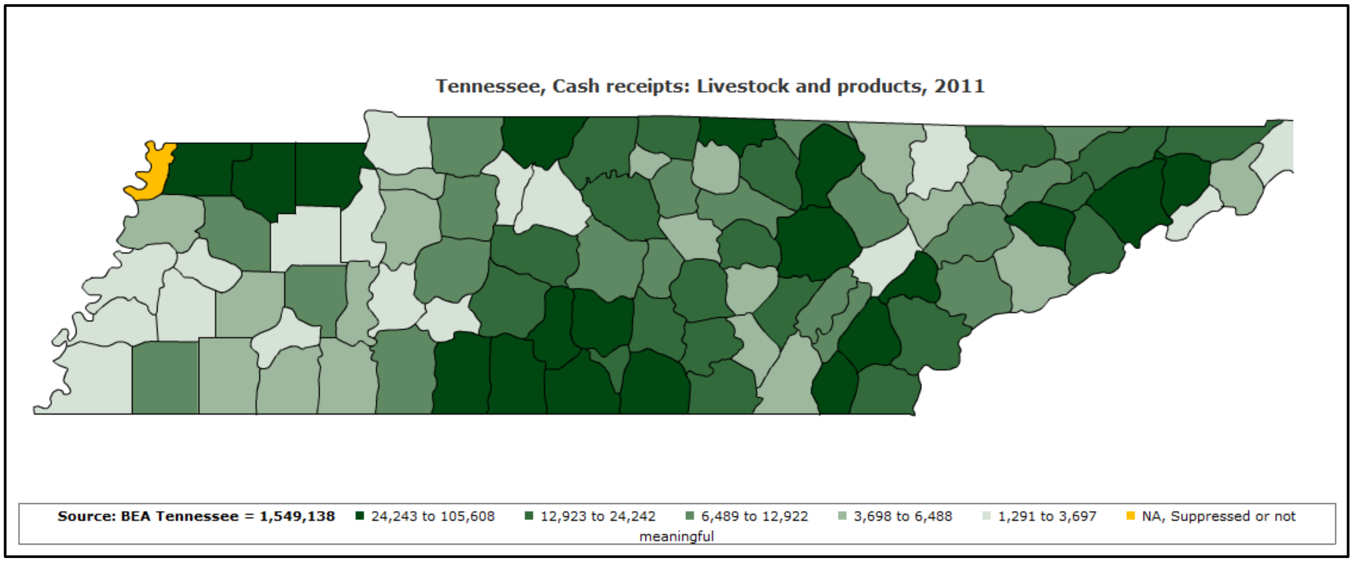
Rural and Isolated Population Reservoirs

Livestock facilities in rural areas post a consistent and demonstrable communicable disease risk addressed in FEMA's Biological Incident Annex publication 12 from 2008. A statistically significant rise in H3N2v in Tennessee has been reported since July 2012; this variant of "swine flu" is significant and poses a higher risk to children than to adults. Along with rises in swine flu, international observation by the WHO and others has pointed to the occurrence of H7N9 (avian influenza) in human populations as a reason for more careful monitoring of poultry facilities throughout the US, particularly those in proximity to international ports and gateways. With over $454 million of farm income generated in 2012, poultry is Tennessee's second largest agricultural product (beef is the first). With the unique combination of a high worth product, a susceptible population in concentrated areas (poultry farms and chicken houses) and Memphis International Airport handling the largest amount of cargo in the world (3.91 million tons in 2012 alone) surveillance and integration with U.S. Customs and Border protection is imperative.

In Germany, in 1993 and in the Netherlands in 1994, the cost of outbreaks of Classical Swine Fever cost each country more than $5 billion. In 2001, the outbreak of Foot and Mouth Disease in the United Kingdom cost more than $6 billion, nearly 0.5% of the UK's Gross Domestic Product. The outbreak affected nearly 25% of all farms in the UK. Because of the time of year at which Foot and Mouth Disease struck, British tourism suffered greater direct losses than the livestock industry. With these figures in mind, it is critical that state and local officials have mitigation plans for communicable disease outbreaks because of the direct threat to human food supplies from meat, milk, and animal by-products. FEMA and the USDA estimate the direct cost of a Foot and Mouth Disease outbreak in the U.S. is as high as $13.5 billion. Indirect costs could be far higher. Given Tennessee's reliance on beef and swine agriculture, the impact could be particularly acute at the state level.

The following map illustrates county livestock cash income, and as such, higher value counties that warrant more significant surveillance due to economic exposure.

Map 54 – Tennessee Livestock



Beef cattle are Tennessee's highest revenue agricultural product, accounting for over 16% of all agricultural cash and more than 2 million head of cattle in the state. As such, protection of the beef industry through the Tennessee Department of Agriculture is a paramount concern, in addition to the human risk that bovine communicable diseases pose. The identification in 2003 of a BSE case in Canada, and the subsequent identification later that year of a BSE case in the United States, which had been imported from Canada, led to the concern that indigenous transmission of BSE may be occurring in North America. From 2004 through August 2006, the evidence for such transmission in North America was strengthened by the confirmation of 9 additional indigenous North American BSE cases (seven in Canada and 2 in the United States).

Ports and International Gateways

Tennessee is home to 2 international airports, 1 in Nashville and the other in Memphis. This exposure, along with security breaches that have occurred in the state such as the Y12 breach in July of 2012, prompted the development and implementation of new tracking technology by TrakLok Corporation. This project was funded in part by Innova of Memphis, and through the Tennessee Investment Company Credit Act to better secure freight with flexible locking and container refusal times (e.g. while the cargo is still in transit before arriving at port). This significantly reduces not only the potential for terrorist activity, or unvalidated cargo, but allows for real time refusal to prevent the entry of communicable disease or biologic contamination in port before arrival. With almost 4 million tons of cargo arriving in Memphis annually this investment has measureable benefits that include safety and increased business due to reassurances by the state and port authorities.

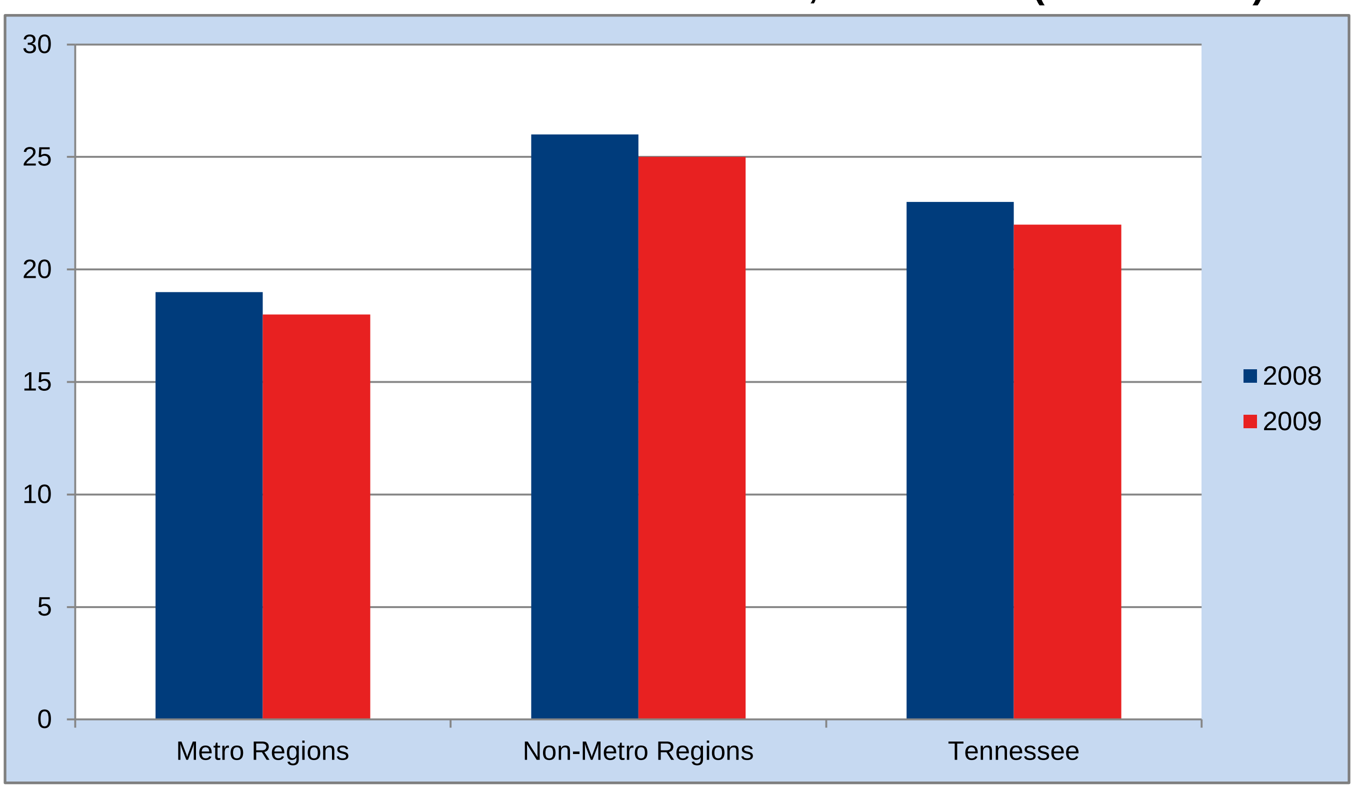
With borders on 7 states, importation or transport requirements for livestock include brucellosis and pseudo rabies for swine, National Poultry Improvement Plan certified flock certificate for poultry as well as a negative Pullorum-Typhoid test within 90 days, and Trichinosis tests for all bulls transported to or through the state.

3.3.5 – Historical & Potential Scenarios

Influenza

In 2012, Tennessee was listed by the CDC as one of the highest influenza burdened states in the nation. On average, 20% of the nation's population will contract the seasonal influenza every year. Tennessee carries a higher than average mortality and morbidity rate for influenza and associated pneumonia, with 20.9 per 100,000 compared with the national average of 16.2 per 100,000. In light of this burden, the Tennessee Department of Health maintains a Pandemic Influenza Response Plan, last updated in July of 2008. This plan outlines the response to a pandemic level influenza outbreak, and addresses state and local responsibilities in monitoring potential outbreak scenarios, as well as the economic impact of a given epidemic. At the time of writing this report, H3N2 is of greatest significance, though the ability for any influenza Type A to mutate into highly pathogenic forms is the most difficult facet of the disease. Regional disparities continue to be problematic for influenza vaccine distribution and compliance, as well as lack of access issues in rural areas. Urban vaccination rates are significantly higher than rural or suburban population rates. Thus, lower per capita mortality and morbidity can be assumed though transmission liability is higher in denser population centers. However, the CDC MMWR only maintains data for major metropolitan areas, as such, assumptions for flu cost and containment are made based on their Nashville, Chattanooga, Knoxville, and Memphis P&I rates combined with TDH Resident Death Certificate data for metro versus non-metro regions. The chart below demonstrates regional discrepancies and provides a point of reference for these in the state at large. Rates are deaths per 100,000 across all ages, race, and gender, from 2008 to 2009.

Chart 27 – Human West Nile Virus Cases, Tennessee (2008 – 2009)



** The data are from the Texas Department of Health.*

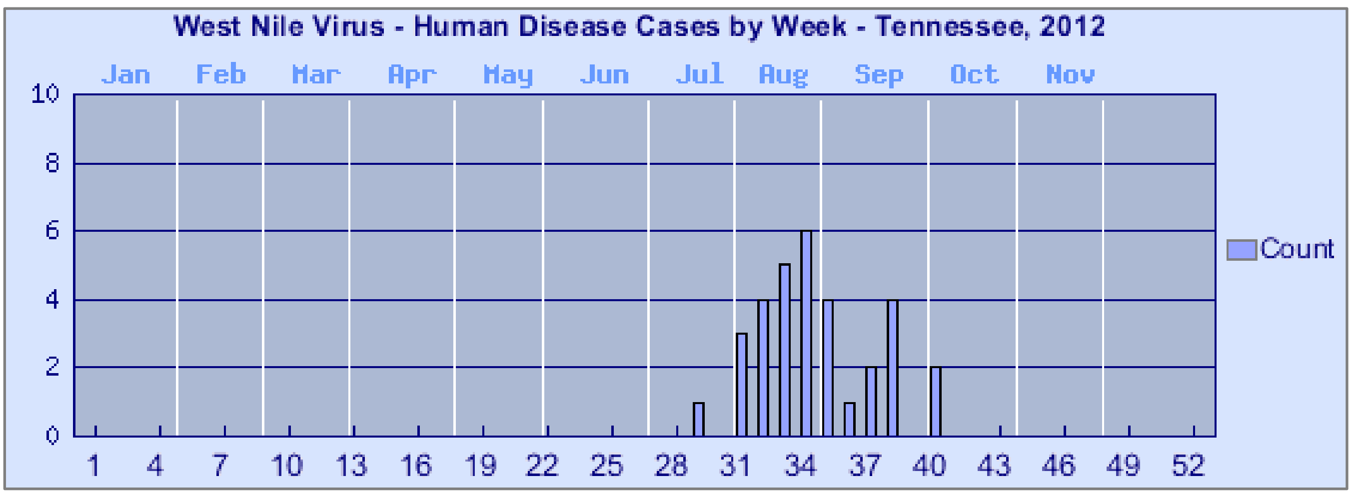
HIV/AIDS

The incidence of HIV/AIDS and their associated comorbidities (including tuberculosis) increased in Tennessee from 2006 to 2012 across almost all ages, sexes, and races, with the exception of diagnosed AIDS cases in 2011, which decreased markedly. The 2 are categorized separately by both state and federal agencies due to differing mortalities and comorbidities for each. HIV/AIDS mitigation efforts focus on Diffused Effective Behavioral Intervention programs (DEBI), Health Education and Risk Reduction programs (HERR), and prevention programs for HIV infected persons (HIV-IP) to each of 5 health regions throughout the state. Allocations are based on priorities identified in the Comprehensive Community Plan. Lead agencies in each region contract with community-based organizations within their regions, which are responsible for implementing interventions. Currently in Tennessee, 18 community-based organizations are funded to implement a wide-range of science-based HIV prevention programs.

West Nile Virus (WNV)

West Nile Virus is a mosquito-borne illness that saw record levels of infection in humans as well as animals in 2012, with Tennessee being no exception. The CDC documented 32 cases in Tennessee alone in 2012, with peak levels the fourth week of August as shown in the following chart

Chart 28 – West Nile Virus – Human Cases, Tennessee (2012)

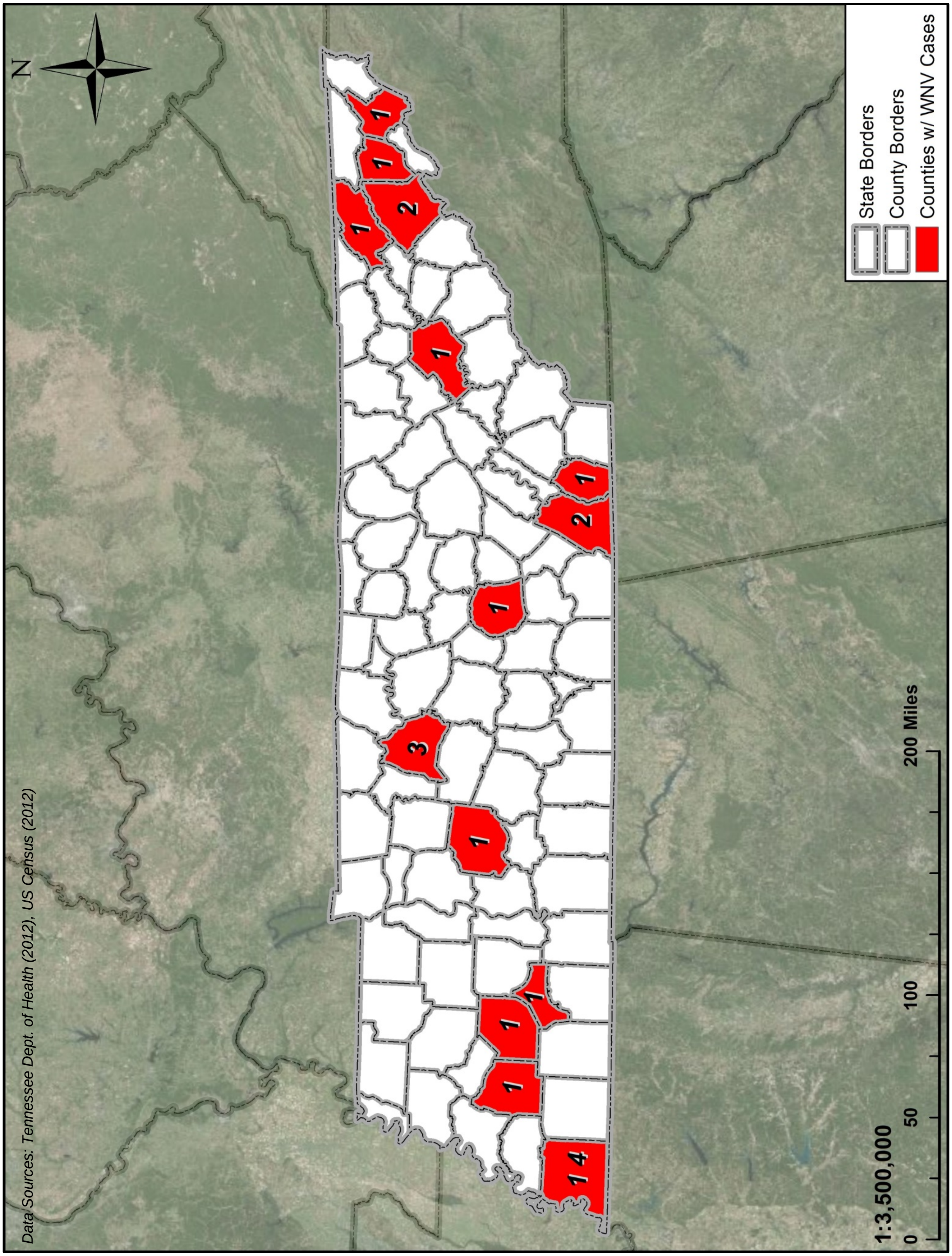


**The chart is provided courtesy of CDC.*

80% percent of individuals infected with WNV will not present with symptoms. The remaining 20% may experience a range of flu-like symptoms including but not limited to fever, headache, weakness, stiff neck, nausea, vomiting, muscle aches and pains, rash, and in some cases diarrhea, and sore throat. Less than 1 percent of individuals infected with WNV will develop acute illness. Persons over 50 years of age are at highest risk of developing the most severe form of the disease and persons over the age of 70 with other health problems are at greatest risk for death.

As is evident in the following map, WNV infections remain evenly distributed throughout the state. Eradication programs include vaccination of horses and veterinary tracking of vaccination records, as well as community programs to fog or disseminate pesticides over large bodies of stagnant water, and encouraging local residents to remove pools, tires, trash, and other breeding grounds for mosquitos, as well as maintaining good hygiene in standing supplies of water for bird baths, pet water bowls, and children’s pools.

Map 55 – Human West Nile Virus Cases by County, Tennessee (2012)



Rabies

As a viral infection that attacks the nervous system of any mammal and causes encephalitic inflammation, rabies constitutes one of the most persistent, yet preventable public health threats in Tennessee. The state mandates (TCA 68 – 8 – 1) the vaccination of all domestic dogs and cats age 6 months and older on an annual basis. Equine vaccinations are also key to control as horses are exposed in pasture to wild animal bites and feces, and are kept in close quarters in stable and boarding scenarios. These horses come into direct contact with humans through saliva and injury. In addition, the state deposits the ORV (oral rabies vaccination) Raboral VRG® into rural areas by crop dusting methods with aircraft and helicopters to passively vaccinate skunk, raccoon, and opossum populations. 2012 was the eleventh year these baitings occurred with widespread support for their successful reduction in rabid feral animal populations. Large scale kills and poisonings have also been used in Middle Tennessee for high carrier populations that are aggressive, such as coyotes and red tail fox. The “Rabies Control Manual” provided by the state details state level responses, local mitigation efforts, and ongoing monitoring techniques. Rutherford County continues to maintain the highest animal incidence of positive rabies tests, with the primary reservoir population being skunks. The Zoonosis Control Branch of the Texas Health Services Department is the only single repository in the nation for a comprehensive list of rabies-related human fatalities from 1947 through 2008, though TDH maintains state records. As an outbreak often involves bordering states, this data should always be compared to that in the Texas Health Services Database.

Influenza Zoonotic Strains

In 2012 and 2013, the WHO found human carriers of more virulent strains of avian influenza, including H7N9. Unlike H5N1 that raised concerns starting in 2003 and 2009, H7N9 does not manifest in a symptomatic way in poultry, making tracking the movement of the virus and containing it exceptionally difficult. These strains of influenza threaten poultry industry states, but also those states that border them. Multiple poultry producers operate large scale broiler plants in Chattanooga, Monterey, Obion County, Shelbyville, and Morrison, TN. The large footprint of Tyson, Perdue, Koch, and Pilgrims Pride and a growing number of independent mid-scale farms demonstrate the need for continued surveillance and intra-agency communication between the Department of Agriculture and TDH. Currently, these strains post a human health hazard. The economic impact of an outbreak could be difficult to mitigate once the virus is present. Large scale culls have so far been the only mitigation technique to prove successful against a virus that remains latent and asymptomatic for long periods of time. While reinsurance covers large-scale insurance claims by these producers, insurance does not encompass health care or tertiary expenses incurred by the state.

Tertiary Events

Hepatitis C

In 2012, the CDC revised its recommendations to include prophylactic screening for Hepatitis C for anyone born between the years 1945 and 1965. This screening is seen as paramount to reducing potential contamination in the blood supply as Hepatitis C is spread primarily through contaminated needles and drug use. Prior to 1992 blood supply screening techniques were not used resulting in Hep C being transmitted through blood transfusions and organ transplants.

Hepatitis A

The most common mode of transmission for Hep A is person-to-person, resulting from fecal contamination and oral ingestion, and contaminated shellfish. In 1995, a major outbreak of Hepatitis A occurred in Tennessee with Shelby County documenting over 80% of the diagnosed cases. In the fall of 2003, approximately 80 cases were attributed to a Hepatitis A outbreak resulting from ingestion of contaminated green onions at a restaurant in East Tennessee.

Hepatitis B

Hepatitis B is transmitted through blood or body fluids, semen, cervical secretions, and saliva. People with chronic HBV infection are the primary reservoirs for infection. With the exception of the year 2001, from 1995 to 2002, Hepatitis B acute cases steadily decreased. The prevalence of HBV infection among adolescents and adults is 3 to 4 times greater for black individuals than white individuals. Children born to Hepatitis B Surface Antigen positive women are at high risk of becoming chronic carriers of hepatitis B. If these children are administered Hepatitis B Immune Globulin and hepatitis B vaccine at birth, their chances of being protected from the illness are greatly increased. The result is the endorsement of this mitigation procedure by the TDH and the CDC.

3.3.6 – Economic Impact

Economic impact analyses from communicable disease events of any scale must take into account medical response, state and private resources, loss of production hours, and human resource drains. According to the Critical Infrastructure Assurance Office (CIAO), the Nation's Healthcare and Public Health (HPH) sector is an industry critical to maintaining resiliency during any major event. The HPH Sector constitutes 17% of the Gross National Product and protects all sectors of the economy from hazards such as terrorism, infectious disease outbreaks, and natural disasters. Because the vast majority of the sector's assets are privately owned and operated, collaboration and information sharing between the public and private sectors is essential to increasing resilience of the nation's HPH critical infrastructure.

The communicable disease events categorized by the CDC and the US Department of Labor as the most likely to adversely affect human performance are any and all strains of influenza. In a typical flu season, between 5% and 20% of the public contract influenza resulting in an average of 36,000 deaths. Pandemic flu viruses may cause illness in 20% to 40% of the population and cause more severe illness and deaths than ordinary seasonal influenza. A pandemic virus vaccine could take 6 to 8 months to produce in conjunction with CDC labs in Atlanta, limiting mitigation success in initial months of an outbreak. Because of this potential, the TDH and CDC consider influenza monitoring and reporting of critical importance.

In addition to agriculturally significant communicable diseases, Tennessee's unique horse industry makes it particularly susceptible along with bordering states like Virginia and Kentucky to the economic impact of WNV and EHV1 (Equine Herpes Virus), which are also human health threats. WNV and EHV1 were present in Shelby County at the time of this writing in 2013, and 32 cases had been confirmed as transmitted to humans in 2012 in all 3 regions of Tennessee.

3.3.7 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

The Tennessee Department of Health is responsible for public health at state and local levels in Tennessee during daily operations and during an emergency. This responsibility includes routine surveillance activities of regulated individuals or facilities as well as complaint or data driven investigations initiated externally, internally, or via other state or national agencies. The department is involved in the investigation of disease outbreaks, contact tracing to control the spread of communicable diseases, and activities to assess the risk of exposure. TDH maintains an electronic lab reporting system and public health case reports to the Department of Health system, which providers may participate in voluntarily (though it does not qualify for federal grants monies under meaningful use protocol). TDH tracks immunization rates through the Tennessee Immunization Registry, thus allowing them to maintain accurate reserves and adequate levels of vaccine stores for diseases that are preventable in the event an outbreak should occur.

Health and Safety of Personnel Responding to the Incident

TDH works with OSHA, CDC, and other state response agencies to ensure first responders and clinicians are afforded the protection they need when responding to an incident. State purchases of personal protective equipment follow the guidelines set forth in the Guide for the Selection of Personal Protection Equipment for Emergency First Responders, NIJ Guide 102—00, and is chosen to cover a wide gamut of threats and venues, including but not limited to biologic and communicable disease exposure risks.

Continuity of Operations

The State of Tennessee maintains the Continuity of Operations Plan, and Continuity of Government plans to efficiently and effectively respond to incidents that may temporarily interrupt the State of Tennessee's operations and responses. The TDH COOP includes the following parameters: After assessment of the magnitude of an event, command decisions that directly affect public health will be made by the Tennessee Department of Health, State Medical Officer (Emergency Services Coordinator) at the State Emergency Operations Center (EOC). While communicable disease and biologic events may have limited effects on property, facilities, and infrastructure, the demands on this infrastructure must be taken into accounted in economic impact analyses. The TDH physical facility is located at 426 Fifth Avenue North, in the Cordell Hull Building, where the Bureau of Health Services and Emergency Medical Services (EMS) reside. During a public health emergency or significant event, staffing can be augmented. These facilities can also be augmented via satellite locations while continuing to operate and accommodate the increased number of samples for testing.

Continued Delivery of Services

TDH has organizational plans allowing for restructuring of responsibilities and resumption of operations within a 24-48 hour window.

Environment

Biologic threats often require environmental mitigation; this can include but is not limited to large-scale evacuation or population removal for public use. These actions require emergency orders and require inspections from the local health departments, cooperating agencies, and/or the TDH.

Economic Condition

The economic and financial impacts of public diseases will vary depending on the cause of the epidemic or event. A food borne or water borne outbreak could have a large impact on the economic and financial status of the Tennessee farmers and retail businesses. Specific data regarding economic impact can be found in Economic Impact Assessments.

Public confidence in the jurisdiction's governance

Key to the effectual mitigation of any public health threat is public cooperation and trust in the mitigation efforts themselves. Because of this, it is vital that coordinating agencies maintain open lines of communication to facilitate a unified message and response to public questions and concerns in a timely and effective manner. Lack of public cooperation can extend the time it takes to respond to an emergency, and increase the economic impact significantly.

3.3DLF – Dam & Levee Failure

A dam is a barrier across flowing water that obstructs, directs or slows down the flow, often creating a reservoir, lake or impoundments. Most dams have a section called a spillway or weir, over or through, which water flows, either intermittently or continuously.

Dams fail in 2 ways, a controlled spillway release done to prevent full failure, or the partial or complete collapse of the dam itself. In each instance an overwhelming amount of water, and potentially debris, is released. Dam failures are rare, but when they occur can cause loss of life, and immense damage to infrastructure and the environment.

Common reasons for dam failure are the following:

- Sub-standard construction materials/techniques
- Spillway design error
- Geological instability caused by changes to water levels during filling or poor surveying
- Sliding of a mountain into the reservoir
- Poor maintenance, especially of outlet pipes (Extreme inflow
- Human, computer or design error
- Internal erosion, especially in earthen dams.
- Earthquakes

3.3.1 – Location & Extent

Dam failures can occur with little warning. Intense storms may produce a flood in a few hours or even minutes from upstream locations. A dam failure can occur within hours of the first signs of breaching. Although the floodwaters will drain, the area will be affected by flooding from the dam failure for days to weeks and the destruction will affect the area for years.

Tennessee has a total of 99 dams and levees within its borders containing an average total of 8,301,075 acre-feet or water with a maximum total capacity of 1,7551,438.5 acre-feet. Table 41 on the following page lists a complete dam inventory for Tennessee. Map 56 depicts dam locations sized according to their maximum water holding capacity.

The USACE and the TVA profile 3 potential inundation areas as dam failures of prime concern. These are the Center Hill Dam in middle Tennessee, the Wolf Creek Dam in southern Kentucky, and the Tellico Dam in east Tennessee. Maps 57 through 60 depict the inundation studies for these dams as developed by the USACE and the TVA.

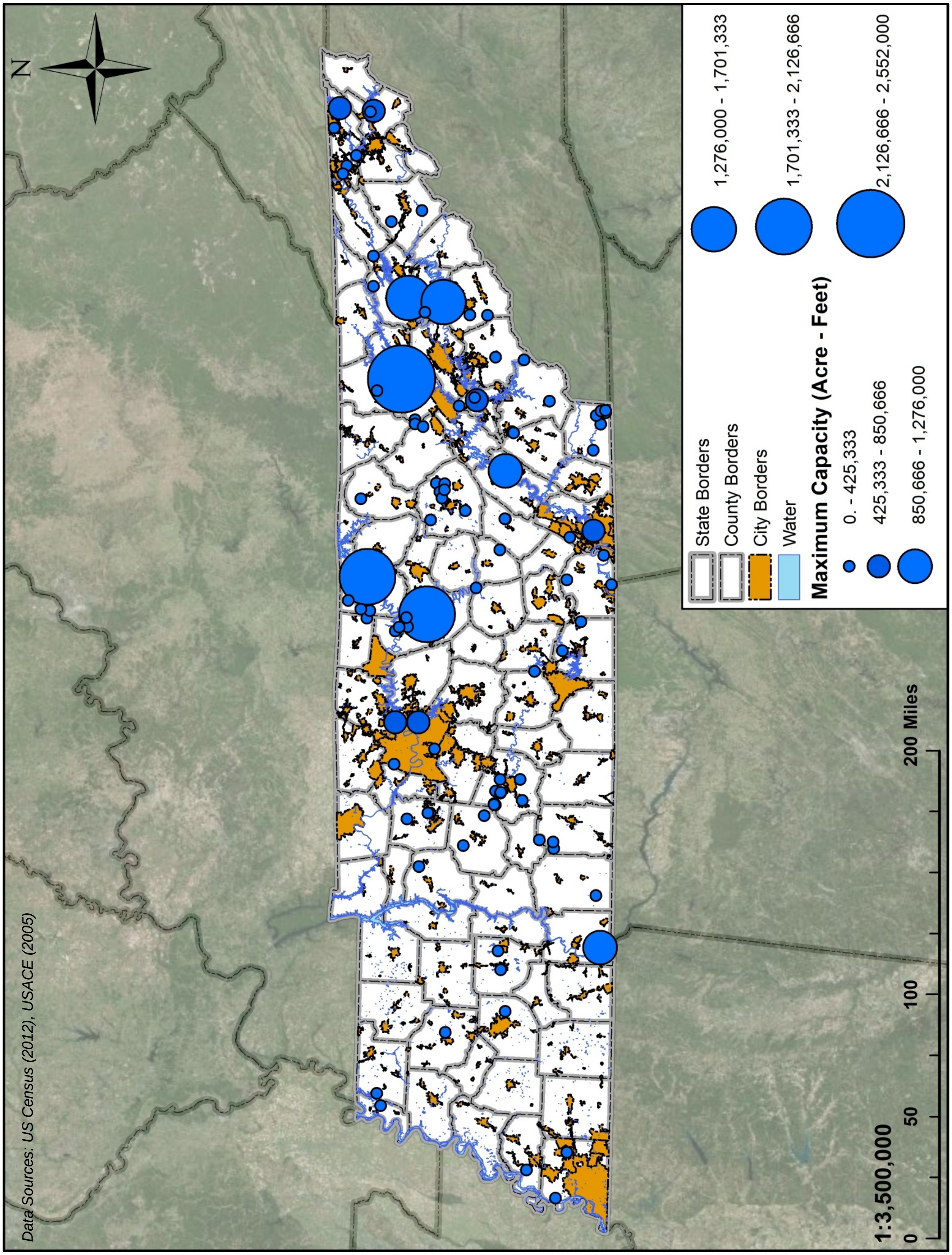
Table 41 – Dam & Levee Inventory, Tennessee			
Dam/Levee Name	**Year Built**	**Maximum Storage (Acre-Feet)**	**Average Storage (Acre-Feet)**
Nickajack	1967	251600	220100
Gypsum Pond	1972	1270	750
N. Potato Creek Diversion	1979	4100	0
London Mills Tailings Pd	1944	2416	800
Raccoon Mountain	1978	37310	2200
Ocoee No. 3	1942	4180	551
Pickwick Landing	1938	1105000	687300
Campbell Cove	1963	2430	1394
Ocoee No. 1	1911	83300	52270
Weatherford-Bear Creek 1B	1970	4600	200
Chickamauga	1940	737300	392000
Jackson	1968	674	460
Lakeland	1950	8711	5617
Boston Branch	1968	478.2	333
Tn Consolidated Coal #1	1976	1342	20
Elk River Dam	1952	101844	77915
Poplar Tree	1952	2255	1535
Tellico	1910	942	402
Laurel Hill Lake	1970	9400	3800
Vfw Lake	1951	467	353
Chief Creek	1970	3130	1520
Normandy	1976	126100	65600
Glenn Springs	1993	9450	5399
Calderwood	1930	0	41100
Rhone Poulenc #21	1980	4600	550
Old Columbia	1925	0	1000
Sweetwater Creek #16	1978	213	46
Sweetwater Creek #15	1979	492	82
Watts Bar	1942	1175000	796000
Twin Lakes #2	1969	282	220
Twin Lakes #1	1969	124	76
Lake Graham	N/A	13841	6451
Lambert	1965	454	361
Beech	1963	15400	7350
Fall Creek Falls	1970	9393	6100
Solutia #2	1962	262.9	20
Solutia #11	1962	2012	500
Occidental Chem #10	1965	1838	1758
Pin Oak	1964	12700	7560
Solutia #15	1977	32945	23614
Lake Marian	1958	114.3	80
Shellcracker	N/A	2508	2205
Goldeneye Lake	N/A	1200	981

Dam/Levee Name	Year Built	Maximum Storage (Acre-Feet)	Average Storage (Acre-Feet)
Bluecat Lake	1979	5,760	4,200
Littlelot Washer Plt #1	1950	449	64
Tellico	1979	467,600	304,000
Fort Loudoun	1943	393,000	282,000
Hidden Mountain #2	N/A	66	62
Great Falls	1916	50,200	14,500
Tansi	1959	16,000	12,300
Melton Hill	1963	126,000	94,100
Crystal Lake	1989	1,756	1,382
Douglas	1943	1,461,000	210,000
Gibson County Lake	1999	12,701	7,338
Glastowbury	1979	2,880	2,400
St. George	1965	2,400	1,801
Fox Creek Lake	1966	2,590	2,340
Otter Creek	1995	5,227	3,808
Dartmoor	N/A	6,070	4,000
Radnor	1914	2,035	1,132
Nolichucky	1913	2,003	1,507
Caryonah Lake	1970	465	297
Young Mill Tailings Impoundment	N/A	15,450	0
Creech Hollow Dam	1973	2,098	1,490
Acorn	1939	715	370
Center Hill Dam	1951	2,092,000	1,330,000
Brushy Mountain	1949	139	68
Gum Branch Slurry Dam	N/A	250	0
Gum Branch	1982	2,025	1,134
Hooper	1999	0	0
J Percy Priest Dam	1967	652,000	202,000
Cherokee	1941	1,541,000	393,000
Elmwood Tailings	N/A	9,500	0
Norris	1936	2,552,000	630,000
Laurel	1975	1,895	1,489
Cheatham Dam	1954	104,000	8,4200
Big Ridge	1936	1,100	1,027
Savage Zinc Tailings Pond	1974	3,900	250
Cordell Hull Dam	1973	310,900	258,000
Old Hickory Dam	1954	545,000	420,000
Marrowbone	1939	1,670	510
Watauga	1948	677,000	324,000
Wilbur	1912	715	388
Reelfoot Lake	N/A	0	33,500
Pond No. 1A	N/A	493	0
Eblen-Powell #2	1964	808	385
Clinch Valley "A"	1992	1,704	1,363
Reelfoot-Indian Creek #18	1988	5,289	855
Jennings Creek #18	1963	1,260	125

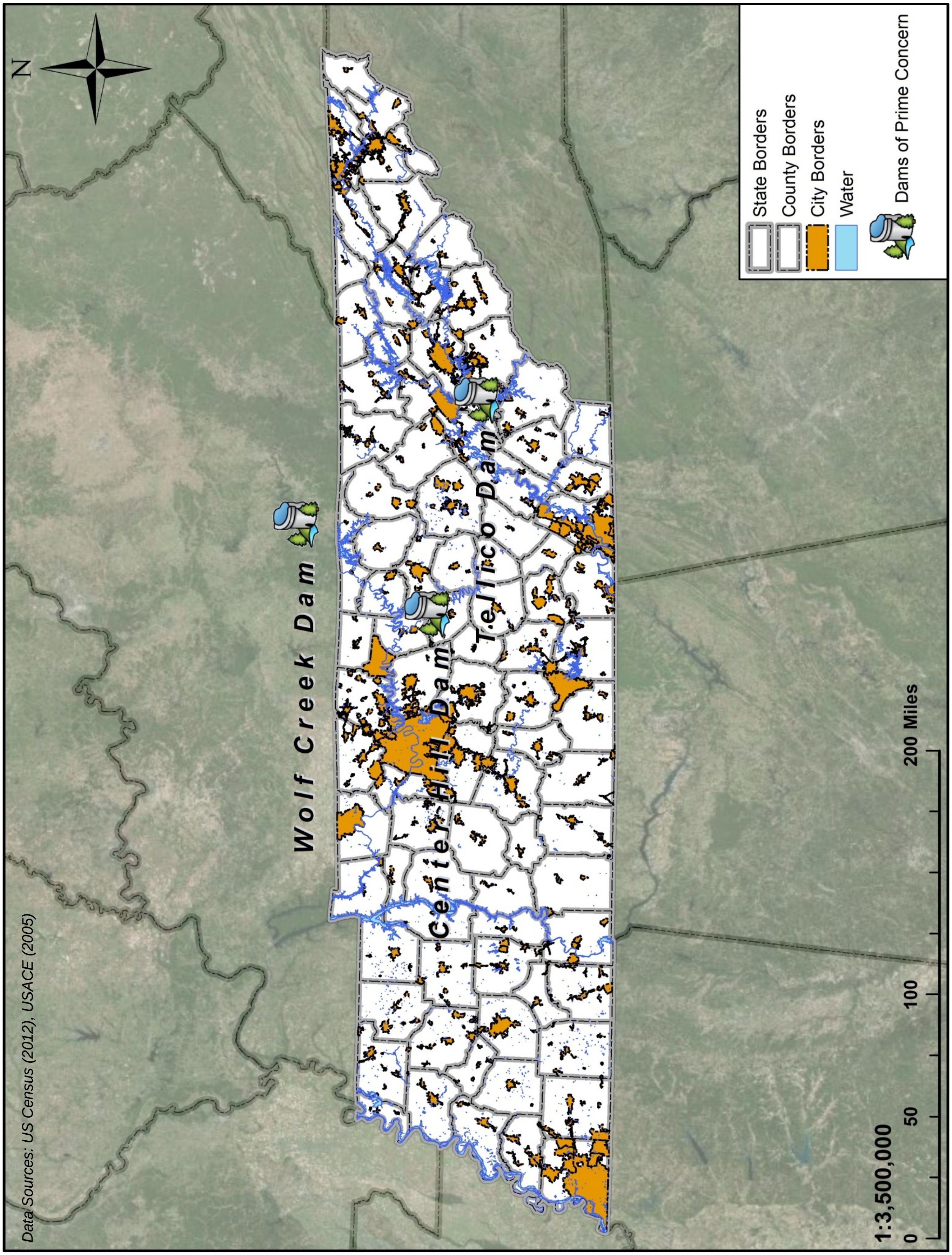
Dam/Levee Name	Year Built	Maximum Storage (Acre-Feet)	Average Storage (Acre-Feet)
Boone	1952	193,400	45,000
Dale Hollow Dam	1943	1,706,000	857,000
Jennings Creek #17	1962	1,930	137
Whispering Winds	1976	1,492	1,492
Jennings Creek #13	1961	400	20
Fort Patrick Henry	1953	26,900	22,650
South Holston	1950	764,000	325,700
B Bend Hollow	1997	1,090	500
Steele Creek	1963	1,989	528
Line Creek #3B	1965	1,446	90

**The data are from the USACE's National Dam Inventory.*

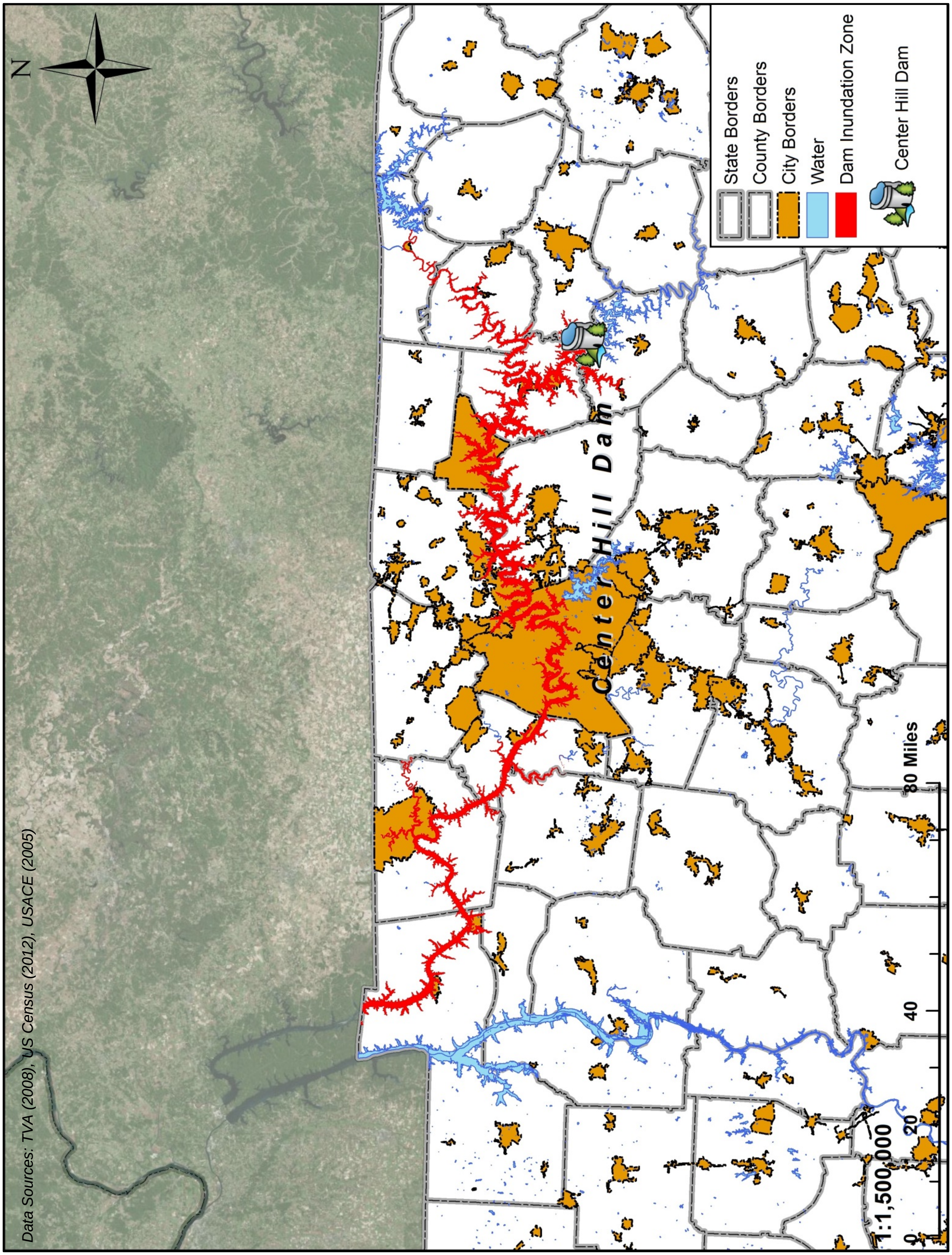
Map 56 – Dams & Levees by Maximum Capacity (Acre – Feet), Tennessee



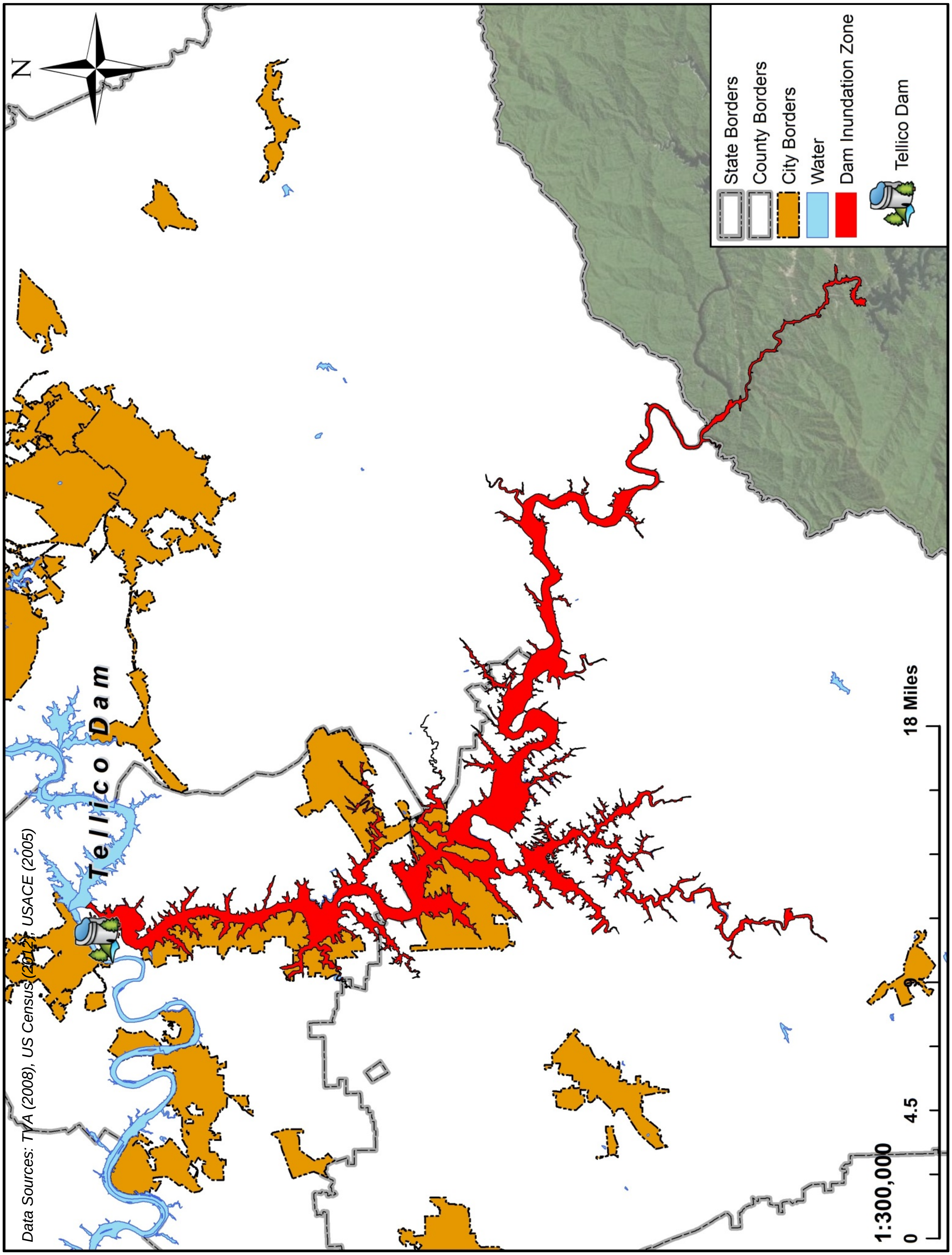
Map 57 – Dams of Prime Concern, Tennessee



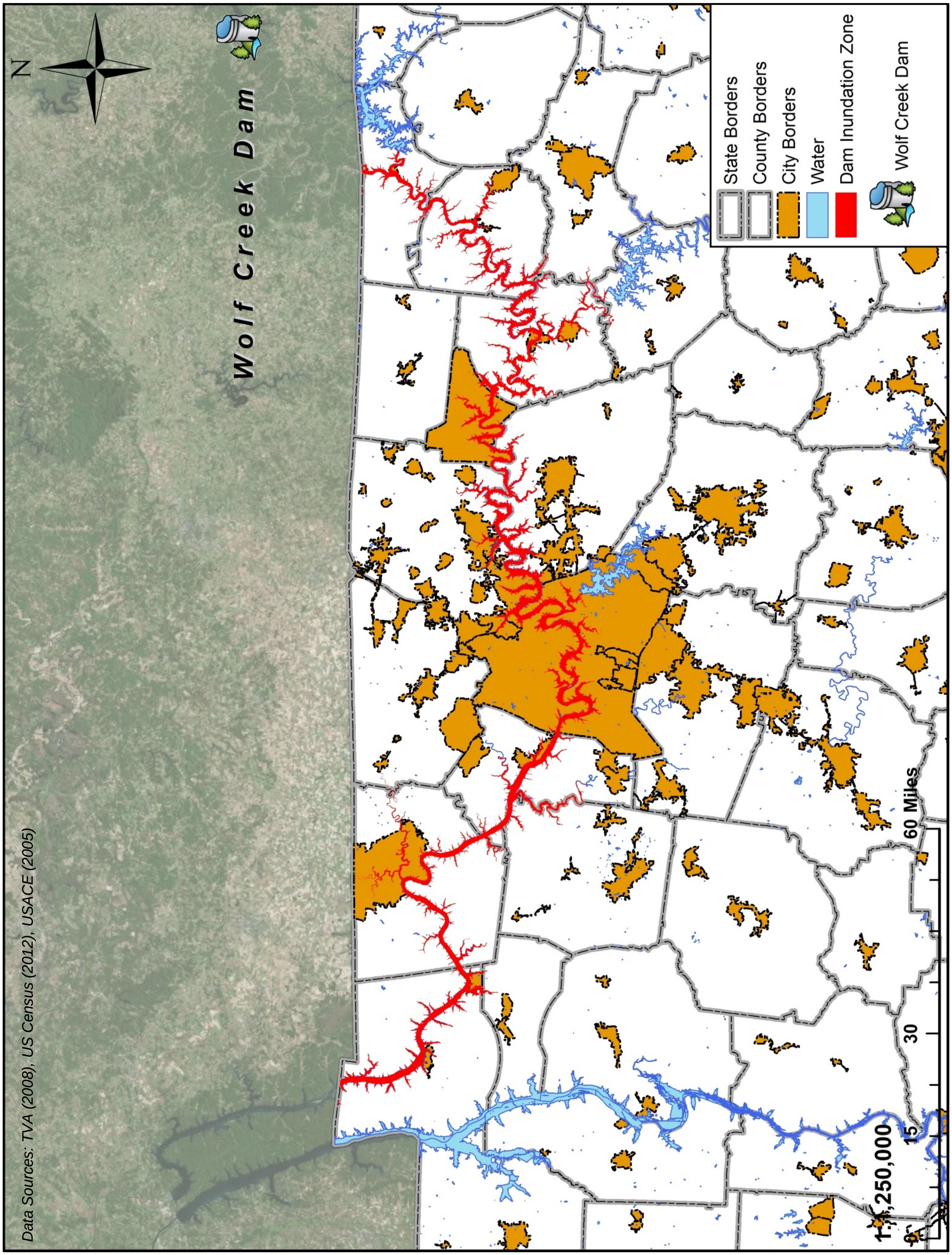
Map 58 – Central Hill Dam Failure Inundation, Tennessee



Map 59 – Tellico Dam Failure Inundation, Tennessee



Map 60 – Wolf Creek Dam Failure Inundation, Tennessee



3.3.2 – Previous & Future Occurrences

Tennessee has been fortunate enough to not have any catastrophic dam failures throughout its history. Below are the only recorded dam and levee failures in the state.

Historic Event – Dam/Levee Failure – December 2008
50 miles west of Knoxville, the TVA owned and operated levee gave way to 5.4 million cubic yards of sludge, a coal ash slurry. The levee was containing a 40 acre industrial waste pond for the Kingston Coal Plant. The industrial waste cleanup operations cost an estimated 1 million dollars.

Historic Event – Dam/Levee Failure – August 1916
An unnamed dam in Claiborne County gave way to heavy rainfall. No one was injured or killed, but an estimated $50,000 to $100,000 (in 1916 dollars) was incurred in property damage.

Historic Event – Dam/Levee Failure – November 1912
A Nashville city reservoir gave way to seepage dumping 25 million gallons of water into Nashville. No one was injured or killed. Property damage estimates are not available.

3.3.3 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

The primary concern with any dam or levee compromise or full breech is loss of life due to flooding or infrastructure damage. While the public assumption is that heavy rains and surface water are prime instigators of dam failure, the most common causes are 1) structural failures (approximately 30%) including slope instability and damage from earthquakes, 2) mechanical malfunctions of gates, or obstruction from sediment in conduits and valves, and finally 3) hydrologic design insufficiency, e.g. overtopping because of spillway blockage or settling of dam crest. For emergency planners, these typical failures represent more mollifiable risks with more lenient time frames for those persons living or working in the affected area before and during an incident. Even planned releases however create challenges for protecting the welfare of those in the immediate area: adequate public notice and communications infrastructure is paramount for both planned and emergency evacuations. FEMA issued FIRMS (Flood Insurance Risk Maps) serve as guides for the potential areas affected by inundation subsequent to failure. In rural areas where many dams, power plants and levees are located, contacting property owners can be a challenge. Both the TVA and USACE maintain teams and Type 1 assets ready for door-to-door delivery of evacuation notices, with designated teams for areas at risk of radiologic consequences (Watts Bar and Sequoyah Nuclear). These specific regions are broken into response team zones based on proximity and calculated nuclear fallout from a core reactor epicenter. The emergency planning zone includes a 10 miles radius, while the ingestion pathway zone extends to 50 miles from a given plant. Rhea County also provides community based volunteer teams to assist the TVA in defense of the Watts Bar facility and report directly to emergency responders and FEMA ESF-9 Urban Search & Rescue teams about potential casualties or injuries. FEMA and the EPA have jointly developed Emergency Response Plan standards mandating that all private dam owners and operators develop and internally publish said ERPs. While any dam release can have devastating effects, those with long term repercussions typically include the release of toxic waste slurries secondary to coal power production or those that involve municipal waste water treatment facilities.

Radiologic contamination is an acknowledged risk with dams linked to nuclear power facilities, as well as those facilities that are located in inundation zones; in particular, those located in proximity to large suburban or residential areas require faster response plans and more refined ERPs as asphalt and concrete infrastructure accelerate water and fluid speeds over terrain lacking trees, grassland and other topologic barriers. The USACE estimates ground speed for every 1 acre/foot of water released as traveling over level ground at 223 feet per second initially, or covering 1000 square meters over the course of 24 hours. Further, asphalt acts as an absorptive medium for specific high value uranium such as U-238 and U-235, and poses a persistent risk after exposure.

Health and Safety of Personnel Responding to the Incident

Lessons from the coal ash spill at Harriman on December 22, 2008 have been applied to other TVA and Army Corps of Engineers operations. During this event, standard equipment issued to contractors responding to the scene with D6, D9 Catepillars and less than 260hp motors proved inadequate to the weight loads and volume of liquefied earth. Joint operations request protocols are now in place with Forestry, TDOT and other agencies to more quickly distribute the necessary DHS Type 2 and 3 assets. The initial assessment of heavy metal toxicity, and other contaminants may not be accurate in the first hours of response, as some will precipitate out of slurries, some will chelate, and additional contaminants will be picked up and carried with moving surface waters (municipal water treatment plants and their chemical and biohazard contents are of particular risk to first responders). The simple sediment that often precipitates mechanical failure in a dam or levee is itself toxic in many cases. Decades of upstream source contaminant accretion without leachate release can lead to levels of hydrogen sulfide, arsenic and copper, and Polycyclic Aromatic Hydrocarbons. These can have particularly severe results for first responders, but also for livestock and cropland downstream from the release or floodway. Crop damage and long term soil deterioration often account for upwards of 75% of the economic impact. Sediment sampling is a common practice in most states with dense dam distribution for better understanding of the potential contaminants that would be released in the event of failure. To date, the TVA has not developed a comprehensive program to monitor these risks, though USGS, the EPA and TDEC have coordinated efforts to monitor the suspended-sediment content counts along major waterways and dams throughout the state.

Continuity of Operations

Of those dams in Tennessee, the majority are owned and maintained by the TVA; however Department of the Interior, Army Corps of Engineers and Department of Agriculture also share in the operation and maintenance of certain dams. Coordination between these agencies is paramount to continued operations (nuclear, hydroelectric, or floodway control) during an event. The EPA and TDEC offices maintain emergency service and COOP plans, along with surge staff and emergency assessment teams designed to respond to a variety of disasters specifically affecting water quality, supply and the impairment of other public sector services.

Continued Delivery of Services

Of primary concern for services impacted by dam or levee failure are electric delivery and water supply. The following agencies are responsible for the evaluation of water quality subsequent to an event: EPA, TVA, TDEC, Tennessee Department of Agriculture, Department of the Interior, and the US Department of Agriculture. In the event of grid disruption, municipal regulators and the consolidated districts are responsible for coordinating with TVA, grid technicians and local emergency responders to assess where electricity supply can be safely delivered, but is also most urgently needed.

Dam and levee failure impacts not only floodway control and electricity delivery in Tennessee but barge and water based cargo traffic. The lock system that controls access from the Mississippi, Missouri, and Ohio Rivers as they run into the Cumberland and Tennessee Rivers is also particularly vulnerable to dam or levee functional interruption. These inland waterways (Cumberland and Tennessee Rivers specifically) deliver coal to other power plants thus maintaining efficient energy supply, they also safely transport hazardous waste, lumber and any number of durable goods too heavy for efficient roadway transport.

Environment

The chemical content of sediment released from dam or levee failures can have particularly severe results for livestock and cropland downstream from the release or floodway. While crop damage and long term soil deterioration account for upwards of 75% of the economic damage from dam failure the total economic assessment may not be known for 1 to 3 crop cycles, and soil remediation and replacement may be necessary.

Dams themselves constitute unique ecosystems with microclimates which support a myriad of domestic and migratory populations. Dam events have the potential to significantly disrupt surrounding ecosystems by disturbing or displacing populations that have established themselves around those water bodies. Fish populations in particular must be dealt with carefully, as migration and spawning are directly affected by planned and emergency releases, with locks enabling fish to swim to spawning grounds and cross dam barriers with relative ease. Many hydroelectric companies in the US have obtained grants from the EPA and the BLM to construct fish lift locks along major waterways, to prevent significant damage to fish populations in the event of a dam failure or planned release, though to date no systemic accommodations have been made in Tennessee.

With 40% of the United States' coal ash impoundments located in the Southeast, 9 of these have the potential to directly affect Tennessee, and the environmental exposure for any compromise of the following dams' structure is significant. The following table lists those impoundments (7) legally inside of Tennessee's borders with total amount of ash slurry stored:

Table 42 – Slurry Ash Storage, Tennessee	
Name	**Slurry Ash (Gallons)**
Gallatin Power Station	2,985,776,639
Cumberland Fossil Plant	6,988,535,588
Johnsonville Power Station	880,450,560
Watts Bar Fossil	46,596,754
Kingston Power Station	2,996,855,588
Bull Run Power Station	2,245,768,046
John Sevier Power Station	1,009,813,577

Economic Condition

Both the mitigation efforts surrounding dam protection and response required in the event of a dam or levee incident have the potential to strain even federal budgets. State responsibility for adequate planning in the immediate vicinity of a dam or levee and its resources are significant. As sources of hydroelectric power, water reservoirs, mechanisms for flood control and public recreation land, the repercussions of failure or compromise can be fiscally devastating. The impact can extend to property values depreciating (as in the case of Harriman, TN and the ash slurry) and entities such as the TVA needing to purchase unusable homes and farm land as occurred in 2007. The estimated cost for this incident had exceeded 1 billion dollars by 2010, with no definitive end to remediation in the extended area.

The economic exposure of dam production value cannot be overstated: the USACE produces $40 million in annual revenue with 3.4 billion hydroelectric kilowatt hours from 28 generators at 9 plants in the Cumberland River Basin.

Economic investment in surveillance activities for both dam condition and contents are critical, the Bureau of Reclamation has devoted 2.2 million dollars since 2007 to securing and managing emergency action plans across its infrastructure and devoting funds to mitigation as well as response plans. This is funded in part by the Dam Safety and Security Act of 2002 (P.L. 107-310). These funds remain available for better securing dams across the United States.

Public Confidence in the Jurisdiction's Governance

The public relations strain surrounding the announced release, redaction, and then reissue of the Wolf Creek Dam failure model in 2007 for the Nashville District of the USACE highlights some of the challenges in garnering and retaining public trust in mitigation activities and responses in the event of a failure. Infrastructure failures are particularly difficult because of their public nature and the assumption of government maintenance responsibility. Catastrophic events like the Teton Dam collapse in Idaho or the Harriman coal-ash spill only serve to undermine future trust in government response. Collectively, government agencies only own 3,225 dams in the United States, many more are owned, partially owned or operated by private corporations or entities. 11,000 are owned by local or municipal watershed districts. Comprehensive programs where the TVA or other agencies have purchased homes damaged by an event, or SRL properties that have a high likelihood of being damaged in the future, improve public confidence in response and mitigation activities. Making residents aware through enforced regulations surrounding property disclosures at time of sale, and thus aware of their overall risk, will help the public better understand events when they occur.

3.3HZMT – Hazardous Materials Release

3.3.1 – Description

Hazardous materials are any substances that pose a risk to health, life, or property when released or improperly handled. Generally, the term refers to materials with hazardous chemical or physical properties, though sometimes biological agents can fall under this category. The hazardous properties can be combustible, flammable, toxic, poisonous, corrosive/severely acidic, reactive, radioactive, or noxious. Though EPA, DOT, and OSHA categorize these in different ways, a basic distinction among hazardous substances is their persistence in the environment and respective levels of health risk that these pose. A release of a hazardous material can be caused by a spill, leak, explosion, pipeline break, transportation accident, or human action. If the material has escaped its container into the outside environment, a potentially hazardous situation exists.

Hazardous materials are so widely used, transported, and stored, often in large quantities, so a spill or other event could happen nearly anywhere in the state. Because of the ubiquity of hazardous materials, risk mitigation requires cooperation among state agencies, the EPA, OSHA, DOT, and many private and public corporations.

3.3.2 – Scope of Threat Management

By EPA classification, hazardous substances are generally materials that “if released into the environment, tend to persist for long periods and pose long-term health hazards for living organisms. Hazardous materials present acute health hazards that, when released, are immediately dangerous to the lives of humans and animals and cause serious damage to the environment.” The major categories of chemical/material hazards are classified according to their predominant effects−corrosive, flammable, toxic, irritant, or explosive being the essential classes. These properties may overlap, and commonly do with chemicals used in industry, agriculture, and energy. While over 500,000 substances are considered HAZMATs, a few thousand products account for common hazards. Many of the costlier hazardous substance incidents in the United States are petrochemical in makeup, but event reports indicate that substantive numbers of accidents involving all major chemical classes occur regularly. Deadly explosions at chemical plants occur with some regularity in Tennessee. When facilities have hazardous materials in quantities at or above the threshold planning quantity, they must submit “Tier II” information to appropriate federal and state agencies to facilitate emergency planning.”

The basic types of hazardous materials may be categorized according to more than 6 different systems; but the categories of U.S. Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11002) will be used here.

Extremely Hazardous Substances
These materials have acutely toxic chemical or physical properties and may cause irreversible damage or death to people, or harm the environment if released or used outside their intended use. Common examples include ammonia, chlorine gas, sulfuric acid, formaldehyde, hydrocyanic acid, nitrogen dioxide, phenol, phosphorus trichloride, and polyvinyl acetate. Radioactive materials are extremely hazardous.

Hazardous Substances

These are any materials posing a threat to human health and/or the environment, or any substance designated by the EPA to be reported if a designated quantity of the substance is spilled into waterways, aquifers, or water supplies or is otherwise released into the environment. Many common fuels and most petrochemicals fall under this list.

Additionally, some materials require registration if present in chemical facilities above the threshold quantity. These *hazardous chemicals* require a Material Safety Data Sheet under the Occupational Safety and Health Administration Hazard Communication Standard. These chemicals might cause fires and explosions or adverse health effects such as cancer, burns, or dermatitis, but they are not necessarily dangerous or volatile in all quantities. *Toxic chemicals* cause disease with long term exposure or chronic illness above a certain threshold exposure. This includes carcinogenicity.

The ATSDR and CDC both keep a list of hazardous materials ranked for hazard planning purposes. It is ranked according to a material's use, ubiquity, toxicity, and the likelihood of exposure. The list is provided in Addendum II. These are mapped along with known aquifers that supply large numbers of residential wells, municipal sources, known floodways and FEMA flood zones. General inferences as to the risk of cross contamination and transmission of the compound can be made from these maps, though for specific risk TDEC registry or coordinating agency of response and their information should be consulted.

Hazardous materials incidents can occur at the factories, laboratories, refineries, and storage facilities where such chemicals are present. But incidents can also happen during transportation, loading and unloading, and pipeline transport. Contributing and/or causal factors include human error; natural hazards such as earthquakes, tornadoes, floods, and lightning strikes; automobile and railroad accidents; power outages; electrical fires; computer malfunctions or server breakdowns. The scope of damage to persons, property, and economy is vast, though impact can often be contained with quick response by trained teams. The quantity, chemical, and physical properties of the material involved in an incident determine the scope of threat, but weather during and after the incident, location, proximity to human and wildlife populations, to rivers and lakes, and to major ecological vulnerabilities must be considered in assessing the scope of the threat posed.

Hazardous materials may also be released as a secondary result of a natural disaster like floods or (in lower probability event in TN) an earthquake. Buildings or vehicles can release their hazardous material contents when they are structurally compromised or involved in traffic accidents. Pipelines can be exposed or ruptured from collapsed embankments, road washouts, bridge collapses, and fractures in roadways.

Prevention and mitigation of a hazardous materials incident comprises analysis with different measures of the threats that exist in specific categories per region or locality. These sometimes overlap, but must be considered separately when possible to determine the best allocation of resources and response strategies should a HAZMAT event occur. The basic planning categories of hazard, vulnerability, and risk apply to hazardous materials preparation. In this context, the hazard category includes the nature of the chemicals present and the locations where an incident is likely; the vulnerability describes what damage might occur, the range of the impact, and what types of incidents are possible in a given community or region; The risk analysis assesses the probability of damage (or injury) that would occur in the community if a hazardous material were released and the actual damage (or injury) that might occur, in light of the vulnerability analysis

3.3.3 – Governing and Coordinating Agencies

TDEC is the coordinating and primary agency responsible for mitigation strategies and surveillance programs. However, first responders, hospitals, the CDC, TDH and TDOT maintain supplies, strategic stockpiles and assets that are in many cases, deployed during a HAZMAT event. These agencies input in mitigation planning are not only germane but essential to effective strategies that utilize all available resources. They coordinate responses to hazardous materials events, report directly to the EPA and inter-state agencies when necessary. With almost 3,000 employees and a budget of over $357 million, TDEC maintains one of the largest footprints of any state agency, with employees in every county, municipality, and region of the state.

Directly supporting private integration of mitigation strategies, TDEC maintains the Fleming Training Center in Murfreesboro. This center offers cutting-edge technology and advanced classes in a variety of water areas to assist certified operators with ongoing training and services as they complete their continuing education requirements. It educates and certifies thousands of treatment plant and water management staff every year throughout the state. The plans and certifications this program supports directly enable private contractors and companies to coordinate with the state to facilitate mitigation planning, surveillance, and response.

Pre-emergency / Notification

Once a HAZMAT incident is suspected, TDEC, municipal and regional authorities are notified, as well as any necessary supporting agencies. Pre-emergency, the state may allocate a first response responsibility to a dedicated team or set up several such teams. If a spill, accident, or fire occurs, the firefighters or other first responders will alert the HAZMAT Emergency Response Teams. If a suspected incident occurs (someone smells gas or reports strange substances in a street, a building, etc.), a preliminary HAZMAT emergency response team evacuates the site and conducts an inspection.

Notification via local responders, the 911 call operator, or other mediums should be directed to TEMA, which then can decide to activate the Emergency Response Team; then notification goes to the National Response Center, OSHA, TN State Police, and the DOT and/or CDC, if indicated. Typically, after the initial 911 call, local first responders, (fire or police), will arrive on the scene and evaluate the incident.

Emergency Response Teams

Emergency Response Teams are assembled for each region of the state by population. Each team requires an on-site commander, who should be chosen in coordination with TEMA and relevant state agency officials. Typically this person is an official with experience of environmental and chemical dangers. The commander should activate an emergency response plan, gather the team, designate the initial perimeter for entrance, evacuation, and the like. If the team is of the first responders, they should also decide the evacuation range. If the fire department personnel are first responders, the emergency response teams must coordinate with them. The commander of the response team is responsible for the placement of the staging area for equipment, personnel, and medical resources, if needed. He or she should also assign the remaining staff and determine the relationship of the team to other responders.

The team should also include members with a minimum of 160 hours specialized training per EPA guidelines. Technicians familiar with decontamination and cleanup should be included in all team planning, drills, and notification schemes.

When a Regional Hazardous Materials ERT arrives on the scene, their job is to provide technical resources to the incident commander, whether this person is a local, federal, or the state-appointed HAZMAT team commander. The local first responder retains incident command in small, containable situations. If the incident is large enough to require a unified command, the team leader becomes a part of that structure. The regional teams are responsible for mitigating and containing the incident. Once the situation is stable, the Department of Environmental Quality is responsible for working with the responsible party to assure cleanup of the incident is completed appropriately. A full team may not respond in every instance. The system provides for a tiered response ranging from technical advice over the phone, to on-site reconnaissance, then to a full team response. Specialized considerations should include stress management, supplemental air purification systems and other respiratory support, and sufficient personnel for large incidents to allow for 3 daily shifts.

3.3.4 – Locations

The threat of a spill, leak, explosion, or hijacking affects the entire state of Tennessee. Many chemical plants, particularly in the eastern half of the state, store and process hazardous materials in bulk. But the major transportation routes passing through TN ensure that chemicals from across the United States pass within state borders not directly regulated by the state of Tennessee or its agencies. Interstates 65, 40, 24, 75, and 81 all pass through Tennessee, and transport of hazardous materials on these highways occurs continually. The Illinois Central Railroad passing through western Tennessee along the Mississippi river valley, along with rail lines operated by CSX and by the Norfolk Southern Railroad, carry carloads of hazardous materials in varying quantities throughout the state. Furthermore, the agricultural supply chain involves the transport of fertilizers and other explosive and incendiary chemicals. Natural gas and petrol transportation is ubiquitous on the highways and railroads. There is regular transport of chlorine gas and of ammonium nitrate and phosphorus across roads, rail lines, and occasionally barges along the Mississippi.

Communities where hazardous materials are fabricated, processed, and stored as well as those designated for hazardous waste storage or disposals have higher risk, as do localities near or on transportation corridors that carry these materials at elevated risk. Areas with known methamphetamine labs or a disproportionately high (for the state) number of drug raids in the past should be considered at significant risk. Both TBI and the DEA and ATF maintain comprehensive records now accessible for public review of the homes and locations of known and closed methamphetamine labs, either flagged for mitigation, demolition or other remediation strategies. Contamination from methamphetamine production contributes to Tennessee's elevated hazardous materials concerns in otherwise rural communities, as well as in mobile housing, which is difficult to trace except by VIN number, in state parks, motels, apartment complexes, and places with large transient populations.

Highly developed areas or priority environmental resources located near a high risk facility, mitigation strategies must be regularly reviewed. These include facilities with permitted air releases, hazardous waste sites, radioactive materials storage or disposals, facilities permitted to release toxic materials, and facilities permitted to discharge chemicals into surface waters. For transportation corridors, both localities along highways and major systems are at elevated risk.

The EPA recommends surveillance, assessment, and registration of the following classes of location:

- Chemical plants
- Refineries
- Industrial facilities
- Petroleum and LPG tank farms
- Storage facilities/warehouses
- Trucking terminals
- Drinking water plants
- Wastewater treatment plants
- Refrigeration plants
- Select retailers (e.g., agricultural, swimming pools suppliers, home supply stores)
- Railroad yards
- Hospital, educational, and government facilities
- Waste disposal and treatment facilities
- Waterfront facilities, particularly commercial marine terminals
- Vessels stored in ports along the Mississippi and Cumberland Rivers
- Airports
- Nuclear facilities
- Major transportation corridors and transfer points
- Suspected and known methamphetamine lab sites

Tennessee has the following primary chemical locations:

- Dow Chemical Company, Plant, Knoxville, Knox County
- Dow Chemical, Old Hickory Dam, Nashville, TN
- 3M Manufacturing, Old Hickory Dam, Nashville, TN
- W.R. Grace and Company, Grace Davidson, Chattanooga
- Eastman Chemical Company, Kingsport
- Olin Chlor Alkali Products plant / Arch Chemicals Plant, Charleston
- Helena Chemical Company, Collierville
- Austin Powder, Greene County, ammonium nitrate
- Goodyear Tire and Rubber Co
- Bridgestone Tire and Rubber.
  PennAKem, Memphis
- BASF Chattanooga Amicola Plant, Chattanooga
- Multiple Multinational plastics manufacturers, Calsonic, Nissan and subsidiary industries, Shelbyville, TN

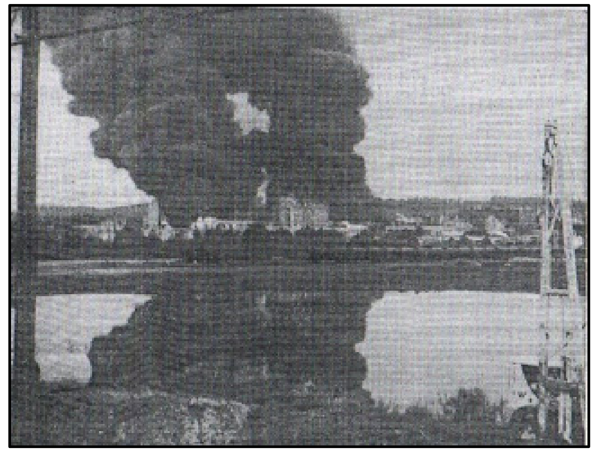
Tennessee has the following Superfund sites:

- Amnicola Dump, Chattanooga area
- American Creosite Works, Jackson
- *At the time of writing, the EPA was evaluating an extensive list of sites for potential remediation needs in the state of Tennessee. These will be updated as they become available.

Tennessee has the following petroleum pipelines:

- The Tennessee Gas Pipeline
- East Tennessee Natural Gas Pipeline
- Tengasco Pipeline
- Colonial Pipeline

3.3.5 – Historical & Potential Scenarios



Hazardous materials incidents occur with relative frequency in Tennessee, and some major disasters related to chemical plants and accidental gas releases have led to nationally significant damage. Historically important events include the Eastman Chemical Plant explosion of 1960 that left 16 dead and 200 injured; significant damage to the town of Kingsport occurred. In 1978, in Waverly, a Louisville and Nashville freight train derailed, consequently causing the explosion of a tank car containing liquefied natural gas. The spill was continued post-12 hours after the event, allowing for wide spread dispersion of the LPG. The cost of this event was $1,800,000 (the equivalent of $5,693,810 in 2013).

Recent event profiles range from mild chlorine leaks to major power plant spills. Selected typical incidents include:

- May 2012, chlorine leak at the Chattanooga Doubletree;
- September 2012, the PennAKem plant explosion in Memphis critically injured several workers, killing one;
- June, 2011, extensive leak of chlorine gas at Rogersville Sewer Treatment Plant;
- May 2011, Hoeganaes Iron Power Plant in Gallatin experienced an explosion caused by a leaking hydrogen gas pipe, involving combustible iron dust and a subsequent fire. Two fatalities occurred;
- 2008, the TVA coal power plant in Kingston spilled over a billion gallons of sludge (coal fly ash), endangering the Tennessee River the Clinch River tributary, and covering more than 300 acres of land. The largest ash release in U.S. history, the incident elevated toxic metal levels in a vast strip in TN due east of Knoxville, and killed fish and small wildlife. Local agencies have yet to report population recovery and the EPA continues to monitor the area.

3.3.6 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

HAZMAT incidents vary widely in their effects on exposure. Most of the common chemicals can quickly cause death or permanent injury in high concentrations with relatively little exposure time, but some toxins cause injury only with repeated exposures, or are carcinogenic. Emphysema or other chronic lung diseases can result from toxic gas inhalation. Caustics, acids, and some other compounds cause immediate burns. Clothing, vehicles, and personal effects can be contaminated by most hazardous materials, often regardless of their chemical state (gas or liquid). Even properly-contained limited impact HAZMAT incidents can swiftly harm those in the affected area before first responders arrive, and leave chemical residues that persist for months or years. A few injuries and deaths occurring at a large chemical plant or oil refinery fire can lead to many casualties from smoke exposure or residential area contamination if the incident is inadequately contained. Winds, flooding, ground elevation, and accessible terrain might increase exposure. Fires and explosions may cause structural damage. Nuclear power plant incidents put anyone nearby at elevated risk of radiation poisoning and/or long-term contamination.

Obviously health and safety of people present at a HAZMAT incident will vary by more than the chemical type: proximity to other volatile or flammable substances, warning time and evacuation protocols, the duration and location of the accident (relative to population centers and to their food and water supplies), and the presence or absence of secondary incidents such as fires and explosions. Transportation-related HAZMAT events can lead to fatalities and injuries caused by the combination of the chemical effects with automobile and road damage, and possible pile-ups. Rail car incidents can occur anywhere; but if an event happens while a train passes through a populated area, mortality and morbidity risk increases significantly. The risk of a rail incident injuring significant numbers of people, based on historical incidence tables, is lower than that of a fixed-location HAZMAT event.

Health and Safety of Personnel Responding to the Incident

All HAZMAT incidents potentially endanger personnel responding to the scene. If unprepared or encountering a large-scale disaster, personnel risk death and serious injury from the hazardous materials themselves or from secondary events like chemical fires. Immediate safety risks may come from toxic chemicals, burns, heat or smoke-related injuries, skin, visual, or respiratory injuries, among other common problems caused by chemical exposure. Without proper physical protection, respiratory support, and decontamination, the risk is high. Additionally, exposure to carcinogens may endanger personnel over time by increasing their risk of developing certain cancers.

First responders face many of the same hazards as persons in the area at the time of the accident. This is especially problematic before an incident's chemical has been identified.

Continuity of Operations

Operating under the assumption that all but the gravest HAZMAT spills or other incidents will impact a limited area, continuity of operations is a relatively secure parameter. In the event that operational capacity is limited during an event, COOPs exists for TDEC and Forestry. If a spill directly impacts an agency, operational continuity may be disrupted until a temporary or permanent new operating location is operational. The mission essential functions of TDEC specifically require direct data connectivity with the governor's office, data infrastructure integrity and firewalls. Their vital records include, but are not limited to: Air Quality Monitor Polling, Aerometric Information Retrieval System Air Quality System's local databases, Ozone Fine Forecasting, Enforcement and Inspection Tracking, Vehicle Emission Testing Data, Asbestos Contractor Tracking System, Permit Logs, Article Processing Charges, Air Emission Inventory, Smoke School, Time & Activity, Mail Log, Federal Project Review Log, and Small Business Environmental Assistance.

Property, Facilities, and Infrastructure
Property, facilities, and the infrastructure may all be damaged by different hazardous material events, especially spills and fires. Hazardous material spills may contaminate a facility so that it must undergo extensive cleaning or be abandoned permanently. They may ignite or explode, destroying anything nearby; these occurrences at a chemical plant or a factory storing other hazardous materials may cause dangerous chemical fires that can release toxic smoke into the surrounding air. A destructive HAZMAT incident at an oil refinery or a natural gas facility or a pipeline could disrupt part of Tennessee's supply chain. If a nuclear plant accident occurs, or if radioactive waste is spilled during transport or processing, the location may be rendered permanently dangerous and would have to be abandoned.

Even without fire, HAZMATs may corrode facilities or infrastructure, leaving it in need of replacement, and react with other chemicals, necessitating the replacement of many costly industrial components.

Continued Delivery of Services
The same situation exists with continuity of operations, but with the added hazards of transportation. If the HAZMAT event is such that an area must be closed for a lengthy period of time or if a transportation incident blocks roads necessary for delivery, then for services to be maintained, new routing or a new method of delivery must be implemented; in the interim, delivery of some services might be interrupted. Other than an incident affecting the state's major oil pipeline, most HAZMAT events will only delay delivery of services because alternative roadways, railways, and waterways can reach most parts of Tennessee.

Environment
Environmental impacts range from minor contamination of already urban land to regionally catastrophic loss of habitats and endangering wildlife populations, pollution of water, and destruction of wild and cultivated land to the extent it is no longer capable of normal plant growth. Repeated contamination from long-term chemical plants, particularly in the eastern third of the state, could be exacerbated by a HAZMAT incident.

Incidents near the Mississippi occur with some regularity; but any event involving spills into the Tennessee, Cumberland, or Ocoee Rivers and their tributaries, among at least a dozen other waterways, could have unforeseen environmental impact in several states.

An incident involving radioactive hazardous materials could cause environmental consequences for centuries if surrounding flora, fauna, and land were exposed to high enough levels of radioactivity.

Economic Conditions
The economic consequences of large hazardous material spills can be wide ranging and can last for years or decades. Smaller events can impair or even bankrupt small or midcap company, but are unlikely to affect the state's economy as a whole. A town where a chemical plant or factory is the main employer, however, could be seriously harmed by a disruptive HAZMAT event at such facility. The economic exposure depends on the chemical released; the size of the spill or extent of the fires, if any; the number and size of the businesses impacted; the number of homes damaged, contaminated or destroyed; and if critical roads/railways/infrastructure are disrupted. As with environmental impact, typically, only a radioactive event causes permanent economic loss, but the closure of a large-cap corporation's plant in Tennessee can potentially lead to extensive layoffs or the need for a corporation to assist in the closure of a facility, limiting its ability to rehire employees. A widespread chemical incident that destroys homes or multiple businesses or the land’s agricultural potential can be devastating from an actuarial perspective. .

Public Confidence in the Jurisdiction's Governance

Outside of a major oil spill or a nuclear plant incident, it is unlikely that average HAZMAT events will affect confidence in the jurisdiction's governance. Effective communication regarding chemical properties and the extent of the control mechanisms in place, plus remediation and mitigation planning already existent will mollify public concern.

3.3II – Infrastructure Incidents

3.3.1 Description

Infrastructure disasters are complex scenarios. They can be difficult to respond to, prepare for, and mitigate, as the infrastructure itself is often a mechanism in responding to, preparing for, and mitigating hazards. Further, infrastructure is often owned by a variety of public and private interests, and in some cases both, making the delegation of responsibilities and assessment of state liability difficult.

Infrastructure is defined as any permanent or semi-permanent asset that facilitates the transport of goods, services, human resources, or information. This can include but is not limited to roadways, rail, airports, telephone, cellular, and data communications mediums, hospitals, waste water treatment facilities, municipal water reservoirs and community support facilities (shelters, libraries, and historic registrar sites). Dams and Levees are treated separately in 3.3DLF.

3.3.2 Scope of Threat Management

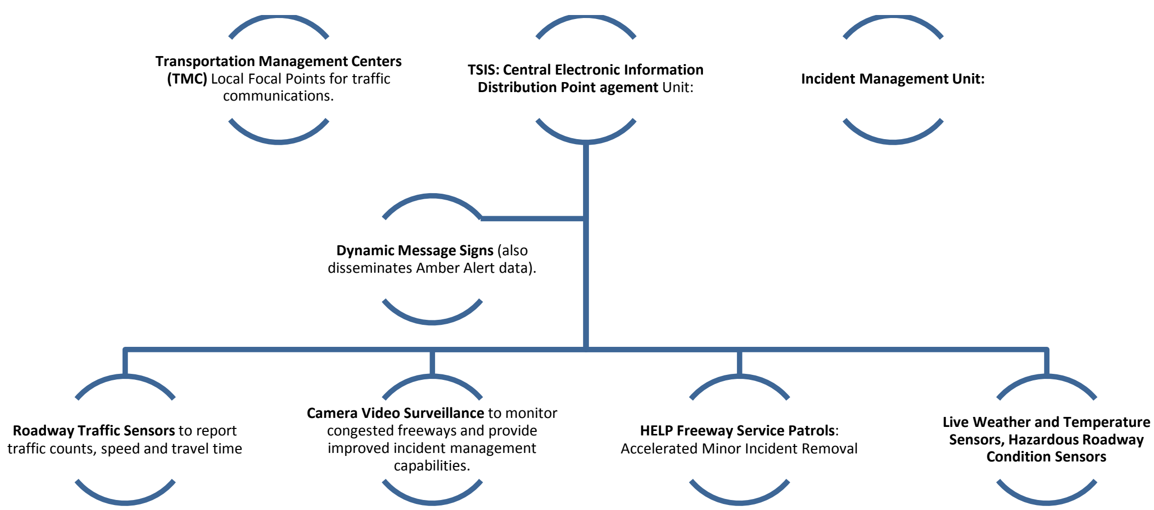
Most states, including Tennessee rely on a Perpetual Inventory Method (PIM) to value roadway infrastructure value and depreciation. The function is defined as

$$\textit{Infrastructure Assets}_{\textit{Year}} = \textit{Capital Investment}_{\textit{year}} + (1 - r)\ \textit{Infrastructure Assets}_{(\textit{year} - 1)}$$

This formula allows for estimation of depreciation on existing infrastructure, but does not take into account active costs for events. It can however, according to the Bureau of Economic Analysis (BEA), be used to accurately value, for actuarial purposes, existing structures at the time of an event.

Roadways

The primary mitigation component for active and passive management in the Tennessee roadway system is “SmartWay”: a series of components owned and operated by TDOT in conjunction with other regional and national authorities. SmartWay is defined as an ITS (Intelligent Transportation System) that uses both wireless and wire technology to maintain a fluid response to ongoing events during normal and emergency operations.



Tennessee's well integrated intrastate infrastructure makes quarantine procedures and the localization of threats particularly challenging with over 87,000 miles of total highway, all with direct out of state connections, 80 public airports, and 6 major rail lines with 2,098 miles of track.

The direct infrastructure budget for 2013-2016 includes an additional $1.5 billion in infrastructure investments for 80 individual project phases in 47 counties, as well as 15 statewide programs. These have dedicated funding for 15 transportation programs including Rockfall Mitigation, Spot Safety Improvement, and the statewide HELP Program. TDOT's multimodal comprehensive plans include specific, mitigation targeting grant funding from the following sources for roadways alone (airports, airstrips, and air space access are handled by the Tennessee Aeronautics Commission). Specifically, the Governor's Highway Safety Office handles grant funding designed to mitigate the costs and consequences of highway incidents. Tennessee ranks in the top third per capita for states with multimodal fatalities, with the highest density of counties.

The NHTSA considers fatal crash incidence a general indicator for predicting roadway liability in other arenas, particularly the likelihood for large scale events like those on the I81 and I77 corridor in Virginia involving 95 cars. The section of interstate had long been flagged by NHTSA and DOT as a high risk corridor warranting mitigation strategies. Further, large-scale accidents or repetitive risk areas are designated as warranting specific mitigation strategies as defined by EMAP standards. General fatality rates by county can be seen on the following page.

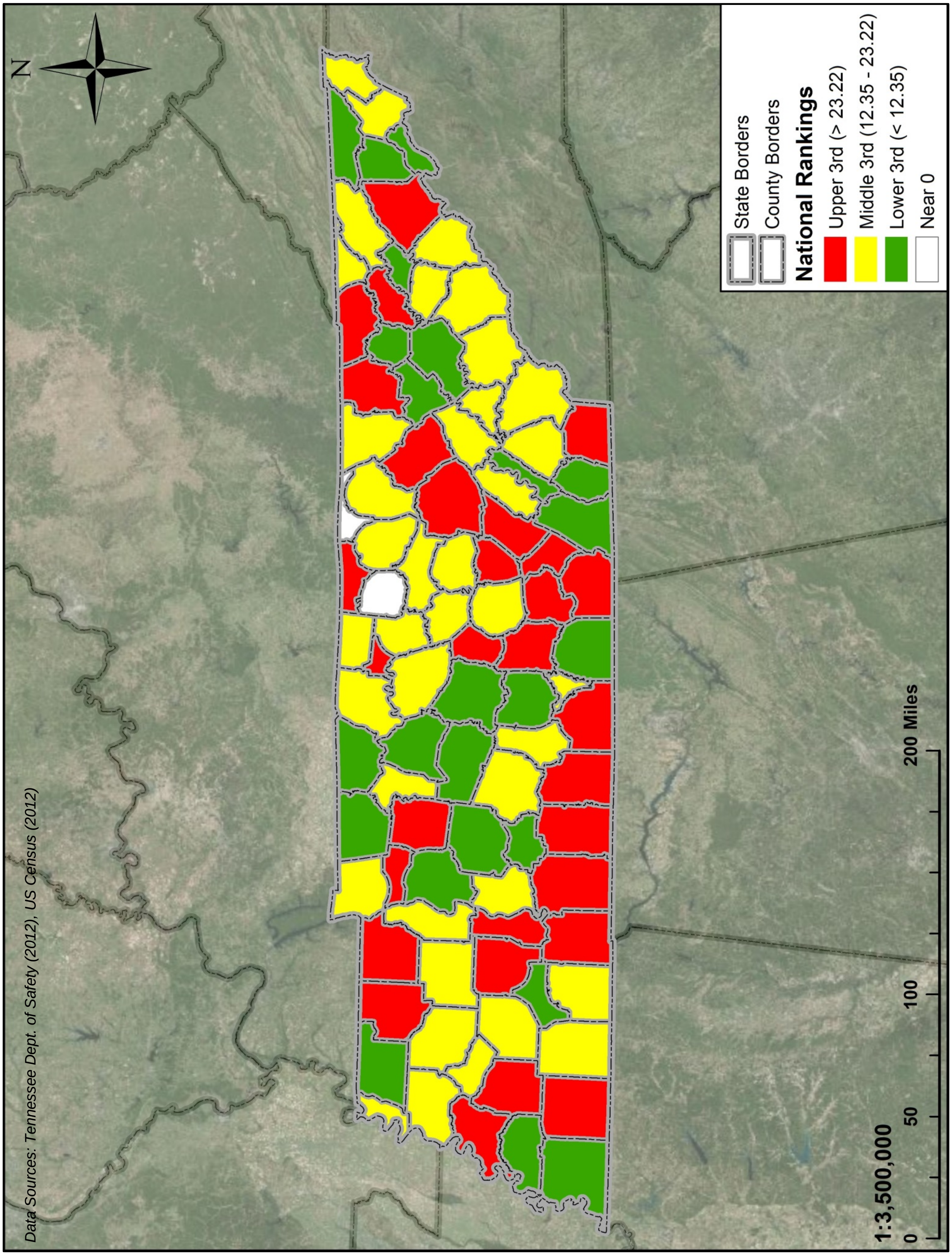
Federal Safety Grant Funding for Tennessee is based on legislative efforts in the state, as well as programs included that meet federal criteria. Tennessee does not qualify for Occupational Safety Protection grants, Primary Law grants, or credits for the prohibition of racial profiling. Tennessee receives $24,291,000.00 dedicated for direct mitigation of fatal events that are broken down in the following table.

Table 43 – Federal Safety Grant Funding, Tennessee

Grant Program	Amount
Formula	$4,478,971.00
Open Container Transfer	$16,386,385.00
Data Improvement	$500,000.00
Motorcycle	$131,350.00
Booster Law	$321,535.00
Alcohol	$2,472,459.00

**The data are from the National Highway Transportation Safety Administration.*

Map 61 – Vehicle Fatalities Per 100,000 People, By County, Tennessee (2012)



The State of Tennessee's roadway incident exposure remains statistically high, with a large number of uninsured motorists proportional to its population. The large number of licensed drivers and a relatively high number of vehicle miles driven, are shown here, as well as crash statistics collected from 2008-2010.

Table 44 – Vehicle Transportation Statistics, Tennessee			
State Size: 42,146 Square Miles	**2008**	**2009**	**2010**
Population	6,214,888	6,296,254	6,492,736
Registered Vehicles	6,228,842	6,478,705	6,685,288
Licensed Drivers	4,455,754	4,484,769	4,520,542
Miles of State & Federal Roadways	13,882	13,871	13,867
Miles of Interstate	1,105	1,104	1,104
Total Crashes	158,845	157,713	168,077
Number of Non- Injury Crashes	112,358	111,260	120,334
Injury Crashes	45,431	45,675	46,786
Fatal Crashes	958	918	957
Injuries	65,228	65,618	66,546
Fatalities	1,043	986	1,031
Vehicle Miles Travelled (100 Millions)	696.61	702.92	704.29
Fatality Rate Per 100 Million VMT	1.5	1.4	1.46

**The data are from the Tennessee Department of Safety.*

Rail

Tennessee railways are not heavily dependent on other existing infrastructures to the extent that eastern seaboard or trans-continental railways through the northwest are. Slightly less than 20% of Tennessee rail lines traverse floodways or known seismic threats, though railways often transport large amounts of hazardous materials considered too dangerous or heavy for interstate transit, and their exposure should be accounted for through improved communications among private transit companies, TDOT, TDEC, and regional authorities.

Railways, carriages, and cargo remain vulnerable at the national level, due to the slow moving speeds of freight and unobserved stops through a variety of rural and urban terrain. Further, rail lines and depots are often unmonitored by CCTV, or equipped with motion activated lighting or alarms.

Both roadway and rail infrastructure necessitate the use of bridges, with a proportionally high number of these in Tennessee due to intersections of waterways with transport lines. TDOT has compiled and published a list of deficient bridges slated for remediation as of 2011. This list is located in Addendum II.

Airports

The Tennessee Aeronautics Commission (TAC) is responsible for most major decisions regarding infrastructure improvements and mitigation or surveillance strategies. In 2013, they approved the Bolivar Video Security System for $50,000, as well as Lebanon Security Enhancements for $25,000.

Home to the single largest air cargo and freight depot in the world, Memphis, along with other Tennessee airports are responsible for proportionally large volumes of both material and human transport. Boeing's Air cargo analysis for 2012 reports that the trans-border air cargo market was 318,000 tons in 2009 and grew 7.9% in 2010, and 3.6% in 2011. Traffic from the United States to Canada rose 8.3% in 2010, and 5.7% in 2011. Traffic from Canada to the United States was up 6.3% in 2010 and down 6.0% in 2011 as the economic recovery stalled in the United States. Overall the general trend has been one of increased air freight from Canada into the United States versus waterway or port to rail transit. Further, Canadian cargo and airfreight have increased at levels greater than any other route internationally or domestically.

A map of direct service airports from BNA is included below. For both cargo and passenger security, direct service destinations warrant the closest attention.

Map 62 – Direct Service Airports, Tennessee

Communications

Communications infrastructure has expanded rapidly in the past decade, with nearly a 112% increase in cell towers and fiber optic lines. Increasingly, emergency responders and state and local governments rely on these often privately held infrastructures, with minimal oversight of their disaster mitigation strategies. Verizon Wireless, the state's largest cellular provider, has a dedicated disaster response team, and multiple continuity of operations and business continuity plans in place. Smaller providers however have not yet dedicated the staffing resources to these needs, and often serve more inaccessible and remote locations.

The loss of communication infrastructure concomitant with a disaster can exacerbate logistical difficulties. As such, enhanced communication and integration with the existing business continuity plans on file with cellular infrastructure owners and operators can facilitate faster recovery times and alternate communications. Verizon maintains COWs (Cells On Wheels) and COLTs (Cells On Light Trucks) for all of its major regions including Tennessee. These not only provide replacement coverage when towers are damaged, but can provide supplemental coverage for increased network burdens during an emergency (land lines and other means of communication are often impaired, and individual communication needs can overwhelm a given network) and reach inaccessible regions where coverage may not be adequate to the response needs.

Verizon as the largest regional provider also maintains an extensive fleet of mobile and permanent on-site generators to supply power when municipal grids are compromised or over-extended. Not all cellular network providers though maintain systemic continuity of operations models and supplies, and as such, larger providers are often asked to bridge the gap in operations during an emergency.

Electric Delivery

In 2011, EPB of Chattanooga, a TVA distributor received the largest DOE ARRA stimulus grant for a municipal utility of $111.5 million to accelerate a fiber optics project for integration of the grid into fiber optic lines and transmitters. This integrated “Smart Grid” qualified for federal mitigation grant funding as it promises to provide a 40% in outage reductions resulting from improved distribution system management and intelligent switch technology.

In an area at risk of extreme weather events, the mitigation benefits of smart grid technology cannot be overstated. A University of Vermont study analyzed the data surrounding large scale blackouts from 2010-2012 and found the following causes.

Table 45 – Hazard Caused Blackout Statistics, USA

Event Type	% of Events	Mean Size in MW	Mean # Customers
Earthquake	0.8	1,408	375,900
Tornado	2.8	367	115,439
Hurricane/Tropical Storm	4.2	1,309	782,695
Ice Storm	5	1,152	343,448
Lightning	11.3	270	70,944
Wind/Rain	14.8	793	185,199
Other cold weather	5.5	542	150,255
Fire	5.2	431	111,244
Intentional attack	1.6	340	24,572
Supply shortage	5.3	341	138,957
Other external cause	4.8	710	246,071
Equipment Failure	29.7	379	57,140
Operator Error	10.1	489	105,322
Voltage reduction	7.7	153	212,900
Volunteer reduction	5.9	190	134,543

**The data are from the University of Vermont.*

Energy Supply

Tennessee is home to a variety of natural gas (NG), liquid natural gas (LNG) and petroleum lines. Petrol depots and dispensing stations are located in Nashville, Chattanooga, Knoxville, and Memphis, with the majority of the state reliant on Colonial Pipeline for delivery of both diesel and gasoline to the Middle and Eastern Regions of the states. Complications with this dependence were highlighted during Hurricane Katrina in 2005 when Middle and Eastern Tennessee suffered serious shortfalls in supply, though Memphis did not experience the same shortages with the Valero Refinery and supply routes along the Mississippi. Extended reliance on the Western supply from Valero or by barge delivery, should take into account seismic threats, addressed in Section 3 at greater length.

Mapping of seismic threats to specific lines, along with the potential for aquifer and municipal water contamination from petroleum lines is included in Addendum II. In particular, karst aquifer and porous limestone substrates are at greatest risk of long term side effects resulting from a spill or compromised line. Areas with a high likelihood of seismic activity should be considered at increased risk for compromised lines. Even small scale events and geologic disturbances can disturb a line, and pressure changes or leaks may not be detected for weeks to months if the incremental leak is small enough.

Waste Water Treatment and Municipal Supplies

Water infrastructure falls broadly into 2 categories: disposal and treatment, and storage and supply. While the EPA provides specific guidelines for agencies such as TDEC to follow in the treatment and disposal of waste water both from municipal and private sources, the infrastructure that handles these requirements is often compromised or destroyed during flooding or seismic activity. Tornados and damaging winds can shut down power to waste water treatment plants and private septic systems for hours or days, and recovery windows can be complicated by increased burdens or flooding that occurs in the interim.

The EPA outlines 4 components necessary for the recuperation of municipal supplies that must continue to operate during and after an emergency:

- Chemical – for disinfection and other treatment processes
- Transportation – for delivery of chemicals for treatment and fuel to power equipment and to enable employees to commute to their jobs
- Energy and Electricity – to power pumps and motors
- Communications – to maintain Supervisory Control and Data Acquisition (SCADA) systems

Water represents 1 of Tennessee's greatest resources and 1 of its greatest liabilities. The droughts of 2006 and 2012 highlighted the state's dependence on underground aquifers, reservoirs, and secondary supplies. WHEAT (Water Health and Economic Analysis Tool), an EPA developed program, provides threat-neutral consequence analysis for events that jeopardize both waste water treatment and potable supplies. To generate effective cost scenarios, each module should be run for counties independently. Some districts share municipal providers (such as Nashville, which uses Suburban Madison supplies and Metro Davidson supplies within proximity to each other). As such, the inputs for the WHEAT model must take into account revenue and supply costs from all suppliers in a given district or county, as well as breakdown of shared versus independent miles of line. Nashville Metro alone maintains 2800 miles of independent line, while Suburban Madison supplies almost 4300. These 2 suppliers maintain all water access for a population density of 1204 people per square mile. Memphis and Shelby County Metro are supplied by MLGW, which is the sole supplier for a population density of nearly double that of Nashville (2307 per square mile) but maintains only 3600 total miles of line. The resulting dependence is greater for a higher number of households, on fewer total miles of lines. Further, MLGW and consolidated service providers who also manage gas and electric delivery may experience a greater burden on their staff and infrastructure during an emergency than those suppliers that provide 1 direct service or product, and can concentrate efforts on a single recovery tactic.

3.3.3 – Governing and Coordinating Agencies

While TDOT is responsible for the coordination of assets specific to transportation, the consolidation of infrastructure demands is limited by regional needs and attributes. TDOT addresses these needs by dividing the state into 4 subsidiary regions shown on the following page.

For water infrastructure coordination, TEMA holds an annual table top exercise for ESCs, which includes modules on “Drinking Water Supply and Pollution Control.”

The EPA, CDC, and DHS encourage the development of cooperative relationships between state primary agencies responsible for water resources and state emergency management. Facile coordination among the agencies will speed deployment of federal resources if necessary during an emergency. FEMA provides the following infrastructure to assist in recovery for water sector services.

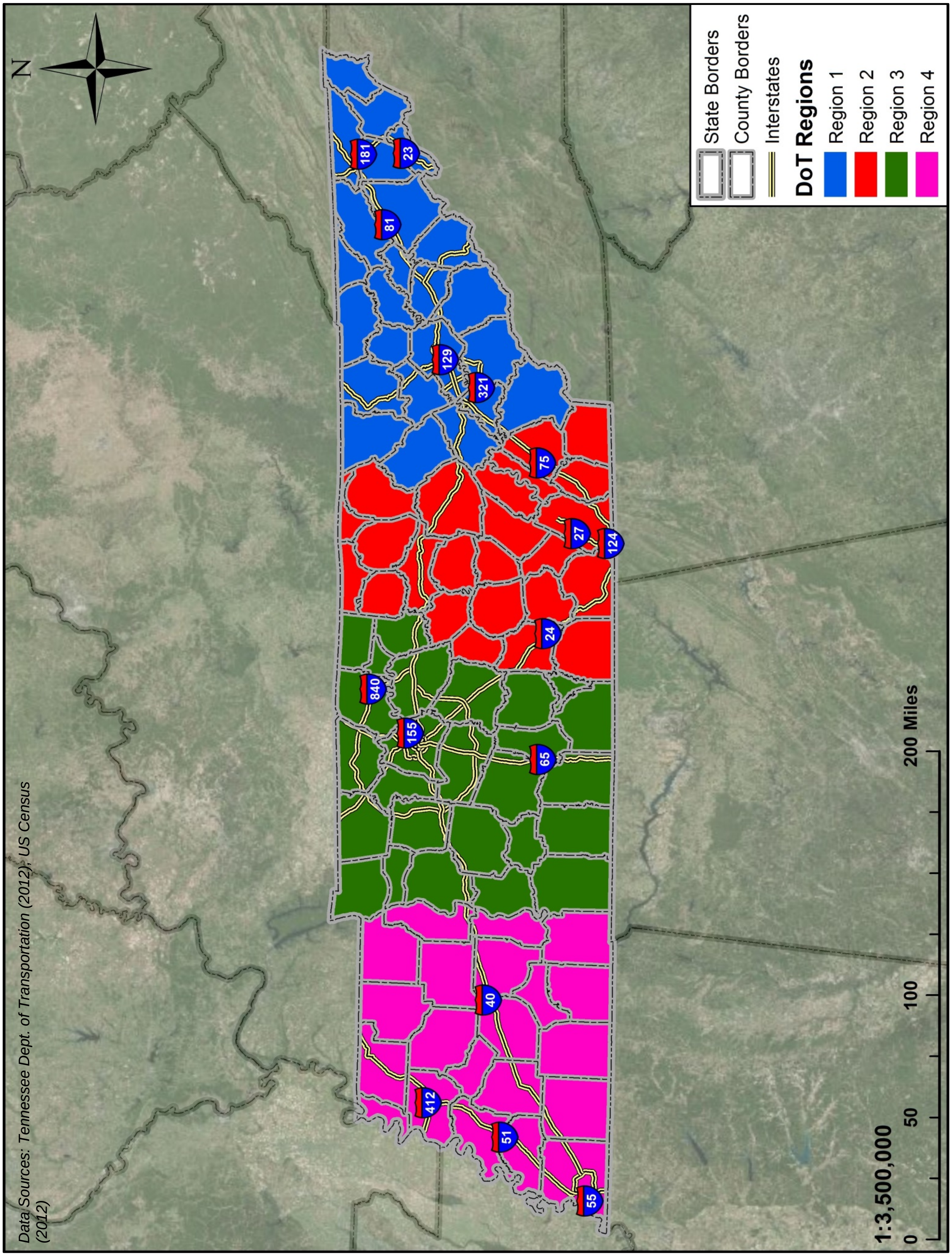
- A water sector liaison(s) at the state EOC or primacy agency to help coordinate resource requests, coordinate efforts among the various local, state, and federal agencies involved, and to help the state understand and navigate the “federal system.”
- Water sector technical assistance and expertise to augment state personnel and help manage response and leadership for the sector.
- Goods or services for water utilities to begin initial restoration of services. This can include items such as bulk water, portable generators, temporary storage, treatment chemicals, treatment units, bypass pumps, and other commodities that cannot be acquired locally immediately after the disaster strikes

Waste water treatment locations and raw sewage represent a real and ever expanding mitigation need: with urban centers expanding in Tennessee (Murfreesboro alone is expected to double in size from 240,000k to 500,000k over the next 20 years, making Rutherford County 1 of the 5 fastest growing counties in the US) the placement of treatment locations and strategies for dealing with man-made and natural hazards affecting this infrastructure must be addressed.

Additional agencies responsible for infrastructure maintenance and response include, but are not limited to:

- TVA
- TDH: Division of Healthcare Facilities and Asset Management
- EPA
- TDEC

Map 63 – Tennessee Department of Transportation Regions



Data Sources: Tennessee Dept. of Transportation (2012); US Census (2012)

3.3.4 – Historical & Potential Scenarios

In 2012, infrastructure liabilities and response plan needs were highlighted by the multi-month and multi-million dollar landslide that closed Interstate I40 east and west bound lanes at mile marker 451. This landslide required extensive rerouting of commercial and normal traffic flows, with significantly increased traffic burden on ancillary and municipal roadways, plus extended petrol consumption for tractor trailer and commercial traffic which relied on I40.

The land subsidence and natural hazard contributing factors to this landslide are addressed in Section 3.3G - Geologic.

The Hatchie River Bridge collapse of 1989 due to deteriorated pylons killed 8 people, while out of state incidents such as the Skagit, WA bridge collapse in 2013, and the Minneapolis I35 bridge collapse of 2007 severely compromised public trust in infrastructure. The allocation of $150,000 to offset losses for local business even in a relatively small geographic area, with advertising and rerouting, highlight the far reaching economic impact 1 infrastructure incident can have. Unexpected technical difficulties in I24 construction and complications with bridge extensions, led to delays that cost businesses in East Nashville several months of decreased revenue.

Historic Hazard Event – Infrastructure Incident – July 1918

The Great Train Wreck of 1918 occurred on July 9, 1918, in Nashville, TN when 2 Nashville, Chattanooga, and St. Louis Railway passenger trains collided head-on. The No. 4 train was scheduled to depart from Nashville for Memphis, Tennessee at 7:00 a.m., while the No. 1 train was coming from Memphis, running about a half-hour late scheduled for Nashville arrival at 7:10 a.m. At about 7:20 a.m., the 2 trains collided while traversing a section of single-track line, which was in the area of present-day neighborhood Belle Meade. Both trains were traveling around 50 to 60 miles per hour and were both derailed and several wooden cars were destroyed after impact. There were 101 fatalities and 171 injuries. This collision is still considered the worst rail accident in United States history.

3.3.5 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)

Heavy equipment, high voltage, auditory, and ocular shock are all inherent risks of individuals in proximity to an infrastructure event. TDOT, OSHA, TOSHA, and Department of Commerce and Insurance are often simultaneously involved in compromised infrastructure disasters. The CDC and OSHA give specific guidance for dealing with electricity supplies during natural and other disasters. Often standing water and the unknown condition of the infrastructure puts persons in the area at increased risk due to the inability to assess whether lines are live, structures are sound, or roadways passable. Contaminated water from floodways that intersect known hazardous materials or waste water treatment areas are often difficult to quantify or identify. When in doubt, persons should be evacuated and areas quarantined until specific threats are identified and addressed.

Health and Safety of Personnel Responding to the Incident

Occupational safety standards are of paramount importance for the health and safety of personnel that respond to infrastructure disasters. These disasters often involve heavy equipment, high voltage, large volumes of water, hazardous materials, and the risk of auditory or other sensory damage. TDOT uses quarantine procedures enforced by the state police and other law enforcement agencies when necessary to protect both assets and human resources responding to an event.

Continuity of Operations

TDOT's COOP is extensive and multi modal to accommodate the wide range of needs and challenges any impairment of its infrastructure will result in. The Department of Labor's COOP includes Mission Essential Functions that encompass major infrastructure as well: including mine rescue operations and fatality, catastrophe, and public complaint services. TDOT maintains a COOP, which includes but is not limited to the following Mission Essential Functions: Maintenance of 5 state-owned fixed-wing aircraft, logs of public use general aviation facilities, wireless communications, issue over-dimensional/overweight permits where appropriate, emergency purchase and procurement of necessary equipment for disaster response, tracking and mobilization of state-owned infrastructure, provision of employees capable of operating necessary equipment for other departments, aerial reconnaissance, photography and documentation of airspace, schematics and design of emergency construction plans, installation of equipment at Emergency Relocation Sites (ERS), creation and management of damage assessment, debris removal and incident scene clearance team, structural engineering staff, signage and demarcation infrastructure for state and private sites.

Property, Facilities, and Infrastructure

TDOT maintains inventory and assessment records for all property, facilities and infrastructure owned and used by the state with the exception of that owned and deployed by TEMA or FEMA during a declared emergency. Major infrastructure inventories held by TVA and select government agencies are assessed and appraised according to RAMCAP Plus II methodologies and software modules. In the event total or large scale replacement or repair must be undertaken, these industry specific modules should be consulted on an as-needed basis.

The United Nations Report on the "Role of the Private Sector in Risk Reduction for Large Scale Infrastructure" specifically highlights the need to incentivize the multiple stakeholders involved at various points in the project. Their influences also vary during the process of the project. One way of incentivizing the inclusion of safety and DRR measures in the planning processes of the project can be done by increasing stakes and improving relative power dynamics.

Improvements occur:

- By improving public participation processes, and improving awareness amongst the masses regarding their Right to Information and large scale planning projects, influences of users and people may be improved.
- By improving capacities of the implementation agencies and regulatory bodies, their influence over the lifecycle of the project may be increased.
- By enforcing professional liabilities legislation, and making the professionals more liable for their practice, their stakes may be increased in every project, and thereby the incentive to include disaster risk reduction strategies during the technical planning processes can be further improved.

The following chart illustrates ways to modulate the stakeholder's incentivization.

Table 46 – Stakeholder Incentives & Influence Dynamics

Stake / Influence	High	Medium	Low
High	Promoters	Investors	
Medium			Technical Professionals
Low	Users and Employees	Regulators	

**The table is from the United Nations' Global Assessment Report on Disaster Risk Reduction, 2013*

Continued Delivery of Services

Infrastructure that is compromised inherently jeopardizes the continued delivery of services. In the event that primary communications, rail, or multimodal transportation lines are disrupted, TDOT maintains tertiary and ancillary route data for accessing most, if not all, of Tennessee communities. The COOP for TDOT is an extensive resource for assessing this agency's ability to respond to disasters of any scale and scope.

Environment

All infrastructure mitigation efforts and disaster responses rely heavily on accurate environmental assessment and data. As such, close coordination with TDEC, the EPA, regional and municipal planners is critical to successful implementation and execution of mitigation procedures.

Economic Condition

The economic condition of an infrastructure response and mitigation strategy is directly proportional to the condition of the infrastructure and its secondary technologies prior to the event. Poorly maintained equipment, badly mapped data lines, and non-current private industry data from electricity, cellular, or waste disposal infrastructure can seriously hinder mitigation efforts. Thus, investment in accurate surveillance and intra-industry communications can greatly improve outcomes.

The economic impact from an infrastructure event varies greatly by the type of infrastructure effected. Highway closures and landslides impairing commercial transit carry real per diem costs in terms of work hours lost or business dollars that are not recovered. The business closures secondary to impaired fuel delivery alone subsequent to Hurricane Sandy exceeded $92 million. When combined with other collateral losses, this impairment of business operation or man hours worked makes efficient restoration of public infrastructure a priority. These closures are often complicated by environmental or structural assessments, which themselves require dedicated funds and can slow recovery time.

Public Confidence in the Jurisdiction's Governance

Infrastructure disasters pose one of the most visible and high profile event risks within the scope of public relations. Roadways, rail, and airports often have large numbers of the public involved or at least witnessing the event, making management of communications and press releases imperative. Cellular, data, and telephone failures result in fear and the perception that the event is not under control because of lack of communications with the public. While small scale electrical service interruptions are handled at the corporate or cooperative level, any large scale disruption often requires municipal response, especially in the event the disruption takes place in underserved or rural communities where access to medical equipment services or supplementary aid may not be readily available. During extreme temperature events, these disruptions are particularly hazardous to the young, aged, or infirmed.

The Minneapolis Bridge collapse of 2007 highlighted public fears regarding infrastructure safety and maintenance, with over 147 individuals killed. Subsequent to this event, Tennessee and other states instituted broad reviews, evaluations, and mitigation strategies for existing bridge infrastructure, and released a list of those deemed deficient, with a rating scale developed to prioritize the remediation of those in worst condition. This list is provided in Addendum II.

3.3TE – Terrorism

3.3.1 – Description

Terrorism encompasses all man-made threats or actions intended and designed to harm the population at large or a subgroup therein, or to cause fear, damage to property, or disruption of social and economic functions. The FBI offers a stricter definition of terrorism as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." Terrorism can occur at any time without warning, affecting multiple geographical areas at once, and inflicting mass casualties and significant property damage. Most problematic, each area under attack can constitute an incident scene, quarantine or hazardous materials zone, and a crime scene simultaneously. This complicates first response considerably. Furthermore, terrorists use a wide variety of targets, tactics, and means, forcing hazard prediction and mitigation to rely on even more variables than most other man-made hazards.

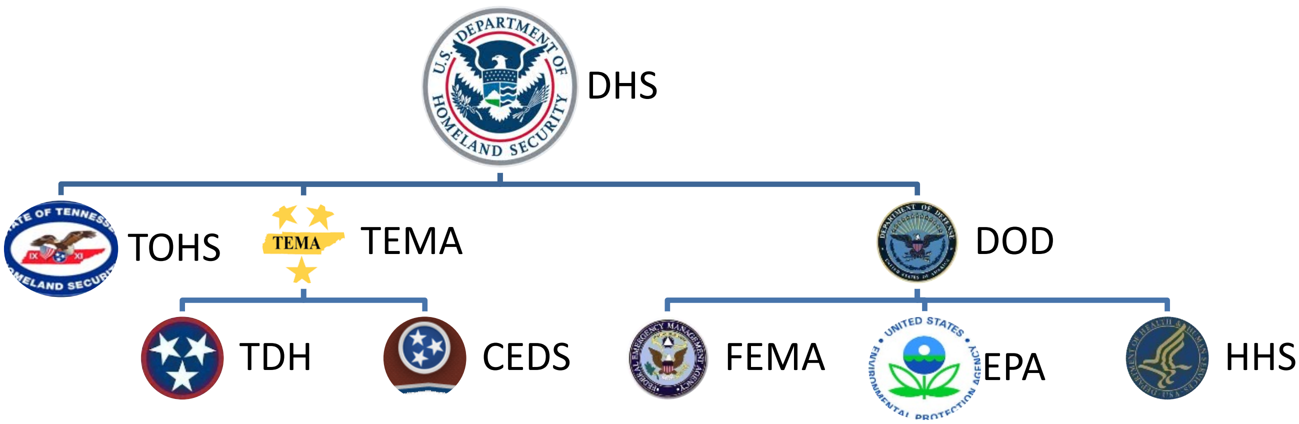
3.3.2 – Scope of Threat Management

The basic categories of attack can be sorted by types of weapons or methods used and by the extent of potential damage. Terrorists may act alone, in small groups, in organized cells and quasi-military hierarchies, and in actual militias. They may be state-sponsored, state-trained, untrained, self-taught organized by paramilitaries, religious organizations, cults, or home based ("home-grown") entities. Terrorist incidents may occur in 1 location or in many, simultaneously or staggered, with thwarted attacks and copycat events following a major terrorist action. A defining feature of terrorism according to the DHS is the need to get public attention and "make a statement," whether about an individual, a cause, or political organization. Small groups or individual terrorists may not succeed in communicating their grievances or causes, and occasionally, serial or pathologic terrorists without a known ideology do strike.

An act of terrorism using WMDs (nuclear, chemical, or biological) can be directed against a population center, disseminated in food or water supplies, fed to domestic animal populations or dispersed into mass transit. Any of these scenarios will produce mass effects, which can overwhelm the capacity of local or state emergency response agencies, requiring both surge personnel and extra facilities to mitigate the damage. Furthermore, conventional terrorism using manufactured or improvised explosive devices (IEDs), or executed through extensive attacks by gunman or saboteurs, can also overwhelm local and regional capabilities, particularly during the initial phase of an attack. The resolution and threat mitigation required after an act of terrorism demands rapidly response and smooth, well-rehearsed cooperation among agencies; successful responses also demand cooperation of law enforcement, emergency management agencies, and the first responders. Major airports, shipping hubs, ports, interstate highway intersections, rail stations, water purification facilities, armories, chemical processing plants, communications towers, and other critical infrastructure components need to be guarded against terrorism and incorporated into a special category of high-risk sites for planning purposes.

3.3.3 – Governing and Coordinating Agencies

Because of the scope of any terror incident, the number of agencies and responders are difficult to define; however the responses outlined in the following section will follow the basic organization of coordinating and cooperating agencies shown below.

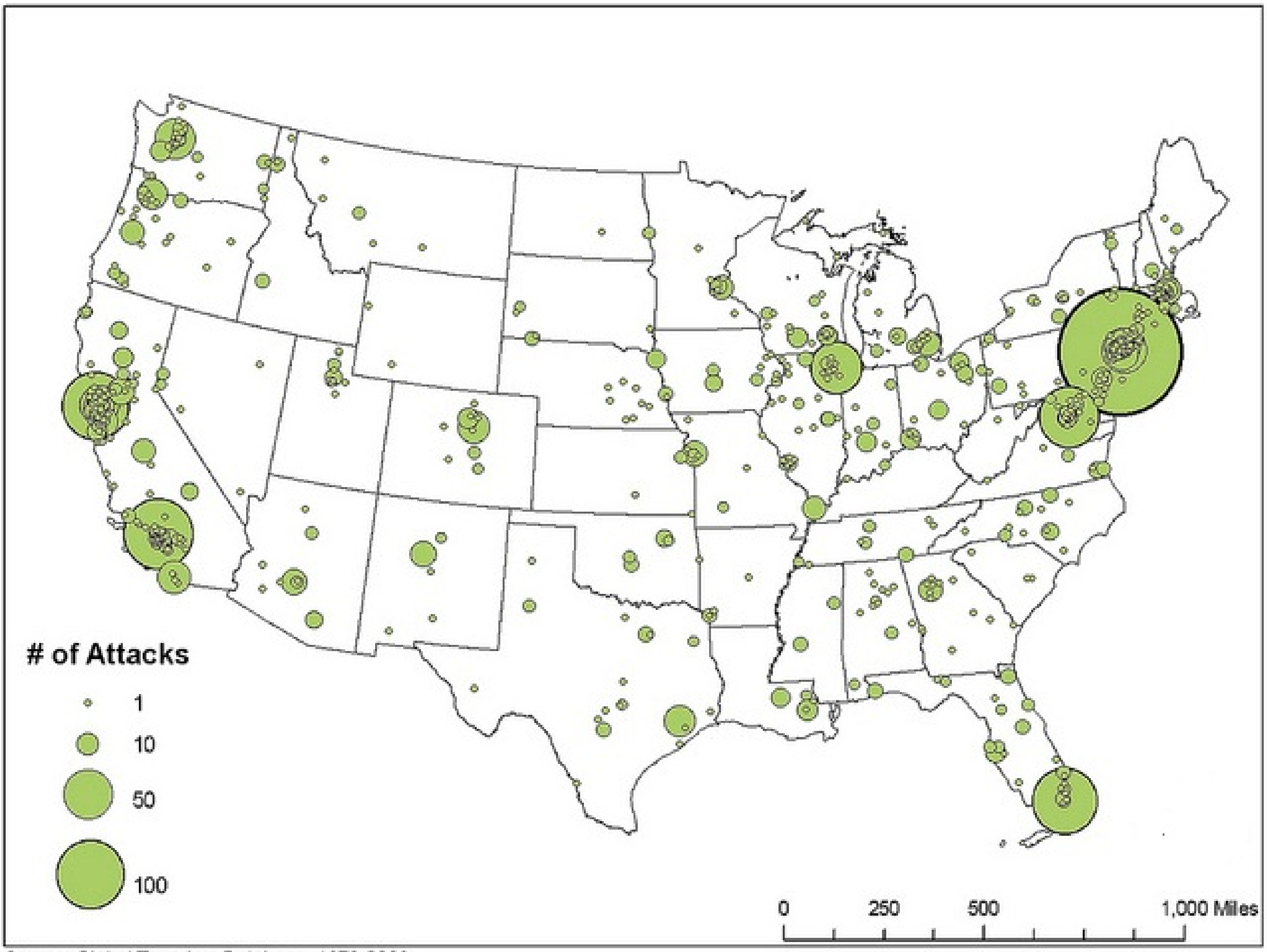


In addition, multiple law enforcement, military and National Guard resources may or may not be deployed during an event. Coordination of these resources is critical, and accreditation and proper vetting of personnel on the scene is typically managed by the FBI or DHS. Threat assessment and the mitigation approach must be modified sufficiently to prepare for efficient communication among agencies at local, metropolitan, state, and federal levels and to assure readiness for different types of terror threats without the aid of probability models that are used for natural hazards like floods or tornados. By legal definition, terrorist attacks will mandate state and federal cooperation at all agency levels, as well as for response and resolution. Terrorist events have markedly different event structures and profiles. This results in the scope of the threat changing with the scale of the event and the means of attack. Immediate events account for the majority of terrorist threats based on historical data. They require prompt and coordinated deployment of state and non-state personnel and equipment, and rapid response to a crisis. Cascading events present over time and may not be immediately perceived as terrorist attacks. This timeline, and sometimes the similarity of attacks dispersed across geographical regions present evidence of terrorism.

3.3.4 – Locations

Despite the historical data of past attacks worldwide, authorities have no reliable risk metrics for a terrorist attack probability. Though recent studies suggest that select metropolitan areas are repetitive risk or loss areas: The START Center (Study of Terrorism and Responses to Terrorism) at the University of Maryland found that some traditional predictors of ordinary crime also predict terrorist attacks, while many robust correlates of ordinary crime do not. As such, terror remains an unquantifiable rather than quantifiable risk. An attack's severity, economic impact, location, duration, and most other details will be uncertain. The START Center's datasets and conclusions can however point us to statistically more likely "hot spots" within Tennessee for mitigation planning needs. The following START map identifies national event clusters, and the location in Tennessee or proximity to it.

Map 64 – Terrorism Event Clusters



Source: Global Terrorism Database, 1970-2008.
Note: 16 attacks are not shown due to missing geographic information.

Tennessee's unique infrastructure, nuclear and hydroelectric energy facilities, large health care centers, and transportation hubs necessitate location-based threat management, as well as Sector Specific Guidance (SSG) from RAMCAP Plus when applicable to the infrastructure inventory, not all of which may be disclosed per classified information guidelines. The virulence and sophistication of an attack will determine its true impact, but critical infrastructure inventories will act as predictors overall.

3.3.5 – Historical & Potential Scenarios

A list follows of major threat scenarios outlined by the TN DHS, which have historical precedence, and factors affecting the success of a hazard mitigation plan.

Active Shooter Attacks

This category includes any attack where 1 or more people use firearms to commit an act of terrorism. It is the type of terrorist attack for which there is the most historical data, though public shootings do not always meet the DHS or FBI's definition of a "terrorist attack." Active shooter events are dynamic − gunmen may be used by terrorists as a means to an end, in which case they fall under the purview of terrorism; in other instances, mass-shootings may be "one-offs" caused by mentally ill or psychopathic individuals without any strategic or ideological goals. Intent and strategy differentiate the terrorist events from other mass shootings, though the outcome of fear and chaos is often quite similar as is the loss of public confidence and economic impact.

Active shooter terrorists are typically male, acting alone, with previous exposure to weapons training and/or experience. Historically, 2 age groups predominate – 15-21 for school shootings; 35-45 for public place, workplace, and other attacks. Terrorism is usually preceded by a precipitating event, though the venue and victims may not be directly related to this stimulus. For many shooters, domestic and workplace disputes can be precipitating factors, though a minority stem from religious or ideological grievances. Typically (≈75% of incidents) the shooter is a member of the community in which the attack occurs. Hostage-taking infrequently accompanies active-shooter events in the United States, but preparedness planners should take the possibility into account: hostage-taking is common during stand-offs or thwarted escapes. According to a 2012 analysis conducted by the NYPD, 98% of active shooters act alone. Police and/or FBI response teams normally take command of this situation, although the state police, ATF, U.S. Marshals, and National Guard all have potential responsibilities in a situation with an active shooter.

Bombings and other Explosive Device Attacks

After firearms, the easiest mass-use weapon to obtain and trigger is still a conventional bomb or improvised explosive device, because the components are readily, commercially available, as are detailed instructions on constructing such a bomb. Conventional bombs may be built with widely available chemicals and construction materials, even with household appliances. Improvised explosive devices can be purely explosive or incendiary, and thus tools for arson also. Bombs can be timed, remotely detonated, mailed, set to trigger from any number of environmental cues – including temperature, vibration, movement. Because bombs, IEDs, and firebombs together comprise low technology threat, they are most likely to be used in a domestic terror attack of any size, including small group and individual attacks on a single target. The Boston Marathon Bombings of 2013 emphasize the need for adequate surveillance and response personnel present at large event venues. A list of venue locations, capacity, and typical attendance is included in the table on the following page.

Table 47 – Large Scale Events, Tennessee			
Event	**Capacity**	**Average Attendance**	**Dates**
Bridgestone Arena, Nashville, Davidson Country Music Awards, Nashville Predators, Concerts & Festivals	20,000	Unknown	Year Round: Peak November and December
Bristol Speedway, Sullivan County	160,000	97,722	March/August
Bonnarroo Music Festival, Manchester, Coffee County, Manchester	Unlimited	92,000	July
L.P. Field, Nashville, Davidson County: TN Titans Season	69,000	Event: 68,000 Annual: 553,144	September - February
Neyland Stadium, University of Tennessee; Knox County	102,000	70,000	Year Round: Peak September - May
Tennessee Walking Horse National Celebration, Bedford County	Unlimited	250,000	August

According to FBI and FEMA sources, less than 5% of bomb attacks were preceded by any warning. Extent of damage is determined primarily by type and quantity of the explosive, but secondarily affected by the location of the blast, structural integrity of buildings, flammability of materials, and other factors. An explosion's energy decreases logarithmically as a function of the distance from the blast site; therefore, distance, and terrain can either absorb or deflect the energy of a bomb blast, shielding otherwise proximate populations and structures from harm. Conversely, a lack of barriers or shielding, detonation in a crowded, open space, and poorly constructed targets will have higher fatalities and injuries. Bombings may be accompanied by failed attacks or non-detonating bombs in multiple locations. Mitigation strategies must take into account blast- and fireproofing of structures, detection of explosives, and surveillance of transport systems, which could be used to carry and detonate explosives. This requires significant integration with existing TDOT infrastructure.

Arson and/or Incendiary Attack

Arson is a tool of terrorists around the world. Terrorists use incendiaries ranging from crude hybrids to fertilizer bombs with liquid fuels. As with all arson crimes, forests, national parks, and logging areas can all be targeted. Logging source forests have instituted more stringent surveillance to discourage attacks by radical environmentalist groups, who might use fire as a means of slowing the industry. In the early 2000s, the FBI intercepted Al Qaeda plans to start massive wildfires across the Western and South Eastern U.S. Chemical plants, including fertilizer and munitions manufacturing centers in urban or suburban locations, make equally high yield targets for potential arsonists, as do facilities managing the transport or storage of such goods.

The extent of damage caused by an arson attack depends on the type of device used, the quantity of accelerant, and the flammability of materials at the bomb site and in the surrounding structures and/or terrain. Buildings that are non-compliant with fire and structure codes (faulty sprinkler systems and/or concentrations of flammable substances) post a greater risk and increase the probability of an uncontrolled blaze. Structural failure or other longer-term consequences such as burning of noxious or toxic building materials is a hazard to consider, particularly if arson is used against older buildings or chemical plants. Incendiary terrorism – like other forms of arson – may be mitigated by efficient fire protection and detection systems, and quality fire-retardant and fire-resistant construction materials.

Cyber Terrorism
Cyber terrorism is an attack on computer, networks, and data storage. It can consist of any attack using the World Wide Web or internal intranet, ranging from hacking of important corporate data to sabotage and destruction of government databases, often with blanket disconnections of servers from their owners or of businesses from clients. The NSA and US Cyber Command reported 17 times the number of cyber-attacks specifically targeting key infrastructure as designated by CIAO from 2009-2012 over the preceding decade. Cyber warfare is often politically motivated, and consists of hacking to sabotage military and political targets or to conduct espionage on behalf of a state. Cyber terrorism is different in scale and often in goals from cyber warfare, though the two categories are porous. Terrorists are generally uninterested in long-term espionage. Thus most cyber terrorism consists of either unofficial state assisted attacks or entirely non-state terrorists acting on behalf of themselves or a proxy's agenda. Even these less sophisticated attacks have the capacity to impair vital information networks, damage economic productivity, and endanger computer systems' controlling important public works (such as dams and power plants).

FEMA Region IV produces almost 30% of the nation's power supply alone, and Tennessee handles nearly 70% of the grid maintaining distribution of this supply, from a variety of sources. The exceptionally high national reliance on this regional product, emphasizes the importance of remaining aware of ever changing cyber terror surveillance. Individual cyber terror attacks can be conducted by any skilled, motivated individual with hacking, programming, and coding knowledge. Within the State of Tennessee, state government offices are potential targets, but multinational corporations with facilities, plants, or headquarters in the state must be considered as well, as do power plants and TVA facilities. In Tennessee, electrical power grids warrant particular attention from a hazard mitigation perspective: since 2009, and again in 2012, analysts have warned that major cyber warfare states have developed programs to disrupt electrical transmission in the U.S. Data on these programs may not be disseminated at large because of security concerns.

Radiological Terrorism
Radiological terrorism is any nuclear threat excluding and outside of an attack with a nuclear bomb or warhead. An improvised nuclear device (IND) includes any explosive with a nuclear yield. The design must incorporate an appropriate trigger since the trigger determines which isotopes (uranium vs plutonium) will generate the chain reaction. The uranium can be far below weapons grade and still generate a significant nuclear yield. So called "dirty bombs" or radiological dispersal devices (RDD) include any explosive designed to spread radioactive material through detonation. A regular, non-radiological IED can become an RDD if placed near enough radioactive material. Conversely, some RDDs aren't explosive at all, but use existing radioactive substances in ways that spread the radioactivity.

Medical waste, rare earth metals (REM), processing products, and certain chemical industry supplies can all be incorporated into an RDD. Aerosol generators, sprayers, fans, and similar air-circulation devices can disperse radioactive materials, particularly medical wastes. Isotopes vary, but certain ones are most likely to be used by all but the wealthiest and most skilled terrorists. Gamma emitters are considered the greatest threat by the EPA and CDC because of high energy particles like Cobalt 60 and Cesium 137. These have longer half-lives and can extend mitigation timelines and costs significantly. Lighter beta-emitters, like phosphorus 32, are commonly found in medical and laboratory waste, and can travel short distances and still be effective. Alpha-emitters are heavily charged particles sometimes found in industrial equipment waste from illumination industries; they are a threat only if aerosolized or present in the dust scattered by an explosion. Americium 241 is the least protected and most common of these in the Southeast because of medical laboratories located in Tennessee and Georgia.

The surfaces in easily contaminated environments may remain hazardous for years after attacks. Impact of a radiological attack depends on meteorological conditions, the duration of population exposure, distance from the radioactive materials, and the presence or absence of shielding between the victims of attack and the source of the radiation. Gamma-emitters can travel far and penetrate skin and clothing. Radionuclides of beta-emitters may be absorbed through the alveoli of lungs and through wounds or digestion. Once absorbed, a radionuclide crosses through capillary membranes through diffusion and is distributed throughout the bloodstream. In addition to the risk of radiation poisoning, some isotopes that could be used in an IND or RDD can cause heavy metal poisoning in victims. Therefore, the health measures taken to deal with radiological terrorism must prepare for more than just radiation sickness and burns from the explosion. The primary health risk to humans is cancer from radiation exposure and thus not quantifiable as an immediate threat.

Chemical Terrorism
See Annex I below.

Bioterrorism
See Annex II below.

Agro Terrorism
Agro terrorism subsumes direct attacks or covert contamination of food supplies, livestock populations, or sabotage of the agricultural supply chain (food processing, distribution, and retailing system). The National Institute for Agricultural Security (NIAS) is directly responsible for surveillance procedures and reporting of potential events, and the escalation of a case as they deem necessary. They use HACCP (Hazard Analysis and Critical Control Point) planning to actively prevent the introduction of destructive material into the nation's food supply at state and local levels. States with a large proportion of agricultural revenue including Indiana and Pennsylvania have, with the help of NIAS, categorized any act of agro terrorism as a WMD. Introduction of pests, biological agents, or poisons fall into this category. Surveillance is critical for detecting an act of agro terrorism because naturally occurring livestock diseases and error-based food poisoning can have similar effects.

Beyond the baseline national dangers of agricultural terrorism to food production and distribution, states like Tennessee with a high percentage of rural, agricultural business need to consider this a high priority potential threat. Tennessee's agriculture sector faces risks from the smaller land area and concentrated conditions under which livestock are raised when compared to Midwestern producers, making them susceptible to communicable disease introduction. Foreign biological agents can quickly overwhelm the immunity of a domestic livestock population, and can easily be introduced into feed or directly to animals grazing outdoors.

Through agricultural attacks, terrorists can to use low cost and unsophisticated means to threaten or impair the state's economic base, thus giving agro terror a higher payoff. Efficient disease reporting and close cooperation between Tennessee's agricultural authorities and the USDA are important in mitigating this threat.

Critical Infrastructure & Key Resources (CI/KR)

Those facilities deemed most vulnerable to terror attacks and/or vital for response and hazard mitigation include:

- Primary healthcare facilities
- Post offices
- Ports
- Schools and higher educational facilities
- Military bases
- Water treatment centers
- Agricultural transport centers
- Chemical plants, including fertilizer production and storage facilities
- Oil refineries and any supporting petrochemical processing facilities
- Tennessee Valley Authority dams, all electrical power plants
- Junctions of major interstate highways and critical bridges (e.g., at the Mississippi)
- Explosive magazine storage facilities (construction sites, quarries, armories)

Annex I – Bioterrorism

Description

Bioterrorism is the use of organisms or biologically manufactured toxins as weapons of mass destruction. Bioterrorism presents a significant and atypical challenge to emergency preparation and terror threat mitigation in addition to the circumstances created by any terrorist attack. A successful response to such attacks requires coordination of all the public health expertise that would be marshaled against a major communicable disease outbreak, but also the civilian law enforcement and military infrastructure needed to respond to a terror threat. The nature of a bioterrorism event is large enough that an attack with an epicenter far from Tennessee or the South could have devastating local impact. Agents used in bioterrorism include pathogenic bacteria, viruses, and potent chemical toxins manufactured by microorganisms. Some biological weapons are challenging to source or isolate, but most are easy to deploy and cost-effective. Biological weapons are very attractive to potential terrorists for this reason. Some biological agents, particularly those relying on virulent microorganisms, can be made into aerosols and spread through respiratory contact. In aerosols, most biological agents are colorless, odorless, invisible, and very cheap to produce. Biological agents, particularly bacterial toxins, are very potent and can be introduced in food and water supplies with relative ease. Small concentrations of these toxins can kill or paralyze hundreds of thousands from just 1 contaminated source. Compared to nuclear or chemical WMDs, biological weapons – including aerosols – are by far the most affordable and thus present a higher, though unquantifiable, level of threat to the population. A relatively infrequent incidence of such attacks has left little historical data, so estimates of cost and of best scenario planning must rely on extrapolation from 1: Conventional terrorist attacks, 2: chemical weapons attacks, 3: naturally occurring outbreaks of communicable disease.

Relevant legislation – the legal structure for bioterrorism responses

The U.S. Government revised many of the existing preparedness measures for bioterrorism events between 2001 and 2006; individual state plans have lagged behind, but about 2 dozen states have specific protocols in place. Many of the provisions passed between 2001 and 2003 by the U.S. Congress were renewed by the Pandemic and All-Hazards Preparedness Reauthorization Act of 2013.

Following the dispersal of anthrax throughout the U.S. via the postal system in late 2001, several federal agencies updated their guidelines for bioterror response, and different protocols for bioterrorism mitigation have been implemented at the state level. A Tennessee-specific plan could follow broadly the recommendations of the Model State Emergency Health Powers Act, the most popular of these protocols. This was drafted by the Center for Law and Public Health at Georgetown and Johns Hopkins at the coordination of the CDC. 27 states have incorporated pieces of the act into their own bioterrorism preparedness legislation. The Model Act is structured to organize i) Preparedness through comprehensive planning for a public health crisis; ii) Surveillance measures to detect and track these emergencies; iii) Management of Property, ensuring adequate stockpiles and availability of vaccines, pharmaceuticals and hospitals, along with authorization legislation that gives officials latitude in addressing public health threats; iv) Protection of Persons, powers to compel vaccination, testing, treatment, isolation and quarantine when clearly necessary; and v) Communication, providing clear and authoritative information to the public.

There is no national standard for budget allocation to bioterrorism prevention and mitigation, so planning for emergency expenses is scattered from CDC public health allocations through FEMA miscellaneous baskets. Currently, much of the funding of programs to prevent bioterror that is allotted to federal agencies serves a dual purpose with infectious disease research and treatment. Approximately 10% of 2013 federal anti-terror funding goes solely to the prevention of bioterrorism. Programs like the Department of Health and Human Services' (HHS) Hospital and Public Health Preparedness grants, the Department of Defense's (DoD) WMD Civil Support Teams, and the Environmental Protection Agency's (EPA) homeland security programs all have an impact on bio-defense, but they are not solely focused on that purpose. State programs seeking dedicated responses to bioterrorism may choose to allocate differently from how the federal budget has allocated.

Threat Identification and Assessment

Illnesses caused by bioterrorism can be difficult to diagnose in their early, more treatable stages: the diseases caused by most of these pathogens are rarely seen in the developed world. They will first be seen by emergency room or primary care providers and not infectious disease experts. Public health officials will have to recognize the signs that an attack has occurred and that a disease outbreak is underway. The vague, “flu-like” symptoms classically accompanying early stages of infection may go unnoticed until the syndrome progresses. Initially, infection with biological agents may appear to be a naturally occurring outbreak of a communicable disease. Healthcare providers must then identify the organism and begin treatment and prevention measures, such as mass vaccination, quarantine, and expanded dispensing of antibiotics and antivirals; all of these treatments could be less effective if the intentional nature of an attack is unknown.

Therefore, surveillance for a possible bioterror attack needs to consider several indicators of intentional dispersion. It is advisable to assume intentional terrorism if these markers are suspected, so as to prevent losing valuable time for quarantines, vaccinations, and emergency hospital staff increases. Indicators include, but are not limited to, (1 outbreak of infectious diseases in an area to which they are not already endemic; (2 systematic exposure and infection of a large population to an otherwise rare infectious disease; (3 the reappearance of a familiar pathogenic organism with different, genetically modified features or with novel virulence; (4 infection with a genetically identical organism rapidly being diagnosed in many individuals in different cities and towns, or in multiple U.S. states at once; (5 higher morbidity and mortality than expected with a common disease or syndrome; (6 no illness in people not exposed to common ventilation systems, but illness among those people in proximity to the systems; (7 the reappearance of an extinct disease (smallpox) or a rarely occurring infection (inhaled anthrax) in many individuals in 1 location would also suggest an act of terrorism.

The source of an outbreak could obscure an act of terrorism, so surveillance of food poisoning and other mass illness reports is mandated. For instance, staphylococcal enterotoxin contaminated food supplies might be written off as a natural event of contamination somewhere in the supply chain, initially investigated accordingly, and not caught until mass outbreaks of disease were reported. In any event, the incubation period for most of these organisms runs from 3 to 7 days, making it likely that terrorists could escape before an investigation even began, let alone before authorities would be able to focus on a criminal investigation instead of emergency health measures. It is crucial that primary care providers and regional public health officials report any of these anomalous occurrences, communicate with the CDC, and speak to officials in other states about any similar presentations there. The impact of a bioterror attack can be mitigated by a swift diagnosis, and this is only possible with extensive agency cooperation.

Potential Agents of Bioterrorism
The agents that potential terrorists have available to them include bacterial, fungal, and viral pathogens along with endo and exotoxins produced by bacteria. Microbial bioterrorism relies on using communicable pathogens to target a population; other forms may rely on the toxins produced by microbes to cause neurological or other medical emergencies. While some of these toxins – such as ricin – could also be considered chemical weapons, they all have biological origins and thus fall with the purview of bioterrorism. The following list, while not exhaustive, covers the major infectious threats that experts have flagged for special attention by public health officials and anti-terror preparation programs:

The CDC uses a 3 category system to distinguish among these potential bioterror threats.

Category A
includes high-priority agents that result in high mortality, can be easily transmitted from person to person and/or are easily made into aerosols, and which might cause panic and social disruption. Anthrax, botulism, plague, smallpox, and tularemia all fall into this category, as do the rare but virulent and usually fatal infections with viral hemorrhagic fevers such as Ebola, Marburg, Lassa, etc.

Category B
includes moderately infectious and moderately easy to disseminate agents, which nonetheless require special and intensive surveillance to control and contain. These include the many bacterial food safety threats such as *E. coli* strain 0157 and shigella; assorted toxin producing *Salmonella* strains; ricin toxin; brucellosis; water safety threats, especially from the introduction of *Vibrio cholerae* into a public water supply; and the various sources of viral encephalitis.

Category C.
comprises difficult to acquire but virulent emerging infectious diseases (EIDs). It is important to note, however, that both the CDC's and the Department of Homeland Security's list of known threats is by nature incomplete. Previously unknown pathogens are frequently discovered or engineered in laboratories as an effect of the rapid progress in microbiology and biotechnology. It is likely, therefore, that category C threats will expand over time and need to be considered as an open-ended challenge to public health and anti-terror preparations. The Department of Homeland Security lists bioengineered agents as a separate category of threat. The category's classic example is the engineered strain of MDR *Bacillus anthracis.* The CDC maintains a list of bio terror agents updated with regular review periods.

Response Considerations Unique to Bioterrorism

Coordinating the nexus of health and law enforcement officials, and communicating with state and federal authorities amid the confusion of a terrorist attack requires a centralized command; the state could appoint a bioterrorism coordinator to whom responsible agency heads can report and with whom public health officials share relevant information. This individual should have a liaison or personal presence in the state's Emergency Operations Center.

Public health officials need to train extra “surge staff” to be available as reserves in times of a terror-caused disease outbreak, and they need to coordinate the assembly of these reserves in an efficient manner through drills and other preparatory simulations. Surge staff at hospitals, clinics, and emergency vaccine and treatment centers are the highest priority, but surge (volunteer) first responders may be needed depending on the scale of an attack.

Hospitals and local health departments should regularly make use of emergency communication sources, including Health Alert Network, the Emergency Preparedness Information Exchange (Epi-X), the Emerging Infections Program, the Epidemiology and Laboratory Capacity program, Information Network for Public Health Officials, Assessment Initiative, Hazardous Substances Emergency, and Events Surveillance, influenza surveillance, and other emergency response programs including local Metropolitan Medical Response Systems (MMRS). In addition, the CDC recommends a well-publicized 24-hour/day system to facilitate disease reporting to the local and state health departments, especially for reporting diseases related to potential terrorism events.

State laboratories, regional (FEMA Region IV) facilities, the NIH, and the CDC must coordinate analyses and determine the order of testing required. Initial tests should come from the nearest available facility and law enforcement should be notified that testing for potential bioterror agent is underway. The CDC asks that tissue samples and any potentially hazardous or communicable agent is sent to its Atlanta (Clifton Road) offices for testing.

The state should plan the procedures and means by which the public will be notified about a public health emergency, including mediating panic and coordinating appropriate measures such as vaccination. The bioterrorism coordinator should have a script prepared for state agency spokespersons.

Plans for coordinating access to materials from the national stockpile and for keeping local supplies of vaccines and other necessary medicines available should be implemented at the state level. Every local health department must be informed about the protocol for accessing these items in an emergency.

Annex II – Chemical Terrorism

Definition

Chemical terrorism is the use of natural or synthetic chemical agents to inflict mass injury, death, and panic. It has extensive documented historical incidence, including the chemical terrorism used by cult members in the 1990s in Japan through to recent deployment of chemical agents by insurgents in Iraq. In the United States, several terrorist plots to release poisonous gases in cities were thwarted in the early 2000s. Terrorists may use organic chemicals, including byproducts of the petroleum and gas industries; strictly harmful chemical weapons such as nerve agents; common industrial waste and byproducts; and ubiquitous technological and industrial solvents, reagents, and purification agents. Major chemical weapon stockpiles were assembled by the United States and the former Soviet Union; few have been entirely dismantled. Terrorists could access these, but many more options, including robbery of chemical plants and destruction of transports or urban storage facilities with explosives, can facilitate release and dispersal of chemical agents. Many noxious industrial chemicals, while less deadly than actual chemical weapons, can be used by terrorists to inflict harm in certain circumstances. Therefore, the definition of whether or not a chemical is a terrorist weapon really depends upon how it is used.

Threat Identification and Assessment

Common Chemical Agents

Nerve agents

VX is a modified compound based upon organophosphate insecticides. It was created solely as a weapon of mass destruction, and has no other known uses. It is a colorless, odorless, viscous liquid that can be distributed as a gas if heated to a sufficiently high temperature. VX operates as an acetylcholinesterase inhibitor, resulting in severe muscular contractions and eventually flaccid paralysis. Death results from cessation of breathing due to diaphragm paralysis. In a sufficiently high dose it is lethal through skin contact and through respiration; the effects begin within a few seconds of exposure to the vapor form.

VX is not volatile, and is slow to evaporate. It can remain active on clothing in excess of 30 minutes. Typically, VX, because of its density will sink to lower lying areas and pool. Under average weather conditions, it can remain in liquid form for many days; in cold weather, it can remain in liquid form for many months. As a result, VX remains a hazard long after it has been deployed. Active removal of VX is a difficult process but must be attempted to clear out a hazardous zone.

Sarin is a clear, odorless, tasteless liquid that evaporates into a gas in air. Developed in Germany in 1938 as a pesticide, Sarin mixes easily with water and can be used to contaminate water and food supplies. Chemically, Sarin behaves similarly to VX, but it evaporates far more quickly and thus presents an immediate danger, which dissipates in minutes. As with VX, Sarin is toxic because it degrades cholinesterase enzymes and results persistent activity at neuromuscular junctions.

Acids and Noxious Gases

Hydrogen Fluoride

Hydrogen fluoride is a colorless gas that is the principal source of fluorine, and is used in many industrial processes. Large stores of the substance across the state and region make it easier to access than many other agents of potential terrorism. HF is widely available. It's used in the petrochemical industry to make many “superacids” and as a precursor to pharmaceutical products. On contact with biological tissues, HF reacts to become hydrofluoric acid, an especially deadly substance; the poison can destroy the corneas and lung tissue immediately on contact, leading to pulmonary edema. Contact with even a small amount of skin causes deep burns and eventually interferes with cellular calcium balance and can cause cardiac arrhythmias or arrest. Swallowing will constrict the esophagus and stomach, destroying tissue. Calcium gluconate gels are helpful and are included in some states stockpiles in case of an attack.

Mustard Gas

Mustard Gas (sulfur mustard) is a blistering agent that damages skin and mucus membranes on contact. Sulfur mustard sometimes smells like garlic, onions, or mustard but can be odorless. Its phases include vapor (the gaseous form of a liquid), oily-textured liquid, or solid. If sulfur mustard is released into the air as a vapor, people can be exposed through skin contact, eye contact, or by breathing. Sulfur mustard vapor can be carried long distances by wind. It could be introduced into the water supply as a poison. Other than through consumption, sulfur is unlikely to cause fatalities, but scarring, blindness, respiratory impairment, and potentially carcinogenic DNA damage (lung and skin cancer) are common effects. It is heavier than air, so it will sink in low lying areas.

Skin will be affected shortly after exposure. Redness and itching of the skin may occur 2 to 48 hours after exposure and change eventually to yellow blistering of the skin. Eyes will experience irritation, pain, swelling, and tearing may occur within 3 to12 hours of a mild to moderate exposure. A severe exposure may cause symptoms within 1 to 2 hours and may include the symptoms of a mild or moderate exposure plus light sensitivity, severe pain, or blindness (lasting up to 10 days). *Respiratory tract symptoms may include* runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough within 12 to 24 hours of a mild exposure and within 2 to 4 hours of a severe exposure. The d*igestive tract will show increased motility,* abdominal pain, diarrhea, fever, nausea, and vomiting.

Chlorine Gas

In addition to its potential accidental release due to a breach in hazardous material safety, chlorine gas has been used as a military and terrorist weapon. A common product in the U.S. in the manufacture of paper and plastics, it is widespread in all Tennessee counties as a water purification ingredient. Chlorine is produced in 12 to 20 states, and must be transported to most metropolitan areas, including those in Tennessee. Terrorists could intentionally release chlorine from a storage facility in a metropolitan area, resulting in thousands of casualties. Unlike most other chemical weapons, chlorine is already present in quantities that would obviate the need for terrorists to transport or store it in preparation for an attack. Hijacking a facility or using an explosive to release chlorine out of a storage area would be much easier than its production, theft, or transport.

The consequences of a chlorine attack are grave. The DHS lists it in the top-15 list of "National Planning Scenarios," a category of threats both feasible and possible almost anywhere in the nation. Chlorine gas is denser than air, and tends to sink to the ground. It has an intermediate solubility in water, which gives it some irritant warning properties but also makes pulmonary damage likely. Irritation begins at 15 PPM of exposure, and the gas is fatal above concentrations of 430 PPM lasting 30 minutes or more. (OSHA sets the permissible limit at 1 PPM for 8 hours.) Since chlorine can also cause skin and eye injuries, it is important that hospitals have surge capacity to treat the volume of patients that would come in after an attack. Evacuation of the hot zone (zone of chlorine release), decontamination, and pre-hospital respiratory support are necessary to mitigate the scale of damage. Inadequate evacuation, decontamination, and hospital support are likely to raise fatalities. Current scenario estimates predict up to 100,000 injuries and 17,000 fatalities if terrorists release chlorine in a medium to large metropolitan area.

Phosgene

Phosgene is a simple to manufacture acid chloride made from carbon monoxide and chlorine filtered through carbon. It can be formed when chlorinated hydrocarbons are heated, including paint-stripping and dry cleaning agents. A currently active agent used as a chemical weapon since World War I, phosgene is currently found in industries in Tennessee, largely used to manufacture pesticides. It is extremely poisonous, affecting the respiratory system with slow-to-appear symptoms that worsen over the span of several days depending on concentration exposure, and potentially causing pulmonary edema and heart failure.

Blood Agents

Cyanide Gas

Cyanide can be used in several forms, but hydrogen cyanide is the most common and widely available. Also known as Prussic Acid, HCN is a colorless liquid that boils just under 80 degrees Fahrenheit. Its salts are the cyanides, and when introduced to water it forms a solution of hydrocyanic acid. Cyanide is poisonous because it inhibits cellular respiration by inhibiting a critical mitochondrial enzyme. As a terrorist weapon, it is difficult to disperse but widely accessible since it is manufactured on an industrial scale and used across chemical and metal production processes. In high enough concentrations with bad ventilation, cyanide can kill in less than a minute. The best prophylactic measure – accompanying the general hazardous materials protocols – is stockpiling and preparing access routes for the U.S. standard cyanide antidote kits, which consists of several medications. Amyl nitrate, sodium nitrate, and an injection of sodium thiosulfate are the most widespread antidote combinations, and remain standard here despite newer approved alternatives.

Riot Control Agents

These typically do not cause fatalities or permanent injuries, but can be used in conjunction with more destructive chemicals, or to impede responses to an act of terror by adding irritants to the scene of attack. Often collectively referred to as “tear gas,” riot control agents include chloroacetophenone (CN) and chlorobenzylidenemalononitrile (CS) along with some compounds used as fumigants. The compounds cause eye, nose, throat, mouth, and skin irritation at the normal concentration when dispersed. Generally, riot control agents are used by law enforcement for crowd control, although some are available for personal self-defense applications. In the context of countermeasures to terrorism, there is the possibility of 1 or more of these agents to be mixed with other compounds in a mixed chemical attack or of their release with, or following a bombing, among other scenarios. While the effects generally last no more than 30 minutes, the use of these agents could impede time-sensitive rescue efforts and facilitate the evasion of authorities.

Response Considerations Unique to Chemical Terrorism

A chemical terrorism event is likely to be discovered in 1 of 2 ways: through the immediate effects of an attack using fast-acting chemicals or the gradual medical diagnoses of mass effects of a slower-acting toxin or other agent. In the event of an attack on a public space, emergency responders may provide critical on-scene assessments and patient examinations that constitute an informal passive surveillance system. These nationwide monitors could report potential events in a fashion timely enough to allow for rapid intervention. Rapid presentation of exposure symptoms in multiple locations should be assumed to be an attack until proven otherwise. Much of the response to a chemical agent attack should follow the protocols listed under section “Hazardous Materials Agents List.”

Similar to the relationship between infectious/communicable disease prevention and bioterrorism readiness, is the overlap between preparedness efforts for chemical terrorism and HAZMAT accidents. The main differences between industrial chemical accidents and chemical terrorism may be intent and magnitude; the dispersal location during a terrorist incident will likely be much more central to a population hub. Efforts to enhance hazardous materials preparedness and response activities for chemical spills will better prepare Tennessee to respond to chemical terrorism. Likewise, chemical terrorism preparedness activities should enhance regional and statewide preparation for HAZMAT events like spills, truck and rail transport leaks, and accidental explosions.

3.3.6 – Impact & Consequence Analysis

Health and Safety of Persons in the Affected Area at the Time of the Incident (Injury/Death)
There is no consensus on estimates of potential fatalities and injuries for terrorism events. The data here is drawn from several reliable estimates, each using a different statistical model. Major sources include the RAND corporation reports, the Department of Defense, FEMA, and the CDC. By definition, all terrorist attacks pose grave risks to the health and safety of persons present at the location of the attack.

A statistical majority of previous terrorism incidents in the United States have involved bombs as the primary weapon. Bomb statistics are calculated from past incidents. Initial blasts, building damage and possible collapse, secondary fires, and release of hazardous or toxic structural materials together endanger anybody proximate to the explosion site. Death tolls from a conventional bomb, therefore, can run from zero to over 10,000, contingent upon the size and location of the blast and the nature of the surrounding environment. Population density increases the risk to health and safety. Incendiary bombs or blasts coordinated with poisonous or highly flammable gas release will have higher M&M figures in most urban areas than a will single conventional explosive. Injuries in excess of 20,000 or more are possible in major urban centers, but in midsize cities such as those in Tennessee, the count would likely be lower than 15,000. The exception with higher injuries and fatalities is the use of an explosive devised detonated in a crowded stadium, racetrack, or convention center, where the density converges with projectile and shrapnel damage, possible crowd crushing, etc. Tennessee has enough of these venues to consider the risk.

Domestic attacks by active shooters have averaged in the lower dozens of fatalities with fewer than 500 wounded. Choice of weapon and location, along with clip capacity determine relative danger to individuals at the scene. Existing data comes mostly from school and workplace shootings, “Homegrown” violent extremists, and “narco-terrorists.” Other gangs can coordinate several attacks with firearms to cause a greater effect, either by storming a single location or hitting several different institutions simultaneously. Recent international incidents of multiple active shooter terrorism had casualties in the mid-hundreds; it is thought that this occurred with fewer than 6 terrorists participating. People at the scene of an attack may be injured by recoil, ricochet, fragments, and shattered glass in addition to the bullets themselves. The simultaneous use of explosives like grenades pushes estimated casualties, and injuries (particularly permanent disabilities) above 500 and 1,000 respectively, according to some recent models.

For the economic impact of terrorist arson in lives, health, and property, non-terror statistics might be useful. Many people escape the scenes of a fire, whether a house or wildfire, when proper evacuation procedures are in place. Death by asphyxiation is more common than death from being burned to death at the scene of a fire but burns do occur, and many of the injured in an arson scene experience serious burns. Arson induced wildfires and destruction of vacant and abandoned buildings, often result in smoke inhalation deaths and injuries. Terrorists are likelier than juvenile arsonists to employ incendiary devices and attack crowded, flammable targets: the 375-500 average annual deaths, and 2,000 annual injuries from arson is a low estimate of the hazard to persons at the scene of an incendiary terror attack.

Attacks with WMDs are equally difficult to estimate accurately, but for some biological agents the data from epidemiology of natural outbreaks is a guide to health and safety risks. Botulism toxin distributed in a water supply could kill hundreds of thousands. Reliable estimates for anthrax predict 1 kilogram of powder can − with maximally effective delivery – kill 100,000 and cause respiratory illness for several times that number. Response times, medical team availability, and coordination of efforts directly effect changes in mortality and morbidity rates in any bioterrorism event. A study by the Center for

Nonproliferation Studies, for instance, found mortality increased by 85,000 individuals to 125,000 in a scenario in which the response to an attack was slow and ill-coordinated.

Smallpox becomes more dangerous over time without immediate vaccination and drug treatment, so the risk to people at the scene of release is only a small element of the total number of people that could be potentially affected. Smallpox re-release scenarios – regardless of specific statistical model – suggest very high immediate effects. Up to 10 million fatalities could occur if regions of the country are hit where re-vaccination is slow. In a best case scenario, with immediate treatment of affected persons with first-line drugs, enforceable quarantines, and vaccination of surrounding population, in a small city, deaths could easily surpass 50,000. The United States and a few other nations have enough smallpox vaccine for the entire population; but a regional attack, especially in a rural area, could present delays in response and more of the people at the scene of exposure could succumb. In Tennessee, coordination of agencies and speed of treatment because of distances are greater challenges than vaccine access per se (many emergency stockpiles are proximate to most population centers, particularly Memphis, Nashville, Chattanooga, and Knoxville but with extensive metro and suburban areas to each that must be served).

During chemical agent attacks, many people who are injured may experience progressively worse health long after the initial attacks. Data from chemical weapon attacks shows extensive injuries and long-term impairment, even in scenarios with few initial casualties. Nerve gas attacks in the 1990s, for instance, killed 7 to12 but injured 200 to 5,000 per incident. Similarly, a few hundred people near the blast of a dirty bomb might be killed or injured, but tens of thousands could suffer radiation sickness or cancer as a result of the initial exposure.

In addition to permanent physical disability and chronic disease, long-term psychological effects may also plague those present at a terrorist attack, including the non-injured and the first responders. PTSD rates among those present at the scene of a terrorist attack correlate loosely with distance from the event and extent of violence. Survivors of recent domestic terrorist attacks have had PTSD or other psychological impairment at rates of 37%.

Health and Safety of Personnel Responding to the Incident

TEMA specifically develops plans for first responders so "that no one is needlessly killed or injured responding to a hazardous material incident." First responders to conventional terrorist attacks face health risks from fires, damaged or impaired structures, un-detonated bombs and other explosives, toxic chemicals released by blasts or building materials. Bombs can be employed covertly, and could remain undetected near the scene of an already detonated device. This endangers first responders without trained personnel and explosive detection equipment. Secondary explosive devices may also be used as weapons against responders or timed to detonate after emergency teams have arrived at the scene of an earlier blast. Other diversionary attacks could also be aimed at responders, including chemical releases. The regular risks to EMTS, firefighters, volunteers, and the like can be compounded by the size of a disaster. Damage on the scale of a city block in a downtown area could mean longer than average initial response. Fatigue and discomfort from wearing protective/fire turnout gear can be expected in that situation. In a less populated setting, attacks near oil or petrochemical storage facilities can present very similar challenges to stamina and responder agility of personnel. First responders also are at risk for serious fatigue and stress, including long-term psychological impairment that interferes with future work. PTSD is a possibility for responders, as well as victims, of a terrorist event.

At major terrorist-attack sites, emergency workers face manifold safety hazards. These include conventional hazards associated with building fires—flames, heat, combustion by-products, smoke—but also extensive debris, human remains (including bone fragments), rubble blocking pathways and entrances, air filled with fine particles that will cause injury if aspirated, asbestos, ammonia, Freon, and live electricity. In most cases, the conventional training practices of rural, volunteer, and smaller urban responders will not be designed to prepare them for this range of hazards.

The health and safety of responding personnel at a CBNR event is endangered in proportion to the speed with which they recognize that they are responding to a terrorist attack and are able to prepare accordingly. This is especially important with radiological, biological, and chemical terrorism. Contamination from radiation, inadequate shielding from noxious chemicals, and exposure to potential carcinogens become probable; air is polluted. Personnel will require extensive respiratory support and decontamination facilities. Attacks from chlorine gas to improvised radiological devices risk contamination of anyone at the scene. Chemical and biological attack sites can be decontaminated more readily than those with radioactive materials, but in all cases first responders' health risks increase with the time spent at the scene and decrease with their level of physical protection, respiratory support, and decontamination options. Conventional protective gear may impair the mobility and perception of first responders, since it is often bulky and not designed to be worn for the length of time that such personnel might be at the scene of a terrorist attack.

Bioterrorism threatens all personnel responding to an incident. Aerosolized pathogens can travel with wind and thrive with poor ventilation. In a middle-impact scenario, responders will have ventilation suits, but some exposure during the early phases of an attack may occur, especially if there is lag time between the attack and diagnosis. The victims of such a scene may also become carriers of an infectious disease, further endangering the first responders. Inefficient scene control during early phases of response increases this risk.

Continuity of Operations

TBI, and the Department of Commerce and Insurance are primarily responsible for records held relating to bomb, arson and deliberate loss. Continuity of operations can be partly or completely interrupted by terrorism. The basic evaluation of risk sees the loss of operational continuity as much likelier in the case of chemical, biological, nuclear, or radiological incidents in the vicinity of core facilities, offices, and transport routes. In instances of small scale attacks without damage to infrastructure, communications, or loss of key personnel, no disruption may occur. Either Tennessee state agency operations or federal agency operations will likely continue in the case of a regional attack barring WMDs or loss of core capabilities. Within the state, an attack on the capital or central agency headquarters in Nashville could disrupt operations, though regional FEMA and TN county facilities cover certain law enforcement and health capabilities. Regional facilities are dependent on receiving centralized commands from designated centers, most of them in the Mid Atlantic. Tennessee has limited designated continuity of operations facilities, but many decentralized responders would be able to continue operations without such facilities in the event of a conventional terror attack. Conversely, disruption of the federal chain and/or Internet, satellite, and conventional telephone could impede this. Bioterrorist planned outbreaks of a broadly lethal infectious disease may affect continuity of operations at the state level even if the release occurs in another state. In a major disaster, the National Emergencies Act and the protocols of the National Continuity Policy, immediately take force. FEMA's Mount Weather Facility, among others, is a designated continuity of operations center; but it, like other links in the federal continuity system, is dependent on the geographical location of a terrorist attack. Many of the federal facilities closest to the State of Tennessee are within the central Appalachian Mountains, largely in the Shenandoah. A nuclear or radiological attack within this region could disrupt many channels of communication and transport, even if the facilities themselves withstood a blast and were shielded from radiation.

Property, Facilities, and Infrastructure

The weapons used and the scale of a terrorist attack will determine the extent of impact on property, facilities, and infrastructure. Property damage is nearly inevitable in a terror attack. Firearms and small explosives will likely cause scene-of-attack only damage, which can range in costs but typically does not exceed the low millions (less than $10 million). Larger bombings, especially of major residential or commercial urban spaces, can cost upwards of $10 billion. Infrastructure can be affected if electrical, plumbing, or gas lines experience breaks or physical destruction.

Demolition within a metropolitan area will likely impact many critical infrastructure assets and commercial spaces, diminishing output capabilities and essential infrastructure. Attacks on chemical and energy plants and/or storage facilities can destroy surrounding structures, farms, and wilderness with fires; subsequent air pollution can range over hundreds or more miles and deposit toxic substances on nearby facilities.

If shipping or rail facilities receive damage, including secondary damage from a coordinated attack, the loss of this infrastructure can lead to other severe long-term regional consequences. Moreover, industries across the nation may be affected due to “cascading effects of supply chain disruption” - such as occurs when a major supplier of industrial, technological, or chemical supplies is compromised.

Critical infrastructure could also be targeted intentionally by terrorists, so the potential impact is much higher than with most natural disasters. Targets include roads, bridges, culverts, rail, communications, power plants and lines, healthcare facility access and power, and water and wastewater treatment facilities, public lighting, law enforcement and first response command centers, among other facilities. Damaged infrastructure can hamper disaster response, cost lives by delays, and impair recovery efforts by delaying first responders' ability to reach an affected area or deliver medical supplies, vaccines, burn units, trauma kits, etc. In addition, the immediate destruction of infrastructure like the collapse of a bridge or a dam bursting can cause physical harm to people and property proximate to the attack.

Each infrastructure asset’s functional status and contribution to the provision of services affects the total extent of economic impact. As a rule, damage is best mitigated when the entire chain of dependencies of facilities and services can be restored, replaced, or substituted. Restoring an asset, such as a hospital, will not be effective unless the services on which that asset depends—diagnostic laboratory services, power, water, public road transport, and communication—are also restored. Further, because dependencies may be multiple layers deep, restoration of many secondary services may be required to enable a single high priority service.

Continued Delivery of Services

Vital services could be compromised by a major explosive attack, a cyber-attack, or terrorist deployment of CBRNs. No exact estimates are available, but domestic terrorism in the past 2 decades has impeded continuous delivery of emergency medical services, life support and kidney dialysis systems, law enforcement communication and travel ability, industrial services (particularly heavy industry and manufacturing), shipping (including air freight in the instance of an airport or air traffic disruption), interstate and regional highway transportation, and water treatment services. Disruption of mail delivery by a cyber-attack on the postal system or a physical delay of mail delivery financially affects the state and potentially many of its services.

Farms, suburban and rural industrial parks, factories, and other facilities located at a distance from supply centers rely heavily on highway and moderately on rail access. They may experience disruptions because of these dependencies, even if located far from the site of a terrorist incident.

Disruption of the high-traffic transportation arteries in Tennessee, including both the rail and interstate highways, could disrupt continuity of public and private operations. For example, transportation of goods and people into and throughout the recovery area is nearly always a top priority, because it contributes to multiple objectives, including public health, public safety, economic, and security objectives. Attacks on the power grid, regionally, or direct attacks on specific electricity generating plants and/or TVA hydroelectric plants, terrorist bombs in key arteries like Nashville's nexus of interstates or Memphis' port region could have a high impact.

Delivery of services in the immediate aftermath of a terrorist attack almost always will be altered near the site. The extent of that alteration will vary depending on the attack itself; an active gunman scenario could result in closure of streets or neighborhoods and a manhunt; while a dirty bomb or chlorine gas release could necessitate the closure of whole regions of the country for indefinite periods and result in contamination or condemnation of buildings or acres of land.

Environment

Conventional urban terrorism has less of an impact on the overall environment than the use of WMDS or attacks on chemical, energy, or agricultural facilities. Air pollution and water pollution are concerns from conventional terrorism, particularly attacks on combustible assets located near waterways. Tennessee's abundant water supply and central location enhance the risk of spillover from such events into neighboring states. The presence of many cave systems underneath much of the state increases the risk of aquifer contamination, as well as land collapse or sinkhole formation in the event of a seismically significant explosion or synchronous explosions.

Oil and natural gas transportation and storage can be attacked, burned, or sabotaged by terrorists. Tennessee has limited risk from pipeline sabotage, but sufficiently large reserves of natural gas to be of concern. Domestic terrorism against any energy transports in the Mississippi or Cumberland watershed could cause a spill. If this happens in a difficult to contain setting or in a body of water, the environmental impact profile resembles that of an accidental oil spill. Tennessee's aquifer system is relatively superficial, so spills can leak into groundwater quite quickly.

Bioterrorism has many of the same environmental effects as a naturally occurring communicable disease outbreak, but a distinguishing characteristic is the ability of bioterrorists to target agriculture. Engineered or targeted zoonotic diseases risk destabilizing domestic, wild, and human populations. Many animals, particularly mammals, can become vectors for diseases released into the human population; many biological agents, like anthrax, infect multiple species.

Some chemical agents, including the heavier gases, will sink into a location and contaminate the area nearest the surface. But others can disperse in water or travel greater distances in air currents. The environmental impact of a chemical attack often resembles that of an accidental HAZMAT spill, but the concentrations of released agents will vary more widely depending on the skill of the terrorists. Additionally, there is the risk of fire damage to forests, grasslands, and other areas if a rural or semi-rural chemical stockpile or processing plant is attacked with explosives. Use of chemical warfare in urban areas, while very serious for the inhabitants, should have a less severe environmental impact outside of the immediate area of exposure. Concrete and asphalt may keep more of the chemicals out of the soil and groundwater.

Radiological terrorism can poison habitats for centuries. Release of certain isotopes into water and agricultural crop cycles would not only compromise the human food supply chain, but could harm countless other species. A strategically placed bomb or an aircraft strike on a nuclear plant could cause a core meltdown if it struck the reactor. Even if it did not affect the reactor, the effects of an attack on only the fuel stored at a plant could be as catastrophic as a WMD attack in terms of environmental and health risks. Even a smaller-scale attack, such as one using a truck bomb, could inflict severe damage. An attack on a facility near a major metropolitan area, such as the Indian Point reactor near New York

City, could result in massive environmental devastation as well as up to 44,000 near-term deaths and as many as 518,000 long-term deaths. Oak Ridge, while not near a major metropolitan area, is sufficiently close to Knoxville and meteorologically linked to the southern Appalachians, Cumberland Plateau, and much of the water supply of the Atlanta metropolitan area. An attack on Oak Ridge could be devastating environmentally.

Economic Condition

One can estimate the economic impact of acts of terrorism with broad functions: the costs arising from physical destruction, the loss of human life and health, and with respect to the latter the longer term costs resulting from the treatment of chronic injuries, market disruption, and potential psychological traumas. The Department of Mental Health dedicates ESCs for public mental health responses to terrorist events. Most terrorist attacks incur indirect impacts resulting from the disruption of economic processes and activities, which may not be confined to the terrorized city or state's economy but may spill over to other activities, sectors and economies, affecting the United States as a whole.

Conventional terror attacks that detonate explosives in a medium sized urban center might cause damage of around $10-30 billion; in a major urban center, particularly with disruption of transportation and business, this figure could easily rise to above $100 billion. By comparison, several federal departmental estimates of the direct costs of 9/11 average $49 billion; when consequent clean-up and loss economic and social functions are calculated, the cost rises to between $80 and $100 billion, excluding overall market effects like the loss of equity values, decline in aviation industries, and mild recession. The low end of industrial sabotage could cost $100 to $200 million; the higher end, such as a successful attack on a power plant, is estimated to cost over $1.5 billion. Blackouts increase costs disproportionately. If terrorists strike at the power supply of a large city, the economic damage could range from $2.8 billion to $20 billion depending on the resilience of the city and state's disaster response and the scale of the blackout caused.

Terrorists striking with WMDs, even hitting rural targets, can easily inflict damage far above the cost of any historical terrorist attack in the United States. Bioterror attacks focused on agriculture and/or the food supply chain could easily cost $500 million to the tens of billions; successful bioterrorism directed against population centers could cost anywhere from $200 billion to $3 trillion (the latter in the case of a full outbreak across a region or the nation). Anthrax attack models hypothesize costs around 26 billion dollars, a great of deal of which is subsequent to the initial response and public vaccination expenses. Models of smallpox cost cannot indicate any precision total costs, but the range of $30 billion to $200 billion is standard.

No historical data is available for a dirty bomb detonation by terrorists, but robust actuarial studies conducted in 2006 estimate the impact for several urban scenarios. A radiological or chemical weapons attack against a midsized city such as Memphis or Nashville could easily pass the $100 billion mark in immediate cost and longer term economic losses; experts estimate the cost of a WMD attack in Manhattan, for instance, to surpass $700 billion.

Reliable models for the costs of a cyber-attack have yet to be calculated reliably separate from cyber warfare estimates. Attacks on government sites, utilities, and the primary Internet based businesses have the worst estimated impact on stock prices. Serious shutdowns of servers, worm attacks, and virulent computer viruses have only sporadic incidence and limited cost impact analysis at this time. Economic disincentives to immediate public disclosure of attacks may delay response and increase the impact of small-scale cyber terrorism events.

One of the most significant considerations in economic recovery planning is the immediate loss of national and international markets for regionally produced goods. Fears of contaminated goods are likely to significantly reduce demand for those products, and could cause a corporation or industry to decline even without untenable immediate losses.

Financial markets usually become depressed after a terror attack. A regional event of limited impact on actual assets, services, and operations could nonetheless hurt or cripple capital markets and lower share prices in its aftermath. Markets have resilience, but an immediate swing of confidence can take months for recovery. Damage to utilities or to industrial or agrarian supply chains can hurt a specific industry or industries more than the economy at large. Within the state, loss of assets in agriculture, automotive manufacturing, or health care industries could all cause market devaluation and decreased economic confidence and employment.

The extended disruption of community services—such as education, medical care, and social services—will deter individuals and families from remaining in, or returning to, their communities. Businesses that support the directly affected entities will suffer as demand for their products and services declines and consumers are unable to meet financial obligations. Further, mounting national and international concerns over product safety and quality could put entire industries at risk.

Public Confidence in the Jurisdiction's Governance

Public confidence might diminish after a successful terrorist attack. The extent to which this loss of faith will affect the economy and regional society is a function of the quality of the aftermath and response as much as it is of the severity of the attack itself. A poorly planned or executed first response and an extended, unresolved investigation of the terrorists will reflect badly, respectively, on the state and federal governance.

The psychological aftermath needs to be considered. For this reason, mental health preparedness planning needs to be incorporated into any threat mitigation scenario. A basic goal of terrorism is to instill fear into a large population. This is easiest to accomplish with unconventional weapons, like biological WMDs, where the uncertainty of the threat causes widespread fear to the point of irrationality. Counseling of the population, reassurances, and having psychiatric treatments ready needs to be considered part of the state's readiness planning. Public confidence will be undermined by extended trauma, even with government reassurance, if everyday patterns or delivery of goods and services are interrupted for an extended period.

Accidents, possible violence, and loss of public order can arise from any kind of terrorism, but may be exacerbated by the outbreak of a contagious disease. Immediate and delayed forms of hysteria will include so-called psychogenic illnesses, with unaffected people reporting symptoms and unable to work as a result. If communication about the nature of these illnesses is inadequate, public suspicion about the state's capabilities may undermine lifesaving cooperation with public health directives.

Section 4 – Risk Assessment

4.1 – Risk Assessment by Local Plan Integration

A comprehensive review was conducted of all currently approved local hazard mitigation plans in order to integrate the local risk assessments into the state's analysis. Each and every local plan's hazard vulnerability assessment was carefully reviewed, analyzed, and equated to the state's 1 through 6 index to compile a local plan driven loss estimate. The analysis and index equation was performed for every locally profiled hazard for both vulnerability and total risk. Threat was not individually profiled as local planners factored it into their risk calculations. Additionally, they did not provide sufficient and separate enough details on local threat levels to be successfully profiled individually.

The review was conducted by qualified emergency management specialists and approved by TEMA. No modifications or skewing of the local plans' assessments occurred. Instead, the review specialists simply translated the local assessments into the unified model. It was necessary to translate the local plans into a unified model to the high variability in methodologies used across the state. The reviewers used a standard threat, vulnerability, risk matrix to translate the local plans' assessments.

The result of this assessment is more of a total picture of how local jurisdictions perceive threat than an actionable risk assessment. Planners at the local level are limited in scope by analyzing hazard risk to their sole jurisdiction without comparison. This limit creates an effect where, without comprehensive hazard data and unified methodologies, local planners may have a skewed perception of their hazard risks. What 1 emergency manager perceives as catastrophic could be a seasonal impact for another. With such varying analyses, county by county, we must view this aggregation of local plans as a supplement to the state's risk assessment and not a comprehensive assessment itself. Additionally, the number and types of hazards vary among the local plans. This creates an incomplete picture in terms of this assessment.

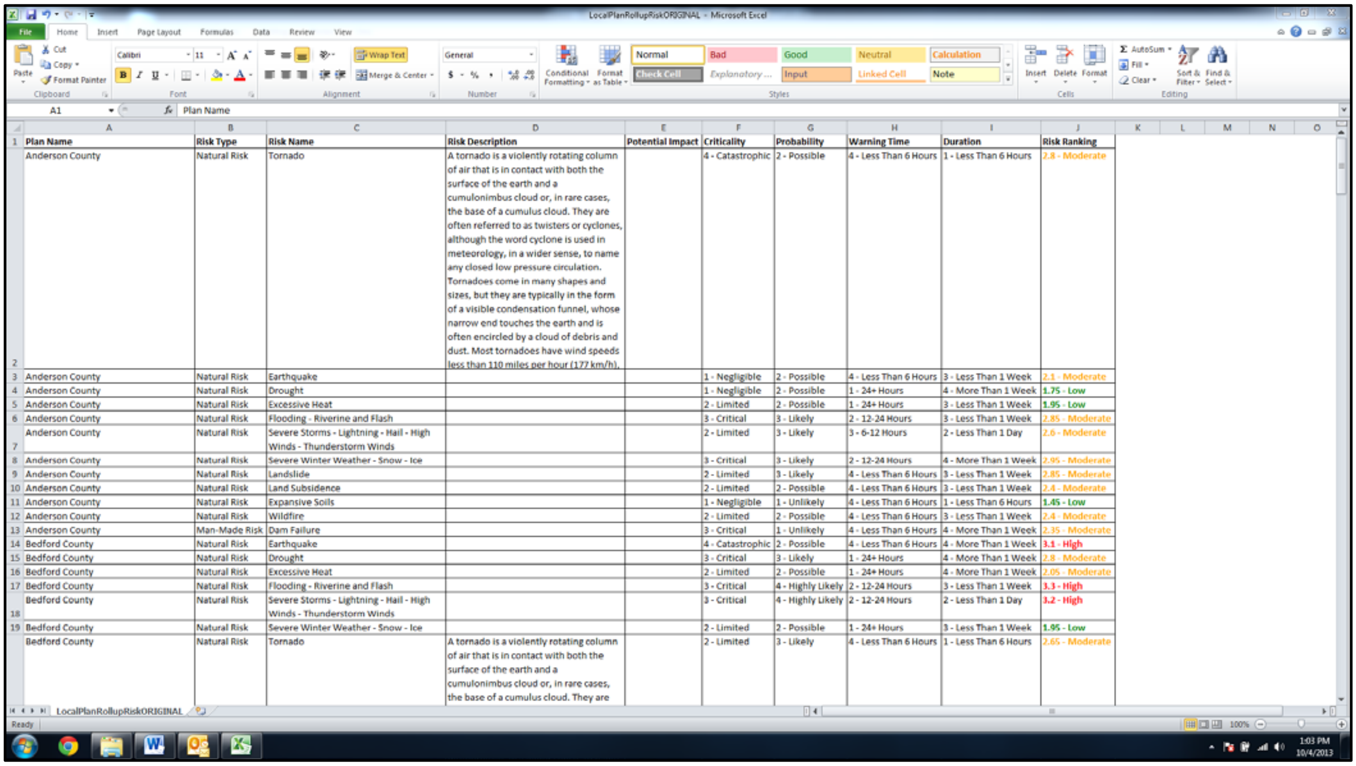
Since the TEMA and the State of Tennessee improved and updated their hazard identification list, as outlined in Section 3.2, there are differences in how the local plans profiled certain hazards and how it is done in this plan. The differences are noted below.

- Extreme Cold – This plan is the 1st time the State of Tennessee has profiled extreme cold events. Being the case, no local plan has profiled this hazard.
- Extreme Heat – In this plan, extreme heat is profiled under extreme temperatures. Since extreme cold is newly profiled, many local plans profiled extreme heat as its own hazard.
- Floods – In this plan flood encompasses the sub hazards flash floods and riverine floods. Local plans in Tennessee have profiled these in combination as simply: "floods."
- Severe Storms – In this plan, severe storms is broken down into many sub hazards. Local risk assessments in the State of Tennessee include the same sub hazards as does this plan, however they assessed their risk as a combined risk whereas this plans separates their risk.
- Winter Storms – This plan profiles winter storms as a sub hazard to severe storms, however, the local plans in Tennessee profile winter storms as a separate hazard.

Step 1: Reviewing of Local Hazard Mitigation Plans

The 1st step in completing a statewide risk assessment based on local risk assessment was to devise a method of unifying and integrating all FEMA approved local hazard mitigation plans. This was accomplished by conducting a comprehensive review of each individual plan and transforming their risk assessment into a unified vulnerability and risk index. The reviewers based their scores on an emergency management approved risk matrix and recorded only the hazards that were profiled, and the vulnerability and risk as written in each plan.

The image below depicts the database used for unifying and transforming every FEMA approved plan in the State of Tennessee.



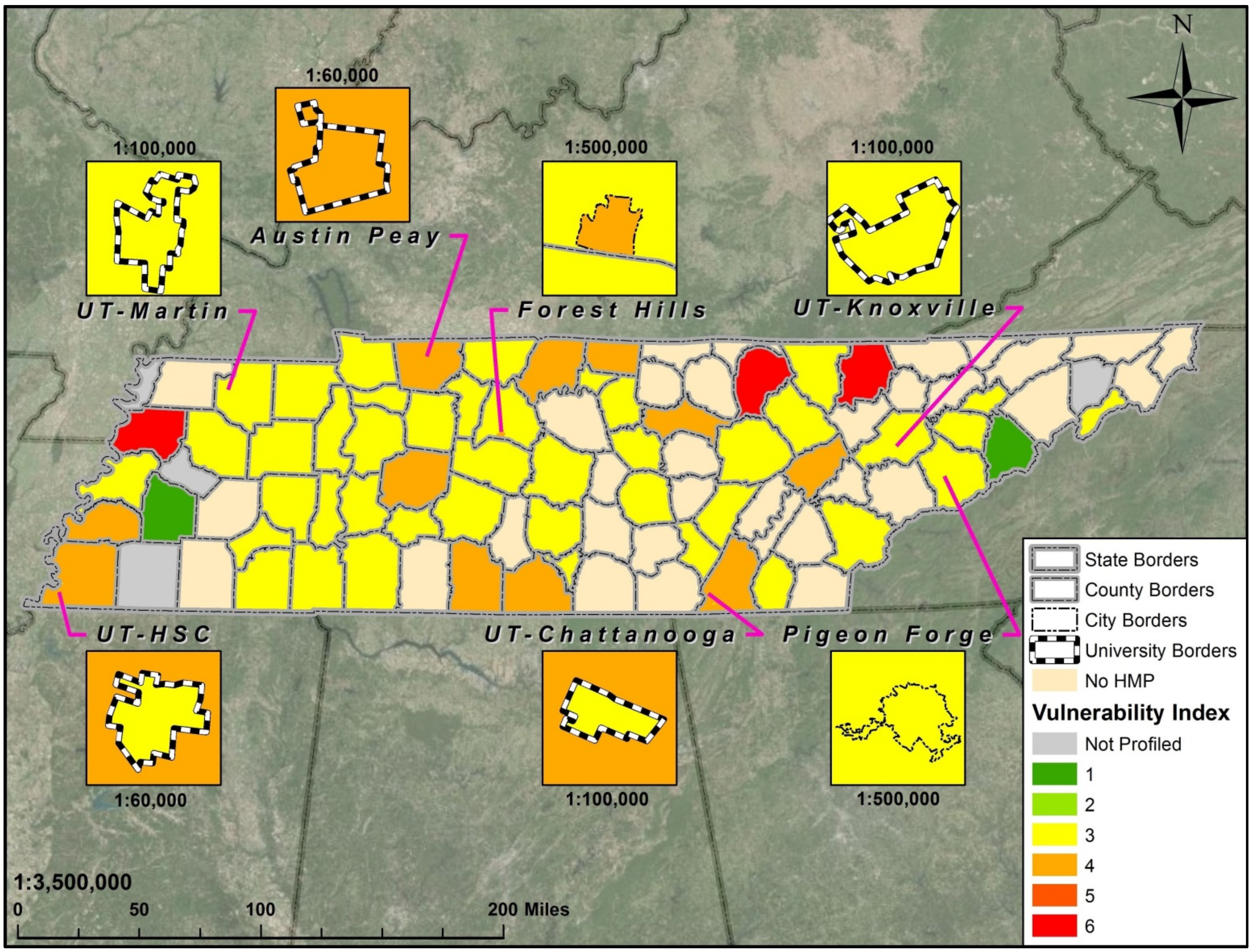
	Plan Name	Risk Type	Risk Name	Risk Description	Potential Impact	Criticality	Probability	Warning Time	Duration	Risk Ranking
2	Anderson County	Natural Risk	Tornado	A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. They are often referred to as twisters or cyclones, although the word cyclone is used in meteorology, in a wider sense, to name any closed low pressure circulation. Tornadoes come in many shapes and sizes, but they are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust. Most tornadoes have wind speeds less than 110 miles per hour (177 km/h),		4 - Catastrophic	2 - Possible	4 - Less Than 6 Hours	1 - Less Than 6 Hours	2.8 - Moderate
3	Anderson County	Natural Risk	Earthquake			1 - Negligible	2 - Possible	4 - Less Than 6 Hours	3 - Less Than 1 Week	2.1 - Moderate
4	Anderson County	Natural Risk	Drought			1 - Negligible	2 - Possible	1 - 24+ Hours	4 - More Than 1 Week	1.75 - Low
5	Anderson County	Natural Risk	Excessive Heat			2 - Limited	2 - Possible	1 - 24+ Hours	3 - Less Than 1 Week	1.95 - Low
6	Anderson County	Natural Risk	Flooding - Riverine and Flash			3 - Critical	3 - Likely	2 - 12-24 Hours	3 - Less Than 1 Week	2.85 - Moderate
7	Anderson County	Natural Risk	Severe Storms - Lightning - Hail - High Winds - Thunderstorm Winds			2 - Limited	3 - Likely	3 - 6-12 Hours	2 - Less Than 1 Day	2.6 - Moderate
8	Anderson County	Natural Risk	Severe Winter Weather - Snow - Ice			3 - Critical	3 - Likely	2 - 12-24 Hours	4 - More Than 1 Week	2.95 - Moderate
9	Anderson County	Natural Risk	Landslide			2 - Limited	3 - Likely	4 - Less Than 6 Hours	3 - Less Than 1 Week	2.85 - Moderate
10	Anderson County	Natural Risk	Land Subsidence			2 - Limited	2 - Possible	4 - Less Than 6 Hours	3 - Less Than 1 Week	2.4 - Moderate
11	Anderson County	Natural Risk	Expansive Soils			1 - Negligible	1 - Unlikely	4 - Less Than 6 Hours	1 - Less Than 6 Hours	1.45 - Low
12	Anderson County	Natural Risk	Wildfire			2 - Limited	2 - Possible	4 - Less Than 6 Hours	3 - Less Than 1 Week	2.4 - Moderate
13	Anderson County	Man-Made Risk	Dam Failure			3 - Critical	1 - Unlikely	4 - Less Than 6 Hours	4 - More Than 1 Week	2.35 - Moderate
14	Bedford County	Natural Risk	Earthquake			4 - Catastrophic	2 - Possible	4 - Less Than 6 Hours	4 - More Than 1 Week	3.1 - High
15	Bedford County	Natural Risk	Drought			3 - Critical	3 - Likely	1 - 24+ Hours	4 - More Than 1 Week	2.8 - Moderate
16	Bedford County	Natural Risk	Excessive Heat			2 - Limited	2 - Possible	1 - 24+ Hours	4 - More Than 1 Week	2.05 - Moderate
17	Bedford County	Natural Risk	Flooding - Riverine and Flash			3 - Critical	4 - Highly Likely	2 - 12-24 Hours	3 - Less Than 1 Week	3.3 - High
18	Bedford County	Natural Risk	Severe Storms - Lightning - Hail - High Winds - Thunderstorm Winds			3 - Critical	4 - Highly Likely	2 - 12-24 Hours	2 - Less Than 1 Day	3.2 - High
19	Bedford County	Natural Risk	Severe Winter Weather - Snow - Ice			2 - Limited	2 - Possible	1 - 24+ Hours	3 - Less Than 1 Week	1.95 - Low
	Bedford County	Natural Risk	Tornado	A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. They are		2 - Limited	3 - Likely	4 - Less Than 6 Hours	1 - Less Than 6 Hours	2.65 - Moderate

Step 2: Illustrating Vulnerability

The 2nd step was mapping and recording vulnerability from the local plan database. The values were entered into ArcGIS, by county per hazard (unless a city or university plan), mapped, and exported into tables. The unified index developed in step 1 ranks each jurisdiction's hazard vulnerability 1 through 6, from lowest threat (ranking 1 – dark green) to highest threat (ranking 6 – red) for each of Tennessee's FEMA approved mitigation plans. Jurisdictions without approved plans are colored in light pink while hazards not profiled are colored grey.

These illustrations can be seen in Maps 65 through 76 and Tables 48 and 49 in the following subsection.

The image below shows an example of a local plan integrated completed vulnerability map.

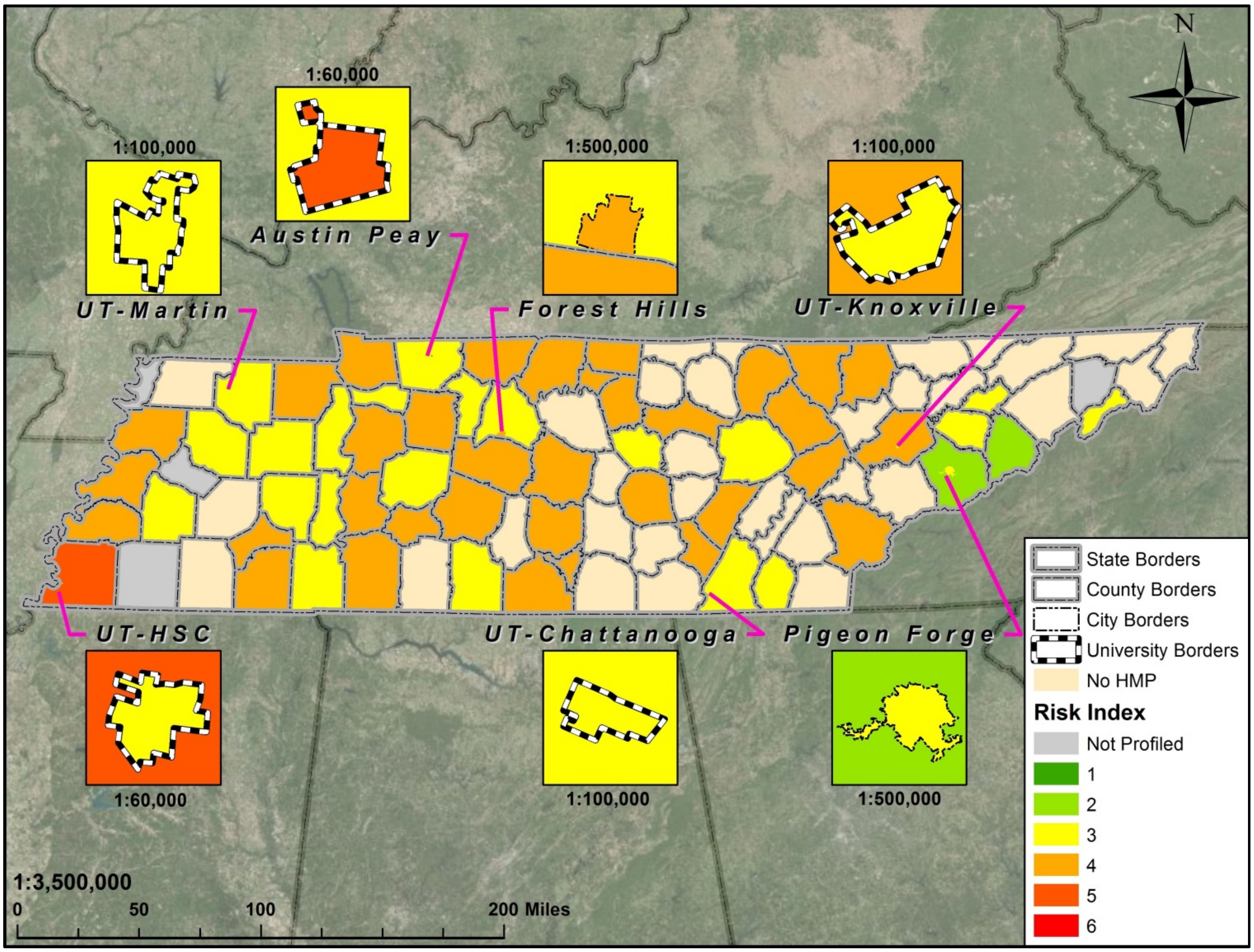


Step 3: Illustrating Risk

The 3rd step was mapping and recording risk from the local plan database. The values were entered into ArcGIS, by county per hazard (unless a city or university plan), mapped, and exported into tables. The unified index developed in step 1 ranks each jurisdiction's hazard risk 1 through 6, from lowest threat (ranking 1 – dark green) to highest threat (ranking 6 – red) for each of Tennessee's FEMA approved mitigation plans. Jurisdictions without approved plans are colored in light pink while hazards not profiled are colored grey.

These illustrations can be seen in Maps 77 through 88 and Tables 50 and 51 in the following subsection.

The image below shows an example of a local plan integrated completed risk map.



Step 3: Potential Losses by GIS Analysis

For the final step, mitigation planners took the composite risk assessment maps from step 2, and overlaid each of these maps with the structural inventory database from FEMA's HAZUS-MH v2.1 SP1 software. The final result of the GIS analysis is a table that describes the total structural loss estimation per county risk rankings for each hazard. The following diagram shows this process. The results can be seen in Table 52 through 61.

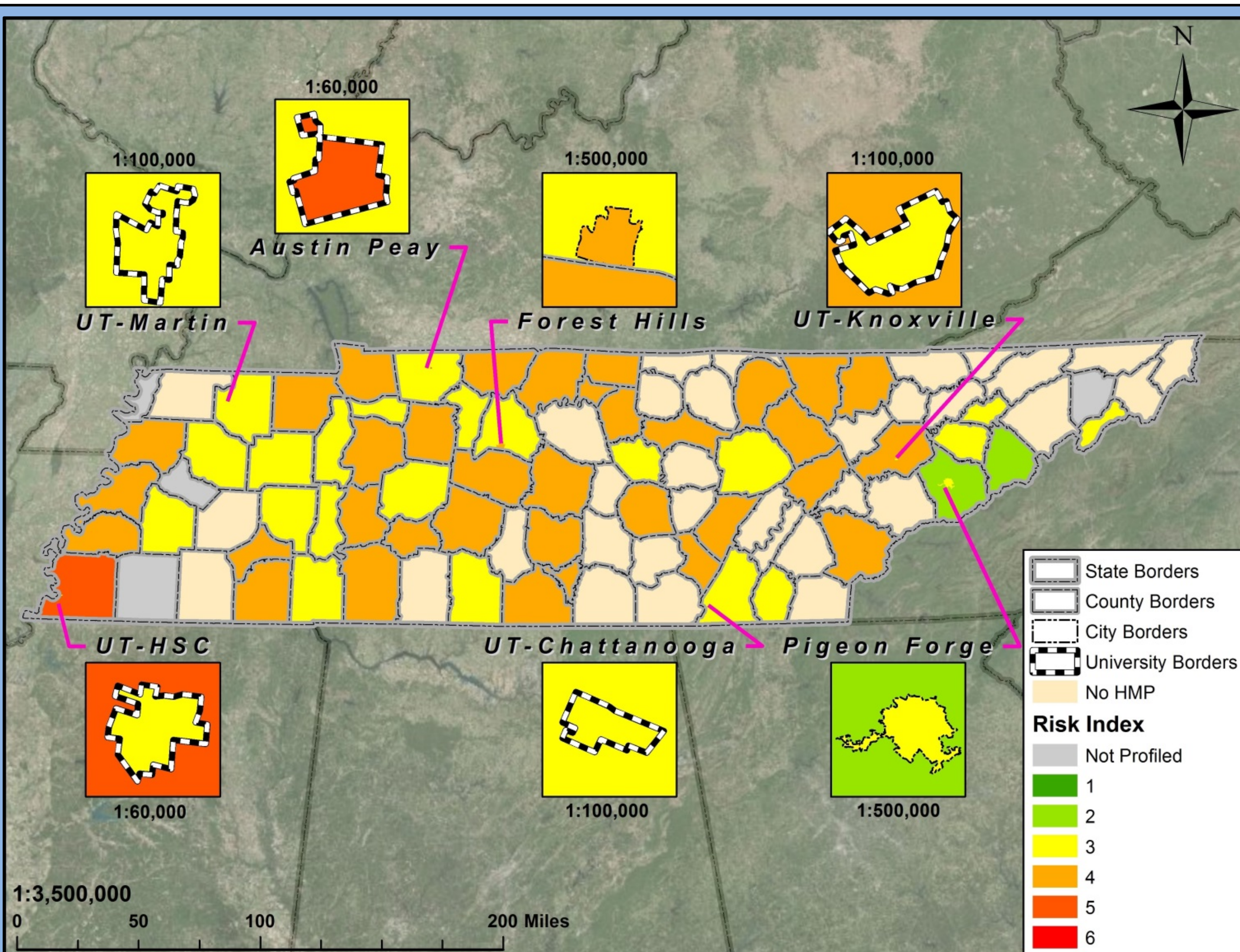


Table 52 – Loss Estimation by Local Plan Integration, Tennessee

Hazard	Risk Index by Local Plan Integration						Total Structure Value
	1	2	3	4	5	6	
Dam Failure	$0	$29,360,452,000	$44,439,481,000	$0	$0	$0	$73,799,933,000

4.1.1 – Vulnerability Assessment by Local Plan Integration

Table 48 – Vulnerability Index by Local Plan Integration Part 1, Tennessee

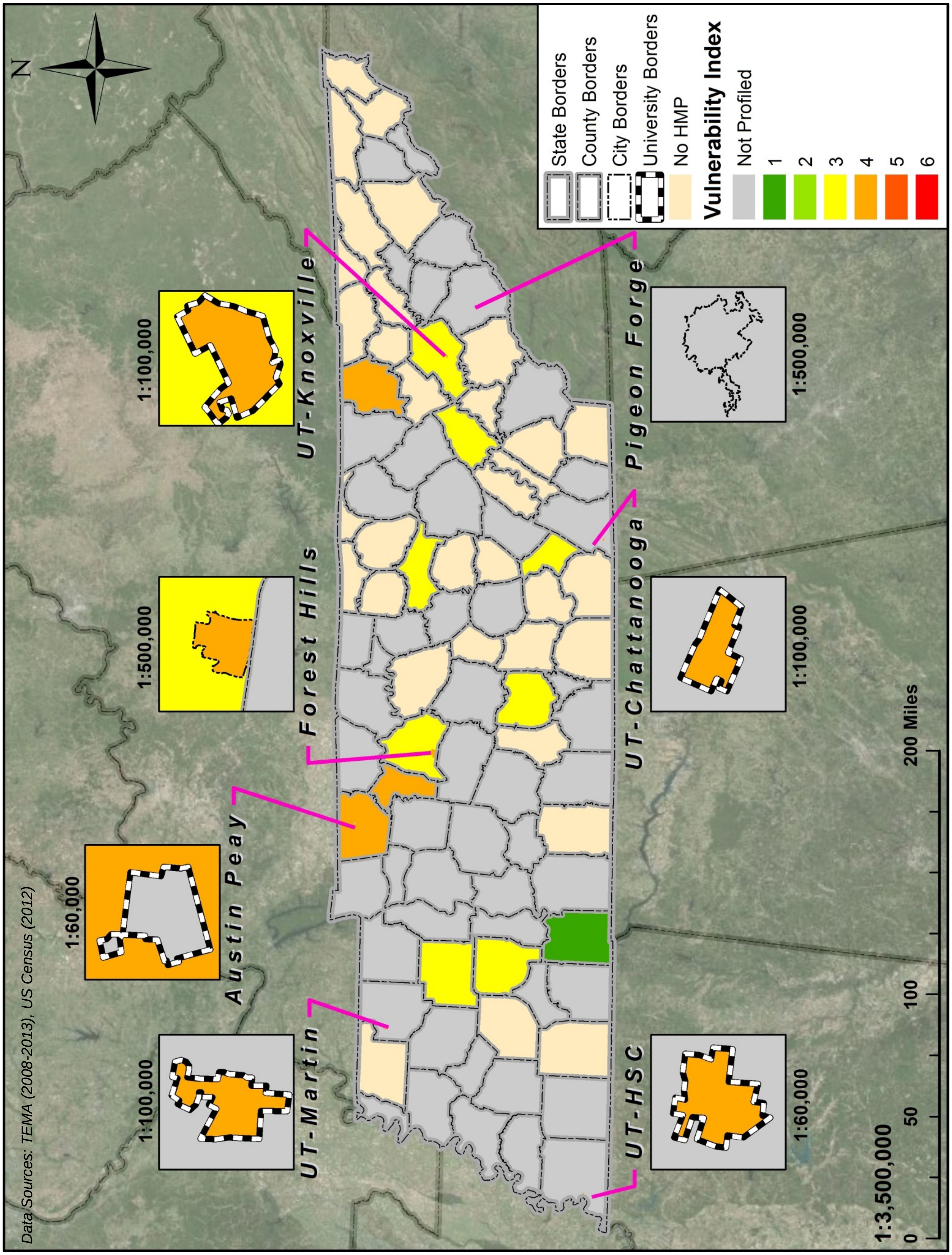
County	Dam Failures	Droughts	Earthquakes	Expansive Soils	Extreme Heat	Floods
Anderson	4.5	1.5	1.5	1.5	3	4.5
Bedford	3	4.5	6	N/P	3	4.5
Benton	N/P	N/P	3	N/P	N/P	3
Bledsoe	N/P	N/P	N/P	N/P	N/P	3
Bradley	N/P	3	1.5	N/P	3	3
Campbell	4.5	1.5	1.5	N/P	3	3
Carroll	3	3	4.5	N/P	N/P	4.5
Cheatham	4.5	N/P	1.5	N/P	N/P	3
Chester	N/P	N/P	1.5	N/P	N/P	3
Cocke	N/P	N/P	N/P	N/P	N/P	3
Crockett	N/P	N/P	6	N/P	N/P	3
Cumberland	N/P	N/P	N/P	N/P	N/P	3
Davidson	3	1.5	3	N/P	1.5	3
Decatur	N/P	1.5	1.5	N/P	N/P	1.5
DeKalb	N/P	N/P	N/P	N/P	N/P	3
Dickson	N/P	N/P	3	N/P	N/P	3
Dyer	N/P	N/P	4.5	N/P	N/P	3
Fayette	N/P	3	4.5	N/P	N/P	1.5
Fentress	N/P	N/P	N/P	N/P	N/P	3
Gibson	N/P	N/P	4.5	N/P	N/P	N/P
Giles	N/P	N/P	4.5	N/P	N/P	3
Hamblen	N/P	N/P	N/P	N/P	N/P	1.5
Hamilton	N/P	3	6	N/P	N/P	3
Hardin	1.5	1.5	6	N/P	1.5	3
Haywood	N/P	N/P	4.5	N/P	N/P	1.5
Henderson	3	4.5	3	N/P	N/P	3
Henry	N/P	N/P	3	N/P	N/P	1.5
Hickman	N/P	N/P	N/P	N/P	N/P	3
Houston	N/P	N/P	N/P	N/P	N/P	3
Humphreys	N/P	N/P	N/P	N/P	N/P	4.5
Jefferson	N/P	N/P	N/P	N/P	N/P	3
Knox	3	3	1.5	N/P	N/P	3
Lake	N/P	N/P	4.5	N/P	N/P	3
Lauderdale	N/P	N/P	1.5	N/P	N/P	3
Lewis	N/P	N/P	N/P	N/P	N/P	3
Lincoln	N/P	N/P	N/P	N/P	N/P	4.5
Macon	N/P	N/P	N/P	N/P	N/P	1.5
Maury	N/P	1.5	4.5	N/P	1.5	3
McNairy	N/P	N/P	3	N/P	N/P	1.5
Monroe	N/P	N/P	N/P	N/P	N/P	1.5
Montgomery	4.5	N/P	4.5	N/P	N/P	N/P
Moore	N/P	N/P	N/P	N/P	N/P	3

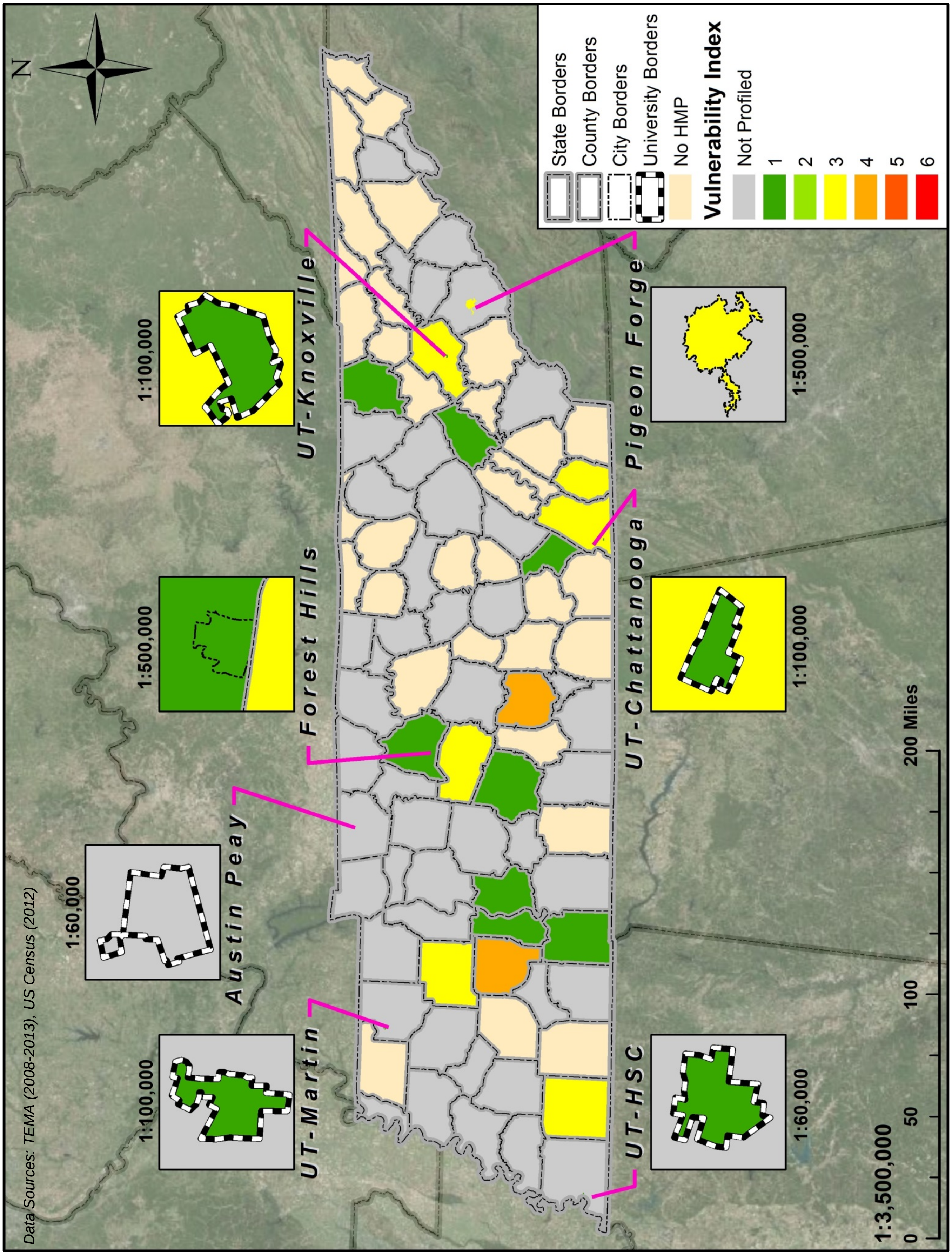
County	Dam Failures	Droughts	Earthquakes	Expansive Soils	Extreme Heat	Floods
Morgan	N/P	N/P	N/P	N/P	N/P	3
Perry	N/P	1.5	N/P	N/P	N/P	3
Putnam	3	N/P	3	N/P	N/P	3
Roane	3	1.5	3	N/P	1.5	3
Robertson	N/P	N/P	N/P	N/P	N/P	3
Rutherford	N/P	N/P	N/P	N/P	N/P	3
Scott	N/P	N/P	N/P	N/P	N/P	3
Sequatchie	3	1.5	3	N/P	1.5	3
Sevier	N/P	N/P	N/P	N/P	N/P	3
Shelby	N/P	N/P	3	N/P	N/P	3
Smith	N/P	N/P	N/P	N/P	N/P	3
Stewart	N/P	N/P	N/P	N/P	N/P	1.5
Sumner	N/P	N/P	N/P	N/P	N/P	3
Tipton	N/P	N/P	6	N/P	N/P	3
Trousdale	N/P	N/P	N/P	N/P	N/P	1.5
Unicoi	N/P	N/P	4.5	N/P	N/P	3
Warren	N/P	N/P	N/P	N/P	N/P	1.5
Washington	N/P	N/P	4.5	N/P	N/P	1.5
Wayne	N/P	N/P	N/P	N/P	N/P	3
Weakley	N/P	N/P	4.5	N/P	N/P	3
Williamson	N/P	3	N/P	N/P	1.5	3
Austin Peay	N/P	N/P	4.5	N/P	N/P	1.5
MTSU	N/P	N/P	4.5	N/P	N/P	N/P
UT-Chattanooga	4.5	1.5	4.5	1.5	1.5	1.5
UT-HSC	4.5	1.5	4.5	1.5	1.5	1.5
UT-Knoxville	4.5	1.5	4.5	1.5	1.5	1.5
UT-Martin	4.5	1.5	4.5	1.5	1.5	1.5
Forest Hills	4.5	1.5	3	N/P	3	4.5
Pigeon Forge	N/P	3	3	N/P	1.5	3

Table 49 – Vulnerability Index by Local Plan Integration Part 2, Tennessee						
County	Land Subsidence	Landslides	Severe Storms	Tornadoes	Wildfires	Winter Storms
Anderson	3	3	3	6	3	4.5
Bedford	3	3	4.5	3	3	3
Benton	N/P	N/P	3	3	N/P	3
Bledsoe	N/P	N/P	3	3	N/P	3
Bradley	1.5	1.5	3	3	3	3
Campbell	1.5	3	3	6	1.5	4.5
Carroll	N/P	N/P	3	3	N/P	3
Cheatham	N/P	N/P	3	3	N/P	3.9
Chester	N/P	N/P	N/P	3	N/P	3
Cocke	1.5	N/P	3	1.5	3	3
Crockett	N/P	N/P	3	N/P	N/P	3
Cumberland	N/P	N/P	3	3	N/P	3
Davidson	N/P	1.5	3	3	N/P	3
Decatur	N/P	N/P	3	3	3	3
DeKalb	N/P	N/P	3	3	N/P	1.5
Dickson	N/P	N/P	N/P	3	N/P	3
Dyer	N/P	N/P	N/P	6	N/P	3
Fayette	N/P	N/P	3	N/P	N/P	3
Fentress	N/P	N/P	3	6	N/P	3
Gibson	N/P	N/P	3	3	N/P	1.5
Giles	N/P	N/P	3	4.5	1.5	1.5
Hamblen	N/P	N/P	3	3	N/P	3
Hamilton	N/P	3	3	4.5	3	3
Hardin	1.5	3	3	3	1.5	1.5
Haywood	N/P	N/P	N/P	1.5	N/P	N/P
Henderson	N/P	N/P	3	3	3	3
Henry	N/P	N/P	3	3	N/P	1.5
Hickman	N/P	N/P	3	4.5	N/P	3
Houston	N/P	N/P	3	3	N/P	3
Humphreys	N/P	N/P	3	3	N/P	3
Jefferson	N/P	N/P	3	3	N/P	1.5
Knox	N/P	3	3	3	1.5	1.5
Lake	N/P	N/P	3	N/P	N/P	1.5
Lauderdale	N/P	N/P	3	3	N/P	1.5
Lewis	N/P	N/P	1.5	3	N/P	1.5
Lincoln	N/P	N/P	N/P	4.5	N/P	1.5
Macon	N/P	N/P	1.5	4.5	N/P	1.5
Maury	N/P	N/P	1.5	3	3	1.5
McNairy	N/P	N/P	1.5	3	N/P	N/P
Monroe	N/P	N/P	1.5	3	N/P	1.5
Montgomery	3	N/P	1.5	4.5	N/P	1.5
Moore	N/P	N/P	1.5	3	N/P	1.5
Morgan	N/P	N/P	1.5	3	N/P	1.5

County	Land Subsidence	Landslides	Severe Storms	Tornadoes	Wildfires	Winter Storms
Perry	N/P	N/P	1.5	3	N/P	1.5
Putnam	N/P	1.5	1.5	4.5	N/P	3
Roane	1.5	1.5	1.5	4.5	1.5	N/P
Robertson	N/P	N/P	1.5	3	N/P	1.5
Rutherford	N/P	N/P	1.5	3	N/P	1.5
Scott	N/P	N/P	1.5	3	N/P	1.5
Sequatchie	N/P	N/P	1.5	3	N/P	1.5
Sevier	N/P	N/P	3	3	N/P	1.5
Shelby	N/P	N/P	3	4.5	N/P	3
Smith	N/P	N/P	1.5	3	N/P	1.5
Stewart	N/P	N/P	1.5	3	N/P	1.5
Sumner	N/P	N/P	1.5	4.5	N/P	1.5
Tipton	N/P	N/P	N/P	4.5	N/P	1.5
Trousdale	N/P	N/P	1.5	3	N/P	1.5
Unicoi	N/P	N/P	N/P	3	N/P	3
Warren	N/P	N/P	1.5	3	N/P	1.5
Washington	N/P	N/P	1.5	N/P	1.5	3
Wayne	N/P	N/P	1.5	3	N/P	1.5
Weakley	N/P	N/P	1.5	3	N/P	1.5
Williamson	N/P	N/P	1.5	3	N/P	1.5
Austin Peay	1.5	N/P	1.5	4.5	N/P	1.5
MTSU	N/P	N/P	1.5	3	N/P	N/P
UT-Chattanooga	1.5	1.5	3	3	1.5	3
UT-HSC	1.5	1.5	3	3	1.5	3
UT-Knoxville	1.5	1.5	3	3	1.5	3
UT-Martin	1.5	1.5	3	3	1.5	3
Forest Hills	3	4.5	3	4.5	3	4.5
Pigeon Forge	1.5	3	3	3	3	3

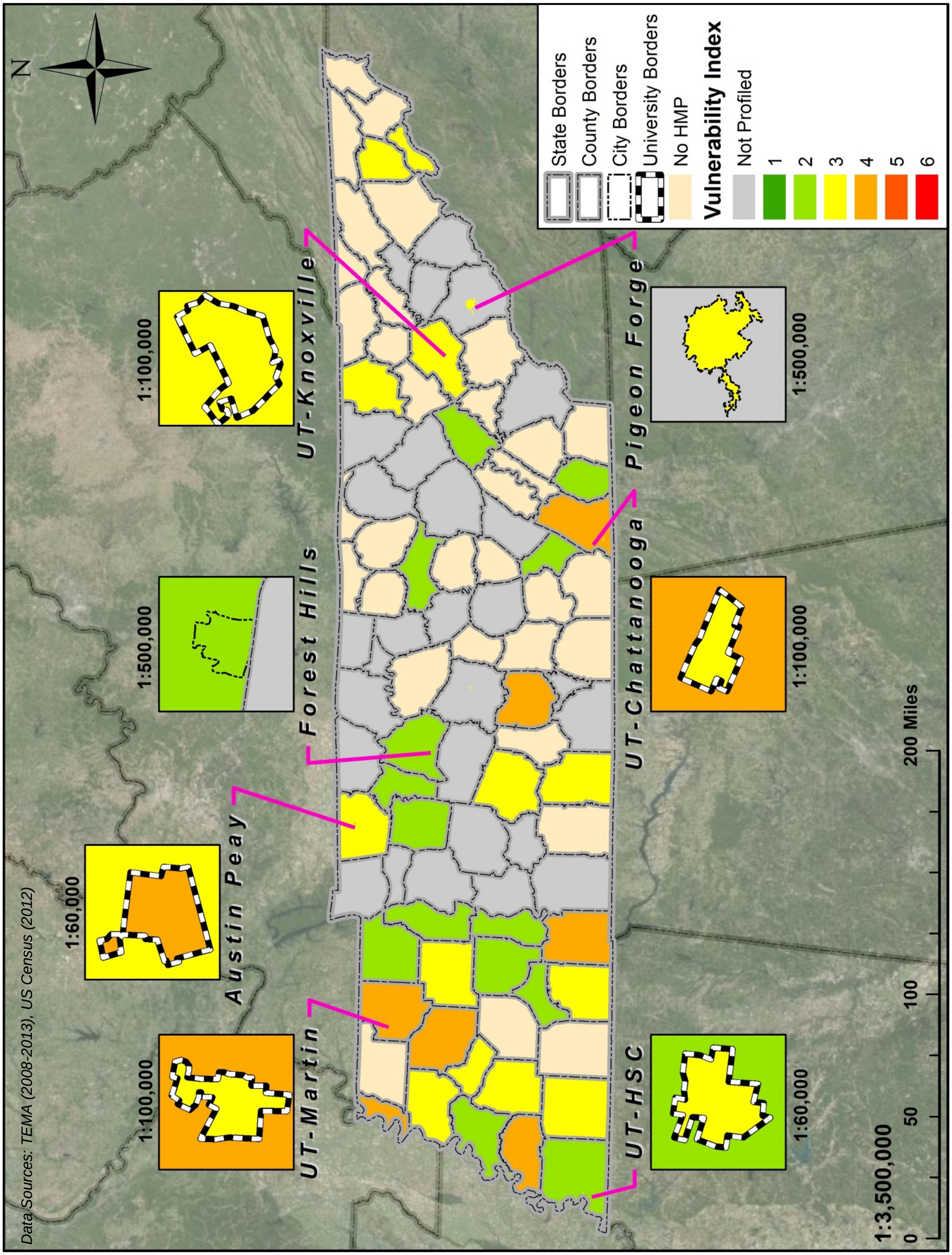
Map 65 – Hazard Vulnerability Index, Local Plan Integration, Dam Failures



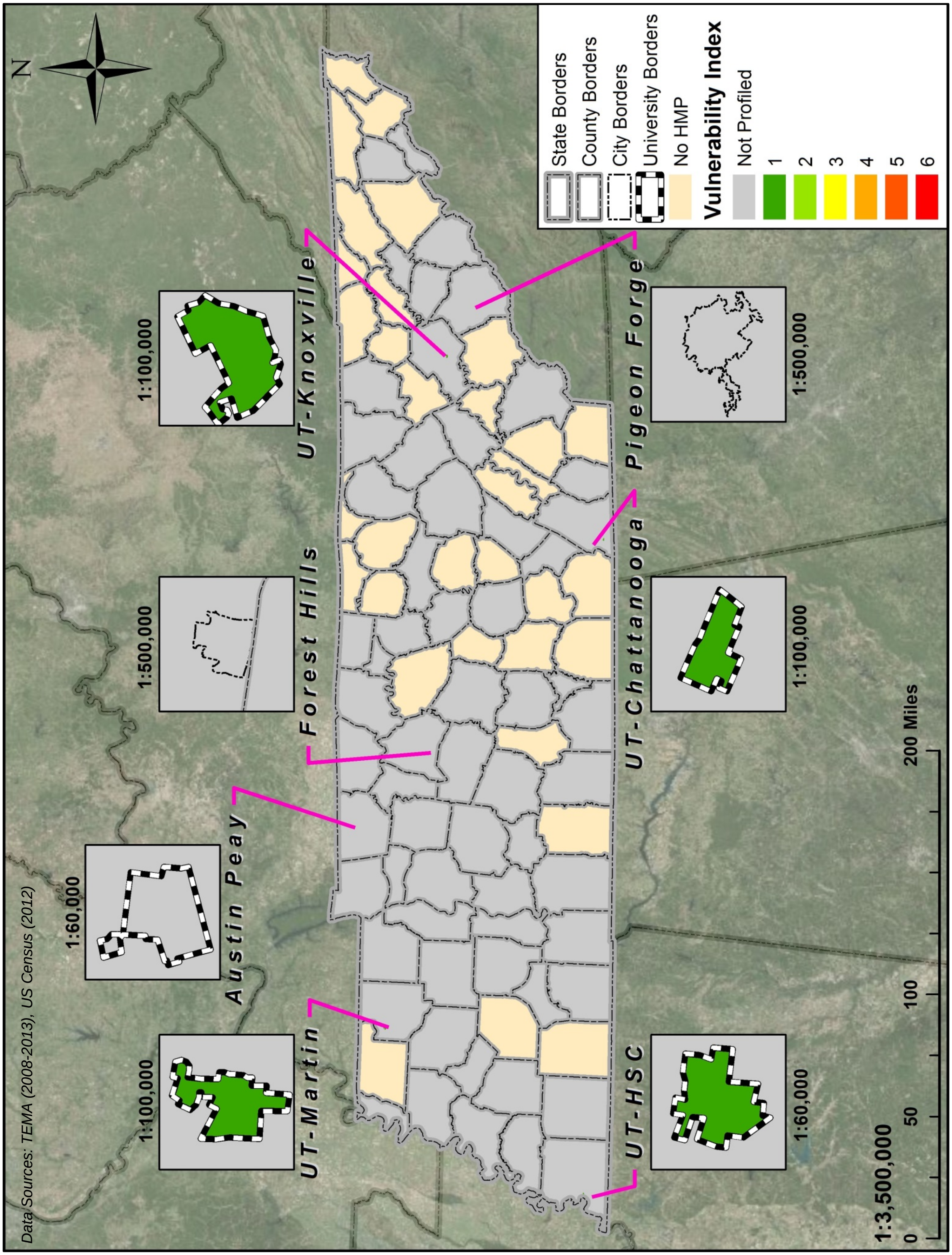


Map 66 – Hazard Vulnerability Index, Local Plan Integration, Droughts

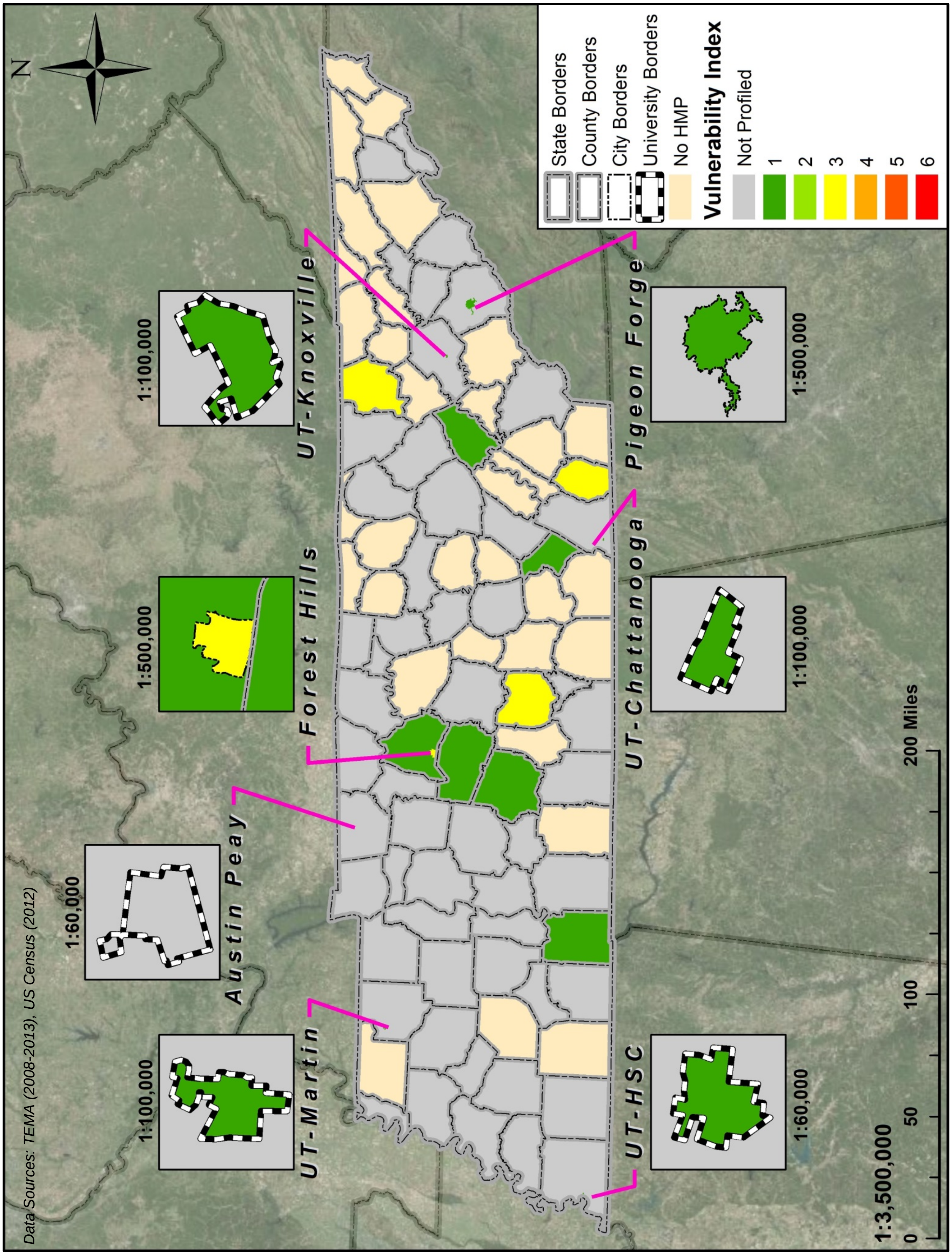
Map 67 – Hazard Vulnerability Index, Local Plan Integration, Earthquakes



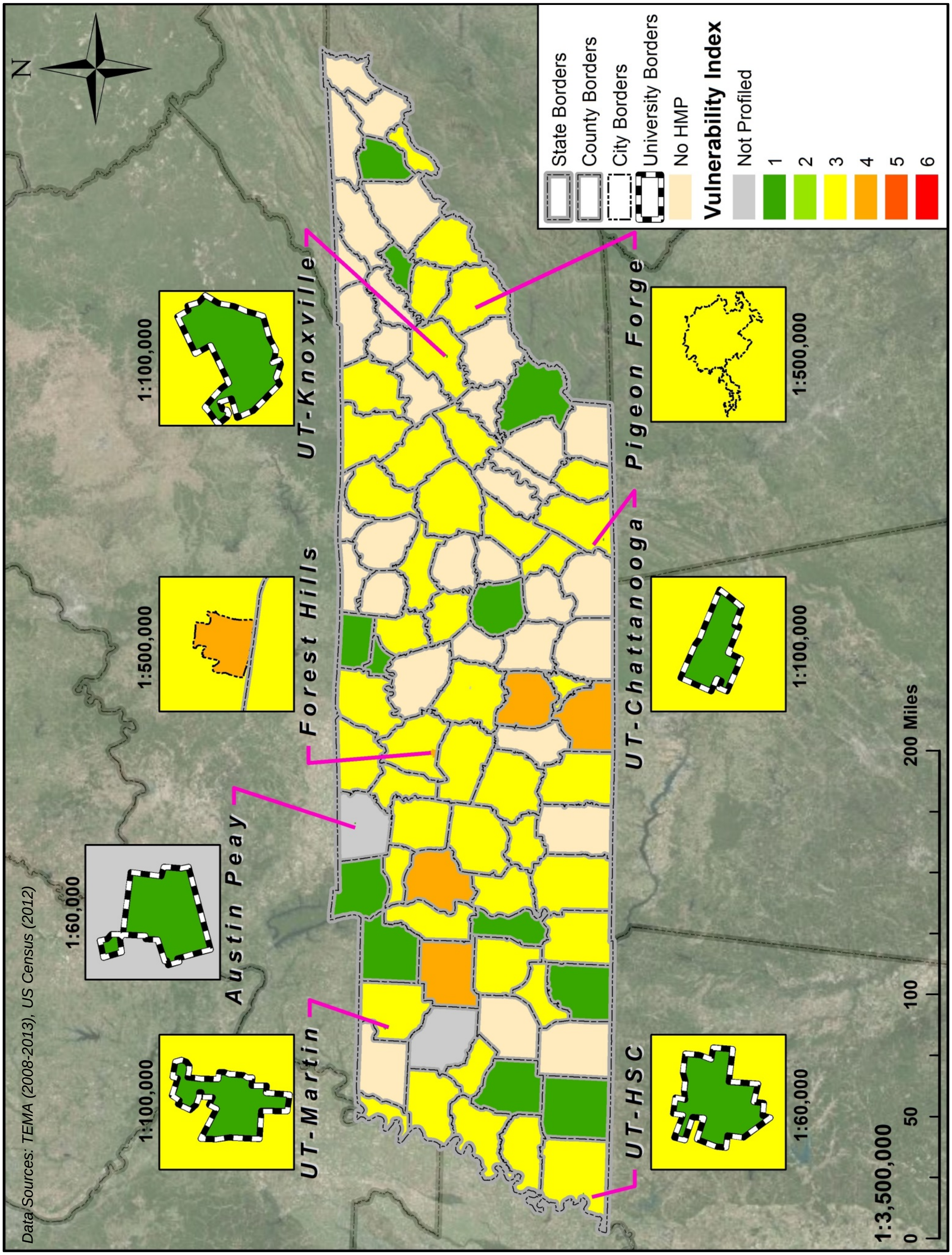
Map 68 – Hazard Vulnerability Index, Local Plan Integration, Expansive Soils

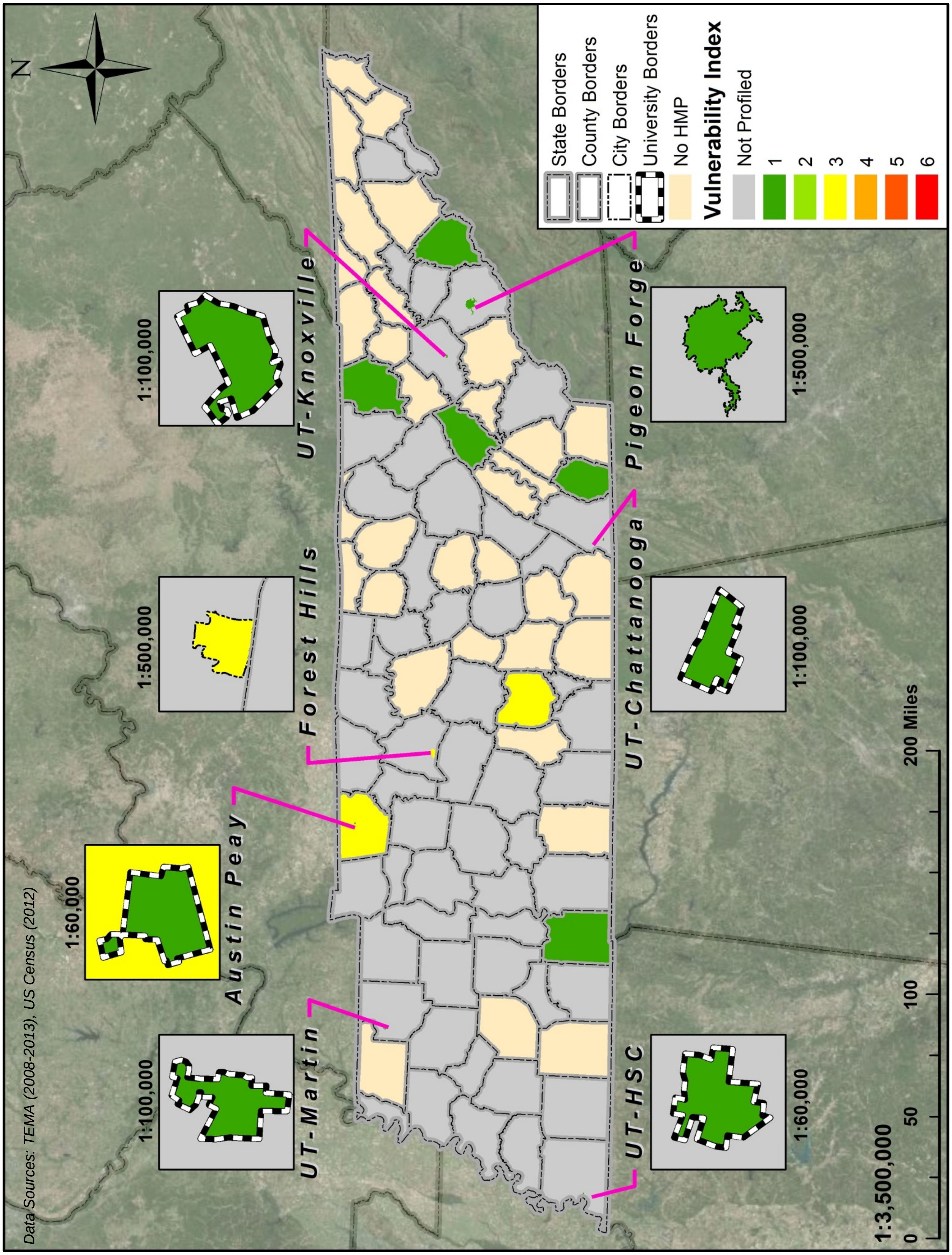


Map 69 – Hazard Vulnerability Index, Local Plan Integration, Extreme Heat



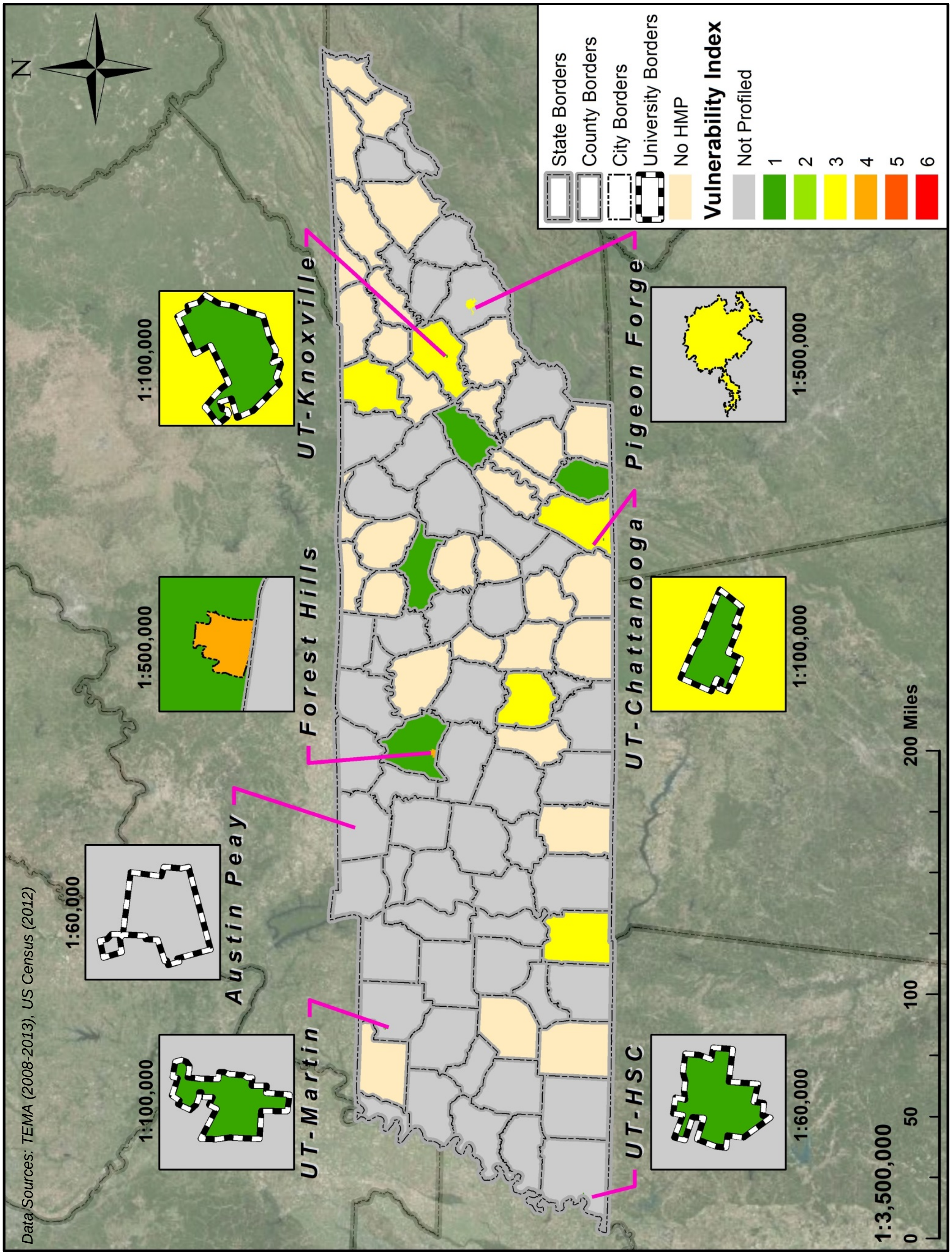
Map 70 – Hazard Vulnerability Index, Local Plan Integration, Floods



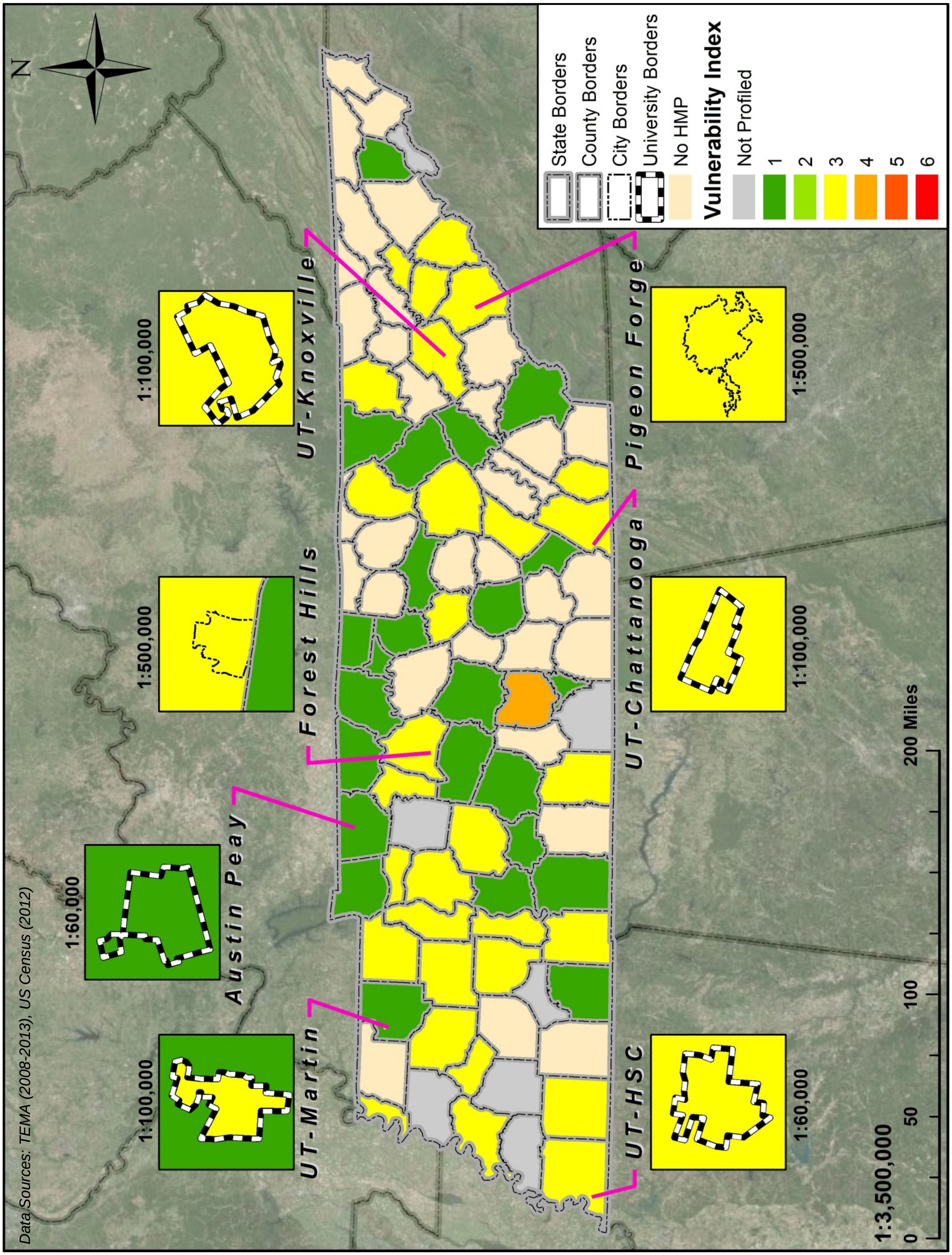


Map 71 – Hazard Vulnerability Index, Local Plan Integration, Land Subsidence/Sinkholes

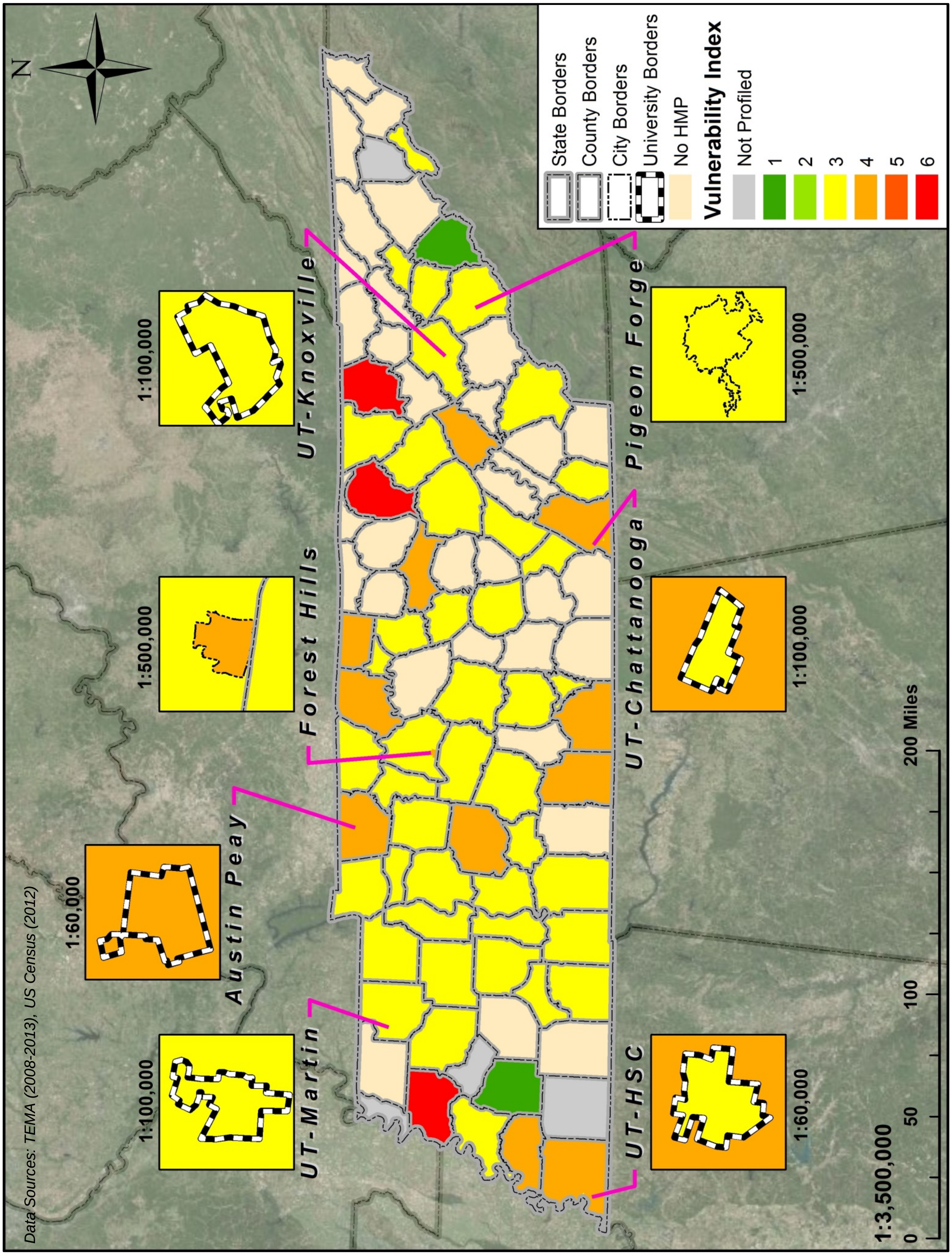
Map 72 – Hazard Vulnerability Index, Local Plan Integration, Landslides



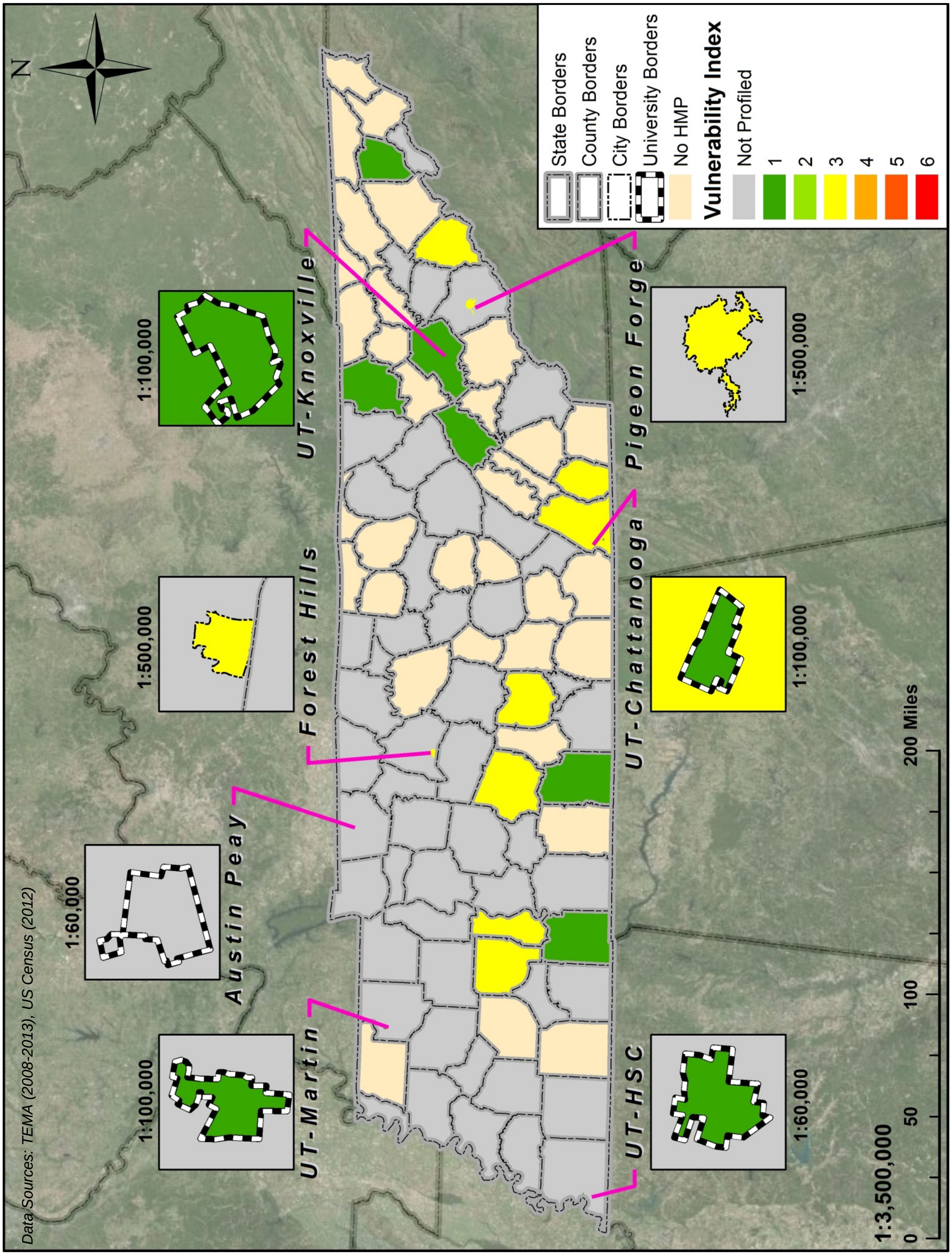
Map 73 – Hazard Vulnerability Index, Local Plan Integration, Severe Storms



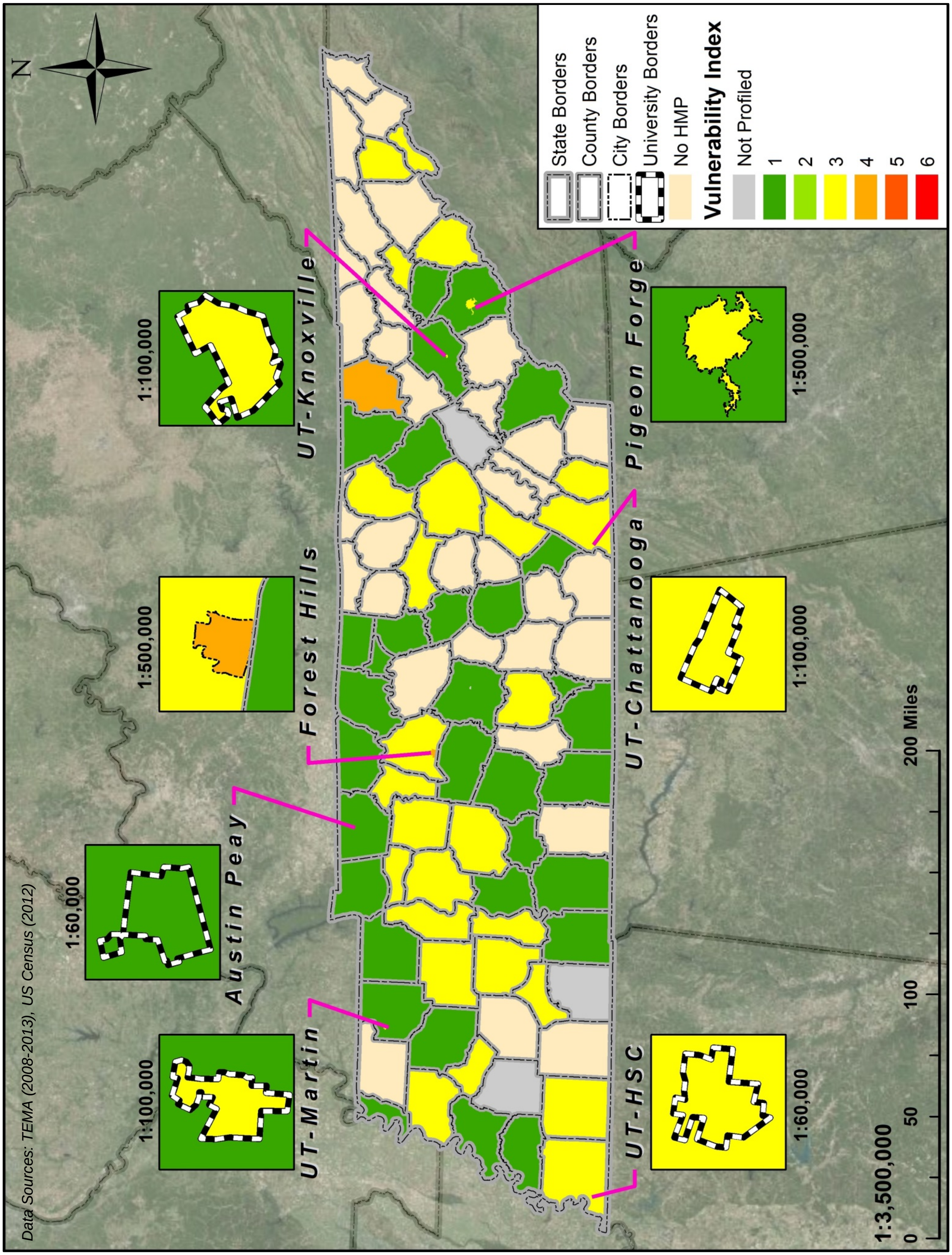
Map 74 – Hazard Vulnerability Index, Local Plan Integration, Tornadoes



Map 75 – Hazard Vulnerability Index, Local Plan Integration, Wildfire



Map 76 – Hazard Vulnerability Index, Local Plan Integration, Winter Storms



4.1.2 – Composite Risk by Local Plan Integration

Table 50 – Risk Index by Local Plan Integration Part 1, Tennessee						
Jurisdiction	Dam Failures	Droughts	Earthquakes	Expansive Soils	Extreme Heat	Floods
Anderson	4.2	3.9	4.4	3.2	2.6	2.9
Bedford	4	4.8	2.9	4.7	4.2	3.1
Benton	3.3	3.3	2.9	2.9	N/P	N/P
Bledsoe	4	4	2.9	N/P	N/P	N/P
Bradley	3.3	3.3	2.9	2.9	2.9	2.9
Campbell	4.2	4.1	4.1	3	2.6	3.8
Carroll	3.3	3.9	2.8	3.9	3.1	N/P
Cheatham	3.3	3	2.9	2.3	N/P	N/P
Chester	4	N/P	2.9	2.2	N/P	N/P
Cocke	2.9	3.3	2.9	N/P	N/P	N/P
Crockett	N/P	4.7	2.9	3.8	N/P	N/P
Cumberland	3.3	3.3	4.3	N/P	N/P	N/P
Davidson	3.3	4	2.9	2.8	2	2.5
Decatur	3.3	3.3	2.9	2.9	2.6	N/P
DeKalb	3.3	3.3	2.5	N/P	N/P	N/P
Dickson	4	N/P	2.9	2.9	N/P	N/P
Dyer	4.2	N/P	2.9	3.9	N/P	N/P
Fayette	N/P	4	3.8	3.4	3.1	N/P
Fentress	4.2	3.8	3.6	N/P	N/P	N/P
Gibson	3.3	3.5	2.5	4.1	N/P	N/P
Giles	3.8	4	2.5	3.5	N/P	N/P
Hamblen	3.3	3.3	3.6	N/P	N/P	N/P
Hamilton	3.8	4	2.9	4	3.1	N/P
Hardin	3.3	4	1.7	4	2.6	2.5
Haywood	3.5	N/P	N/P	3.5	N/P	N/P
Henderson	3.3	4	2.9	2.9	3.5	N/P
Henry	4	4	2.5	2.8	N/P	N/P
Hickman	3.3	3.8	2.9	N/P	N/P	N/P
Houston	3.3	3.3	2.9	N/P	N/P	N/P
Humphreys	4	4.1	3.6	N/P	N/P	N/P
Jefferson	3.3	4.1	3.8	N/P	N/P	N/P
Knox	4	4.1	3.8	3.5	4.2	N/P
Lake	N/P	4.1	3	4.4	N/P	N/P
Lauderdale	4	4	3.2	2.6	N/P	N/P
Lewis	4	3.5	3.5	N/P	N/P	N/P
Lincoln	4.4	N/P	3.2	N/P	N/P	N/P
Macon	4.4	3.5	3.2	N/P	N/P	N/P
Maury	4	3.5	3.2	3.8	3.3	3.2
McNairy	4	3.5	N/P	3.3	N/P	N/P
Monroe	4	3.5	3.8	N/P	N/P	N/P
Montgomery	3.8	3.5	3.8	3.1	N/P	N/P
Moore	4	3.5	3.2	N/P	N/P	N/P

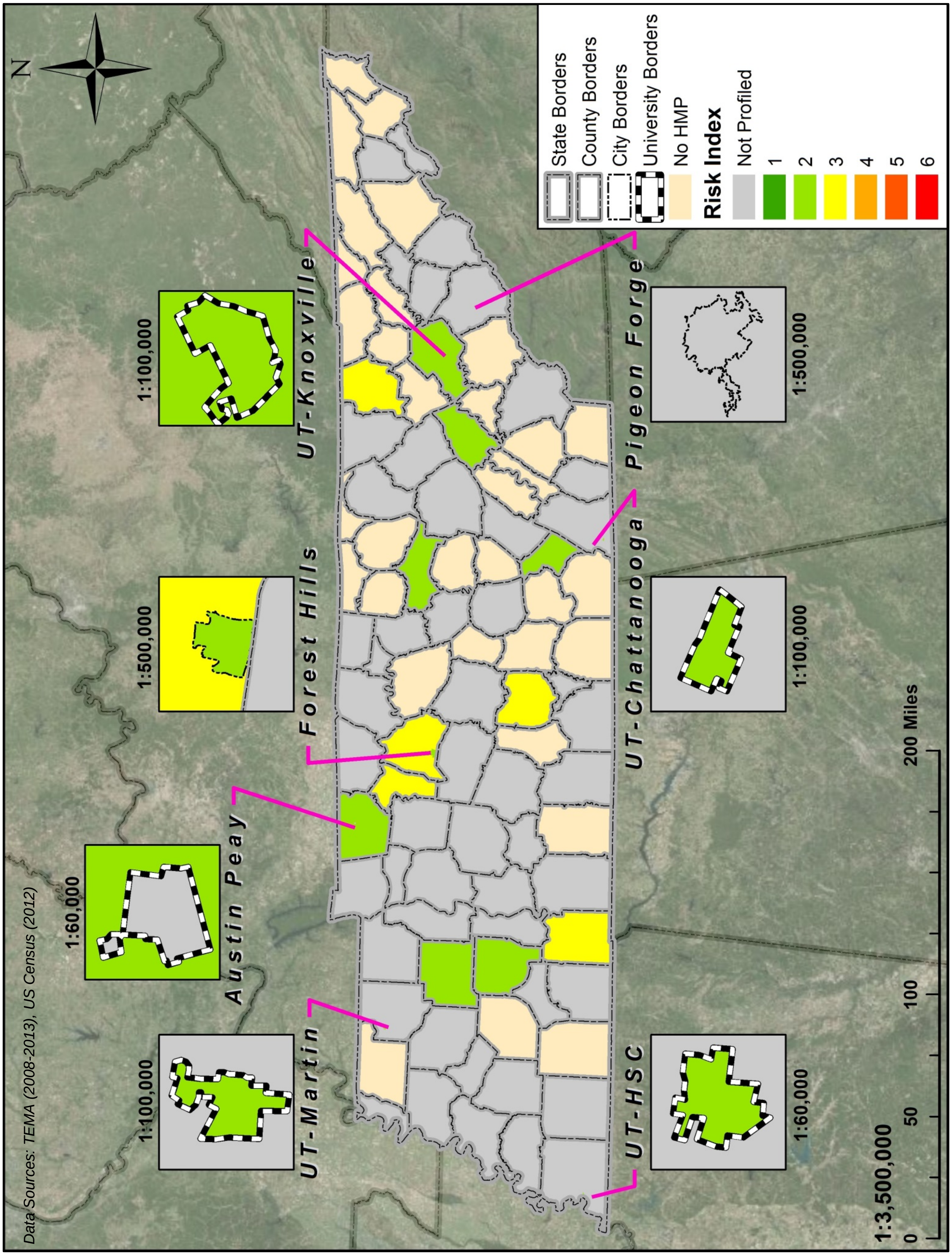
Jurisdiction	Land Subsidence	Landslides	Severe Storms	Tornadoes	Wildfires	Winter Storms
Morgan	4	3.5	3.2	N/P	N/P	N/P
Perry	4.7	3.5	3.5	N/P	3.3	N/P
Putnam	4.4	3.5	4.3	2.6	N/P	N/P
Roane	4.4	3.5	N/P	2.6	3.3	3.2
Robertson	4	3.5	3.2	N/P	N/P	N/P
Rutherford	4	3.5	3.2	N/P	N/P	N/P
Scott	4	3.5	3.2	N/P	N/P	N/P
Sequatchie	4	3.5	3.2	2.6	2.6	3.2
Sevier	2.6	4	3.8	N/P	N/P	N/P
Shelby	5.1	4.4	4.3	2.6	N/P	N/P
Smith	4	3.5	3.8	N/P	N/P	N/P
Stewart	4	3.5	3.8	N/P	N/P	N/P
Sumner	4.4	3.5	3.8	N/P	N/P	N/P
Tipton	4.4	N/P	3.2	4.9	N/P	N/P
Trousdale	4	3.5	3.8	N/P	N/P	N/P
Unicoi	3.3	N/P	4.4	3.1	N/P	N/P
Warren	4.7	3.5	3.8	N/P	N/P	N/P
Washington	N/P	3.5	4.3	3.1	N/P	N/P
Wayne	4.7	3.5	3.2	N/P	N/P	N/P
Weakley	3.3	3.5	3.8	4.4	N/P	N/P
Williamson	4	3.5	3.2	N/P	3.1	2.5
Austin Peay	5.1	3.7	3.2	4.2	N/P	N/P
MTSU	4	3.5	N/P	3.1	N/P	N/P
UT-Chattanooga	3.3	4	2.9	3.8	2.6	1.8
UT-HSC	3.3	4	2.9	3.8	2.6	1.8
UT-Knoxville	3.3	4	2.9	3.8	2.6	1.8
UT-Martin	3.3	4	2.9	3.8	2.6	1.8
Forest Hills	4.7	4.8	5.3	2.8	2.6	4.1
Pigeon Forge	3.5	4.1	4.7	3.6	2.4	1.8

Table 51 – Risk Index by Local Plan Integration Part 2, Tennessee

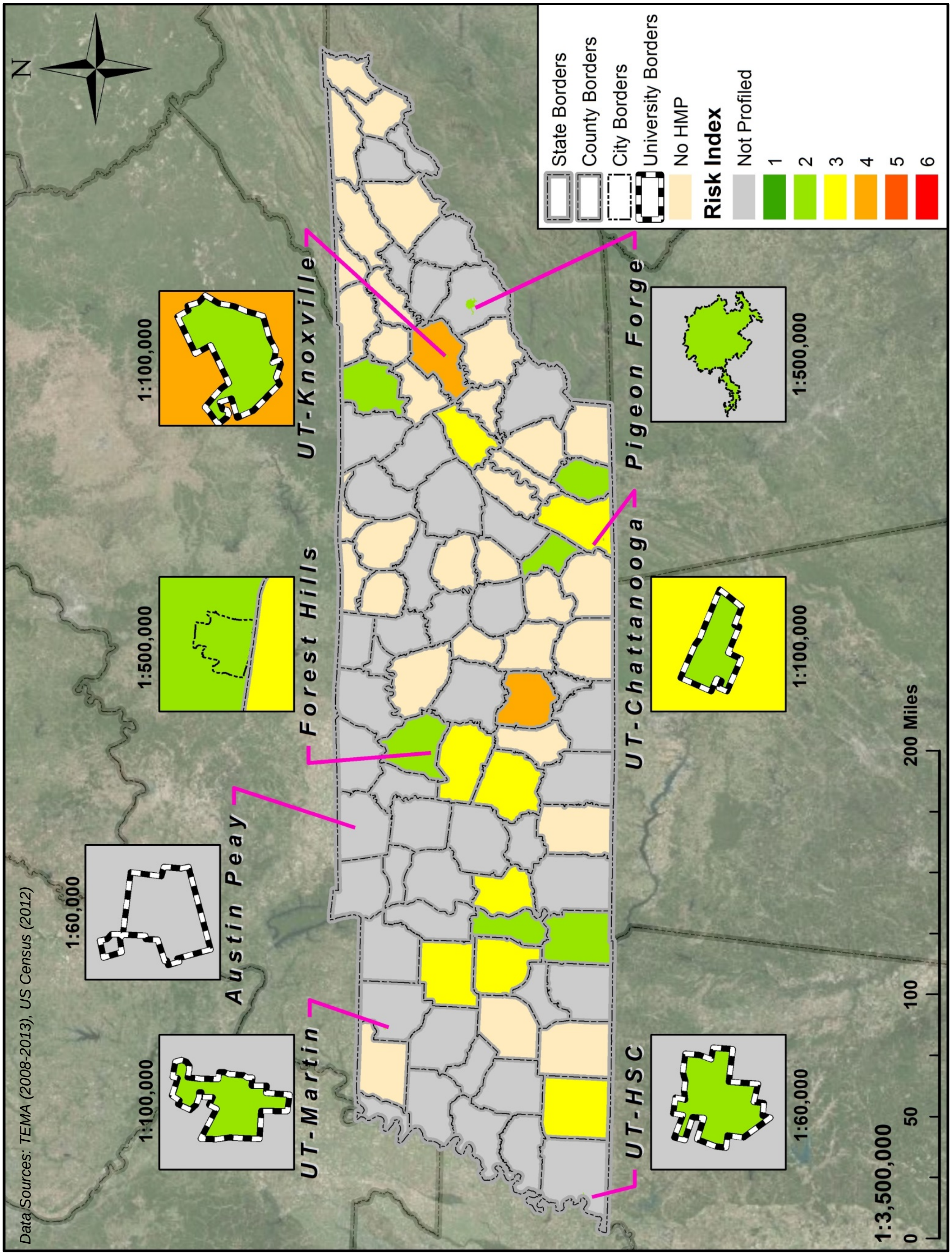
Jurisdiction	Land Subsidence	Landslides	Severe Storms	Tornadoes	Wildfires	Winter Storms
Anderson	4.3	4.3	3.5	2.2	3.6	3.6
Bedford	5	4.1	3.5	N/P	4.8	5
Benton	3.4	N/P	N/P	N/P	N/P	N/P
Bledsoe	4.5	N/P	N/P	N/P	N/P	N/P
Bradley	3.4	2.9	N/P	N/P	2.2	3.6
Campbell	4.1	3.5	3.5	N/P	2.9	3.2
Carroll	4.3	N/P	2.9	N/P	N/P	N/P
Cheatham	3.8	N/P	3.8	N/P	N/P	N/P
Chester	2.9	N/P	N/P	N/P	N/P	N/P
Cocke	3.2	N/P	N/P	N/P	1.8	3.6
Crockett	2.3	N/P	N/P	N/P	N/P	N/P
Cumberland	4.1	N/P	N/P	N/P	N/P	N/P
Davidson	3.8	2.9	3.2	N/P	N/P	N/P
Decatur	2.1	N/P	N/P	N/P	N/P	3.4
DeKalb	2.7	N/P	N/P	N/P	N/P	N/P
Dickson	3.6	N/P	N/P	N/P	N/P	N/P
Dyer	4.1	N/P	N/P	N/P	N/P	N/P
Fayette	2.5	N/P	N/P	N/P	N/P	N/P
Fentress	3.8	N/P	N/P	N/P	N/P	N/P
Gibson	N/P	N/P	N/P	N/P	N/P	N/P
Giles	3.2	N/P	N/P	N/P	N/P	3
Hamblen	2.7	N/P	N/P	N/P	N/P	N/P
Hamilton	4.1	3.3	N/P	N/P	N/P	2.9
Hardin	4.1	2.4	3.1	N/P	2.2	3.2
Haywood	2.9	N/P	N/P	N/P	N/P	N/P
Henderson	3.8	N/P	2.9	N/P	N/P	3.6
Henry	3.2	N/P	N/P	N/P	N/P	N/P
Hickman	4.1	N/P	N/P	N/P	N/P	N/P
Houston	4.1	N/P	N/P	N/P	N/P	N/P
Humphreys	5	N/P	N/P	N/P	N/P	N/P
Jefferson	3.6	N/P	N/P	N/P	N/P	N/P
Knox	4.3	3.8	2	N/P	N/P	3.8
Lake	4.4	N/P	N/P	N/P	N/P	N/P
Lauderdale	4.3	N/P	N/P	N/P	N/P	N/P
Lewis	4.3	N/P	N/P	N/P	N/P	N/P
Lincoln	4.7	N/P	N/P	N/P	N/P	N/P
Macon	3.8	N/P	N/P	N/P	N/P	N/P
Maury	4.3	N/P	N/P	N/P	N/P	3.2
McNairy	2.5	N/P	N/P	N/P	N/P	N/P
Monroe	3.8	N/P	N/P	N/P	N/P	N/P
Montgomery	N/P	N/P	2.6	N/P	4.7	N/P
Moore	3.6	N/P	N/P	N/P	N/P	N/P
Morgan	4.3	N/P	N/P	N/P	N/P	N/P

Jurisdiction	Land Subsidence	Landslides	Severe Storms	Tornadoes	Wildfires	Winter Storms
Perry	4.3	N/P	N/P	N/P	N/P	N/P
Putnam	3.6	2.2	2.3	N/P	N/P	N/P
Roane	3.6	2.6	2.3	N/P	2.2	2.5
Robertson	3.6	N/P	N/P	N/P	N/P	N/P
Rutherford	4.3	N/P	N/P	N/P	N/P	N/P
Scott	3.6	N/P	N/P	N/P	N/P	N/P
Sequatchie	4.4	N/P	2.7	N/P	N/P	N/P
Sevier	4.3	N/P	N/P	N/P	N/P	N/P
Shelby	4.3	N/P	N/P	N/P	N/P	N/P
Smith	4.3	N/P	N/P	N/P	N/P	N/P
Stewart	3.8	N/P	N/P	N/P	N/P	N/P
Sumner	4.3	N/P	N/P	N/P	N/P	N/P
Tipton	4.4	N/P	N/P	N/P	N/P	N/P
Trousdale	3.8	N/P	N/P	N/P	N/P	N/P
Unicoi	4.3	N/P	N/P	N/P	N/P	N/P
Warren	3.8	N/P	N/P	N/P	N/P	N/P
Washington	3.2	N/P	N/P	N/P	N/P	3.3
Wayne	4.3	N/P	N/P	N/P	N/P	N/P
Weakley	4.3	N/P	N/P	N/P	N/P	N/P
Williamson	4.3	N/P	N/P	N/P	N/P	N/P
Austin Peay	3.2	N/P	N/P	N/P	2.9	N/P
MTSU	N/P	N/P	N/P	N/P	N/P	N/P
UT-Chattanooga	1.8	2.2	2.9	2.2	2.2	2.3
UT-HSC	1.8	2.2	2.9	2.2	2.2	2.3
UT-Knoxville	1.8	2.2	2.9	2.2	2.2	2.3
UT-Martin	1.8	2.2	2.9	2.2	2.2	2.3
Forest Hills	5.3	4.3	2.7	N/P	3	2.6
Pigeon Forge	3.2	2.9	N/P	N/P	1.8	3.6

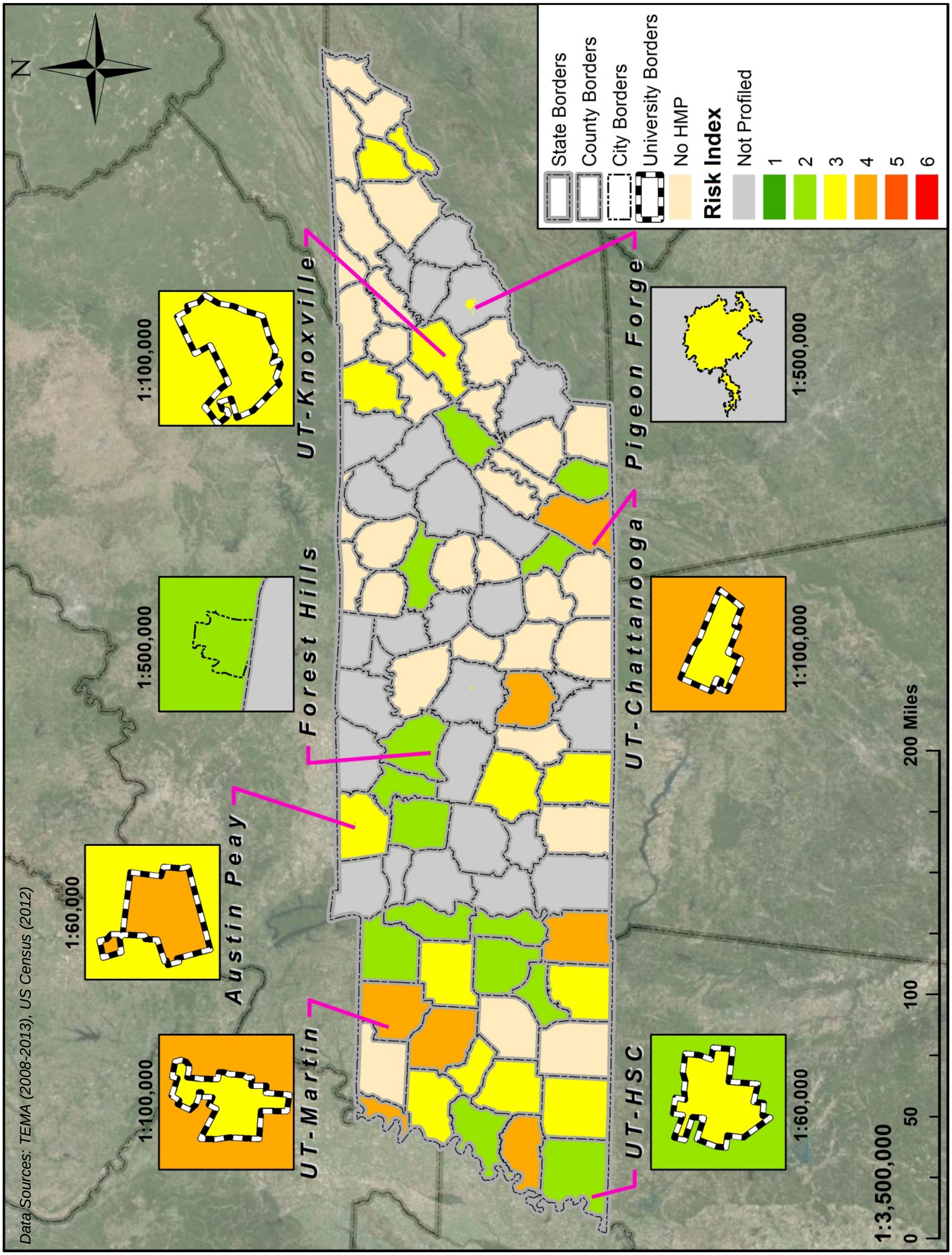
Map 77 – Hazard Risk Index, Local Plan Integration, Dam Failures



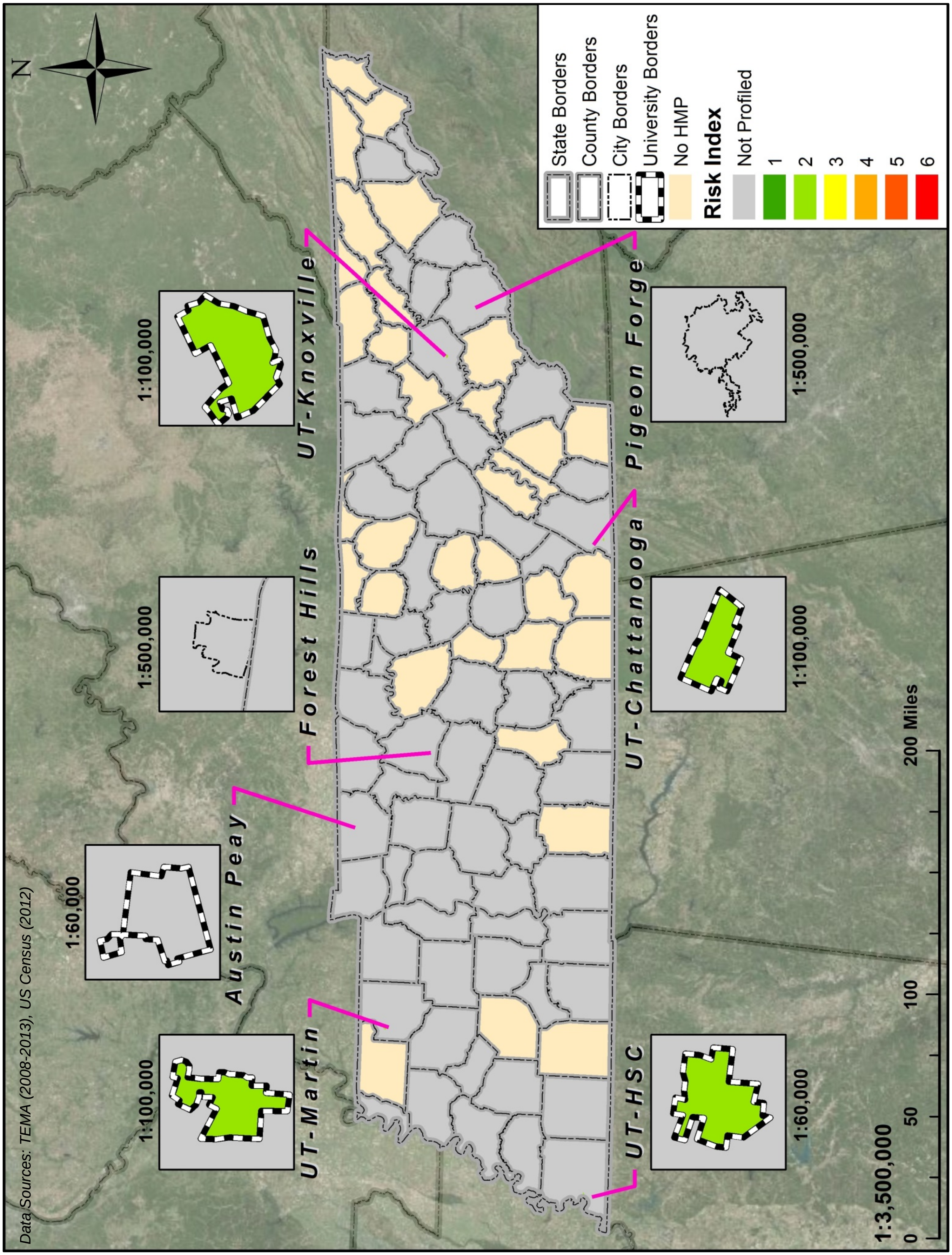
Map 78 – Hazard Risk Index, Local Plan Integration, Drought



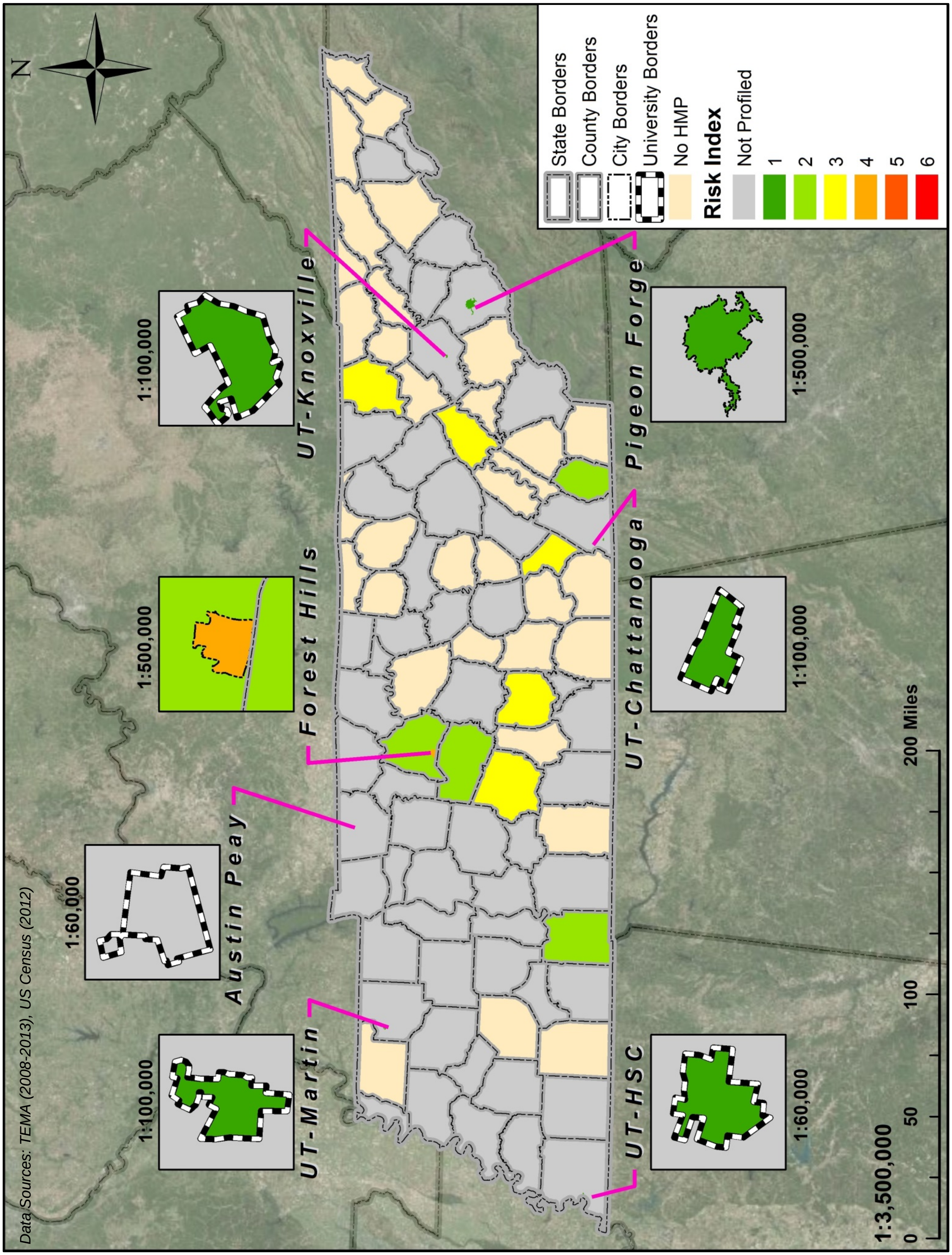
Map 79 – Hazard Risk Index, Local Plan Integration, Earthquake



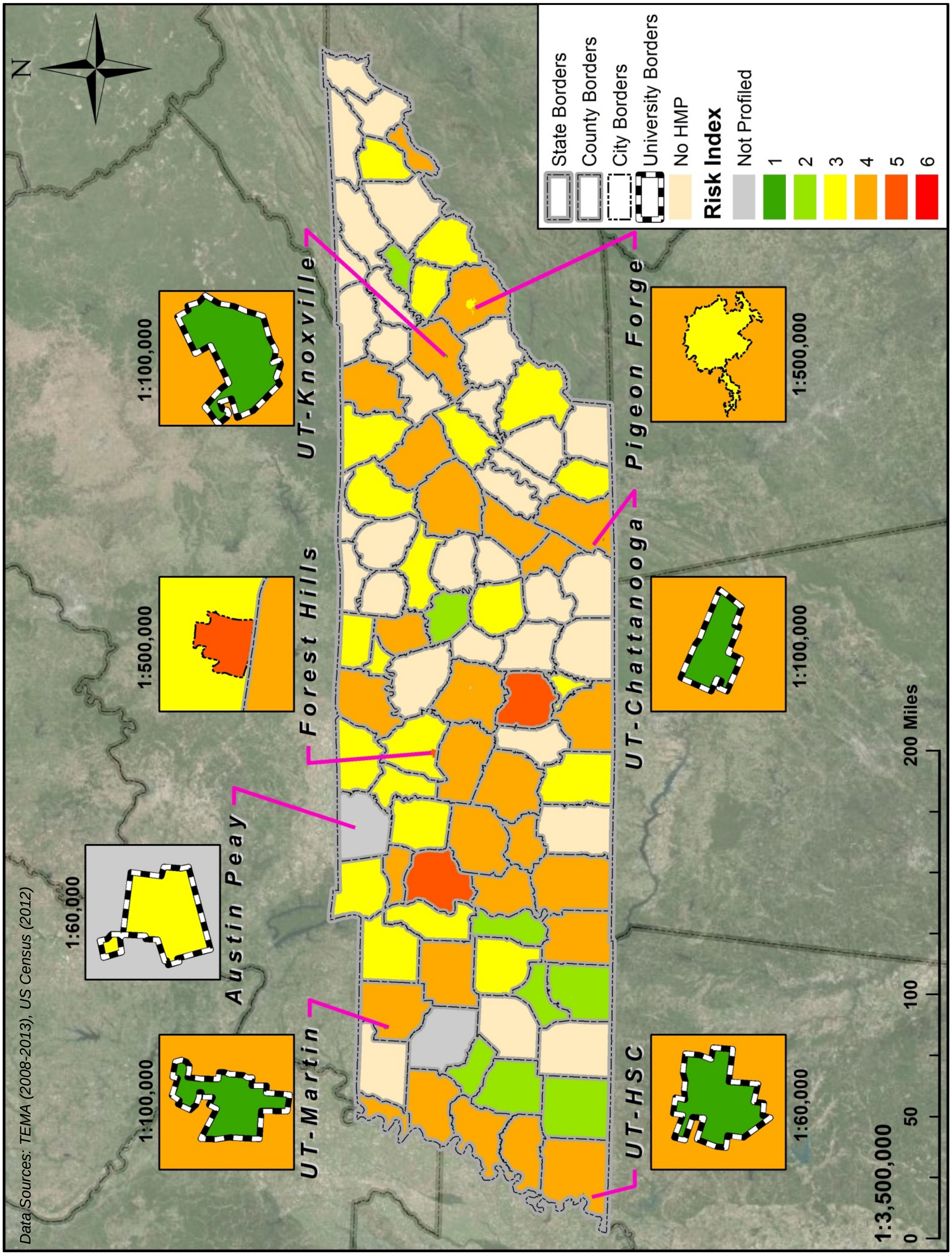
Map 80 – Hazard Risk Index, Local Plan Integration, Expansive Soils



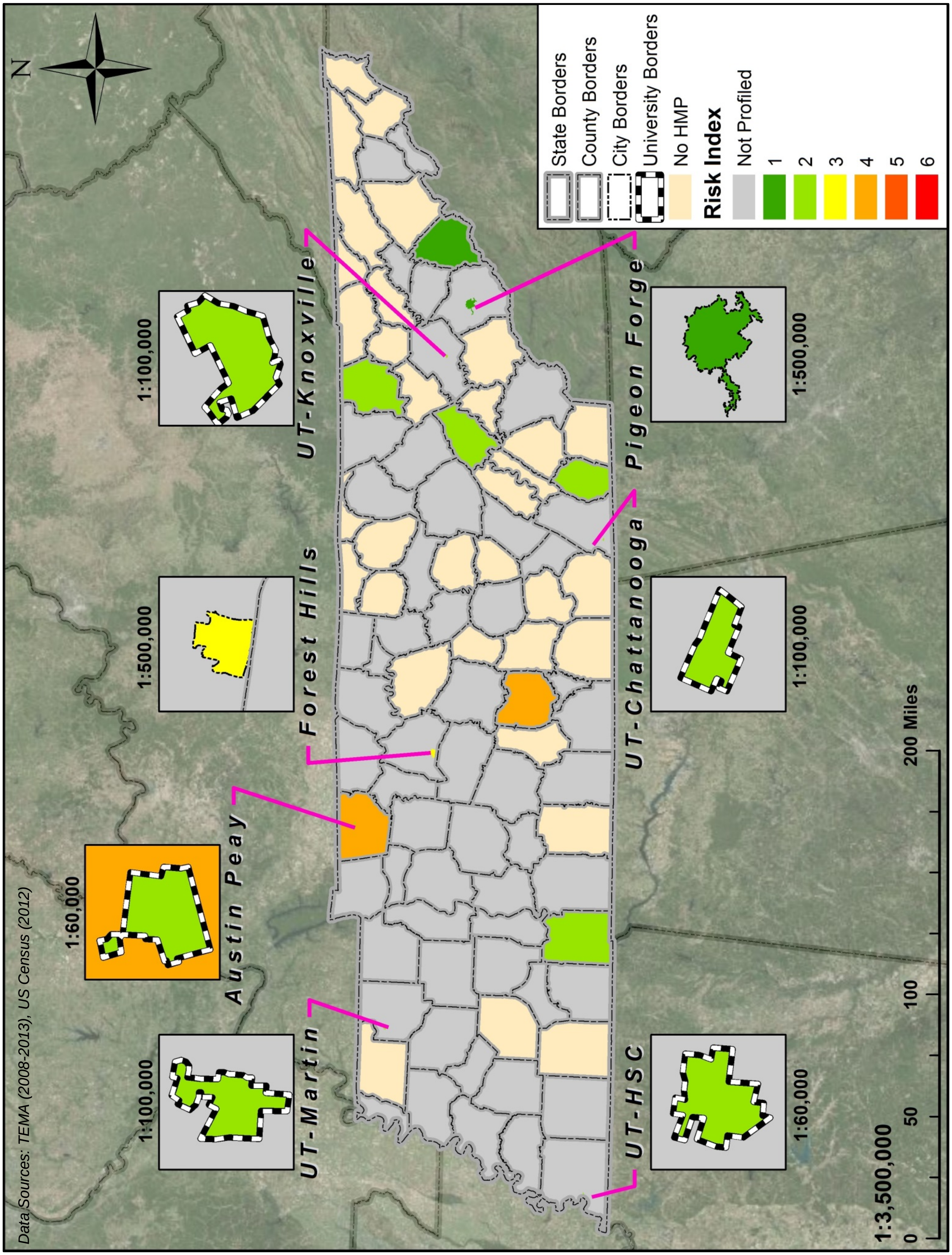
Map 81 – Hazard Risk Index, Local Plan Integration, Extreme Heat

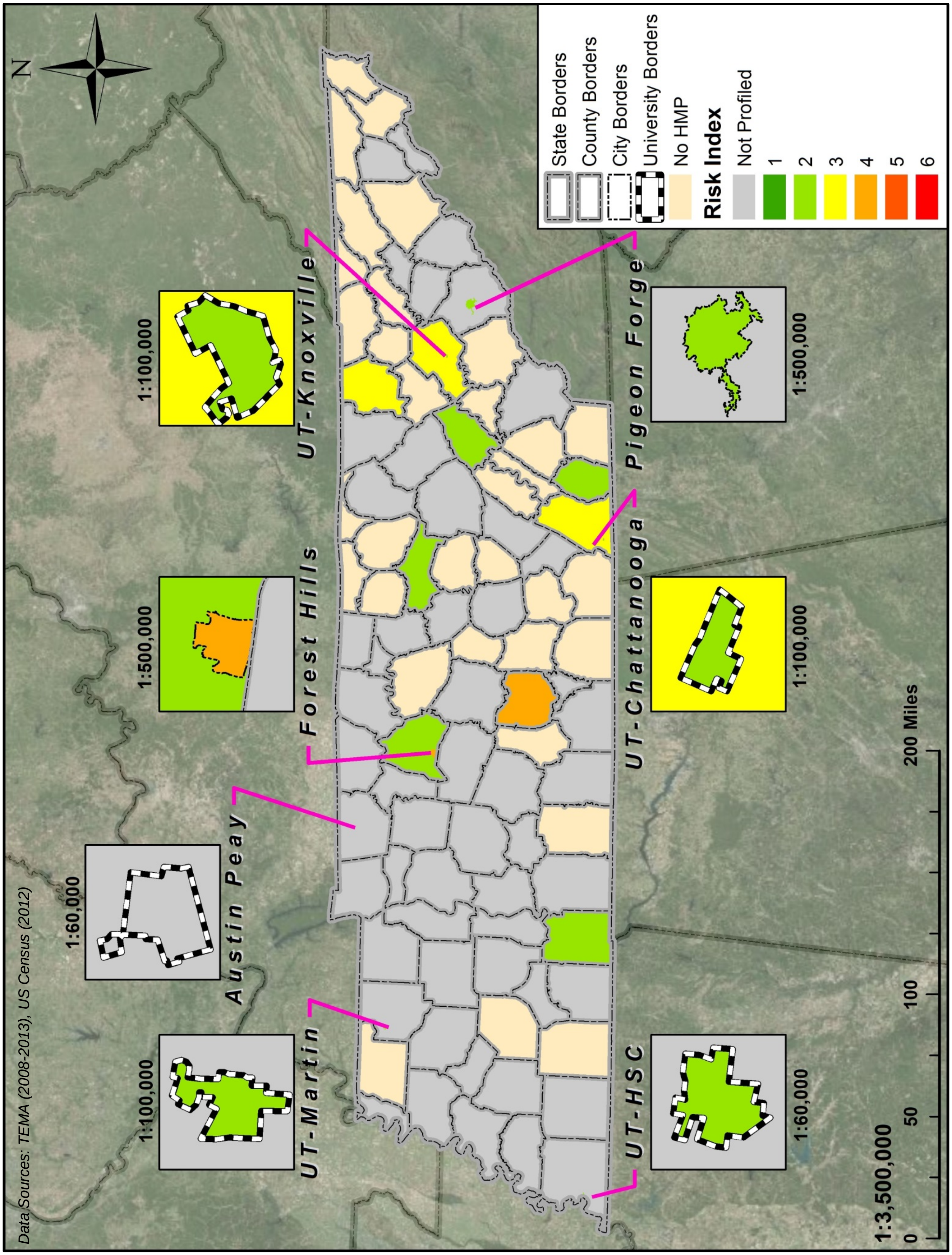


Map 82 – Hazard Risk Index, Local Plan Integration, Floods



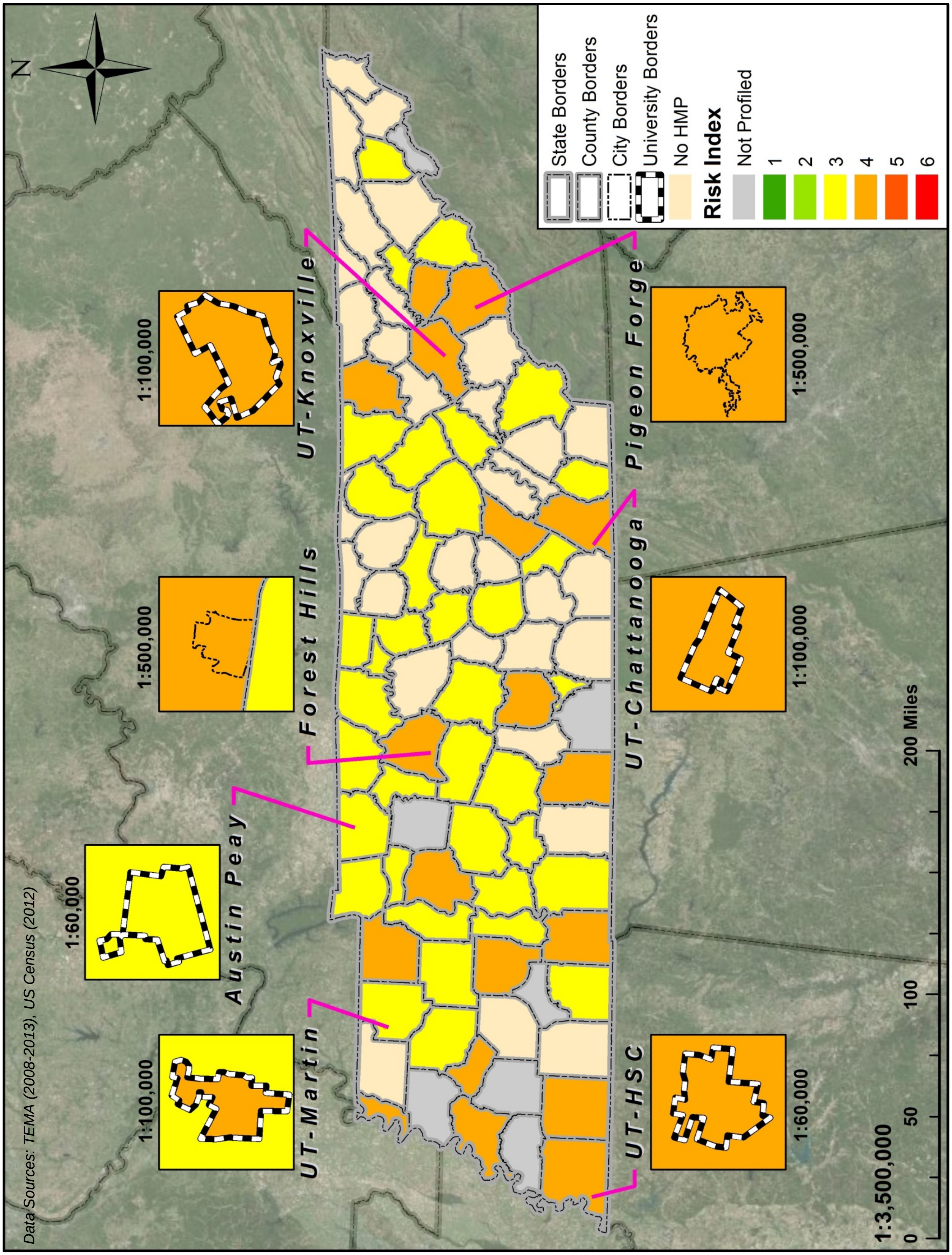
Map 83 – Hazard Risk Index, Local Plan Integration, Land Subsidence/Sinkholes



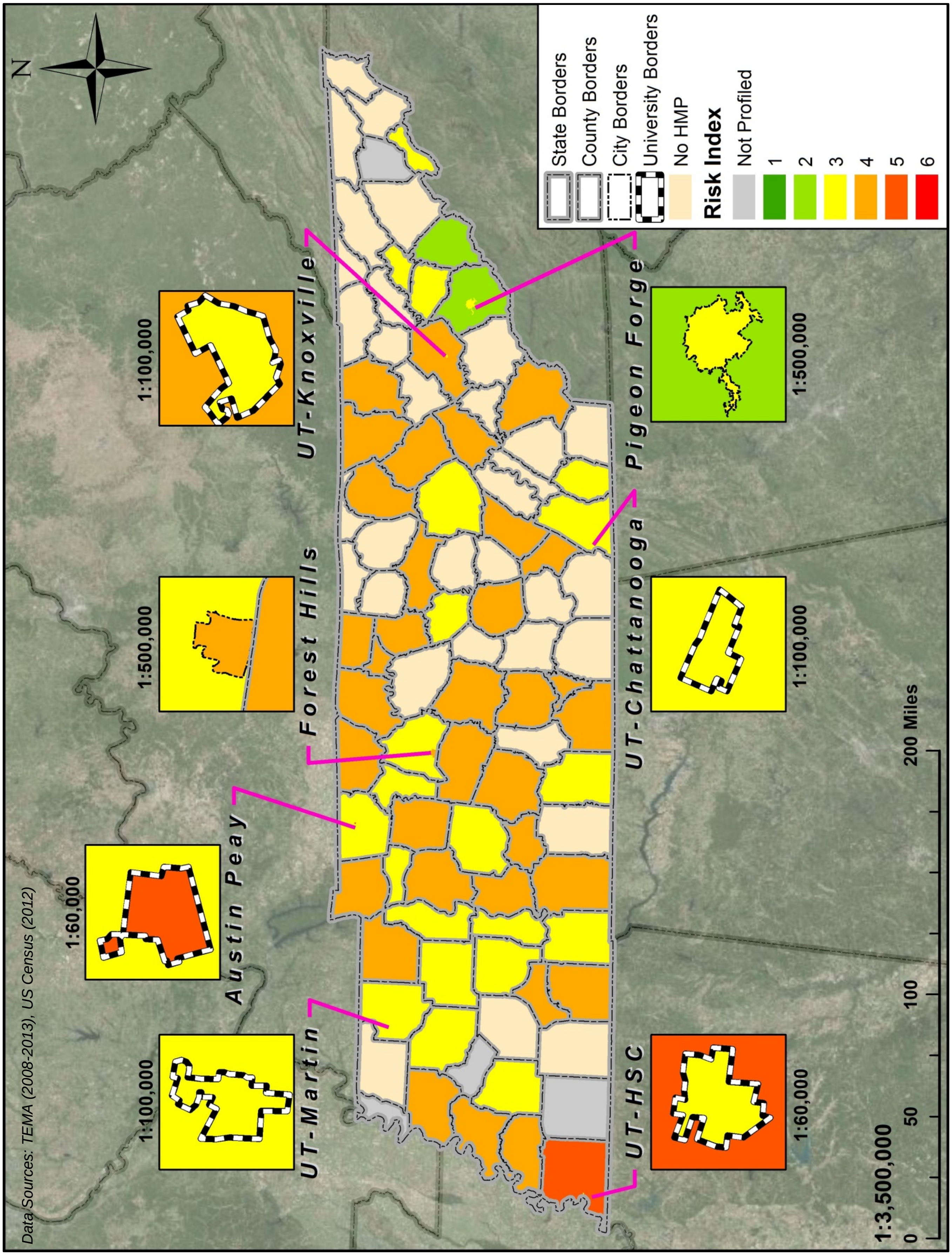


Map 84 – Hazard Risk Index, Local Plan Integration, Landslides

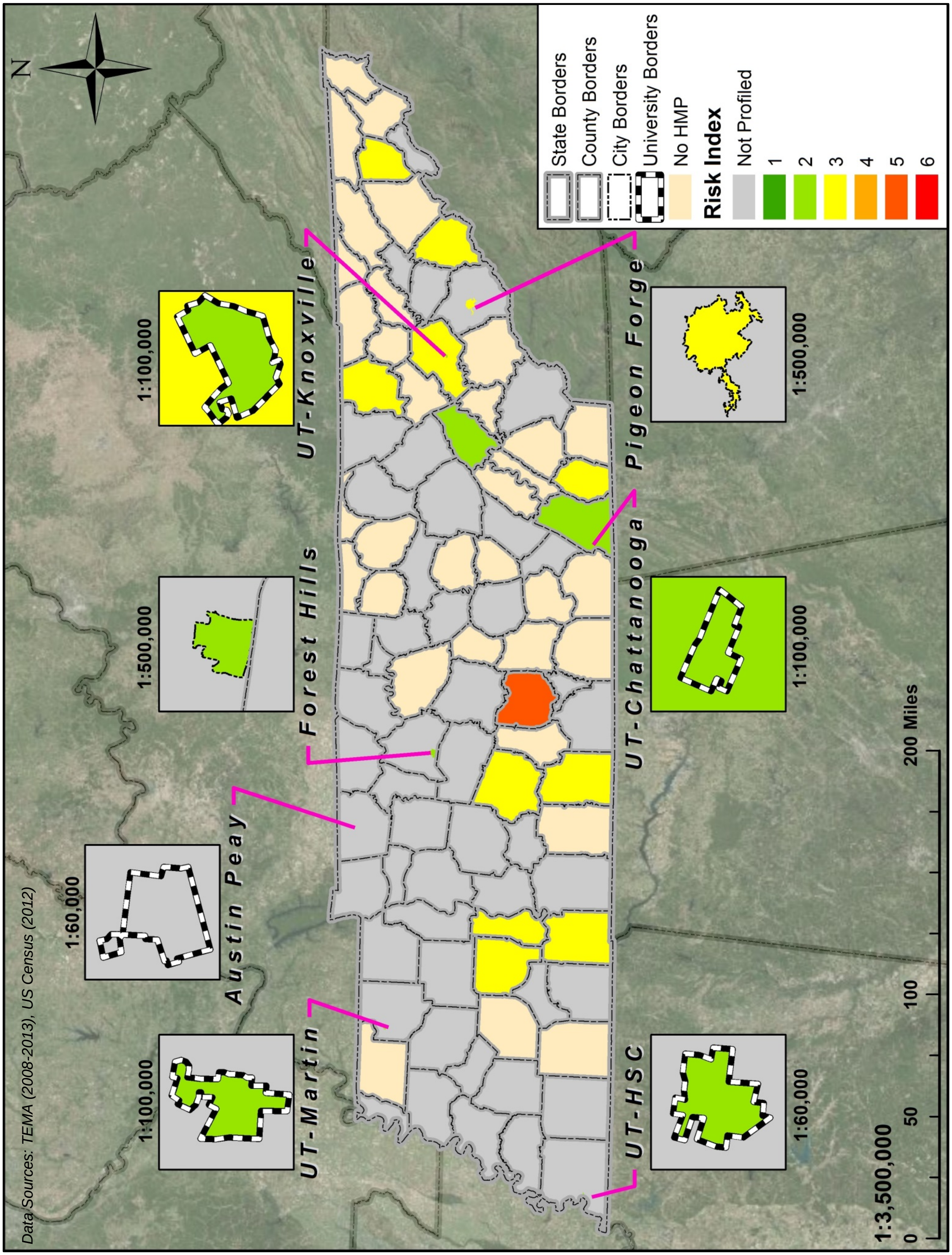
Map 85 – Hazard Risk Index, Local Plan Integration, Severe Storms



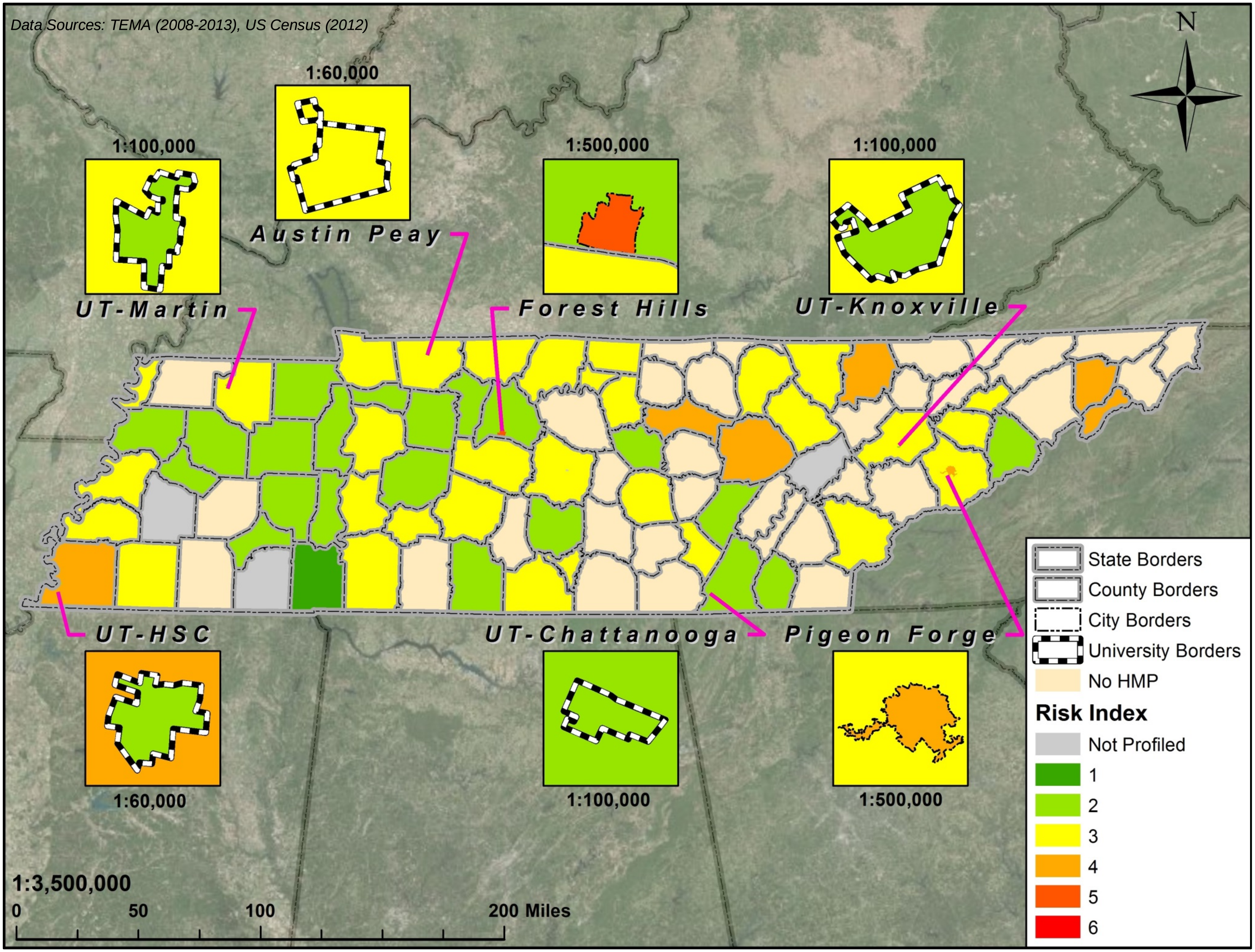
Map 86 – Hazard Risk Index, Local Plan Integration, Tornadoes



Map 87 – Hazard Risk Index, Local Plan Integration, Wildfires



Map 88 – Hazard Risk Index, Local Plan Integration, Winter Storms



4.1.3 – Potential Losses by Local Plan Integration

To estimate the state's potential losses based on the local hazard mitigation plan's risk assessments, their calculated risk indices were cross referenced with each jurisdiction's structural inventory value. The structural inventory value was exported from FEMA's HAZUS-MH v2.1 by Census tract and then spatially joined and aggregated by county. The tables below list the identified vulnerable structural inventory by county per hazard risk index. Drought and Extreme Heat are not listed here as they do not pose a threat to buildings and infrastructure. There is no available structural inventory data for non-county plans (Austin Peay University, Forest Hills, Pigeon Forge, UT – Chattanooga, UT – HSC, UT – Knoxville, and UT – Martin).

Table 52 – Loss Estimation by Local Plan Integration, Tennessee

Hazard	Risk Index by Local Plan Integration						Total Structure Value
	1	2	3	4	5	6	
Dam Failure	$0	$29,360,452,000	$44,439,481,000	$0	$0	$0	$73,799,933,000
Earthquakes	$0	$121,622,431,000	$41,876,371,000	$31,421,788,000	$0	$0	$194,920,590,000
Expansive Soils	$0	$0	$0	$0	$0	$0	$0
Floods	$0	$13,485,195,000	$73,678,858,000	$133,638,662,000	$2,921,819,000	$0	$223,724,534,000
Land Subsidence	$131,260,000	$14,014,578,000	$0	$8,158,192,000	$0	$0	$22,304,030,000
Landslides	$0	$52,194,765,000	$34,452,796,000	$1,742,550,000	$0	$0	$88,390,111,000
Severe Storms	$0	$0	$67,286,017,000	$152,608,084,000	$0	$0	$219,894,101,000
Tornadoes	$0	$4,057,287,000	$91,790,418,000	$69,626,741,000	$61,194,199,000	$0	$226,668,645,000
Wildfires	$0	$20,941,844,000	$32,765,154,000	$0	$1,742,550,000	$0	$55,449,548,000
Winter Storms	$1,044,060,000	$83,790,265,000	$66,309,607,000	$73,174,733,000	$0	$0	$224,318,665,000

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 53 – Loss Estimation by Local Plan Integration, Dam Failure											
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Carroll	$1,230,667	Bedford	$1,742,550						
		Forest Hills	N/A	Campbell	$2,986,882						
		Henderson	$1,475,278	Cheatham	$586,467						
		Knox	$13,667,744	Davidson	$38,079,522						
		Montgomery	$6,415,642	Hardin	$1,044,060						
		Putnam	$3,087,547								
		Roane	$3,143,674								
		Sequatchie	$339,900								
		UT-Chattanooga	N/A								
		UT-HSC	N/A								
		UT-Knoxville	N/A								
		UT-Martin	N/A								

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 54 – Loss Estimation by Local Plan Integration, Earthquakes

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Benton	$932,359	Campbell	$2,986,882	Austin Peay	N/A				
		Bradley	$6,839,962	Carroll	$1,230,667	Bedford	$1,742,550				
		Cheatham	$586,467	Crockett	$811,710	Gibson	$3,075,817				
		Chester	$837,092	Dyer	$2,194,341	Hamilton	$17,798,170				
		Davidson	$38,079,522	Fayette	$1,190,307	Hardin	$1,044,060				
		Decatur	$462,436	Giles	$1,321,101	Lake	$573,379				
		Dickson	$1,032,642	Haywood	$780,779	Tipton	$5,376,454				
		Forest Hills	N/A	Knox	$13,667,744	Weakley	$945,343				
		Henderson	$1,475,278	Maury	$4,972,875						
		Henry	$1,935,167	McNairy	$1,044,059						
		Lauderdale	$1,676,186	Montgomery	$6,415,642						
		Putnam	$3,087,547	MTSU	N/A						
		Roane	$3,143,674	Pigeon Forge	N/A						
		Sequatchie	$339,900	Unicoi	$1,467,892						
		Shelby	$61,194,199	UT-Chattanooga	N/A						
				UT-HSC	N/A						
				UT-Knoxville	N/A						
				UT-Martin	N/A						
				Washington	$3,971,952						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 55 – Loss Estimation by Local Plan Integration, Expansive Soils

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		UT-Chattanooga	N/A								
		UT-HSC	N/A								
		UT-Knoxville	N/A								
		UT-Martin	N/A								

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 56 – Loss Estimation by Local Plan Integration, Floods

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
UT-Chattanooga	N/A	Chester	$837,092	Austin Peay	N/A	Bledsoe	$506,717	Bedford	$1,742,550		
UT-HSC	N/A	Crockett	$811,710	Benton	$932,359	Campbell	$2,986,882	Forest Hills	N/A		
UT-Knoxville	N/A	Decatur	$462,436	Bradley	$6,839,962	Carroll	$1,230,667	Humphreys	$1,179,269		
UT-Martin	N/A	DeKalb	$724,172	Cheatham	$586,467	Cumberland	$466,261				
		Fayette	$1,190,307	Cocke	$131,260	Dyer	$2,194,341				
		Hamblen	$3,705,824	Davidson	$38,079,522	Hamilton	$17,798,170				
		Haywood	$780,779	Dickson	$1,032,642	Hardin	$1,044,060				
		McNairy	$1,044,059	Fentress	$703,483	Hickman	$1,642,658				
				Giles	$1,321,101	Houston	$430,177				
				Henderson	$1,475,278	Knox	$13,667,744				
				Henry	$1,935,167	Lake	$573,379				
				Jefferson	$1,499,816	Lauderdale	$1,676,186				
				Macon	$864,479	Lewis	$553,559				
				Monroe	$1,353,139	Lincoln	$1,632,692				
				Moore	$189,223	Maury	$4,972,875				
				Pigeon Forge	N/A	Morgan	$813,867				
				Putnam	$3,087,547	Perry	$270,866				
				Roane	$3,143,674	Rutherford	$5,323,121				
				Robertson	$1,828,667	Sequatchie	$339,900				
				Scott	$1,289,364	Sevier	$3,926,027				
				Stewart	$761,495	Shelby	$61,194,199				
				Trousdale	$736,985	Smith	$1,289,364				
				Warren	$1,735,696	Sumner	$2,343,418				
				Washington	$3,971,952	Tipton	$5,376,454				
						Unicoi	$1,467,892				
						Wayne	$1,386,123				
						Weakley	$945,343				
						Williamson	$828,101				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 57 – Loss Estimation by Local Plan Integration, Land Subsidence

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Cocke	$131,260	Austin Peay	N/A	Forest Hills	N/A	Bedford	$1,742,550				
Pigeon Forge	N/A	Bradley	$6,839,962			Montgomery	$6,415,642				
		Campbell	$2,986,882								
		Hardin	$1,044,060								
		Roane	$3,143,674								
		UT-Chattanooga	N/A								
		UT-HSC	N/A								
		UT-Knoxville	N/A								
		UT-Martin	N/A								

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 58 – Loss Estimation by Local Plan Integration, Landslides

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Bradley	$6,839,962	Campbell	$2,986,882	Bedford	$1,742,550				
		Davidson	$38,079,522	Hamilton	$17,798,170	Forest Hills	N/A				
		Hardin	$1,044,060	Knox	$13,667,744						
		Pigeon Forge	N/A								
		Putnam	$3,087,547								
		Roane	$3,143,674								
		UT-Chattanooga	N/A								
		UT-HSC	N/A								
		UT-Knoxville	N/A								
		UT-Martin	N/A								

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 59 – Loss Estimation by Local Plan Integration, Severe Storms

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				MTSU	N/A	Bedford	$1,742,550				
				Austin Peay	N/A	Bledsoe	$506,717				
				Benton	$932,359	Campbell	$2,986,882				
				Bradley	$6,839,962	Crockett	$811,710				
				Carroll	$1,230,667	Davidson	$38,079,522				
				Cheatham	$586,467	Fayette	$1,190,307				
				Cocke	$131,260	Forest Hills	N/A				
				Cumberland	$466,261	Giles	$1,321,101				
				Decatur	$462,436	Hamilton	$17,798,170				
				DeKalb	$724,172	Hardin	$1,044,060				
				Fentress	$703,483	Henderson	$1,475,278				
				Gibson	$3,075,817	Henry	$1,935,167				
				Hamblen	$3,705,824	Humphreys	$1,179,269				
				Hickman	$1,642,658	Jefferson	$1,499,816				
				Houston	$430,177	Knox	$13,667,744				
				Lewis	$553,559	Lake	$573,379				
				Macon	$864,479	Lauderdale	$1,676,186				
				Maury	$4,972,875	Pigeon Forge	N/A				
				McNairy	$1,044,059	Sevier	$3,926,027				
				Monroe	$1,353,139	Shelby	$61,194,199				
				Montgomery	$6,415,642	UT-Chattanooga	N/A				
				Moore	$189,223	UT-HSC	N/A				
				Morgan	$813,867	UT-Knoxville	N/A				
				Perry	$270,866	UT-Martin	N/A				
				Putnam	$3,087,547						
				Roane	$3,143,674						
				Robertson	$1,828,667						
				Rutherford	$5,323,121						
				Scott	$1,289,364						
				Sequatchie	$339,900						
				Smith	$1,289,364						
				Stewart	$761,495						
				Sumner	$2,343,418						
				Trousdale	$736,985						

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Warren	$1,735,696						
				Washington	$3,971,952						
				Wayne	$1,386,123						
				Weakley	$945,343						
				Williamson	$828,101						

The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.

Table 60 – Loss Estimation by Local Plan Integration, Wildfires

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Forest Hills	N/A	Bradley	$6,839,962			Bedford	$1,742,550		
		Hamilton	$17,798,170	Campbell	$2,986,882						
		Roane	$3,143,674	Cocke	$131,260						
		UT-Chattanooga	N/A	Decatur	$462,436						
		UT-HSC	N/A	Giles	$1,321,101						
		UT-Knoxville	N/A	Hardin	$1,044,060						
		UT-Martin	N/A	Henderson	$1,475,278						
				Knox	$13,667,744						
				Maury	$4,972,875						
				Pigeon Forge	N/A						
				Washington	$3,971,952						

The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database

Table 61 – Loss Estimation by Local Plan Integration, Winter Storms											
Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Hardin	$1,044,060	Bedford	$1,742,550	Austin Peay	N/A	Campbell	$1,742,550	Forest Hills	N/A		
		Benton	$932,359	Fayette	$1,190,307	Cumberland	$932,359				
		Bledsoe	$506,717	Fentress	$703,483	Pigeon Forge	$506,717				
		Bradley	$6,839,962	Hamblen	$3,705,824	Putnam	$6,839,962				
		Carroll	$1,230,667	Humphreys	$1,179,269	Shelby	$1,230,667				
		Cheatham	$586,467	Jefferson	$1,499,816	Unicoi	$586,467				
		Chester	$837,092	Knox	$13,667,744	Washington	$837,092				
		Cocke	$131,260	Lake	$573,379						
		Crockett	$811,710	Lauderdale	$1,676,186						
		Davidson	$38,079,522	Lewis	$553,559						
		Decatur	$462,436	Lincoln	$1,632,692						
		DeKalb	$724,172	Macon	$864,479						
		Dickson	$1,032,642	Maury	$4,972,875						
		Dyer	$2,194,341	Monroe	$1,353,139						
		Gibson	$3,075,817	Montgomery	$6,415,642						
		Giles	$1,321,101	Moore	$189,223						
		Hamilton	$17,798,170	Morgan	$813,867						
		Henderson	$1,475,278	Perry	$270,866						
		Henry	$1,935,167	Robertson	$1,828,667						
		Hickman	$1,642,658	Rutherford	$5,323,121						
		Houston	$430,177	Scott	$1,289,364						
		UT-Chattanooga	N/A	Sequatchie	$339,900						
		UT-HSC	N/A	Sevier	$3,926,027						
		UT-Knoxville	N/A	Smith	$1,289,364						
		UT-Martin	N/A	Stewart	$761,495						
				Sumner	$2,343,418						
				Tipton	$5,376,454						
				Trousdale	$736,985						
				Warren	$1,735,696						
				Wayne	$1,386,123						
				Weakley	$945,343						
				Williamson	$828,101						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database*

4.2 – Risk Assessment by Statewide Analysis

Social Vulnerability Index© (SoVI)

The Social Vulnerability Index© is an important disaster mitigation planning tool as it depicts an areas vulnerability using historical hazard data as well as by their social conditions. Social vulnerability describes those aspects and elements of a population that influence the capacity of a community to prepare for, respond to, and recover from hazards and disasters. The social vulnerability of a population interacts with natural disasters and processes as well as the built environment to distribute the risks and impacts of natural hazards and in this way creates the social impacts of those hazards and disasters.

Several algorithms and methods have been developed for estimating social vulnerability. However, the index compiled by the Hazards and Vulnerability Research Institute at the Department of Geography, University of South Carolina has come to be the accepted method in the emergency management community. Hazard Vulnerability Research Institute's (HVRI) index measures the social vulnerability of U.S. counties to environmental hazards. Based on national data sources, primarily the 2010 U.S. Decennial Census, it synthesizes 30 socioeconomic and built environment variables that various research literatures suggest contribute to a reduction or increase in a community's ability to prepare for, respond to, and recover from hazards. Of these 30 socioeconomic factors used to evaluate a given population's social vulnerability, 7 components explain 72% of the variance in the data. The 7 factors that explain the relative level of social vulnerability in HVRI's index include: race and class; wealth; vulnerable populations; residents of Hispanic ethnicity; special needs individuals; individuals of Native American ethnicity and individuals with service industry employment.

Utilizing the SoVI© index as a measure of jurisdictional vulnerability is superior to using historical impact data. Although there is a great amount to learn from using historical impact data, it lacks explanatory power by neglecting recent changes in growth and development. On the other hand, the SoVI© has been modeled using historical hazard impacts and that model is based on recent growth and development.

HVRI's SoVI© index can be used by Tennessee to help determine where social vulnerability and exposure to hazards overlaps and how and where mitigation resources might best be used. The color coded maps that follow will show the county variation in Tennessee for all 7 of the social vulnerability index main components.

For more information on the Social Vulnerability Index©, please follow this link:
http://webra.cas.sc.edu/hvri/

Threat Assessment by GIS Analysis

The statewide threat assessment involves a variety of data sources and analysis methodologies to address each hazard county by county. The approach centered around assigning threat ranks, 1 through 6, to areas of the county. These areas were then taken as a percentage of the county's area and totaled together to achieve an aggregate threat score for the county. The following methods were used to achieve threat scores for the county:

- Drought – Historical Impact Density
- Earthquake – Seismic Zones
- Expansive Soils – Linear Extensibility Scoring
- Extreme Temperature – Historical Impact Density
- Flash Flood – Historical Impact Density
- Hail – Historical Impact Density
- High & Strong Winds – Historical Impact Density
- Land Subsidence/Sinkholes – Karst Formations
- Landslides – USGS Threat Index
- Lightning – Historical Impact Density
- Riverine Flood – Floodplain Size
- Thunderstorm Winds – Historical Impact Density
- Tornado – Historical Impact Density (Weighted by EF magnitude)
- Wildfire – WUI Size
- Winter Storm – Historical Impact Density

Composite Risk Assessment by GIS Analysis

Each areas rank was analyzed as a percentage of each county's total area. The newly calculated composite threat scores, per county, were then divided into 6 ordinal ranks, 6 being exposed to the greatest threat and 1 being the least.

The following tables display the threat rank index of each hazard per county. The maps following these tables geographically show the threat index across the state. For comparison purposes, the county's SoVI© score is listed.

The following pages illustrate the assessment process.

Step 1: Illustrating the SoVI©

The 1st step was incorporating the University of South Carolina's SoVI© into tables (Table 62) and developing a series of maps (Maps 89 – 97). The table and maps diagram the 7 components of the SoVI© into 6 rankings based on national comparative scores. This was done for all 95 Tennessee counties. The statistical values using in computing the SoVI© are drawn the 2010 Census, and all calculations of these values were done the University of South Carolina's Hazard Vulnerability Institute.

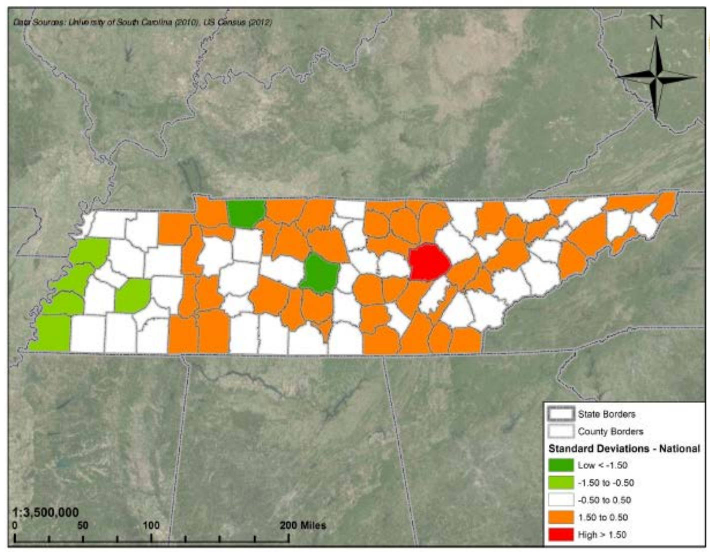
This table and maps assist Tennessee in determining where social vulnerability and exposure to hazards overlaps the greatest and least. Below are screenshots of the table and an example SoVI© map.

Table 53 – Social Vulnerability Index©, Tennessee

Rank 1 – -1.5- -0.50 Std. Dev. | Rank 2 – -0.50- -1.5 Std. Dev. | Rank 3 – -0.50 - 0.50 Std. Dev.
Rank 4 – -0.50 - 0.50 Std. Dev | Rank 5 – High > 1.5 Std. Dev.

County	National Percentile	Age	Ethnicity (Hispanic)	Ethnicity (Native American)	Race & Class	Service Industry Employment	Vulnerable Populations	Wealth (-Correlation)
Anderson	34.93%	3	4	3	3	3	3	3
Bedford	16.93%	2	2	4	3	5	3	4
Benton	65.48%	2	3	3	2	3	4	4
Bledsoe	75.21%	2	3	3	3	2	5	4
Blount	16.16%	3	4	4	3	3	3	3
Bradley	20.78%	2	3	4	3	3	3	3
Campbell	71.11%	2	3	3	2	4	3	4
Cannon	38.43%	3	3	3	3	4	4	4
Carroll	49.89%	3	4	3	2	4	3	4
Carter	73.11%	3	3	3	2	3	3	4
Cheatham	6.11%	2	3	3	4	4	4	3
Chester	32.23%	3	3	3	3	4	4	4
Claiborne	56.47%	3	3	3	2	4	4	4
Clay	61.06%	2	2	4	3	4	4	4
Cocke	76.23%	2	3	3	2	3	4	4
Coffee	33.63%	3	3	3	3	4	3	3
Crockett	49.00%	3	3	4	2	4	3	4
Cumberland	73.97%	1	3	3	3	3	3	3
Davidson	16.58%	2	4	4	2	3	2	2
Decatur	60.77%	2	2	4	2	5	3	4
DeKalb	43.75%	3	2	4	2	4	3	3
Dickson	20.39%	3	3	3	3	4	4	3
Dyer	50.46%	4	4	3	2	3	3	3
Fayette	11.45%	3	4	3	3	4	4	3
Fentress	56.98%	2	3	3	3	4	4	3
Franklin	25.96%	3	3	3	3	4	3	3
Gibson	57.59%	3	4	3	2	4	2	4
Giles	37.51%	3	3	3	3	4	3	4
Grainger	43.65%	2	2	3	3	4	4	4
Greene	44.80%	2	3	3	3	4	4	4
Grundy	80.02%	2	3	3	2	3	4	4
Hamblen	29.88%	3	3	4	3	4	3	3
Hamilton	23.00%	2	4	4	3	3	2	2
Hancock	84.16%	2	3	3	2	4	4	4
Hardeman	83.07%	3	3	3	2	2	4	4
Hardin	63.92%	2	3	3	2	4	3	3
Hawkins	36.40%	3	3	3	3	4	4	3
Haywood	66.21%	3	4	3	1	4	3	4
Henderson	22.11%	3	3	3	3	4	4	4
Henry	59.88%	2	4	3	2	3	3	3
Hickman	49.03%	3	3	2	3	3	4	4

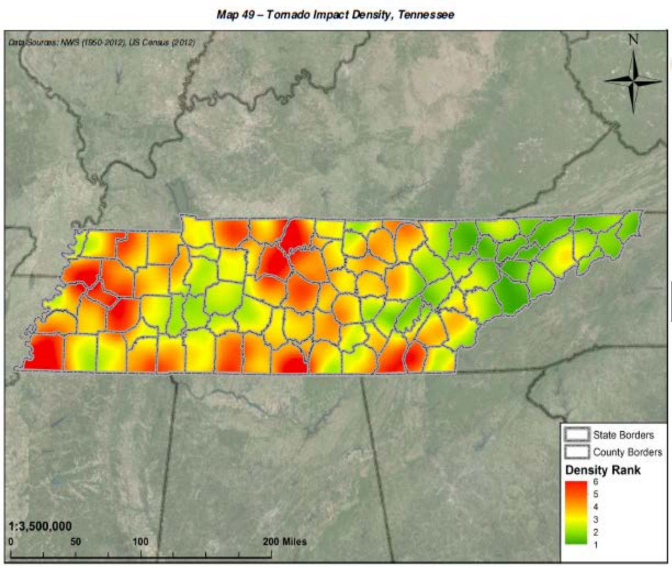
Map 91 – Social Vulnerability, Age National Rank

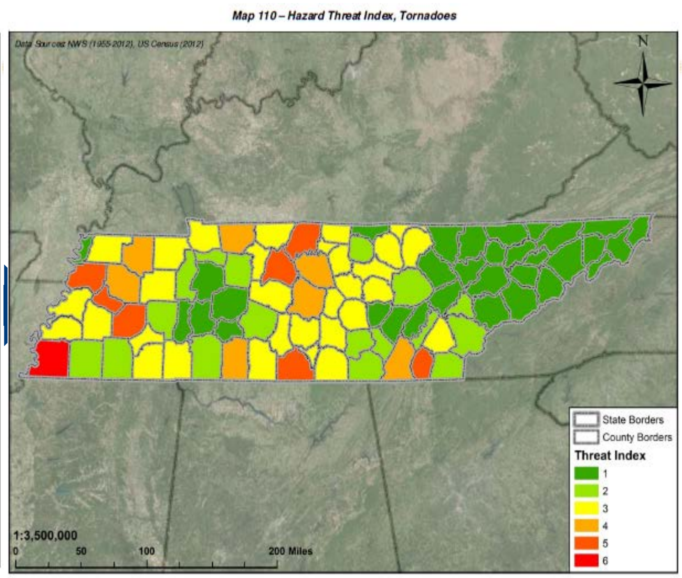


Step 2: Threat Assessment by GIS Analysis

For the 2nd step, planners took the hazard specific maps presented in Section 3 – Hazard Profiles and used ArcGIS to transform them into categorical maps broken down, and aggregated at the county level. These maps profile hazard threats into 6 categories from lowest threat (ranking 1 – dark green) to highest threat (ranking 6 – red) for each of Tennessee's 95 counties. This was done per hazard.

The following depiction shows the ArcGIS transformation of Map 49 – Tornado Impact Density converted to the threat rankings for Map 110 – Hazard Threat Index for Tornadoes.



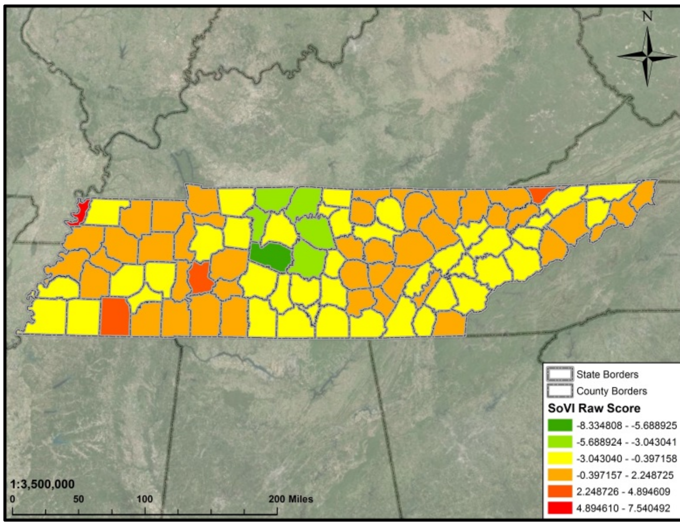


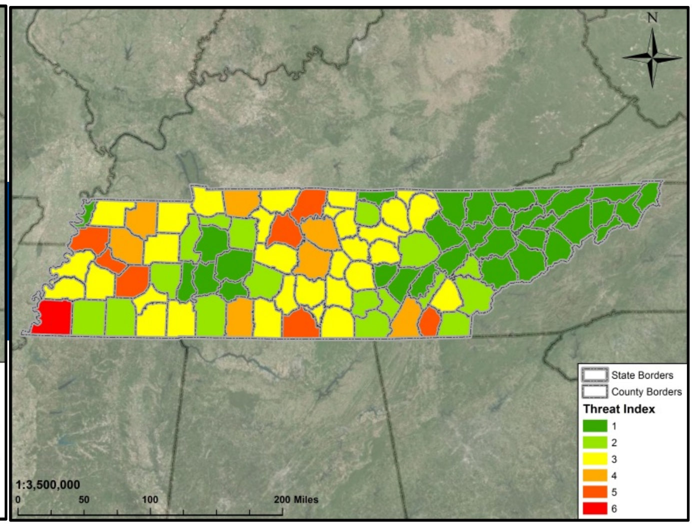
Unlike the SoVI© maps that focus on determining how social vulnerabilities could potentially increase disaster impacts and resource needs by county, the threat assessment maps focus on determining where hazard impacts have historically occurred by county. Tables 63 and 64 and Maps 98-112 profiled the categorical threat assessment results by each natural hazard.

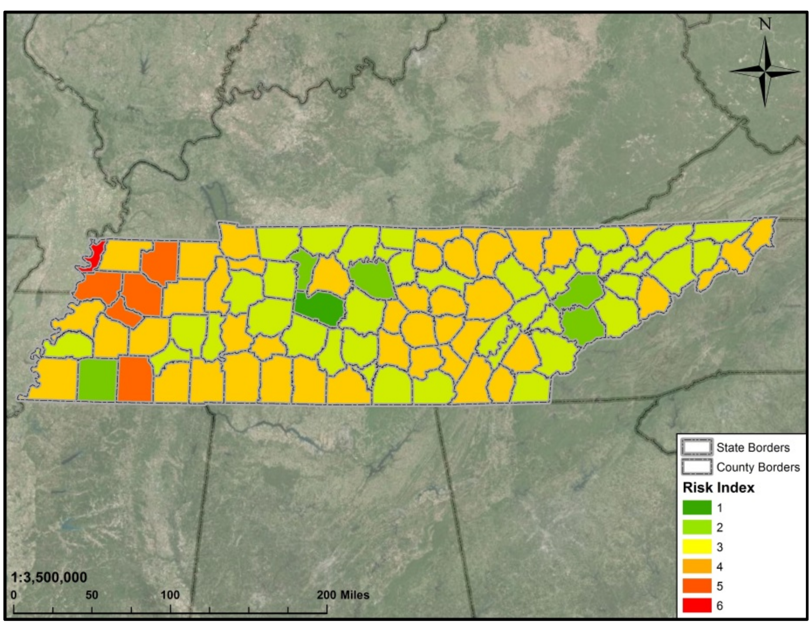
Step 3: Composite Risk Assessment by GIS Analysis

For the 3rd step, planners combined the resulting maps from Step 1 and Step 2 to output the composite risk assessment. To complete this calculation, the SoVI© composite scores were added and averaged with the threat assessment data from Step 2 of this process. The composite risk is therefore a depiction of a county's social vulnerability overlaid with its threats.

Composite risk was broken down into 6 categories from lowest threat (ranking 1 – dark green) to highest threat (ranking 6 – red) for each of Tennessee's 95 counties. This was done per hazard. Tables 65 and 66 and Maps 113-127 profile the categorical composite risk assessment results by each natural hazard. The coupling of Step 1 and Step 2 provided a way to view both social vulnerabilities and historic disaster susceptibilities into a single picture.

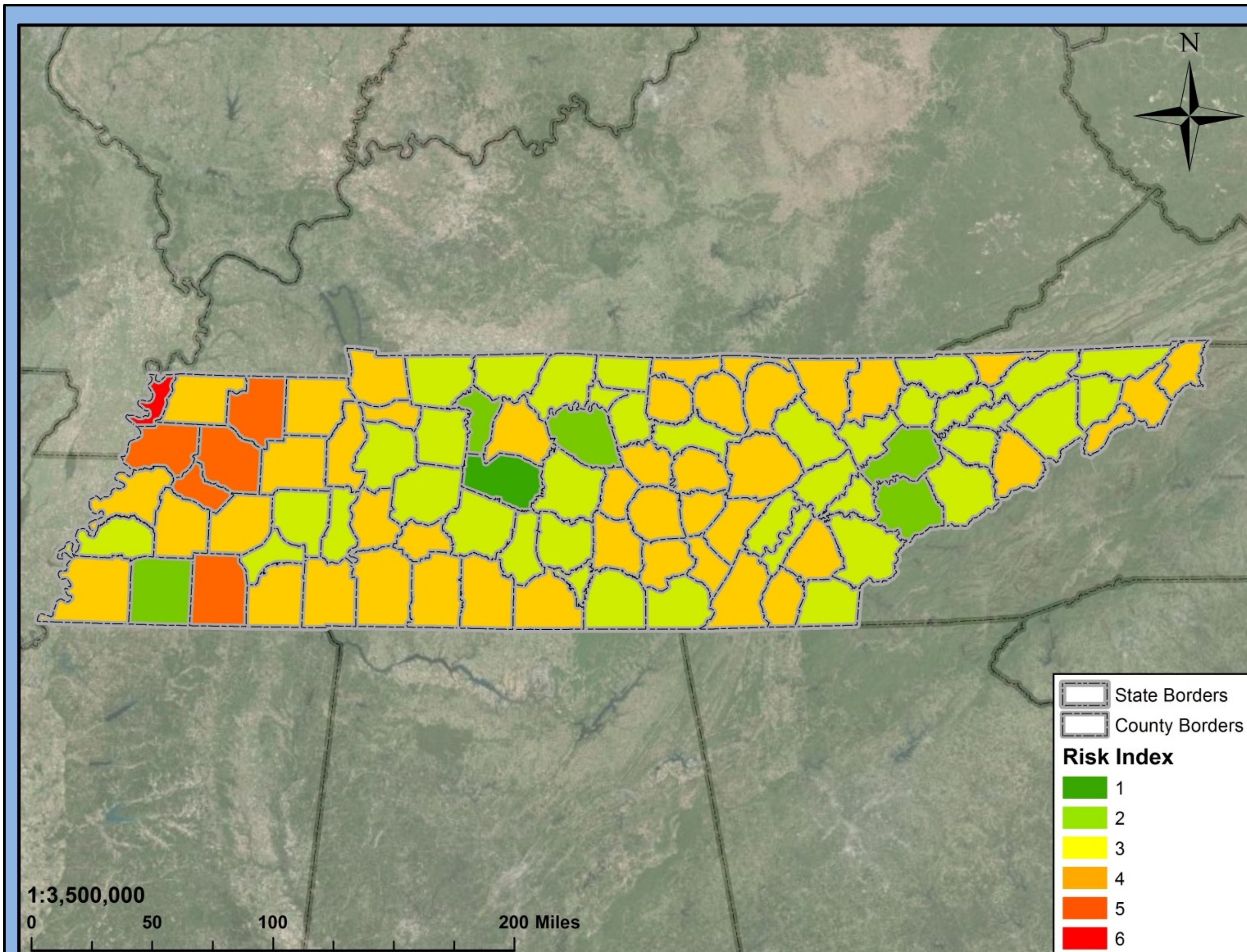






Step 4: Potential Losses by GIS Analysis

For the final step, mitigation planners took the composite risk assessment maps from step 3, and overlaid each of these maps with the structural inventory database from FEMA's HAZUS-MH v2.1 SP1 software. The final result of the GIS analysis is a table that describes the total structural loss estimation per county risk rankings for each hazard. The following diagram shows this process. The results can be seen in Tables 67 through 80.



Loss Estimation by GIS Analysis, Tennessee						
Hazard	Risk Index by GIS Analysis					
	1	2	3	4	5	6
Tornadoes	$828,101,000	$25,971,907,000	$101,264,325,000	$171,452,554,000	$9,205,538,000	$573,379,000

4.2.1 – State Vulnerability Assessment by Social Vulnerability Index©

Age

Much of Eastern Tennessee has an older population while the rest of the state, especially the vibrant counties around Nashville and those along the Mississippi River, are quite young. In the entire state, only Cumberland County shows high social vulnerability due to age.

Ethnicity (Hispanic)

Tennessee has a low percentage of Hispanic residents relative to the national average, thus this factor does not heavily influence Tennessee's social vulnerability. Some of the state's rural farming areas have Hispanic populations, but none of these counties has a high social vulnerability.

Ethnicity (Native American)

Only Hickman County has a significant number of Native Americans to raise it social vulnerability index. The rest of Tennessee has a significantly lower number of Native American residents relative to the national average.

Race & Class

Tennessee displays some social vulnerability due to class and race in its westernmost counties, especially Shelby and Haywood. There is also some weakness in this area along the northeast border of the state with Kentucky. However, Tennessee shows much less social vulnerability due to race and class than its neighboring states other than Missouri. A few Tennessee counties in the Nashville area have a low concentration of poverty and thus demonstrate extremely low social vulnerability from race and class.

Service Industry Employment

A few counties near the Great Smoky Mountain National Park have a relatively high level of service employment. However, proportionately, Tennessee has a very low level of service employment due to its high number of farming, manufacturing, mining, and transportation jobs.

Vulnerable Populations

Tennessee has a very few concentrations of vulnerable populations and people in long term care facilities relative to the national average. No counties in Tennessee display a high social vulnerability from this factor.

Wealth

As with many states, many of Tennessee's rural counties are not wealthy, but its large metropolitan areas have significant wealth and thus lower social vulnerability to hazards and disasters.

Combined Social Vulnerability Index©

Maps 89 - 97 on the following pages illustrate the geographic variation in each Tennessee county's social vulnerability relative to all counties in the United States. The data is depicted in standard deviations. From there the data is broken down into 5 categories where the middle deviation category represents 38.29% of all counties, the 2nd deviation category the next 48.35% of all counties, and the 3rd deviation category and greater represents the last 13.36% of all counties.

Map 90 illustrates the SoVI© raw score throughout Tennessee.

Table 62 on the next page lists the total and individual SoVI© ranks throughout Tennessee.

Table 62 – Social Vulnerability Index©, Tennessee

Rank 1 = -1.5- -0.50 Std. Dev. Rank 2 = -0.50- -1.5 Std. Dev. Rank 3 = -0.50 - 0.50 Std. Dev.
Rank 4 = -0.50 - 0.50 Std. Dev Rank 5 = High > 1.5 Std. Dev.

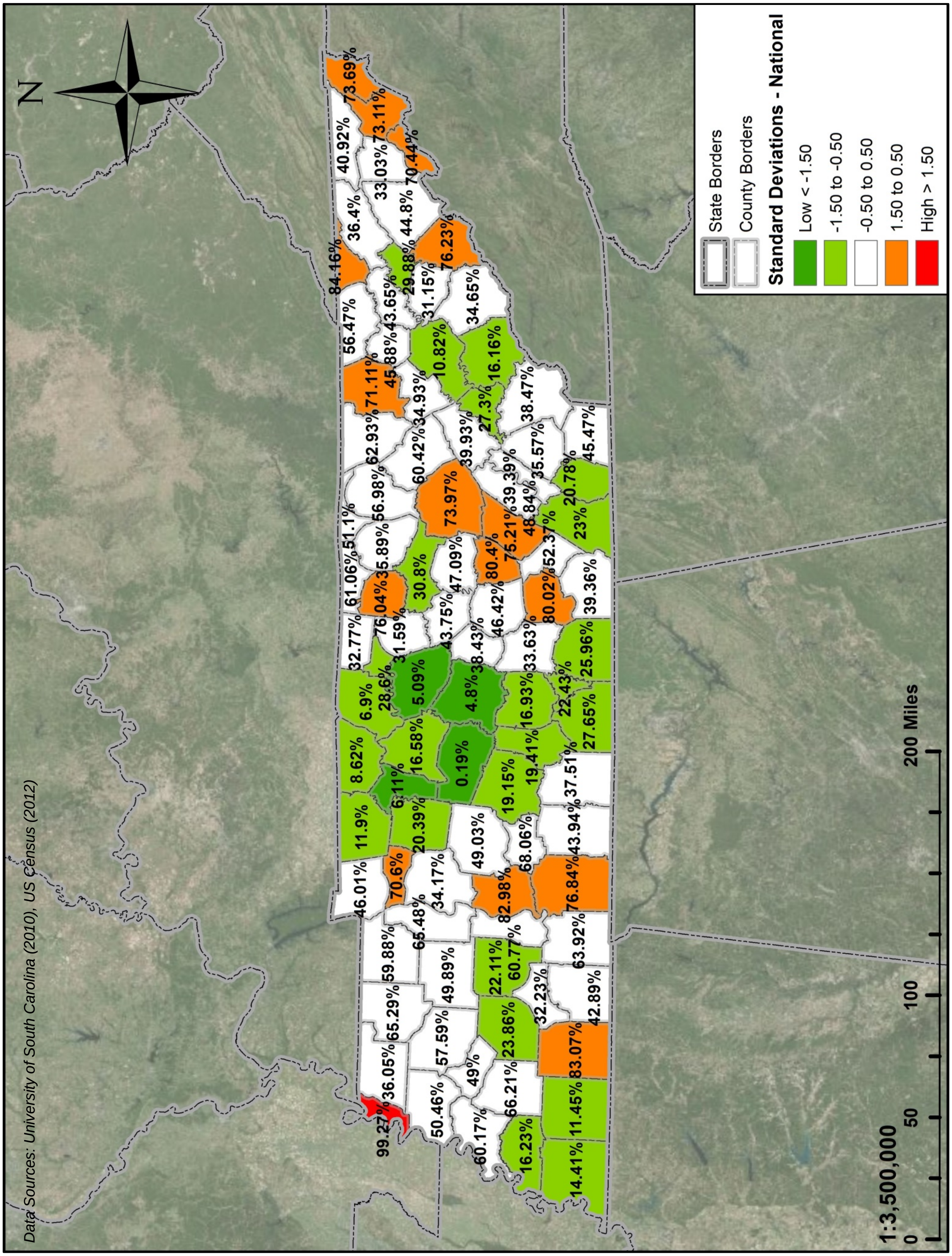
County	National Percentile	Age	Ethnicity (Hispanic)	Ethnicity (Native American)	Race & Class	Service Industry Employment	Vulnerable Populations	Wealth (- Correlation)
Anderson	34.93%	3	4	3	3	3	3	3
Bedford	16.93%	2	2	4	3	5	3	4
Benton	65.48%	2	3	3	2	3	4	4
Bledsoe	75.21%	2	3	3	3	2	5	4
Blount	16.16%	3	4	4	3	3	3	3
Bradley	20.78%	2	3	4	3	3	3	3
Campbell	71.11%	2	3	3	2	4	3	4
Cannon	38.43%	3	3	3	3	4	4	4
Carroll	49.89%	3	4	3	2	4	3	4
Carter	73.11%	3	3	3	2	3	3	4
Cheatham	6.11%	2	3	3	4	4	4	3
Chester	32.23%	3	3	3	3	4	4	4
Claiborne	56.47%	3	3	3	2	4	4	4
Clay	61.06%	2	2	4	3	4	4	4
Cocke	76.23%	2	3	3	2	3	4	4
Coffee	33.63%	3	3	3	3	4	3	3
Crockett	49.00%	3	3	4	2	4	3	4
Cumberland	73.97%	1	3	3	3	3	3	3
Davidson	16.58%	2	4	4	2	3	2	2
Decatur	60.77%	2	2	4	2	5	3	4
DeKalb	43.75%	3	2	4	2	4	3	3
Dickson	20.39%	3	3	3	3	4	4	3
Dyer	50.46%	4	4	3	2	3	3	3
Fayette	11.45%	3	4	3	3	4	4	3
Fentress	56.98%	2	3	3	3	4	4	3
Franklin	25.96%	3	3	3	3	4	3	3
Gibson	57.59%	3	4	3	2	4	2	4
Giles	37.51%	3	3	3	3	4	3	4
Grainger	43.65%	2	2	3	3	4	4	4
Greene	44.80%	2	3	3	3	4	4	4
Grundy	80.02%	2	3	3	2	3	4	4
Hamblen	29.88%	3	3	4	3	4	3	3
Hamilton	23.00%	2	4	4	3	3	2	2
Hancock	84.16%	2	3	3	2	4	4	4
Hardeman	83.07%	3	3	3	2	2	4	4
Hardin	63.92%	2	3	3	2	4	3	3
Hawkins	36.40%	3	3	3	3	4	4	3
Haywood	66.21%	3	4	3	1	4	3	4
Henderson	22.11%	3	3	3	3	4	4	4
Henry	59.88%	2	4	3	2	3	3	3
Hickman	49.03%	3	3	2	3	3	4	4

County	National Percentile	Age	Ethnicity (Hispanic)	Ethnicity (Native American)	Race & Class	Service Industry Employment	Vulnerable Populations	Wealth (-Correlation)
Houston	70.60%	2	3	3	3	4	3	4
Humphreys	34.17%	3	3	4	3	3	4	3
Jackson	76.04%	2	3	3	2	3	4	4
Jefferson	31.15%	3	3	3	3	4	4	3
Johnson	73.69%	2	3	3	3	3	4	4
Knox	10.82%	2	4	4	3	3	3	2
Lake	99.27%	3	2	2	2	1	3	3
Lauderdale	60.17%	4	3	3	2	3	3	4
Lawrence	43.94%	3	3	3	3	4	3	4
Lewis	68.06%	3	3	3	3	3	3	4
Lincoln	27.65%	3	3	3	3	4	3	3
Loudon	27.30%	2	3	4	3	4	3	3
Macon	32.77%	3	2	4	2	5	3	4
Madison	23.86%	4	4	4	2	4	3	3
Marion	39.36%	2	3	3	3	4	4	3
Marshall	19.41%	2	3	4	3	4	3	4
Maury	19.15%	2	4	4	3	3	3	3
McMinn	35.57%	3	3	3	3	4	3	3
McNairy	42.89%	3	3	3	3	4	3	4
Meigs	48.84%	2	3	2	3	4	5	4
Monroe	38.47%	3	3	4	3	4	4	4
Montgomery	11.90%	5	4	3	3	2	3	3
Moore	22.43%	2	3	3	3	4	3	3
Morgan	60.42%	3	2	3	3	3	5	4
Obion	36.05%	3	3	4	2	4	3	3
Overton	35.89%	2	3	3	3	4	4	4
Perry	82.98%	2	3	3	3	2	4	4
Pickett	51.10%	2	2	3	3	5	3	3
Polk	45.47%	2	2	3	3	4	4	4
Putnam	30.80%	2	3	4	3	3	3	3
Rhea	39.39%	3	3	3	3	4	3	4
Roane	39.93%	2	3	3	3	3	4	3
Robertson	8.62%	2	3	4	3	4	4	3
Rutherford	4.80%	5	4	4	3	3	4	3
Scott	62.93%	3	3	3	2	4	4	4
Sequatchie	52.37%	3	3	3	3	4	4	4
Sevier	34.65%	3	3	3	3	2	4	3
Shelby	14.41%	4	4	4	1	3	3	2
Smith	31.59%	3	3	3	3	3	4	4
Stewart	46.01%	2	3	3	3	3	4	3
Sullivan	40.92%	2	4	3	3	3	3	3
Sumner	6.90%	2	4	3	4	4	3	3
Tipton	16.23%	4	4	3	3	3	4	4
Trousdale	28.60%	3	3	3	3	4	4	4
Unicoi	70.44%	2	4	3	3	3	4	3
Union	45.88%	2	3	3	3	4	4	4

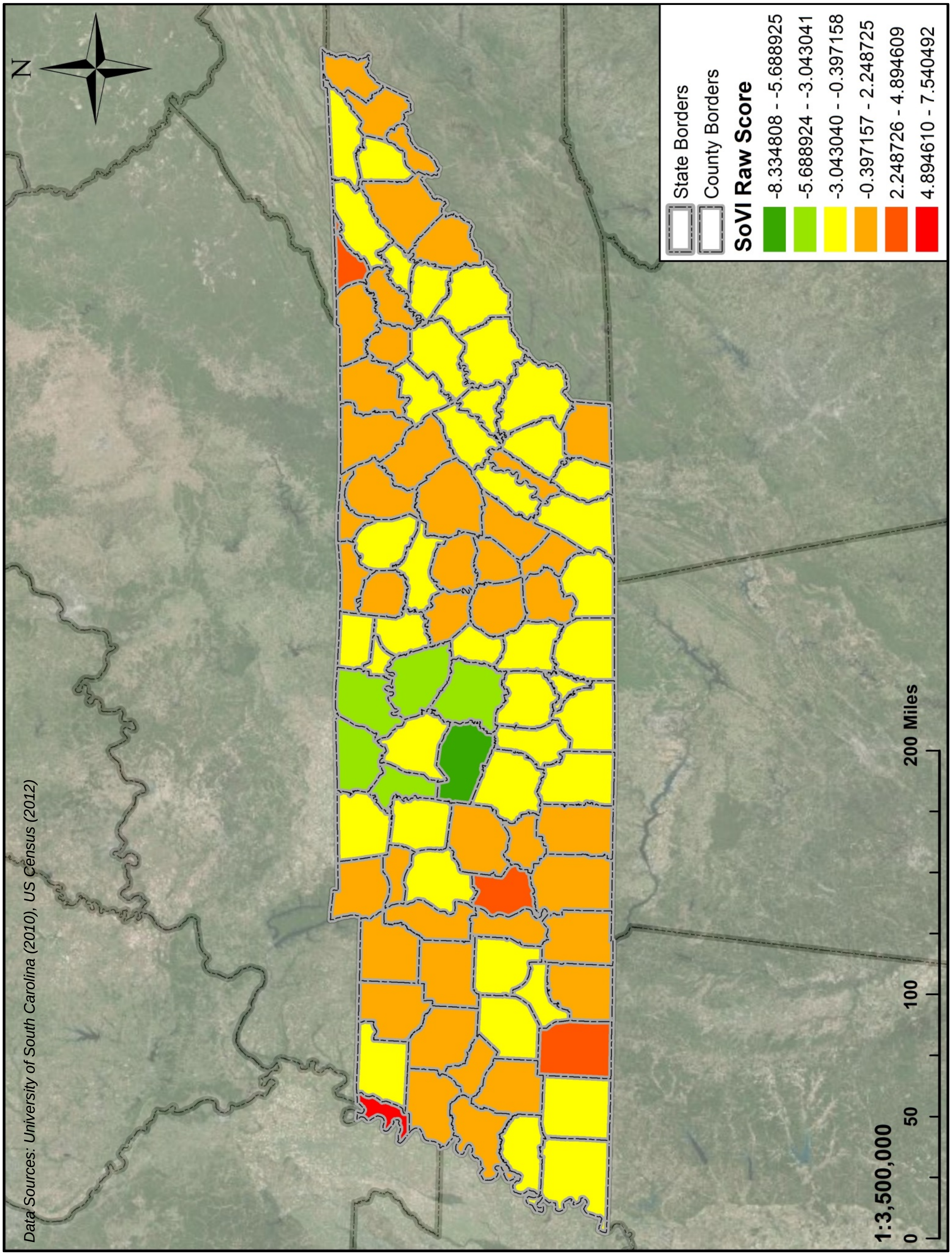
County	National Percentile	Age	Ethnicity (Hispanic)	Ethnicity (Native American)	Race & Class	Service Industry Employment	Vulnerable Populations	Wealth (-Correlation)
Van Buren	80.40%	2	3	3	3	3	4	4
Warren	46.42%	2	2	4	3	4	3	4
Washington	33.03%	3	4	3	3	3	3	3
Wayne	76.84%	2	2	3	3	2	4	4
Weakley	65.29%	3	4	3	3	3	3	4
White	47.09%	3	3	3	3	4	3	4
Williamson	0.19%	3	4	3	5	5	5	1
Wilson	5.09%	2	4	3	4	4	4	3

**The data are from the University of South Carolina, Department of Geography, Hazards & Vulnerability Research Institute.*

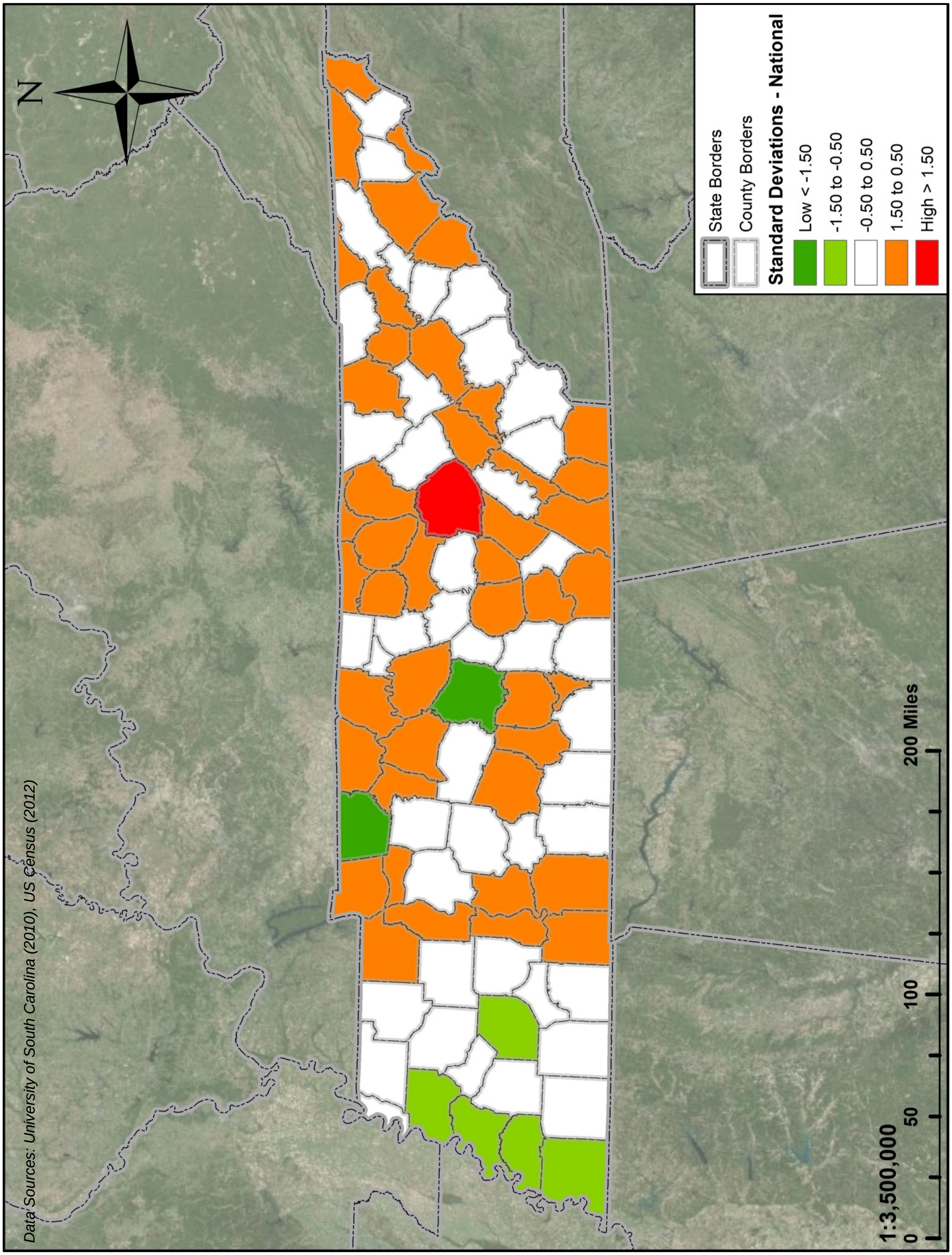
Map 89 – Social Vulnerability, Composite National Rank



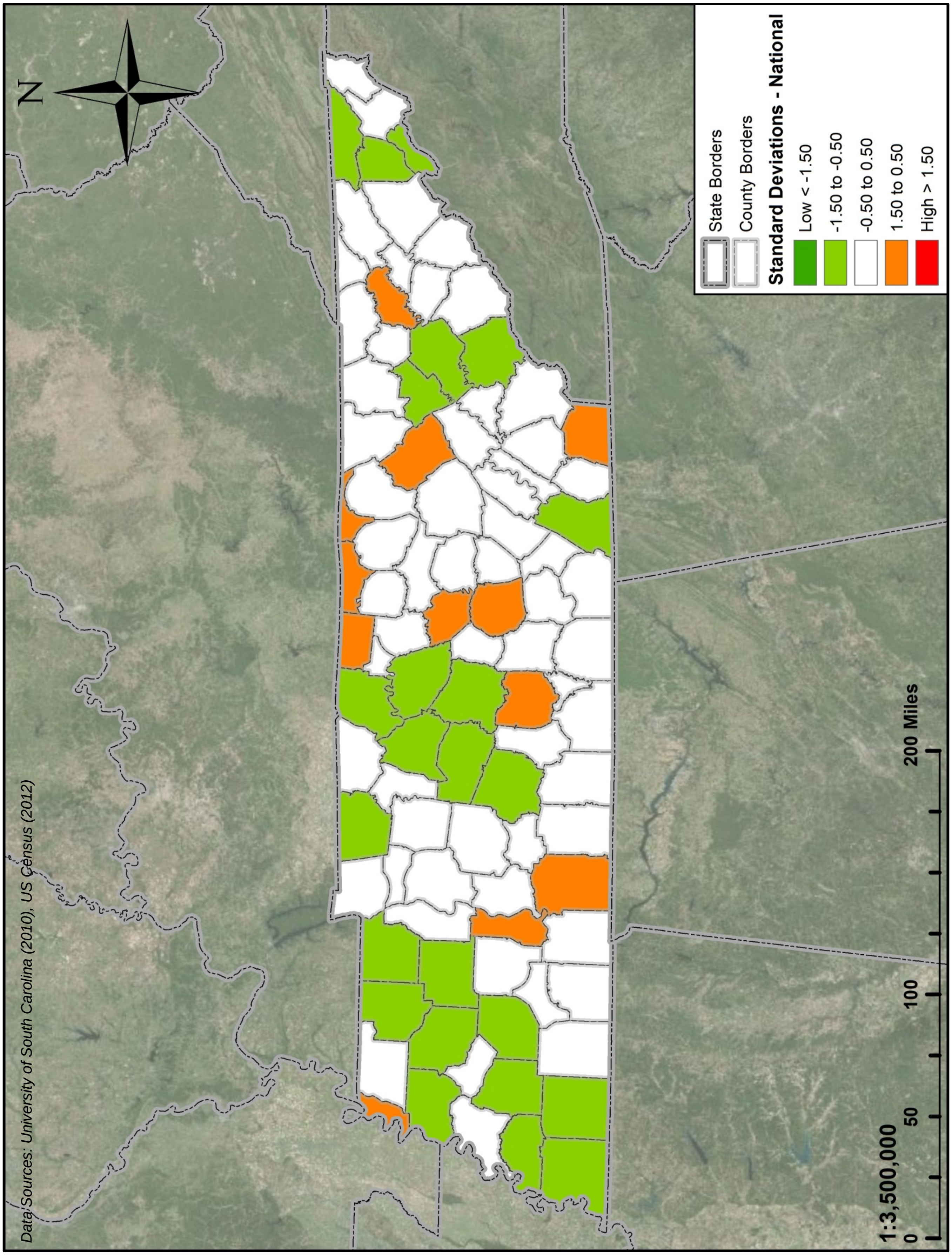
Map 90 – Social Vulnerability, Composite Raw Scores



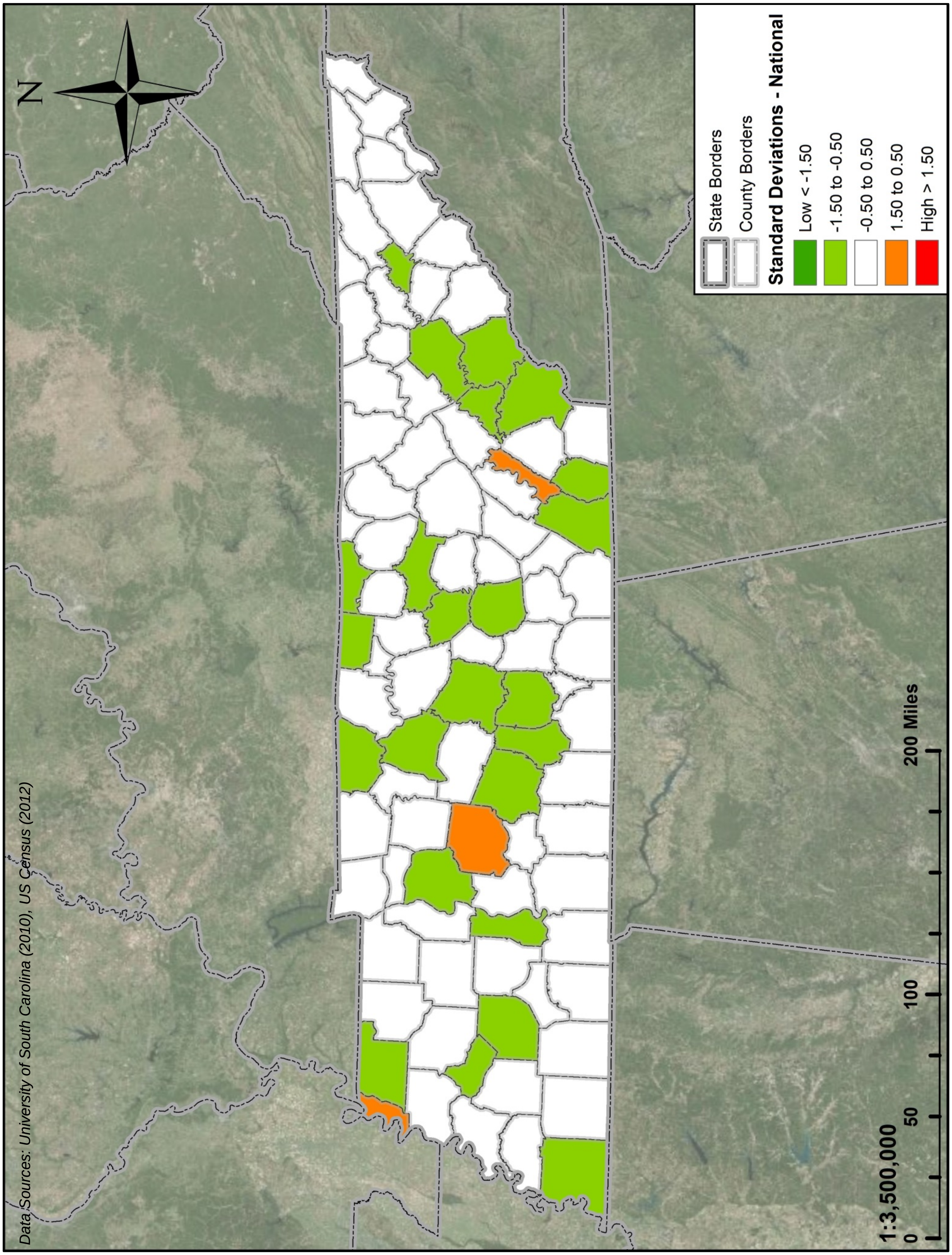
Map 91 – Social Vulnerability, Age National Rank

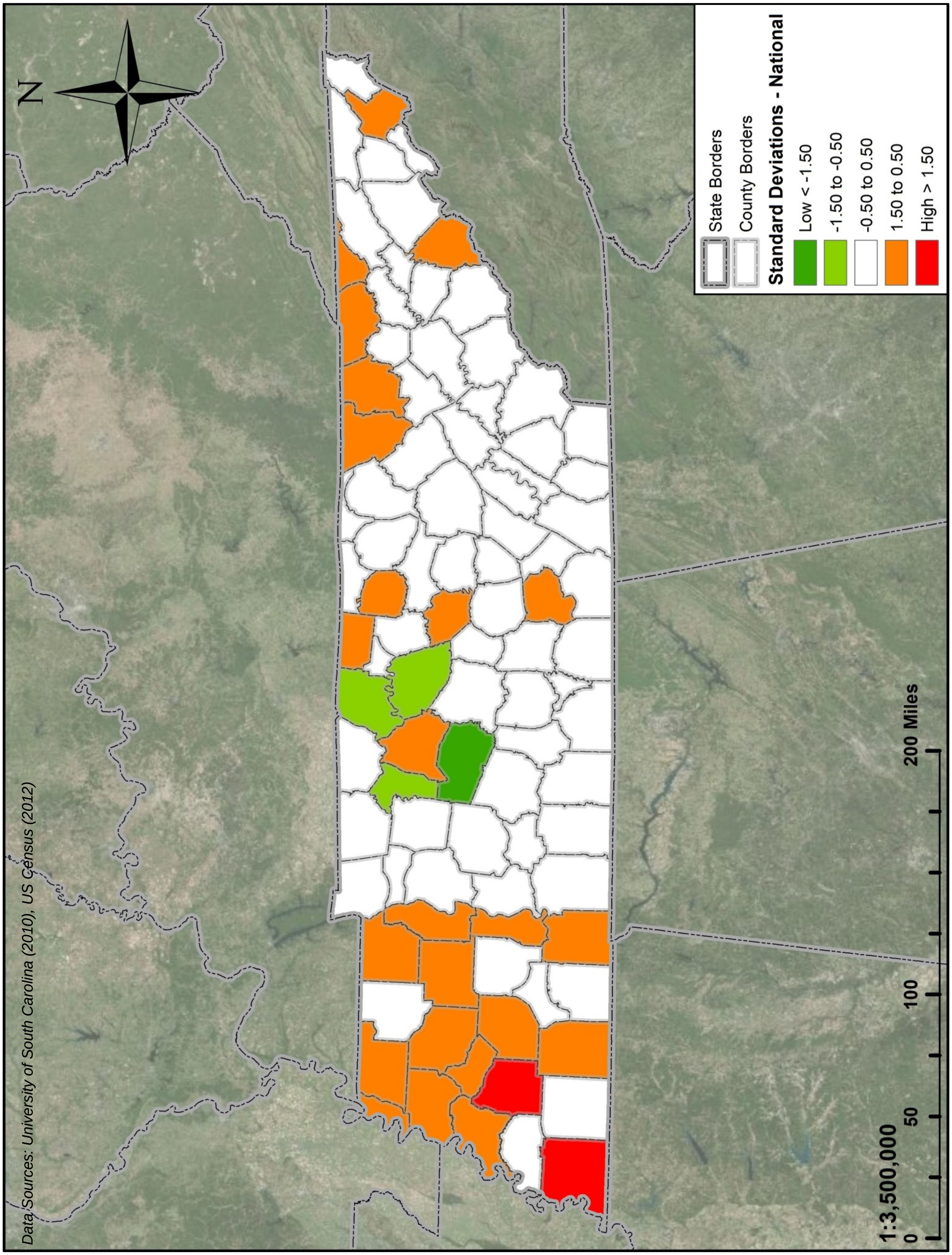


Map 92 – Social Vulnerability, Ethnicity (Hispanic) National Rank



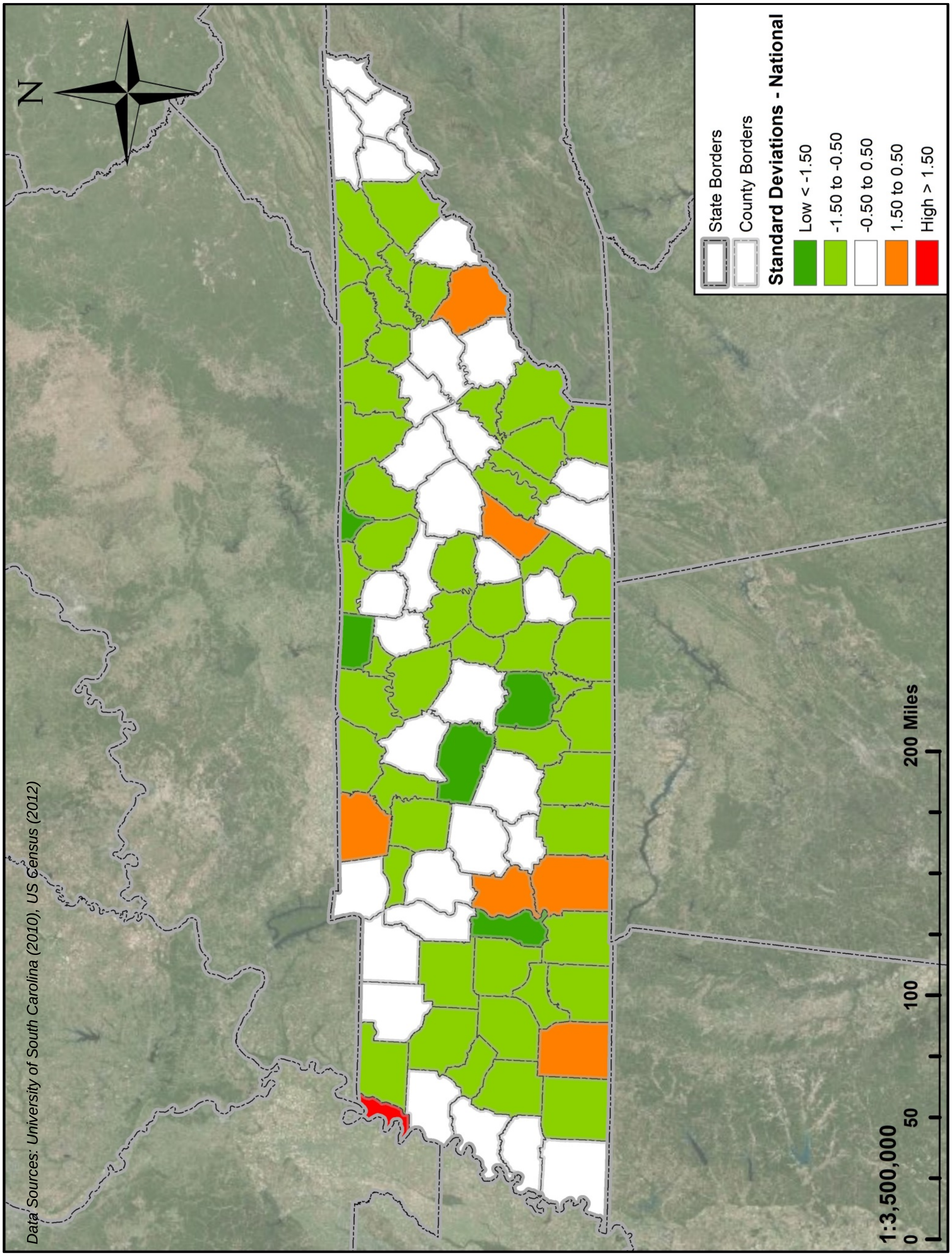
Map 93 – Social Vulnerability, Ethnicity (Native American) National Rank



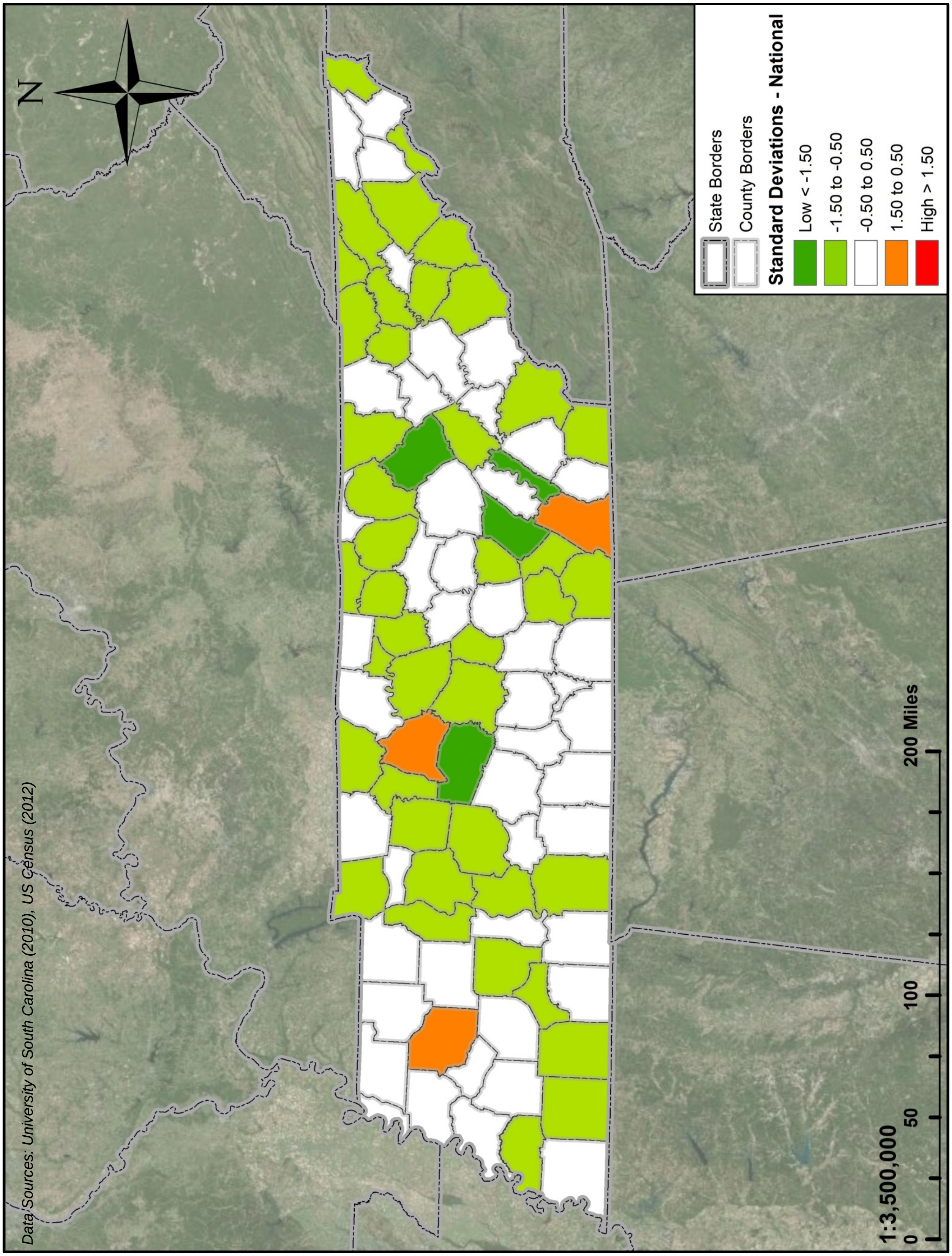


Map 94 – Social Vulnerability, Race & Class National Rank

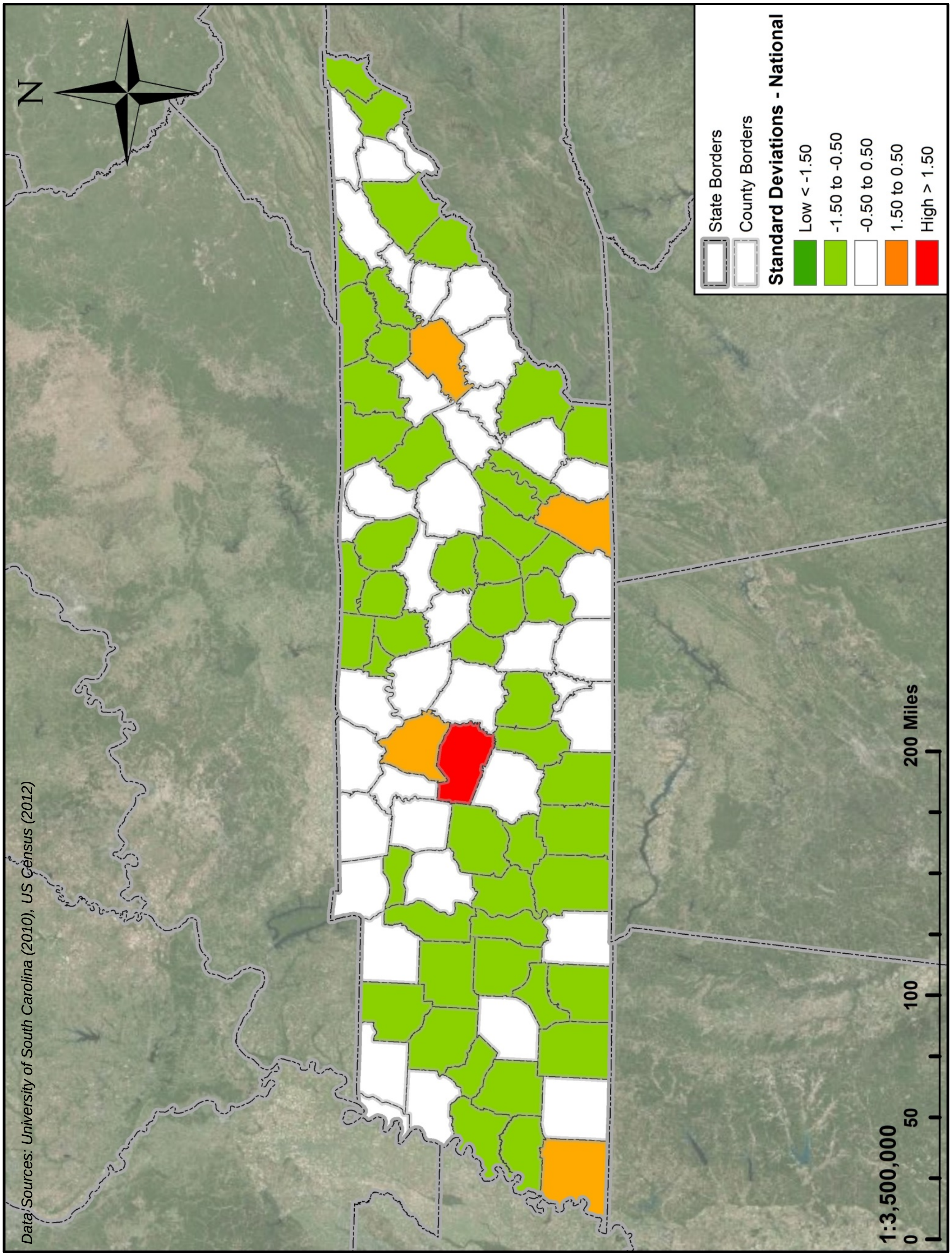
Map 95 – Social Vulnerability, Service Industry Employment National Rank



Map 96 – Social Vulnerability, Vulnerable Populations National Rank



Map 97 – Social Vulnerability, Wealth National Rank



4.2.2 – State Threat Assessment by GIS Analysis

Table 63 – Hazard Threat Index Part 1, Tennessee								
County	**SoVI©**	**Droughts**	**Earthquakes**	**Extreme Temperatures**	**Flash Floods**	**Riverine Floods**	**Expansive Soils**	**Landslides**
Anderson	7.51	1	1	2	4	1	4	4
Bedford	6.01	5	1	2	4	1	5	1
Benton	9.13	3	4	2	4	1	2	1
Bledsoe	9.84	2	1	1	4	1	2	2
Blount	5.93	1	2	2	3	1	3	4
Bradley	6.43	2	2	1	4	1	4	2
Campbell	9.53	1	1	1	4	1	4	6
Cannon	7.71	3	1	1	5	1	4	2
Carroll	8.30	3	4	3	3	2	1	1
Carter	9.70	1	1	1	3	1	2	5
Cheatham	4.28	2	1	1	4	2	3	1
Chester	7.35	3	4	6	3	1	2	1
Claiborne	8.62	1	1	1	3	1	3	4
Clay	8.86	1	1	1	4	1	3	3
Cocke	9.93	1	2	1	3	1	3	5
Coffee	7.44	6	1	2	4	1	4	1
Crockett	8.25	4	5	6	4	3	1	1
Cumberland	9.75	2	1	1	4	1	1	4
Davidson	5.98	2	1	1	6	2	3	1
Decatur	8.84	3	3	5	4	2	3	1
DeKalb	8.01	2	1	1	4	1	3	2
Dickson	6.37	2	2	1	4	1	4	1
Dyer	8.33	3	6	3	3	6	2	3
Fayette	5.41	2	4	3	4	2	1	1
Fentress	8.65	1	1	1	4	1	1	4
Franklin	6.93	5	1	2	4	1	3	2
Gibson	8.68	3	5	4	4	2	1	1
Giles	7.66	3	1	2	4	2	3	1
Grainger	8.00	1	2	1	3	1	4	4
Greene	8.06	1	1	1	3	1	4	3
Grundy	10.28	4	1	1	3	1	2	3
Hamblen	7.21	1	2	1	3	1	6	3
Hamilton	6.66	2	2	2	4	1	4	3
Hancock	10.78	1	1	1	3	1	4	4
Hardeman	10.63	2	4	3	3	2	2	1
Hardin	9.03	2	2	3	3	3	3	1
Hawkins	7.60	1	1	1	3	1	4	3
Haywood	9.18	3	4	6	3	4	2	1
Henderson	6.59	3	4	5	4	1	2	1
Henry	8.80	3	4	2	3	2	1	1
Hickman	8.25	2	2	2	3	1	3	1
Houston	9.49	2	3	1	4	1	4	1

County	SoVI©	Droughts	Earthquakes	Extreme Temperatures	Flash Floods	Riverine Floods	Expansive Soils	Landslides
Humphreys	7.46	2	3	1	4	2	1	1
Jackson	9.91	2	1	1	4	1	2	2
Jefferson	7.29	1	2	1	3	1	6	2
Johnson	9.73	1	1	1	3	1	2	6
Knox	5.31	1	2	2	4	1	4	2
Lake	15.88	3	6	2	3	5	5	4
Lauderdale	8.82	3	6	5	3	6	2	4
Lawrence	8.01	2	1	1	6	1	2	1
Lewis	9.30	2	1	2	3	1	1	1
Lincoln	7.06	5	1	2	5	1	6	1
Loudon	7.02	1	2	1	4	1	5	2
Macon	7.39	1	1	1	4	1	2	1
Madison	6.74	3	4	6	4	2	1	1
Marion	7.76	2	1	1	3	1	1	3
Marshall	6.28	3	1	2	4	1	6	1
Maury	6.25	2	1	2	4	1	2	1
McMinn	7.55	2	2	1	4	1	4	2
McNairy	7.98	2	2	3	3	2	2	1
Meigs	8.25	2	2	1	4	1	5	2
Monroe	7.71	2	2	1	3	1	4	4
Montgomery	5.48	2	2	1	4	1	5	1
Moore	6.61	6	1	3	5	1	5	1
Morgan	8.83	1	1	1	4	1	2	5
Obion	7.57	3	6	2	3	3	1	4
Overton	7.56	1	1	1	3	1	4	2
Perry	10.62	2	2	3	3	2	4	1
Pickett	8.36	1	1	1	3	1	2	3
Polk	8.09	2	2	1	3	1	2	4
Putnam	7.27	2	1	1	4	1	4	2
Rhea	7.76	2	1	1	4	1	2	3
Roane	7.78	1	2	1	4	1	4	3
Robertson	4.86	2	1	1	3	1	4	1
Rutherford	3.83	2	1	2	4	2	6	1
Scott	8.97	1	1	1	3	1	1	6
Sequatchie	8.43	2	1	1	3	1	2	3
Sevier	7.50	1	2	1	3	1	3	5
Shelby	5.75	3	4	5	6	3	1	3
Smith	7.32	2	1	1	4	1	6	1
Stewart	8.11	2	4	1	4	1	2	1
Sullivan	7.86	1	1	1	4	1	2	3
Sumner	4.49	1	1	1	4	1	3	1
Tipton	5.94	3	5	6	4	4	2	3
Trousdale	7.10	1	1	2	5	2	6	1
Unicoi	9.48	1	1	1	3	1	1	6
Union	8.11	1	2	2	3	1	4	4

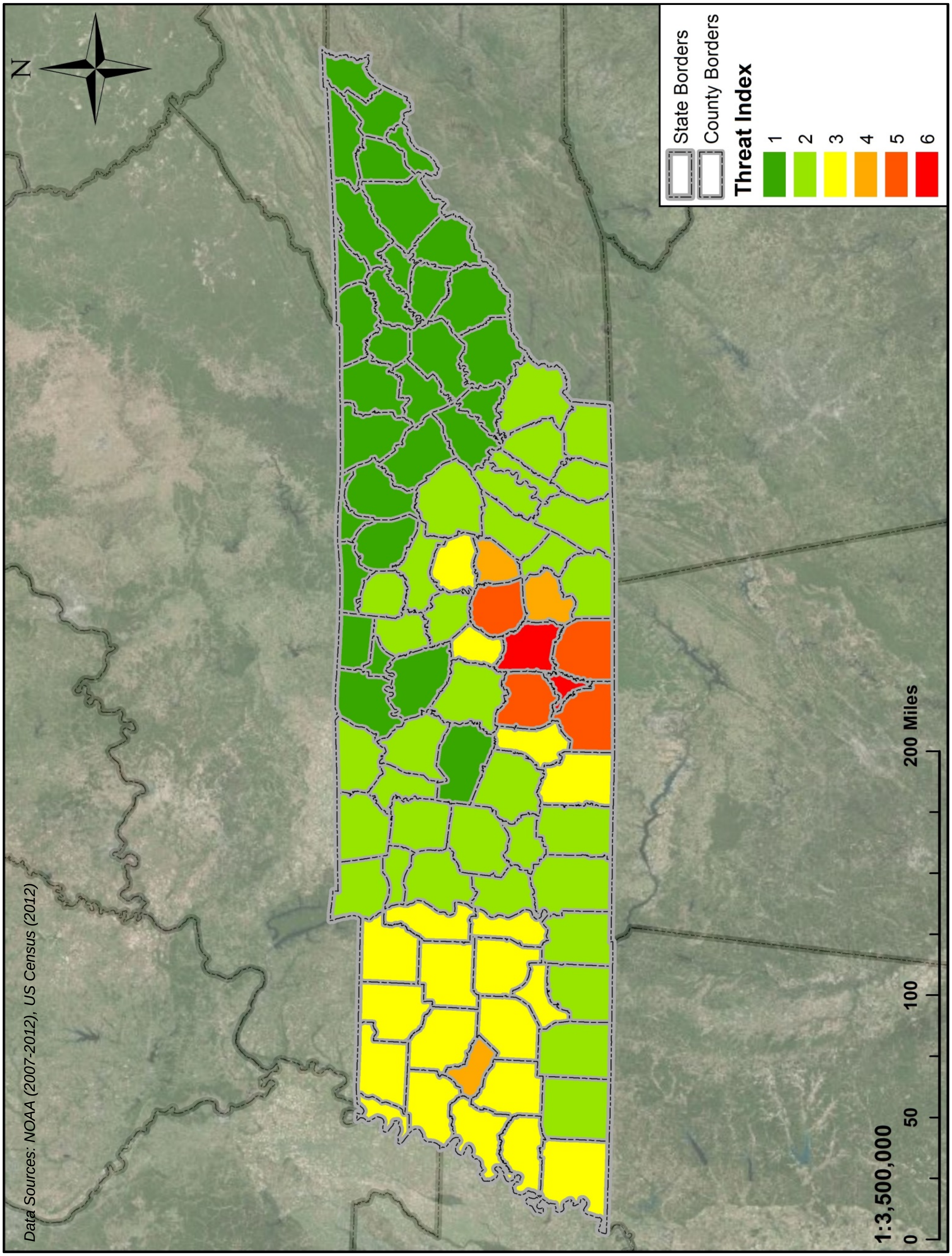
County	SoVI©	Droughts	Earthquakes	Extreme Temperatures	Flash Floods	Riverine Floods	Expansive Soils	Landslides
Van Buren	10.34	4	1	1	4	1	2	4
Warren	8.14	5	1	1	4	1	3	1
Washington	7.41	1	1	2	4	1	3	3
Wayne	9.99	2	1	2	4	1	2	1
Weakley	9.12	3	5	2	3	2	1	1
White	8.16	3	1	1	4	1	3	2
Williamson	0.00	1	1	2	4	1	3	1
Wilson	4.01	1	1	2	5	1	6	1

Table 64 – Hazard Threat Index Part 2, Tennessee

County	Land Subsidence	High & Strong Wind	Lightning	Hail	Winter Storms	Thunderstorm Winds	Tornadoes	Wildfires
Anderson	2	4	2	4	5	5	3	6
Bedford	1	5	4	4	5	4	4	3
Benton	1	4	3	2	5	3	4	5
Bledsoe	4	4	3	4	6	4	3	5
Blount	3	5	2	4	4	5	3	5
Bradley	1	6	4	5	5	5	5	6
Campbell	2	3	2	2	5	4	3	5
Cannon	2	4	3	2	6	3	4	5
Carroll	1	5	4	2	5	3	4	4
Carter	1	6	3	4	6	3	3	5
Cheatham	1	4	3	4	5	4	4	6
Chester	1	4	3	4	5	3	4	5
Claiborne	4	3	3	2	5	4	3	6
Clay	4	3	4	2	5	3	3	5
Cocke	1	5	3	2	5	4	3	5
Coffee	3	4	4	4	6	3	4	4
Crockett	1	5	4	2	6	3	6	2
Cumberland	4	4	5	4	6	3	4	5
Davidson	1	4	5	6	5	6	6	5
Decatur	1	4	2	2	4	3	3	5
DeKalb	2	4	4	2	6	3	4	5
Dickson	1	4	2	4	5	4	4	6
Dyer	1	4	3	2	5	3	6	3
Fayette	1	4	3	4	4	3	4	4
Fentress	3	3	5	2	5	3	5	5
Franklin	3	4	4	2	4	3	4	4
Gibson	1	5	3	4	5	3	5	3
Giles	1	4	3	4	4	4	5	4
Grainger	4	4	3	4	6	5	3	6
Greene	1	6	3	2	5	4	3	4
Grundy	4	4	2	2	5	3	4	5
Hamblen	2	5	3	4	6	5	3	4

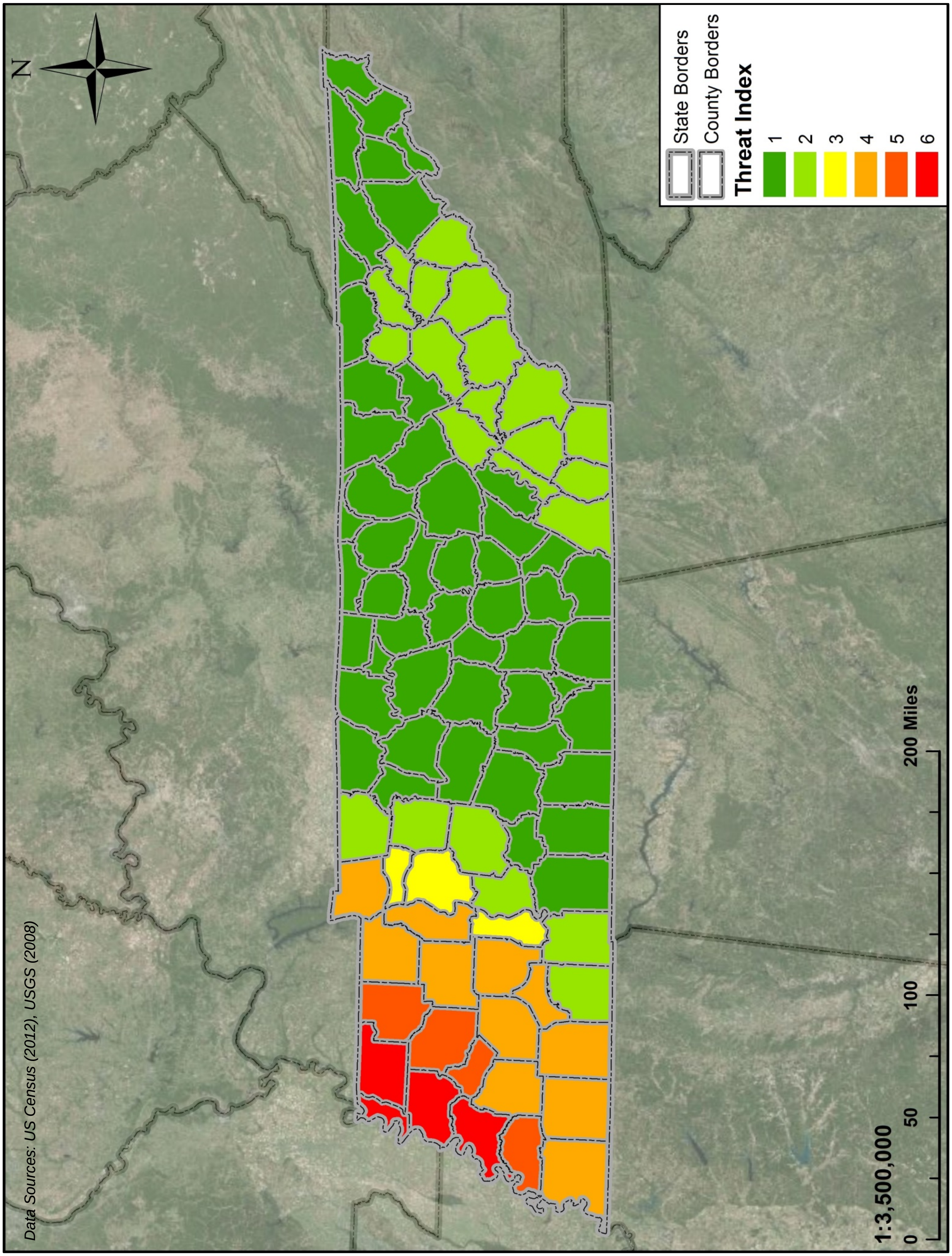
County	Land Subsidence	High & Strong Wind	Lightning	Hail	Winter Storms	Thunderstorm Winds	Tornadoes	Wildfire
Hamilton	1	4	3	5	5	5	5	6
Hancock	2	3	2	2	5	4	3	5
Hardeman	1	4	3	4	4	3	4	4
Hardin	1	3	2	2	3	3	4	4
Hawkins	1	4	2	2	5	4	3	6
Haywood	1	4	3	2	5	3	5	3
Henderson	1	4	3	4	4	3	4	5
Henry	1	4	5	2	4	3	4	4
Hickman	1	4	2	2	5	3	3	5
Houston	1	4	3	2	5	3	4	5
Humphreys	1	4	2	2	5	3	3	5
Jackson	3	4	4	2	6	4	4	5
Jefferson	2	6	3	4	5	5	3	5
Johnson	1	4	2	2	5	3	3	6
Knox	2	5	2	5	5	6	3	6
Lake	1	3	2	2	4	3	3	2
Lauderdale	1	4	3	2	4	3	4	3
Lawrence	1	3	3	4	4	4	5	4
Lewis	1	4	2	2	5	3	4	5
Lincoln	1	4	4	4	4	4	5	3
Loudon	1	5	2	4	5	5	4	4
Macon	1	3	5	2	5	4	4	6
Madison	1	5	5	5	5	4	5	4
Marion	3	3	3	4	4	4	4	5
Marshall	1	5	3	4	5	3	4	4
Maury	1	4	5	4	5	4	4	4
McMinn	1	6	2	5	5	5	4	5
McNairy	1	3	2	4	4	3	5	5
Meigs	2	6	2	4	5	5	4	5
Monroe	2	5	2	2	4	4	4	5
Montgomery	1	3	5	2	4	4	5	5
Moore	2	4	4	4	5	4	5	5
Morgan	2	3	3	4	5	4	3	5
Obion	1	3	3	2	4	3	4	3
Overton	6	4	5	4	6	3	4	5
Perry	1	4	2	2	5	3	3	4
Pickett	3	3	4	2	5	3	5	4
Polk	1	5	2	2	4	3	4	4
Putnam	5	4	4	4	6	4	4	5
Rhea	3	5	3	4	6	4	3	5
Roane	2	4	2	4	5	5	3	6
Robertson	1	3	3	4	4	4	5	4
Rutherford	1	5	5	5	5	4	5	4
Scott	1	3	2	2	5	3	3	5
Sequatchie	4	4	3	4	5	4	4	5
Sevier	2	5	2	2	4	4	3	6

County	Land Subsidence	High & Strong Wind	Lightning	Hail	Winter Storms	Thunderstorm Winds	Tornadoes	Wildfire
Shelby	1	4	6	6	3	5	6	3
Smith	1	4	3	2	6	3	4	5
Stewart	1	3	3	2	4	3	4	4
Sullivan	1	5	3	4	5	5	3	5
Sumner	1	4	4	4	5	5	6	5
Tipton	1	4	3	4	4	3	5	3
Trousdale	1	4	4	2	6	4	4	5
Unicoi	1	6	3	2	6	3	3	5
Union	4	4	3	2	5	4	3	6
Van Buren	6	4	3	2	6	3	3	4
Warren	4	4	3	2	6	3	4	3
Washington	1	6	3	4	6	4	3	4
Wayne	1	3	3	2	4	3	4	4
Weakley	1	4	3	2	4	3	5	3
White	6	4	3	4	6	3	4	4
Williamson	1	4	6	4	5	4	5	5
Wilson	1	4	6	4	6	4	5	4

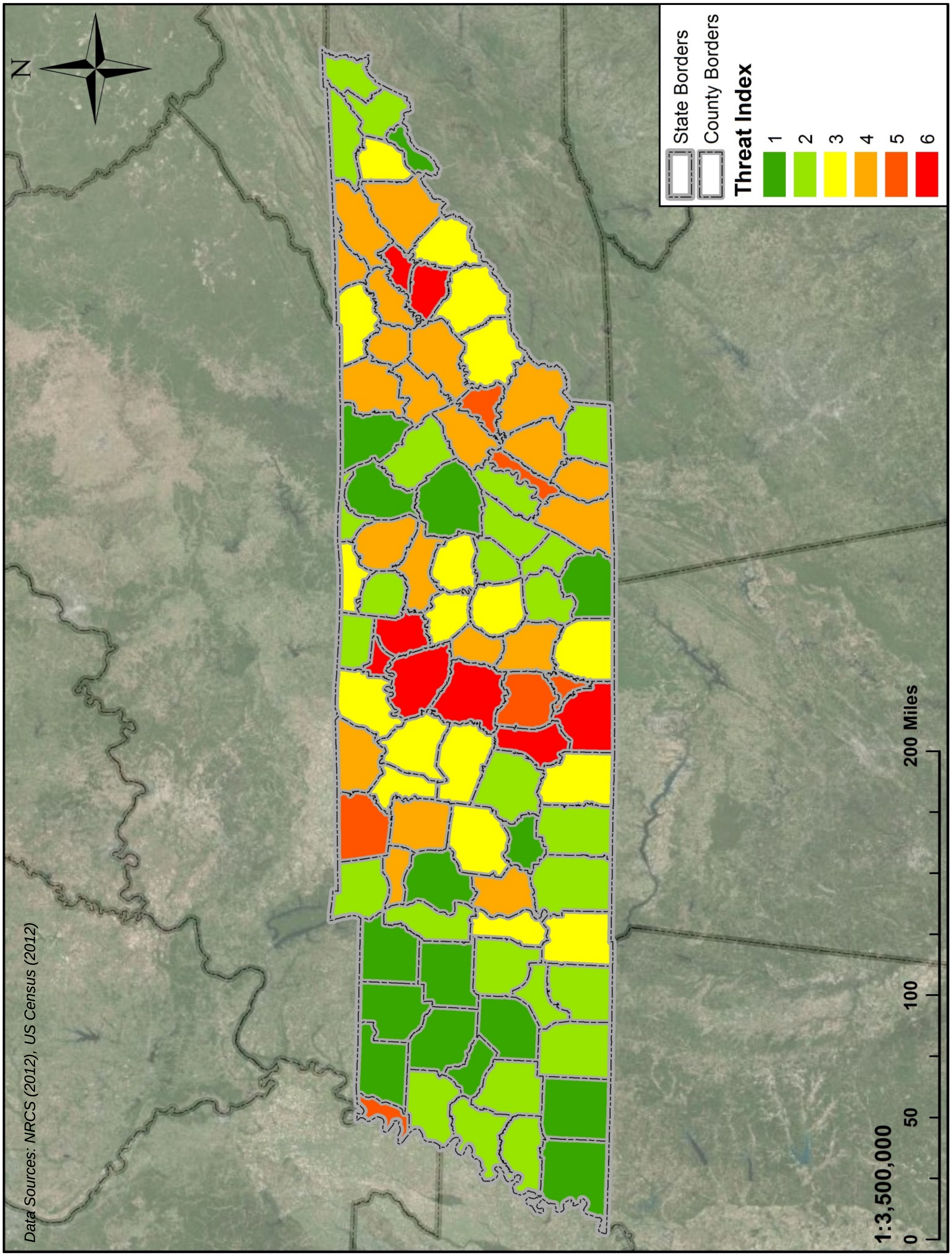


Map 98 – Hazard Threat Index, Droughts

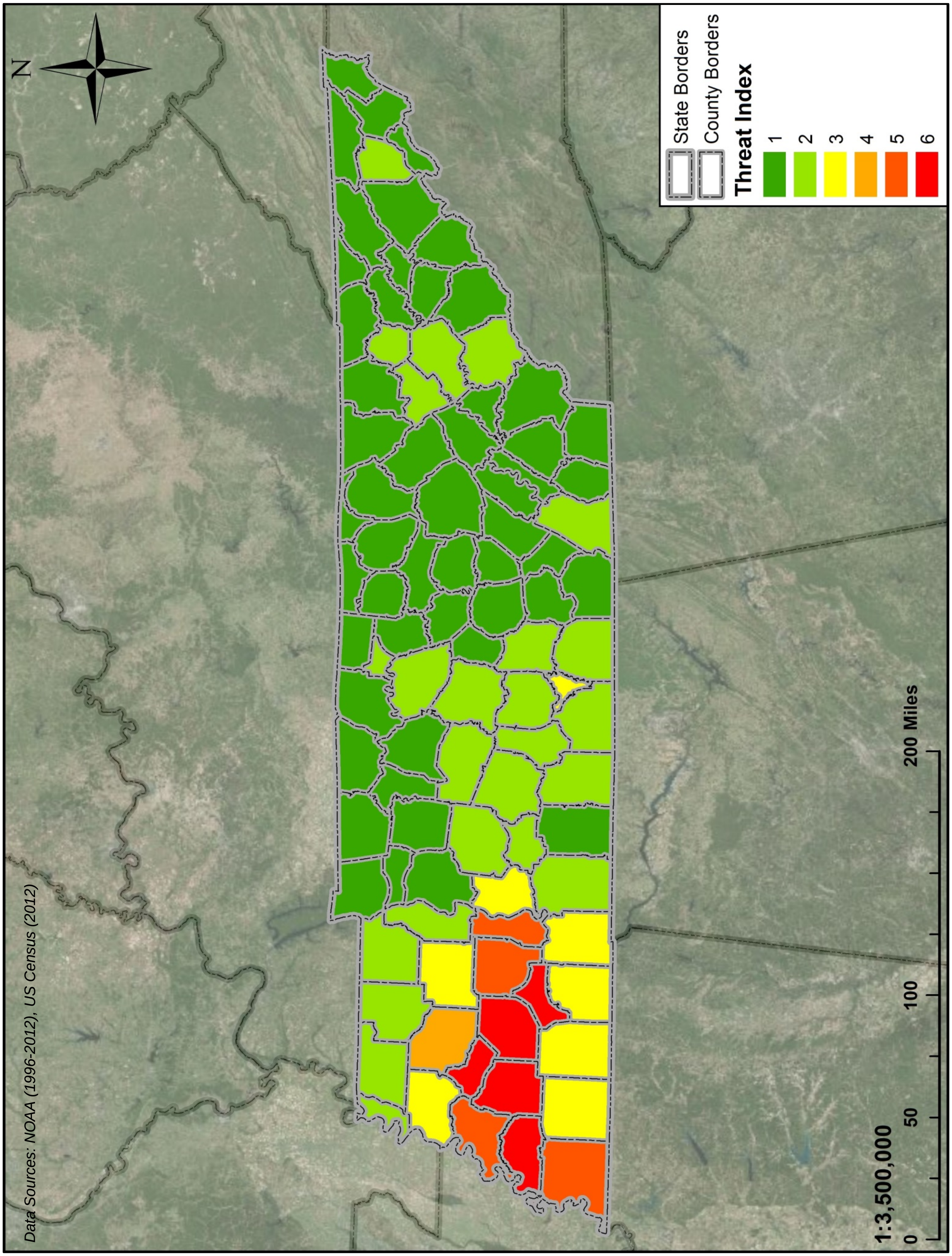
Map 99 – Hazard Threat Index, Earthquakes



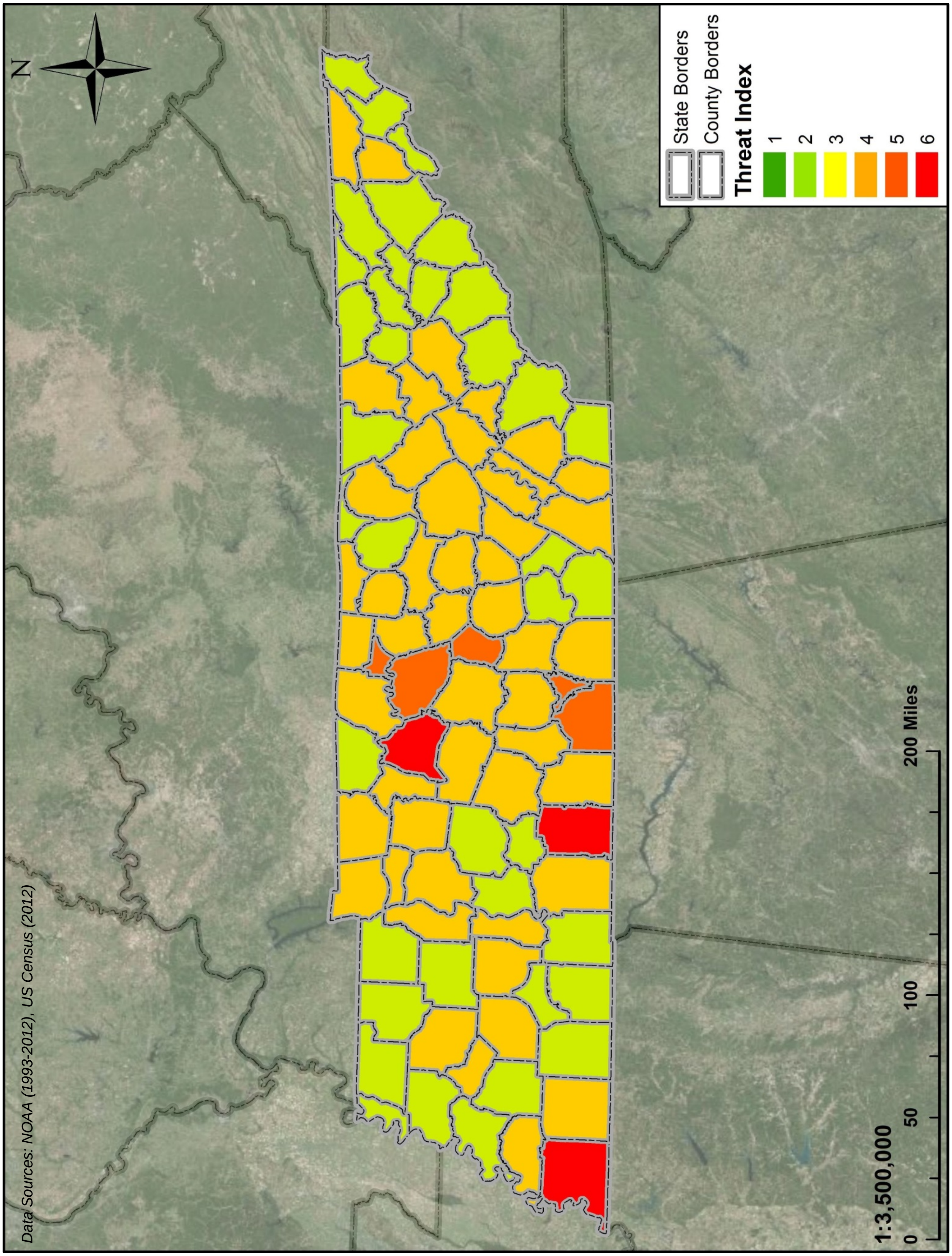
Map 100 – Hazard Threat Index, Expansive Soils



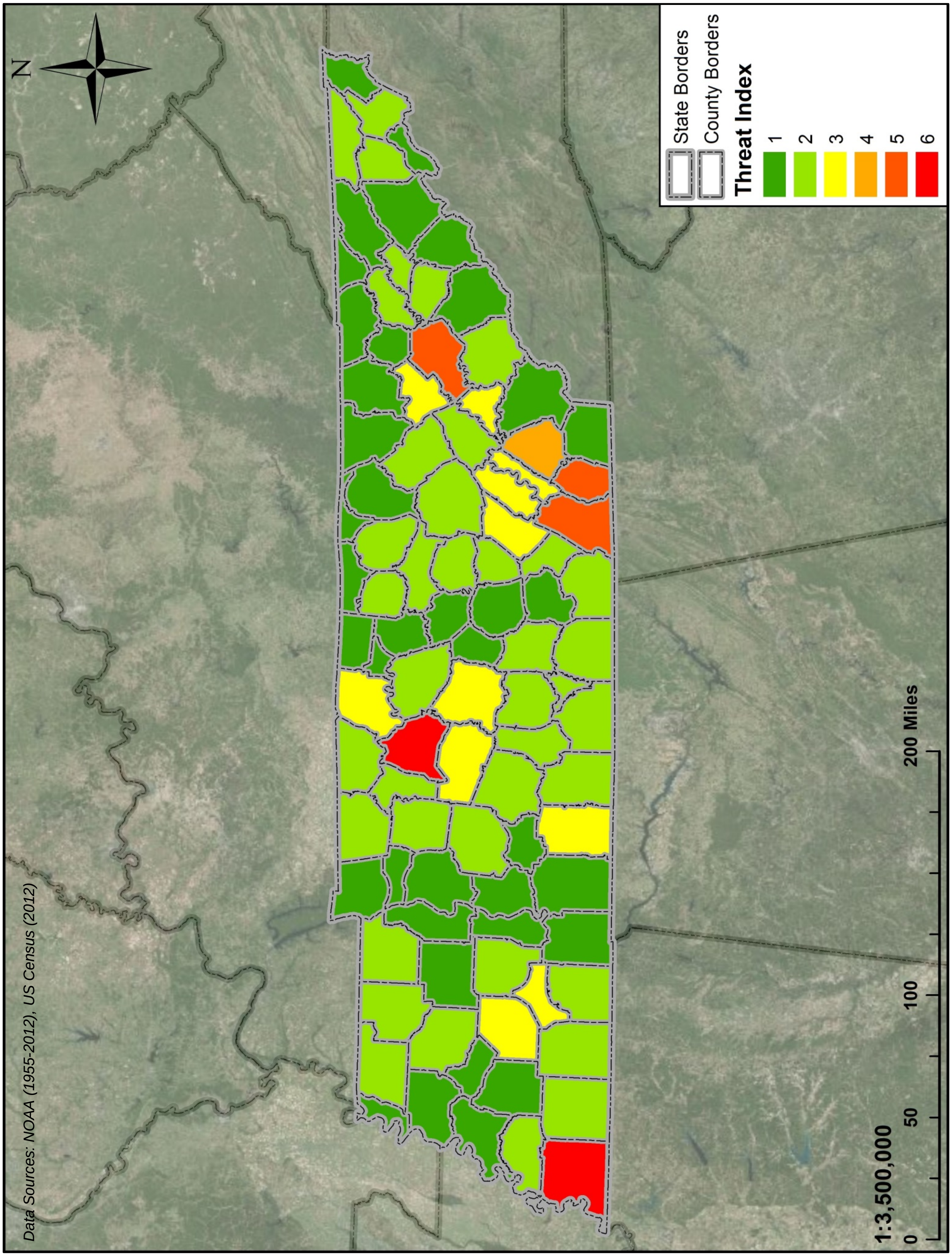
Map 101 – Hazard Threat Index, Extreme Temperatures



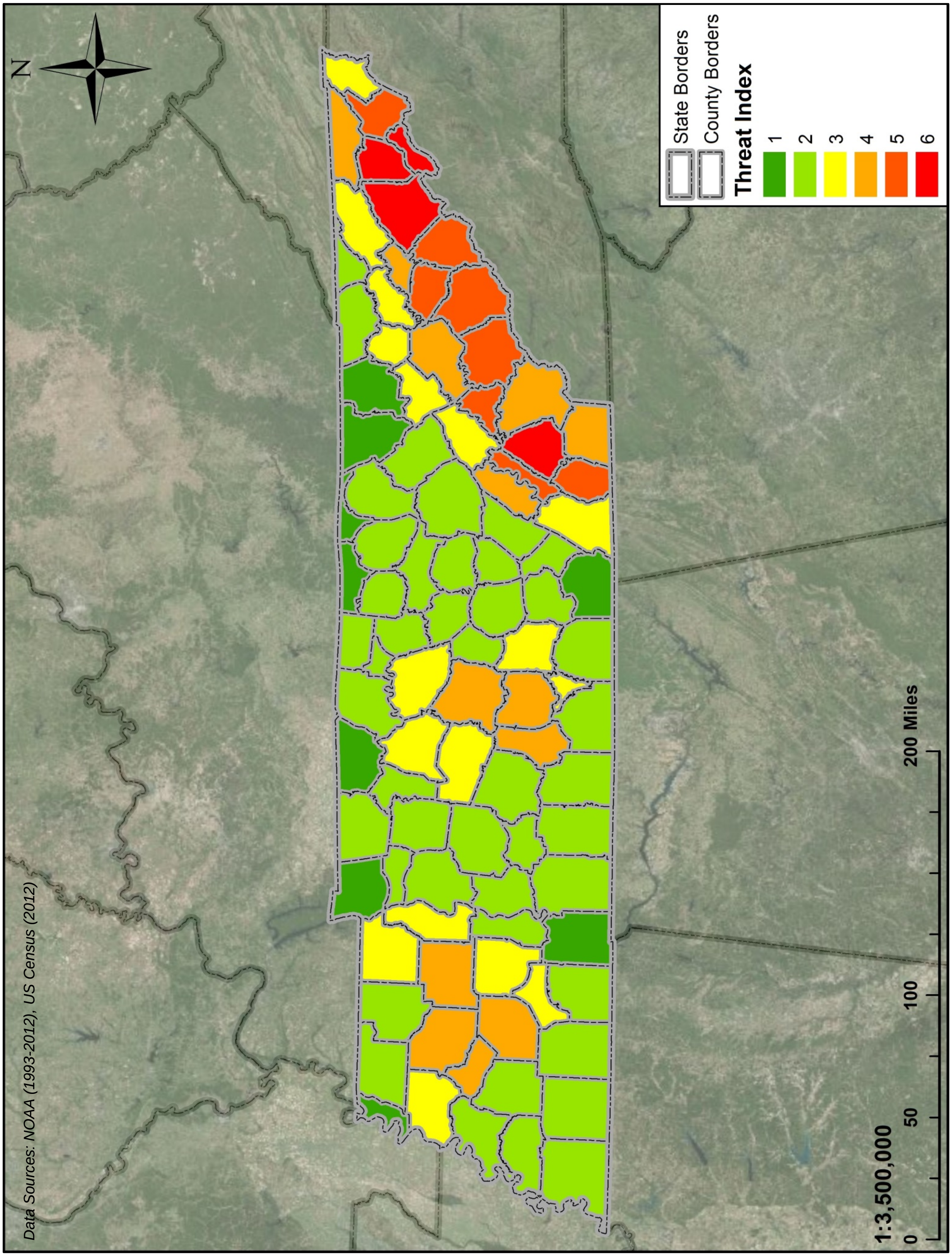
Map 102 – Hazard Threat Index, Flash Floods

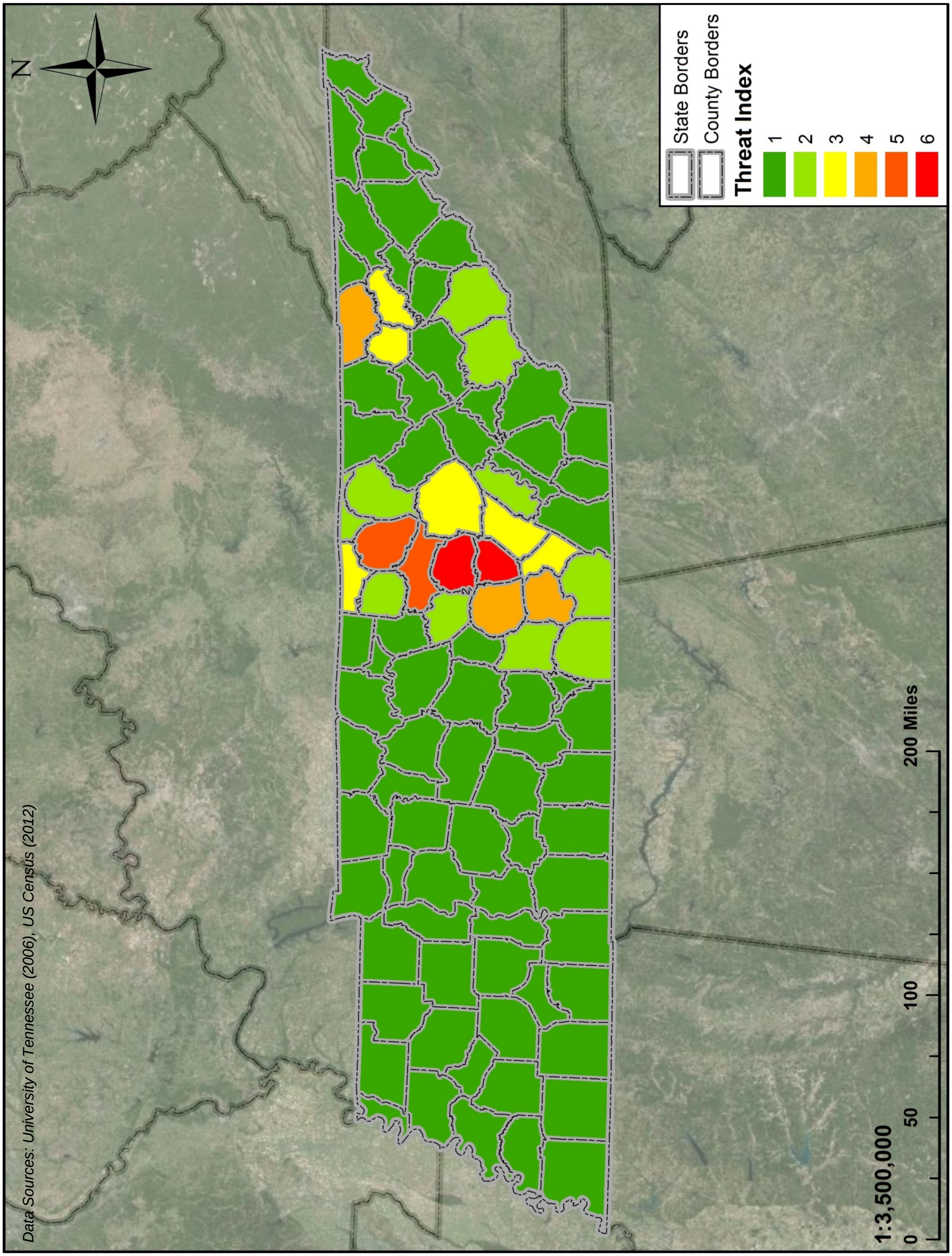


Map 103 – Hazard Threat Index, Hail



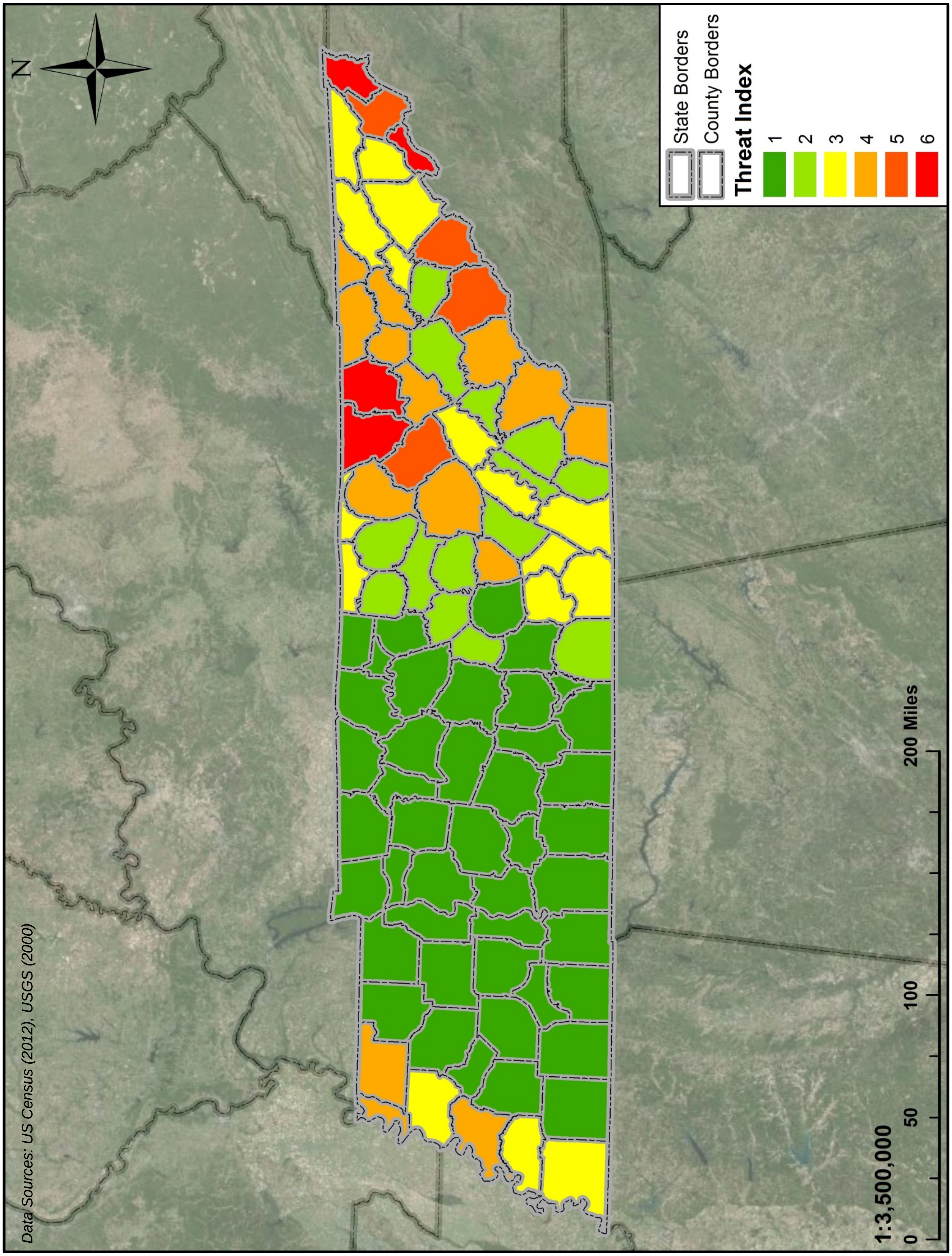
Map 104 – Hazard Threat Index, High & Strong Winds



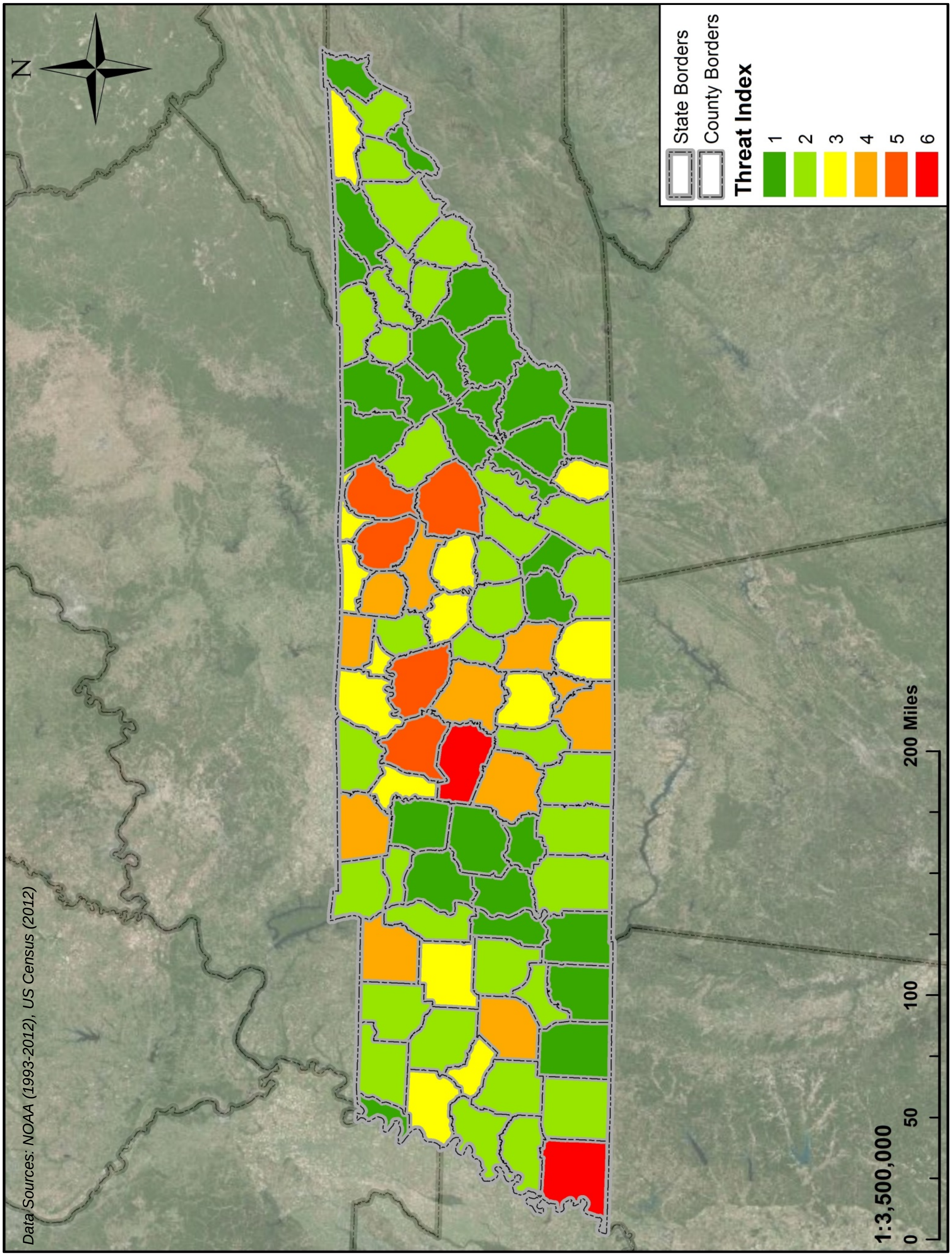


Map 105 – Hazard Threat Index, Land Subsidence/Sinkholes

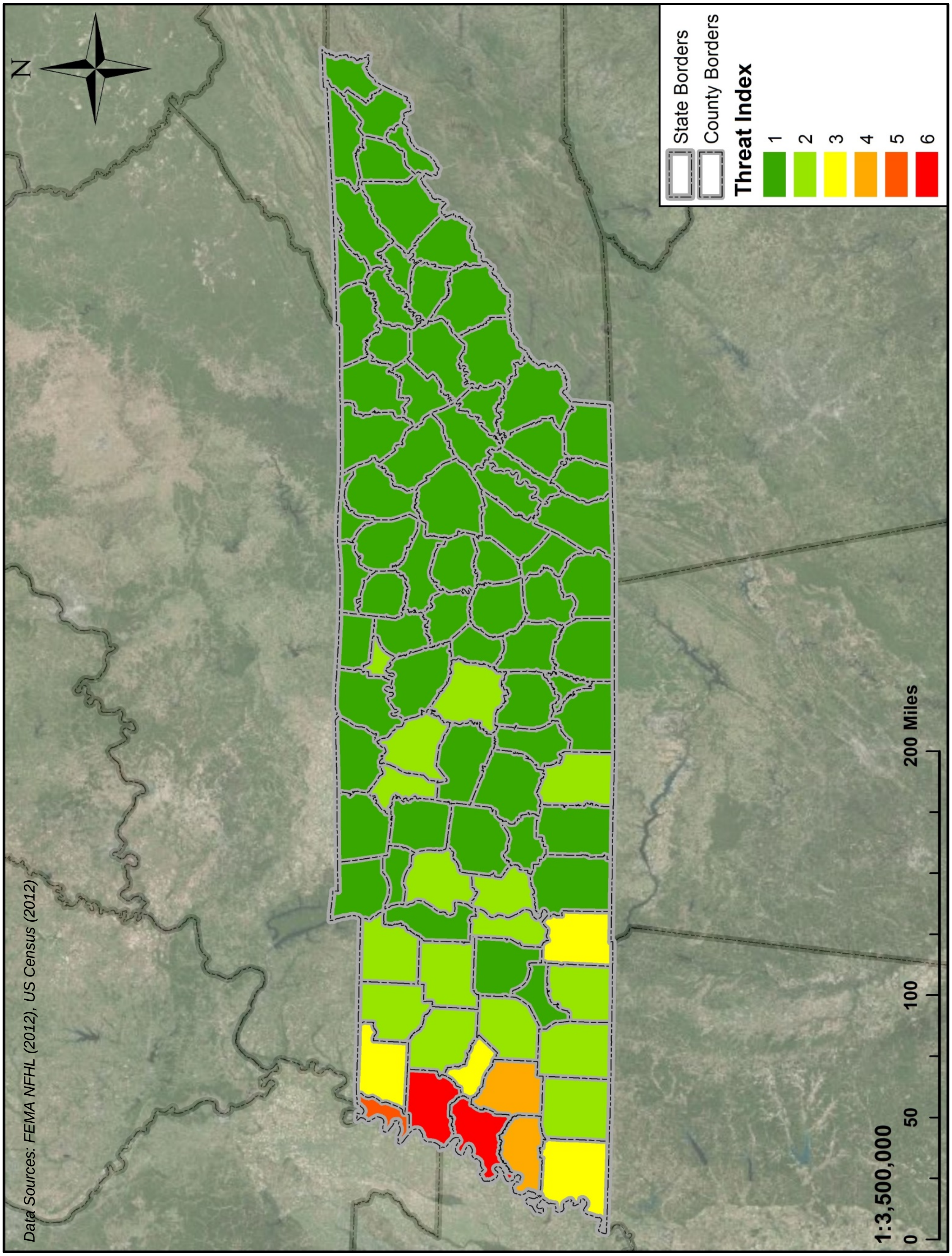
Map 106 – Hazard Threat Index, Landslides



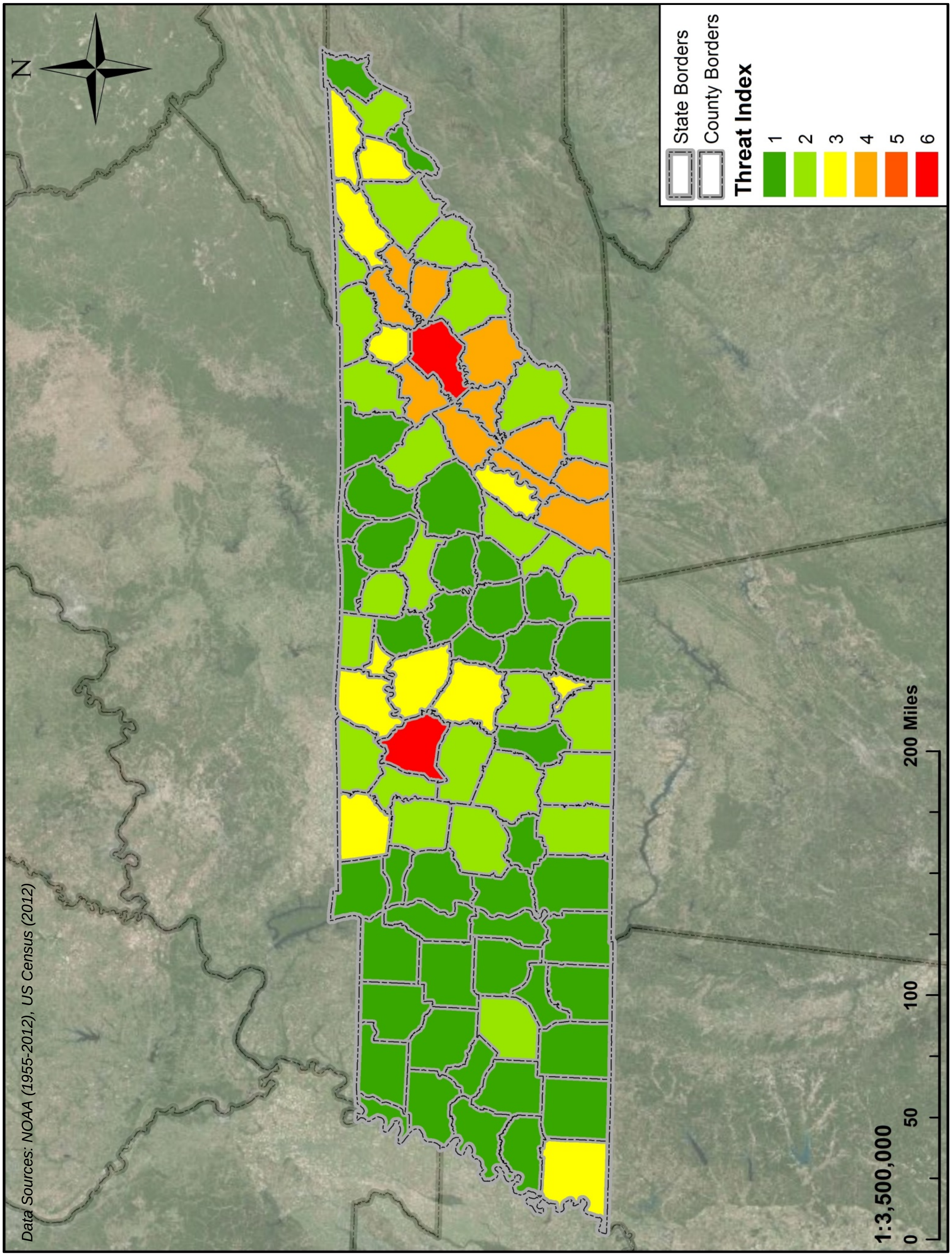
Map 107 – Hazard Threat Index, Lightning



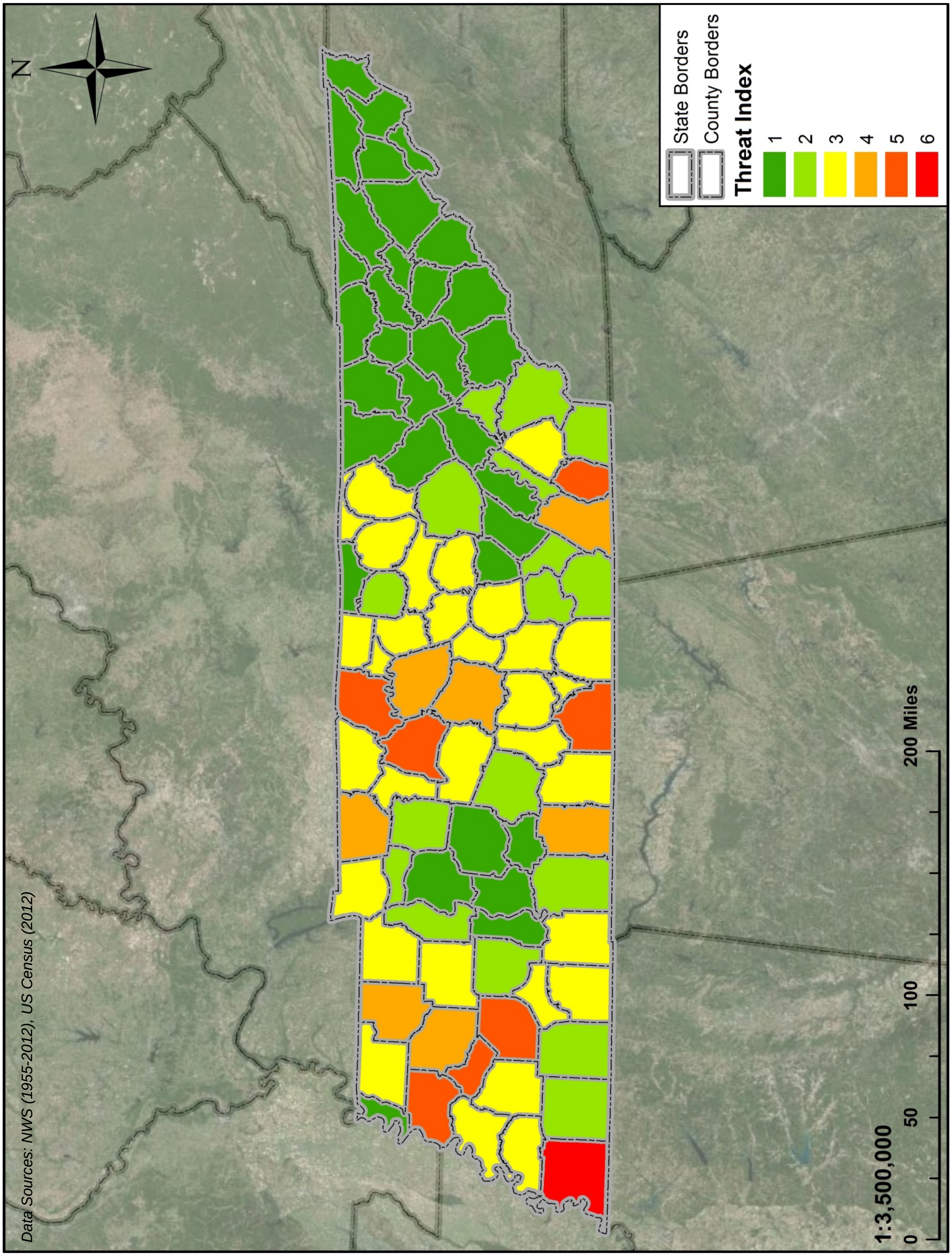
Map 108 – Hazard Threat Index, Riverine Floods



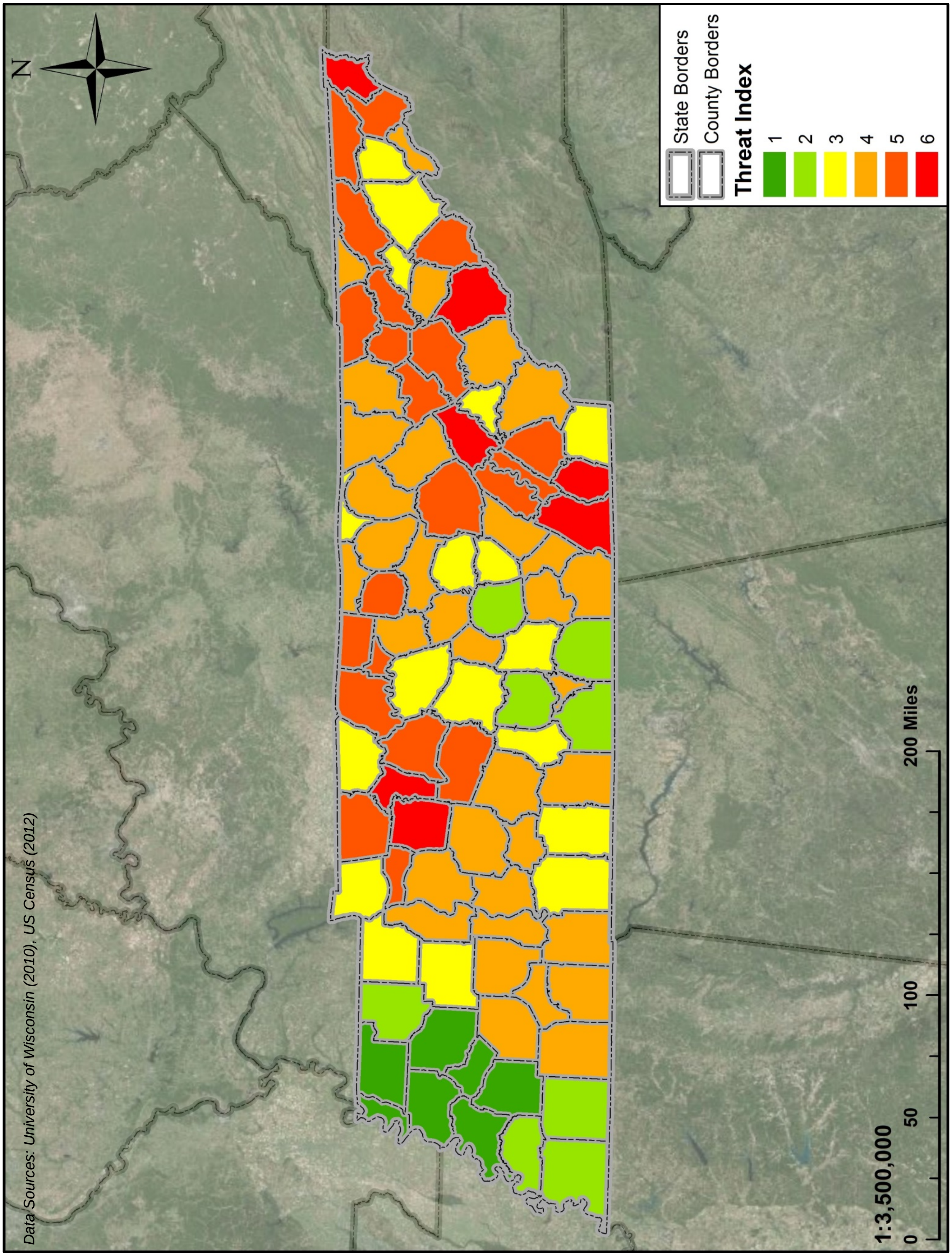
Map 109 – Hazard Threat Index, Thunderstorm Winds



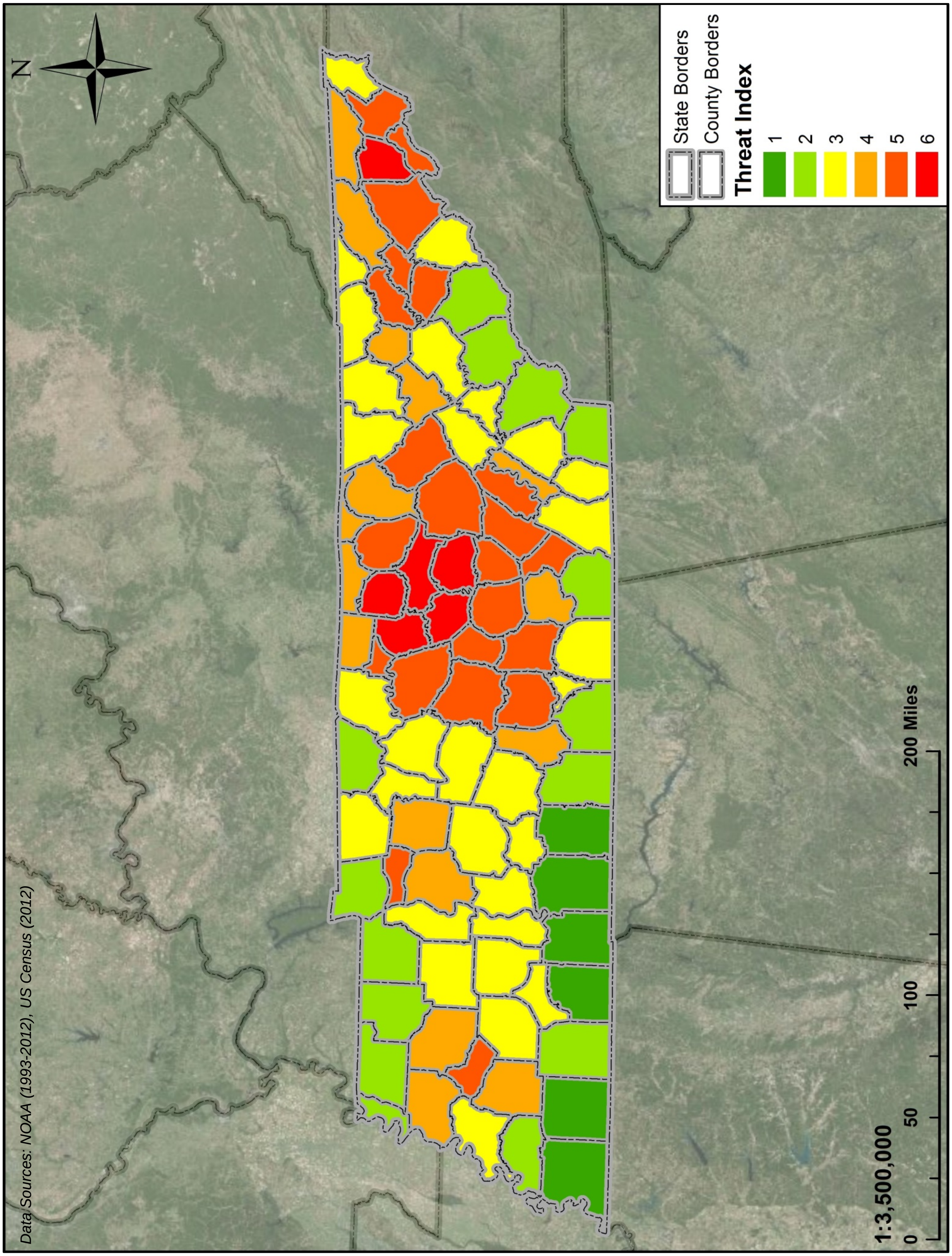
Map 110 – Hazard Threat Index, Tornadoes



Map 111 – Hazard Threat Index, Wildfires



Map 112 – Hazard Threat Index, Winter Storms



4.2.3 – Composite State Risk Assessment by GIS Analysis

In order to calculate composite risk, a combination of the state's vulnerability and its hazards' threats, the hazard threat index was aggregated with the state's SoVI© index. Both values were combined and ranked 1 through 6, 6 being the greatest risk. This was done for each county and for each hazard.

The table below outlines each county's composite risk score. The maps following the table graphically depict the composite risk index.

Table 65 – Hazard Risk Index, Part 1, Tennessee

County	SoVI©	Drought	Earthquake	Expansive Soils	Extreme Temperatures	Flash Floods	Riverine Flood	Hail
Anderson	7.51	3	3	3	3	3	2	4
Bedford	6.01	4	2	3	3	3	2	3
Benton	9.13	4	4	4	4	4	2	3
Bledsoe	9.84	4	3	4	4	4	2	5
Blount	5.93	2	2	3	3	2	1	3
Bradley	6.43	3	2	3	3	3	2	4
Campbell	9.53	3	3	4	3	4	2	4
Cannon	7.71	4	2	3	3	4	2	3
Carroll	8.30	4	4	3	4	3	2	3
Carter	9.70	3	3	4	4	4	2	4
Cheatham	4.28	2	2	2	1	2	2	2
Chester	7.35	4	3	3	6	3	2	4
Claiborne	8.62	3	3	4	3	4	2	3
Clay	8.86	3	3	4	3	4	2	3
Cocke	9.93	3	3	4	3	4	2	4
Coffee	7.44	5	2	3	3	4	2	3
Crockett	8.25	5	4	3	6	4	3	3
Cumberland	9.75	4	3	4	3	4	2	4
Davidson	5.98	3	2	3	2	4	2	5
Decatur	8.84	4	3	4	6	4	3	4
DeKalb	8.01	4	2	3	3	4	2	3
Dickson	6.37	3	2	3	2	3	1	3
Dyer	8.33	4	5	3	5	3	6	3
Fayette	5.41	3	3	2	3	2	2	2
Fentress	8.65	3	3	3	3	4	2	3
Franklin	6.93	5	2	3	4	3	2	3
Gibson	8.68	5	4	3	5	4	3	4
Giles	7.66	4	2	3	3	4	2	3
Grainger	8.00	3	3	3	3	3	2	4
Greene	8.06	3	2	4	3	3	2	3
Grundy	10.28	5	3	4	4	4	2	4
Hamblen	7.21	2	3	3	2	3	2	3
Hamilton	6.66	3	3	3	3	3	2	4
Hancock	10.78	4	3	4	4	4	2	4
Hardeman	10.63	4	4	4	5	4	3	5

County	SoVI©	Drought	Earthquake	Expansive Soils	Extreme Temperatures	Flash Floods	Riverine Flood	Hail
Hardin	9.03	4	3	4	5	4	3	4
Hawkins	7.60	3	2	3	3	3	2	3
Haywood	9.18	5	4	4	6	4	4	3
Henderson	6.59	4	3	3	5	3	2	3
Henry	8.80	4	4	3	4	4	3	4
Hickman	8.25	4	3	3	4	3	2	4
Houston	9.49	4	4	4	3	4	2	4
Humphreys	7.46	3	3	3	3	3	2	3
Jackson	9.91	4	3	4	3	5	2	4
Jefferson	7.29	3	3	3	3	3	1	3
Johnson	9.73	3	3	4	3	4	2	4
Knox	5.31	2	2	3	3	3	1	4
Lake	15.88	6	6	6	6	6	6	6
Lauderdale	8.82	4	5	4	6	4	5	4
Lawrence	8.01	3	2	3	3	5	2	4
Lewis	9.30	4	3	4	4	4	2	4
Lincoln	7.06	5	2	3	3	4	2	3
Loudon	7.02	3	3	3	3	3	1	4
Macon	7.39	3	2	3	3	4	2	3
Madison	6.74	4	3	3	6	3	2	4
Marion	7.76	4	2	3	3	3	2	4
Marshall	6.28	4	2	3	3	3	2	3
Maury	6.25	3	2	3	3	3	2	3
McMinn	7.55	3	3	3	3	4	2	4
McNairy	7.98	3	3	3	4	3	2	4
Meigs	8.25	3	3	4	3	4	2	4
Monroe	7.71	3	3	3	3	3	2	3
Montgomery	5.48	3	2	3	2	3	2	2
Moore	6.61	5	2	3	4	4	1	3
Morgan	8.83	3	3	4	3	4	2	4
Obion	7.57	4	4	3	4	3	3	3
Overton	7.56	3	2	3	3	3	1	3
Perry	10.62	4	4	4	5	5	3	4
Pickett	8.36	3	2	3	3	3	2	3
Polk	8.09	3	3	3	3	3	2	3
Putnam	7.27	3	2	3	2	4	1	3
Rhea	7.76	3	3	3	3	4	2	4
Roane	7.78	3	3	3	3	4	2	4
Robertson	4.86	2	2	2	2	2	1	2
Rutherford	3.83	2	1	2	2	2	2	2
Scott	8.97	3	3	4	3	4	2	3
Sequatchie	8.43	4	3	3	3	3	2	4
Sevier	7.50	3	3	3	3	3	2	3
Shelby	5.75	3	3	2	4	4	3	4
Smith	7.32	3	2	3	3	3	2	3
Stewart	8.11	3	4	3	3	4	2	3

County	SoVI©	Drought	Earthquake	Expansive Soils	Extreme Temperatures	Flash Floods	Riverine Flood	Hail
Sullivan	7.86	3	2	3	3	3	2	4
Sumner	4.49	2	2	2	2	3	1	3
Tipton	5.94	3	4	3	5	3	3	3
Trousdale	7.10	2	2	3	3	4	2	3
Unicoi	9.48	3	3	4	3	4	2	4
Union	8.11	3	3	4	3	3	2	3
Van Buren	10.34	5	3	4	4	5	2	4
Warren	8.14	5	2	3	3	4	2	3
Washington	7.41	3	2	3	3	4	2	3
Wayne	9.99	4	3	4	4	5	2	4
Weakley	9.12	4	4	4	4	4	3	4
White	8.16	4	2	3	3	4	2	4
Williamson	0.00	1	1	1	1	1	1	1
Wilson	4.01	2	1	2	2	3	1	2

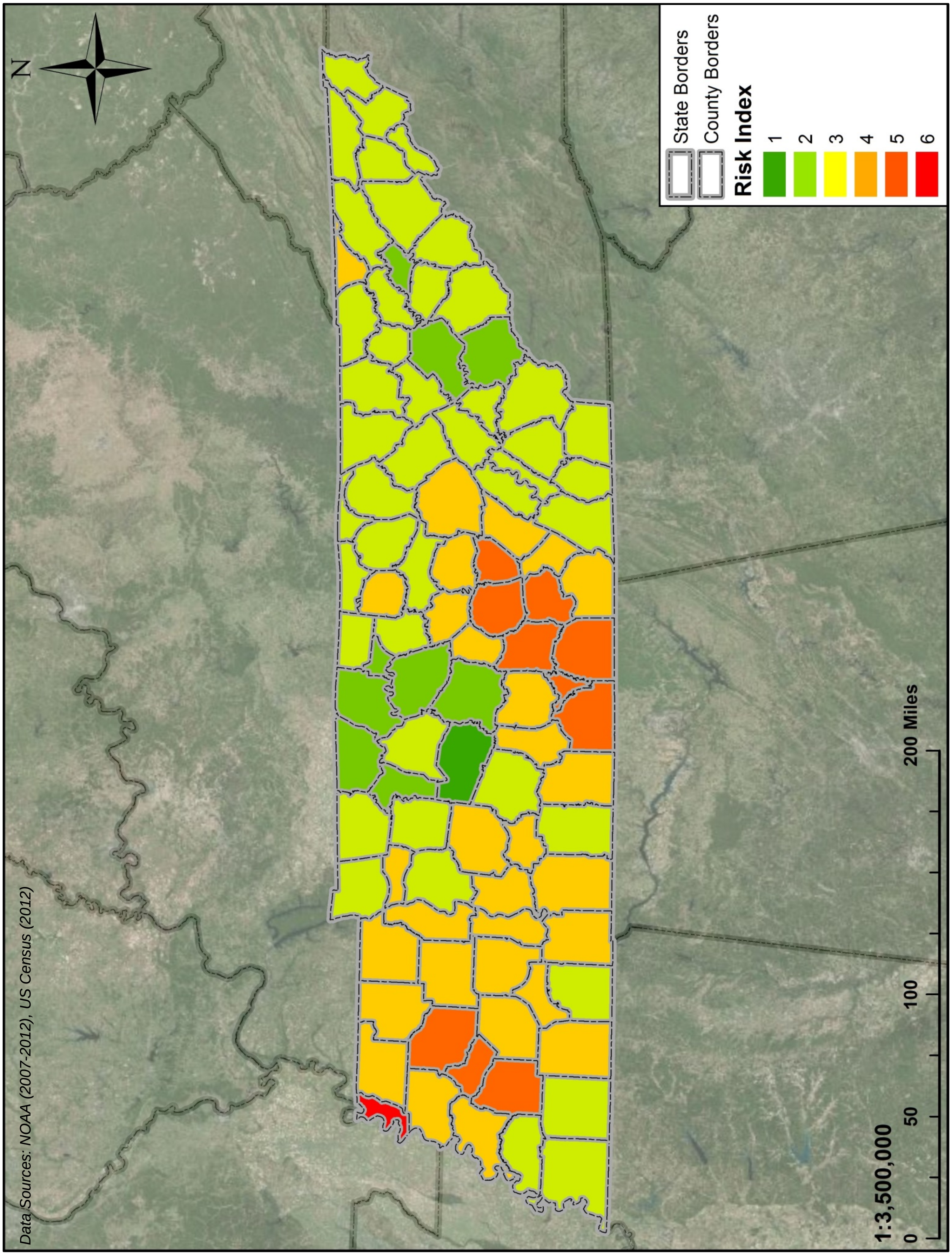
Table 66 – Hazard Risk Index, Part 2, Tennessee

County	High & Strong Wind	Landslides	Land Subsidence	Lightning	Thunderstorm Winds	Tornadoes	Wildfire	Winter Storms
Anderson	4	4	3	1	4	3	4	4
Bedford	4	2	2	2	3	3	2	4
Benton	4	3	3	3	4	4	5	4
Bledsoe	5	4	5	4	5	4	5	5
Blount	4	3	3	1	4	2	3	3
Bradley	5	3	3	2	4	4	4	3
Campbell	4	5	4	3	5	4	5	4
Cannon	3	3	3	3	3	4	4	5
Carroll	5	3	3	3	3	4	4	4
Carter	6	5	4	4	4	4	5	6
Cheatham	2	1	2	1	2	2	3	2
Chester	4	2	3	2	3	3	4	4
Claiborne	4	5	5	3	4	3	5	4
Clay	3	4	4	4	4	4	5	5
Cocke	6	5	4	4	4	4	5	5
Coffee	4	2	3	3	3	4	3	4
Crockett	5	3	3	3	3	5	3	5
Cumberland	4	5	5	5	4	4	5	5
Davidson	3	2	2	3	5	4	3	3
Decatur	4	3	3	2	4	3	4	4
DeKalb	4	3	4	3	3	4	4	6
Dickson	3	2	2	1	3	3	4	4
Dyer	4	4	3	3	3	5	3	4
Fayette	3	2	2	1	2	2	2	2
Fentress	4	4	4	5	4	4	4	5
Franklin	3	3	4	3	3	3	3	3

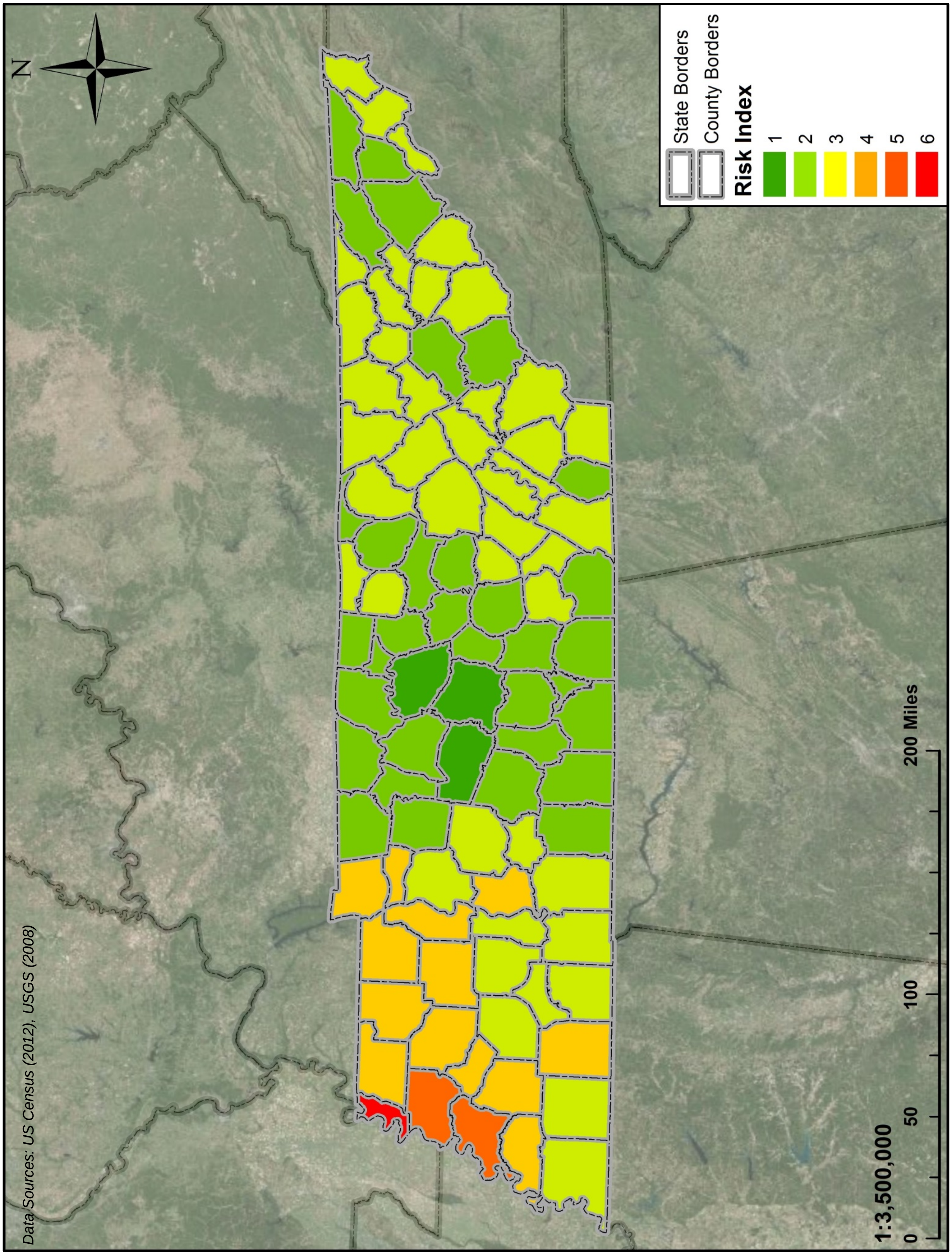
County	High & Strong Wind	Landslides	Land Subsidence	Lightning	Thunderstorm Winds	Tornadoes	Wildfire	Winter Storms
Gibson	5	3	3	3	3	5	3	5
Giles	3	3	3	2	4	4	4	3
Grainger	4	4	4	3	5	3	5	5
Greene	6	3	3	2	4	3	4	5
Grundy	5	5	5	3	4	4	5	5
Hamblen	4	4	3	2	4	3	3	5
Hamilton	4	3	3	2	4	4	4	3
Hancock	4	5	4	3	5	4	6	5
Hardeman	5	3	4	4	4	5	5	4
Hardin	4	3	3	2	4	4	4	3
Hawkins	4	4	3	2	4	3	4	4
Haywood	4	3	3	3	4	4	4	5
Henderson	3	2	3	2	3	3	3	3
Henry	4	3	3	4	3	4	4	4
Hickman	4	3	3	2	4	3	4	4
Houston	4	3	3	3	4	4	5	5
Humphreys	3	2	3	2	3	3	4	4
Jackson	4	4	5	5	4	4	5	6
Jefferson	5	3	3	2	4	3	4	4
Johnson	5	6	4	3	4	4	5	5
Knox	4	3	3	1	4	2	3	3
Lake	6	6	5	6	6	6	6	6
Lauderdale	4	4	3	3	3	4	3	4
Lawrence	3	2	3	3	4	4	4	3
Lewis	4	3	3	3	4	4	5	4
Lincoln	3	2	3	3	3	4	3	3
Loudon	5	3	3	1	4	3	3	3
Macon	3	2	3	4	3	3	4	4
Madison	4	2	3	3	3	4	3	4
Marion	3	3	4	2	4	3	4	3
Marshall	4	2	2	2	2	3	3	3
Maury	3	2	2	3	3	3	3	3
McMinn	6	3	3	1	5	4	4	4
McNairy	3	2	3	2	3	4	4	3
Meigs	5	3	3	2	5	3	4	5
Monroe	5	4	3	1	4	3	4	3
Montgomery	2	2	2	3	3	3	3	3
Moore	4	2	3	3	3	3	3	3
Morgan	4	5	3	3	4	3	4	5
Obion	3	4	3	2	3	4	3	3
Overton	3	3	5	4	3	4	4	5
Perry	5	3	4	3	4	4	5	5
Pickett	3	4	4	3	3	4	4	4
Polk	5	4	3	2	4	3	4	3
Putnam	3	3	5	3	3	3	4	5
Rhea	5	4	3	2	4	3	4	5

County	High & Strong Wind	Landslides	Land Subsidence	Lightning	Thunderstorm Winds	Tornadoes	Wildfire	Winter Storms
Roane	4	4	3	2	4	3	4	4
Robertson	2	2	2	1	2	3	2	2
Rutherford	3	1	2	2	2	3	2	3
Scott	3	5	3	3	4	4	4	4
Sequatchie	4	4	4	2	4	4	4	5
Sevier	5	4	3	2	3	3	5	3
Shelby	3	3	2	4	3	4	2	2
Smith	3	3	3	2	3	3	4	5
Stewart	3	3	3	3	3	4	4	4
Sullivan	5	4	3	3	4	3	4	4
Sumner	2	1	2	1	3	3	3	3
Tipton	3	3	2	2	3	3	2	3
Trousdale	3	2	3	3	4	3	4	4
Unicoi	6	6	3	3	4	4	5	5
Union	4	4	4	3	4	3	5	5
Van Buren	5	5	6	4	4	4	5	6
Warren	4	3	5	2	4	4	3	5
Washington	6	3	3	2	4	3	3	5
Wayne	4	3	4	3	4	4	5	4
Weakley	4	3	3	3	4	5	4	4
White	4	3	6	3	3	4	4	5
Williamson	1	1	1	1	1	1	1	1
Wilson	3	1	2	3	3	2	2	3

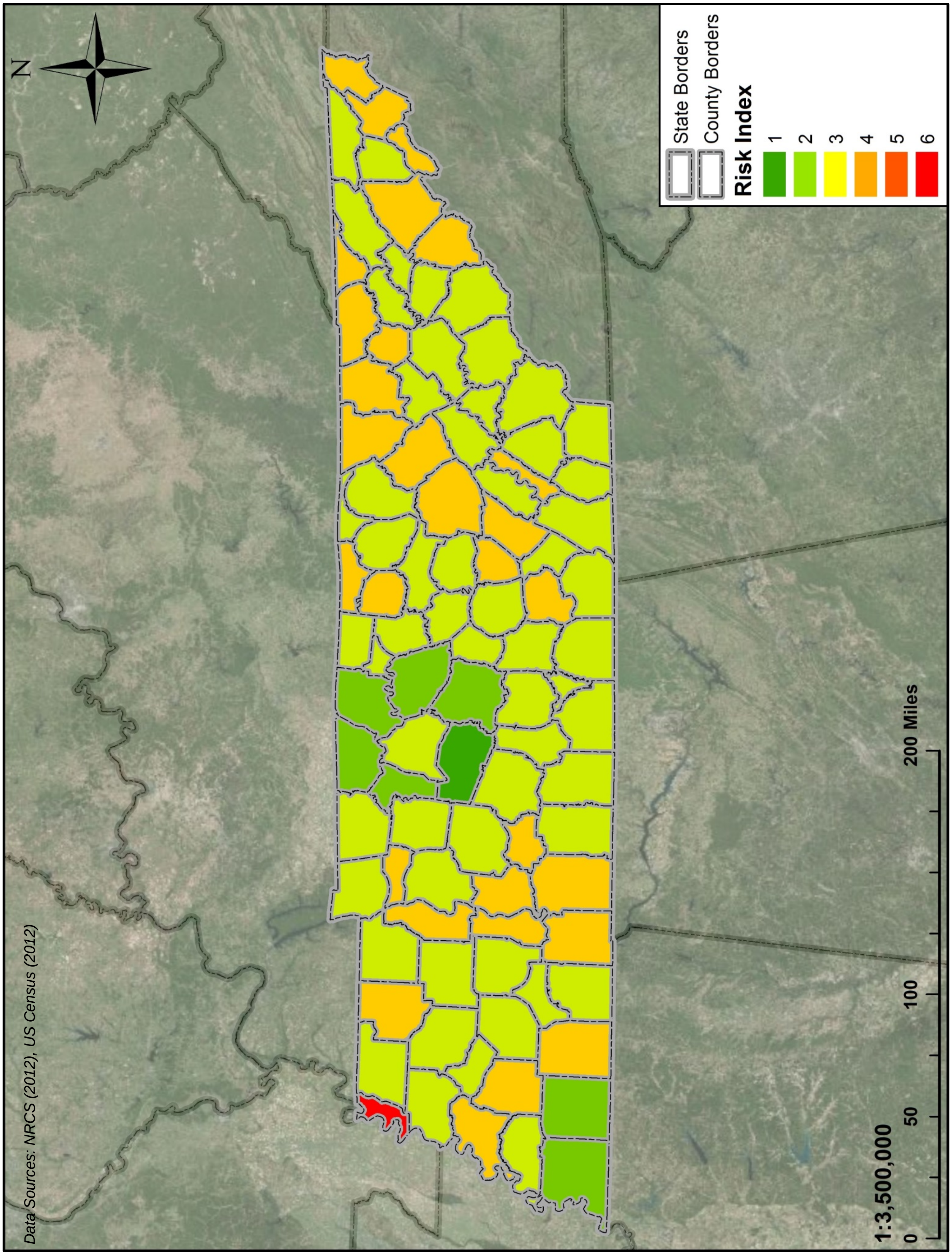
Map 113 – Hazard Risk Index, Droughts

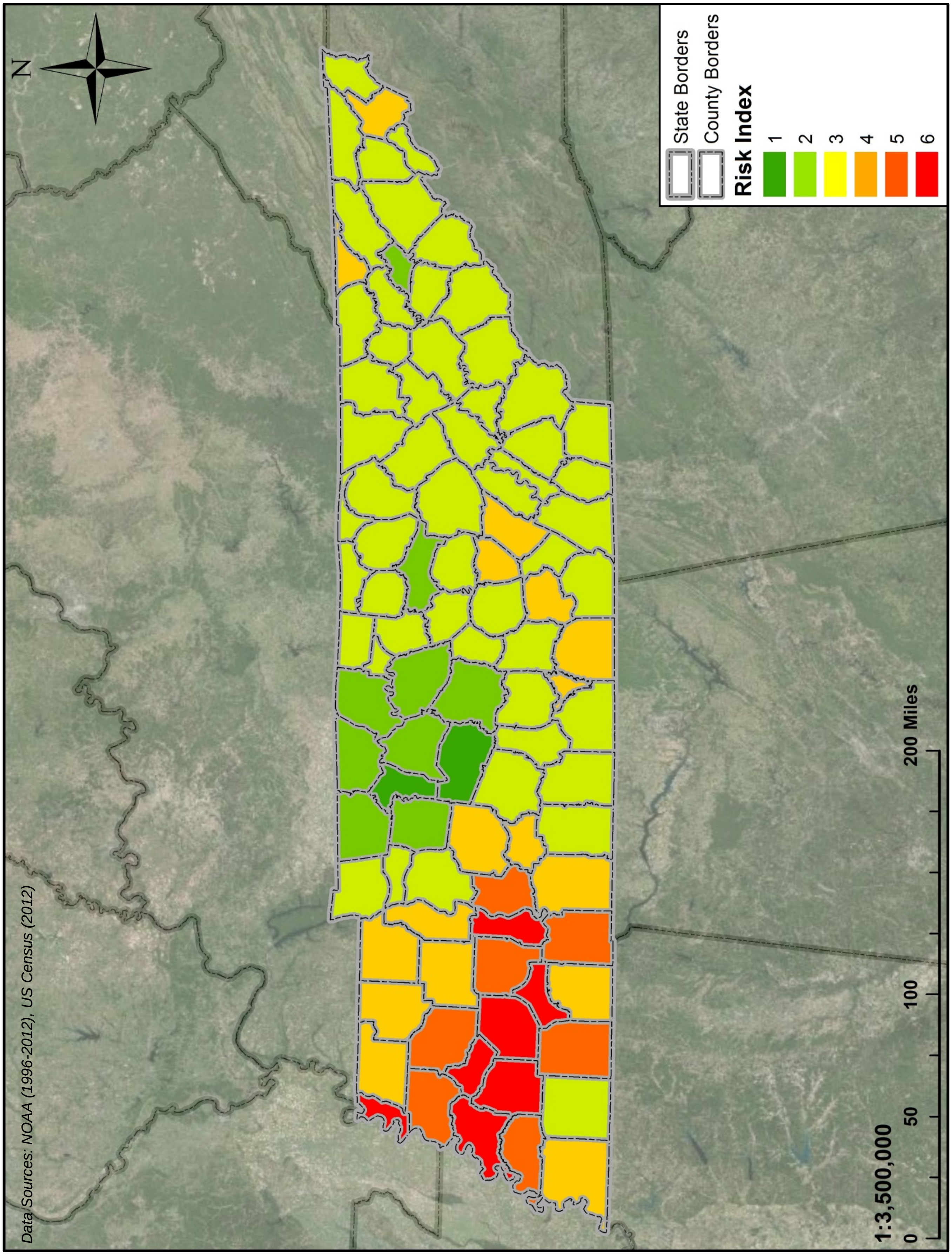


Map 114 – Hazard Risk Index, Earthquakes

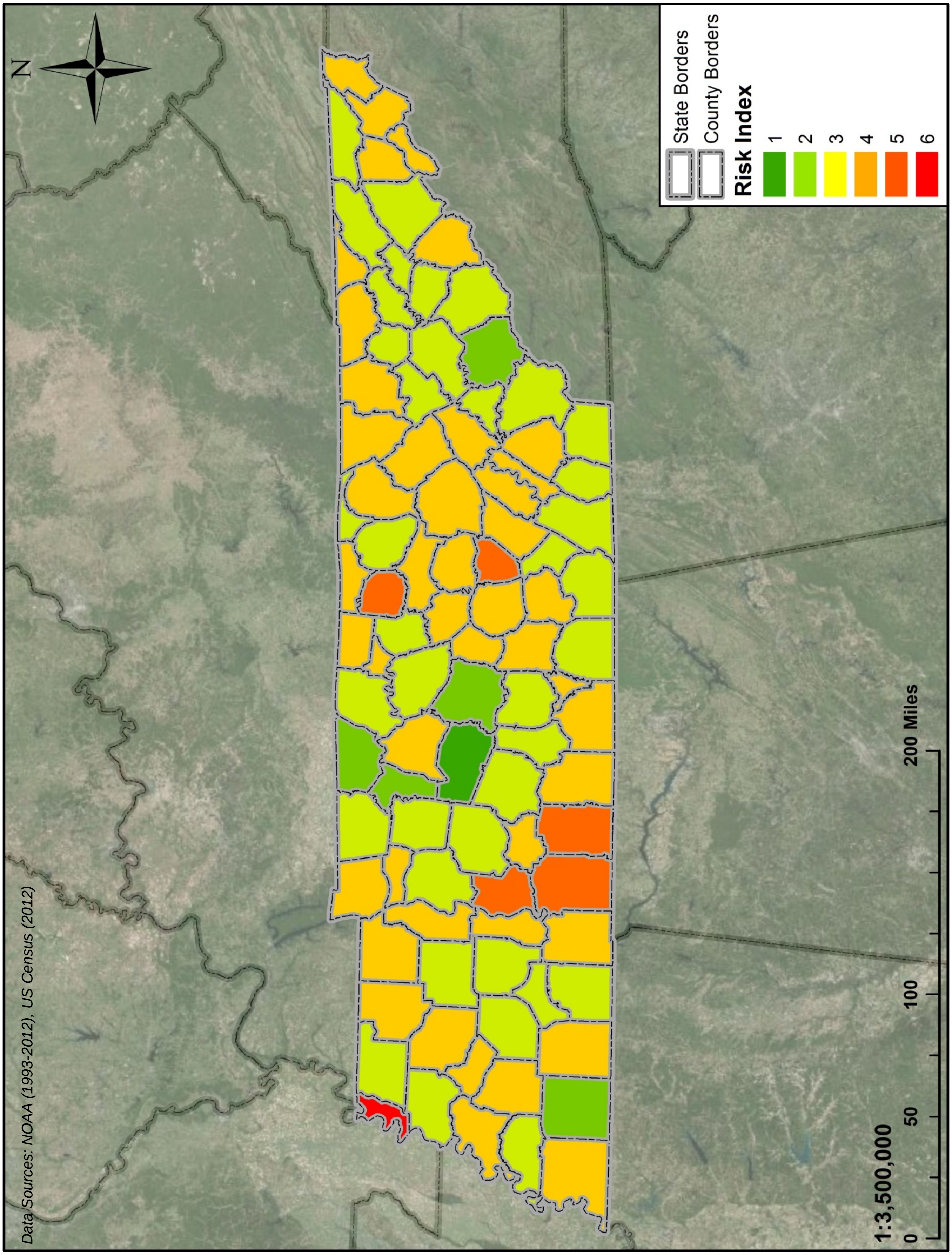


Map 115 – Hazard Risk Index, Expansive Soils

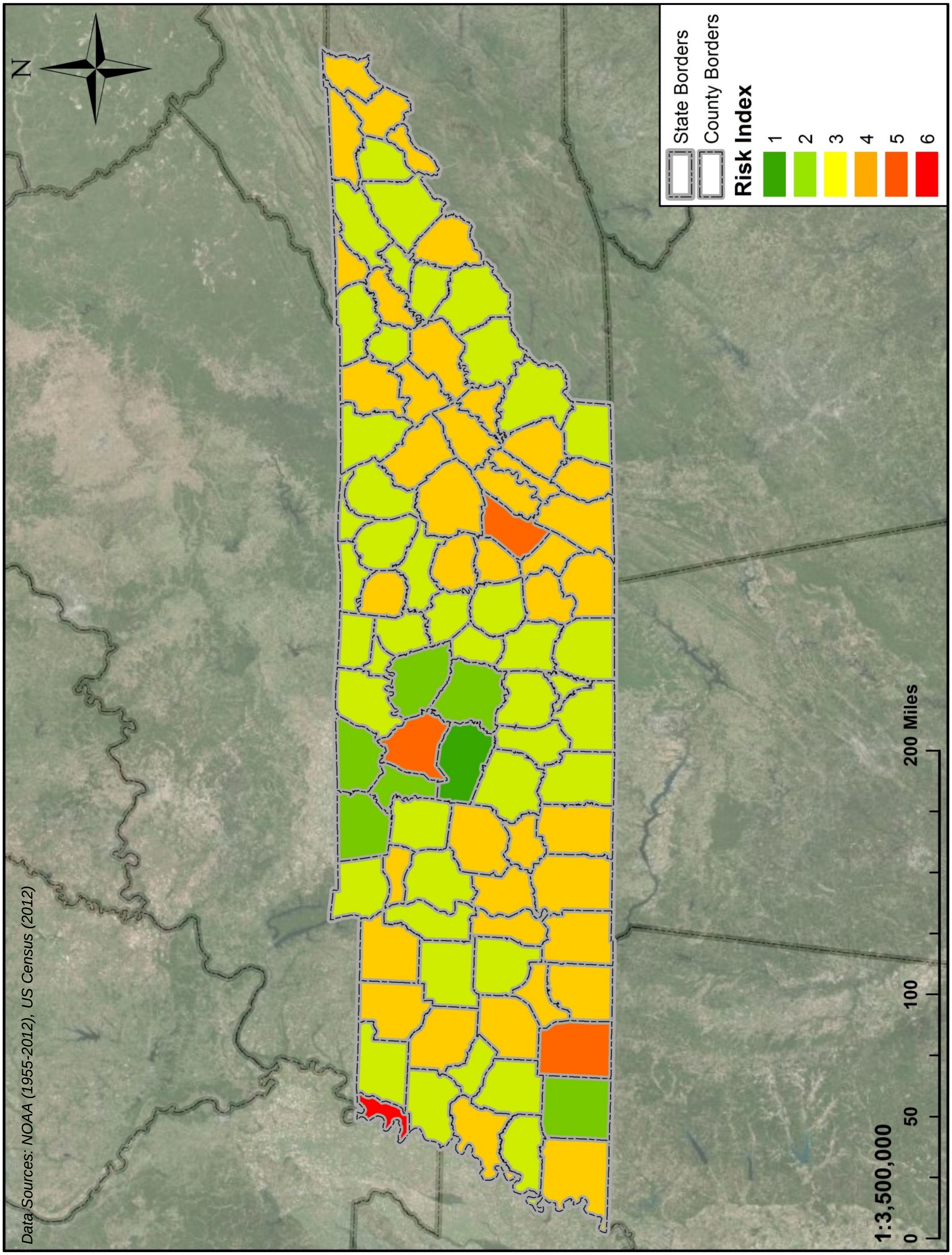




Map 116 – Hazard Risk Index, Extreme Temperatures

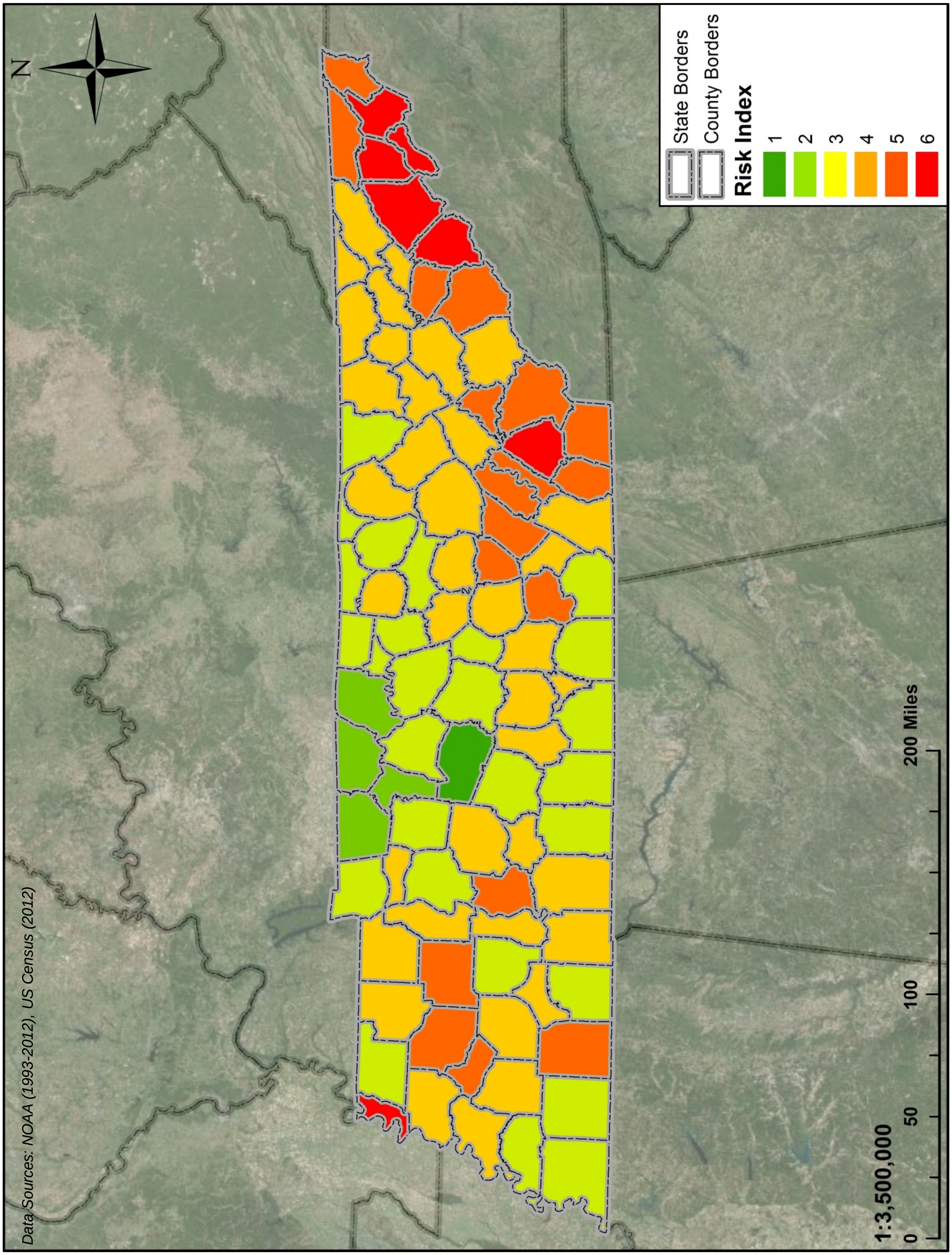


Map 117 – Hazard Risk Index, Flash Floods

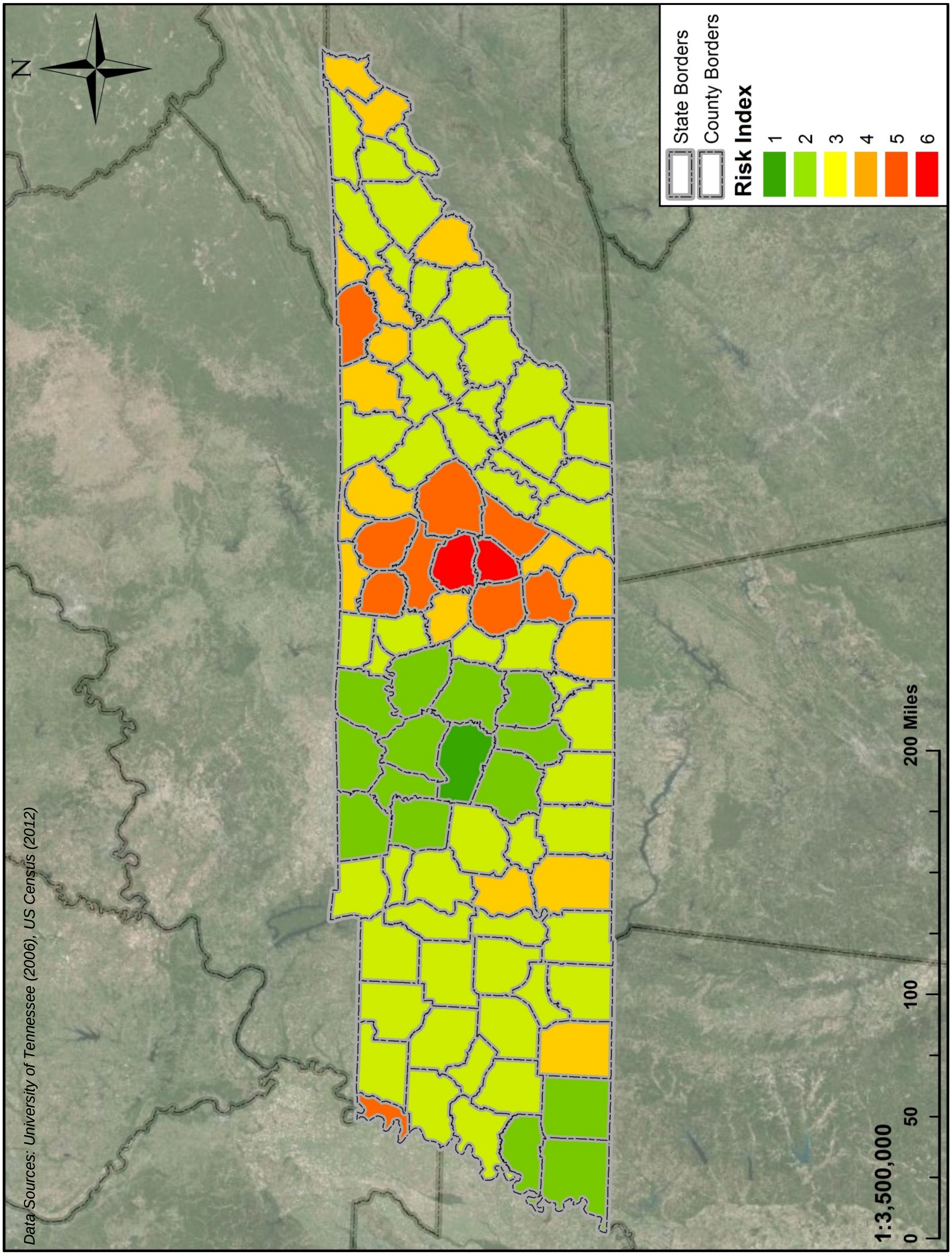


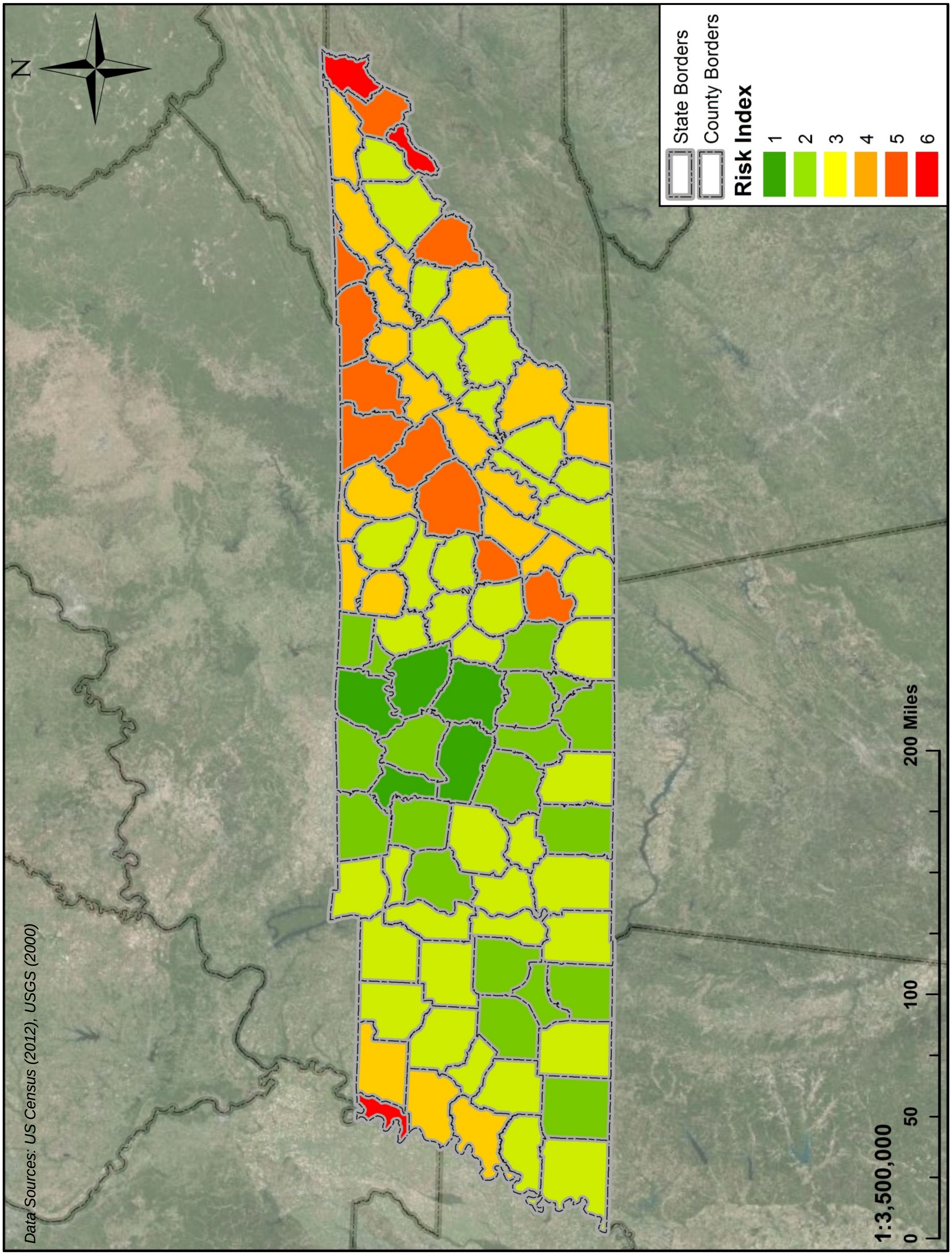
Map 118 – Hazard Risk Index, Hail

Map 119 – Hazard Risk Index, High & Strong Winds



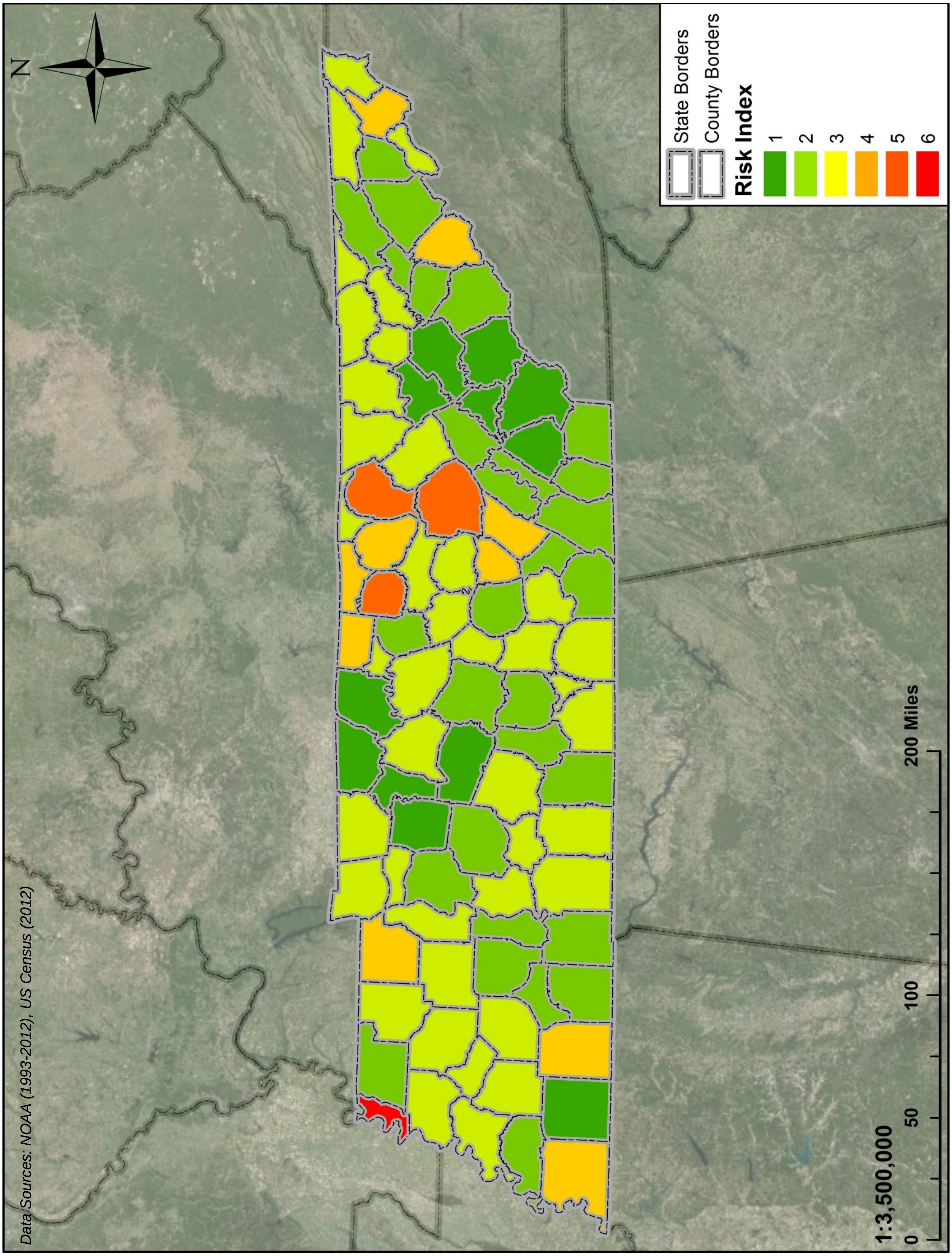
Map 120 – Hazard Risk Index, Land Subsidence/Sinkholes



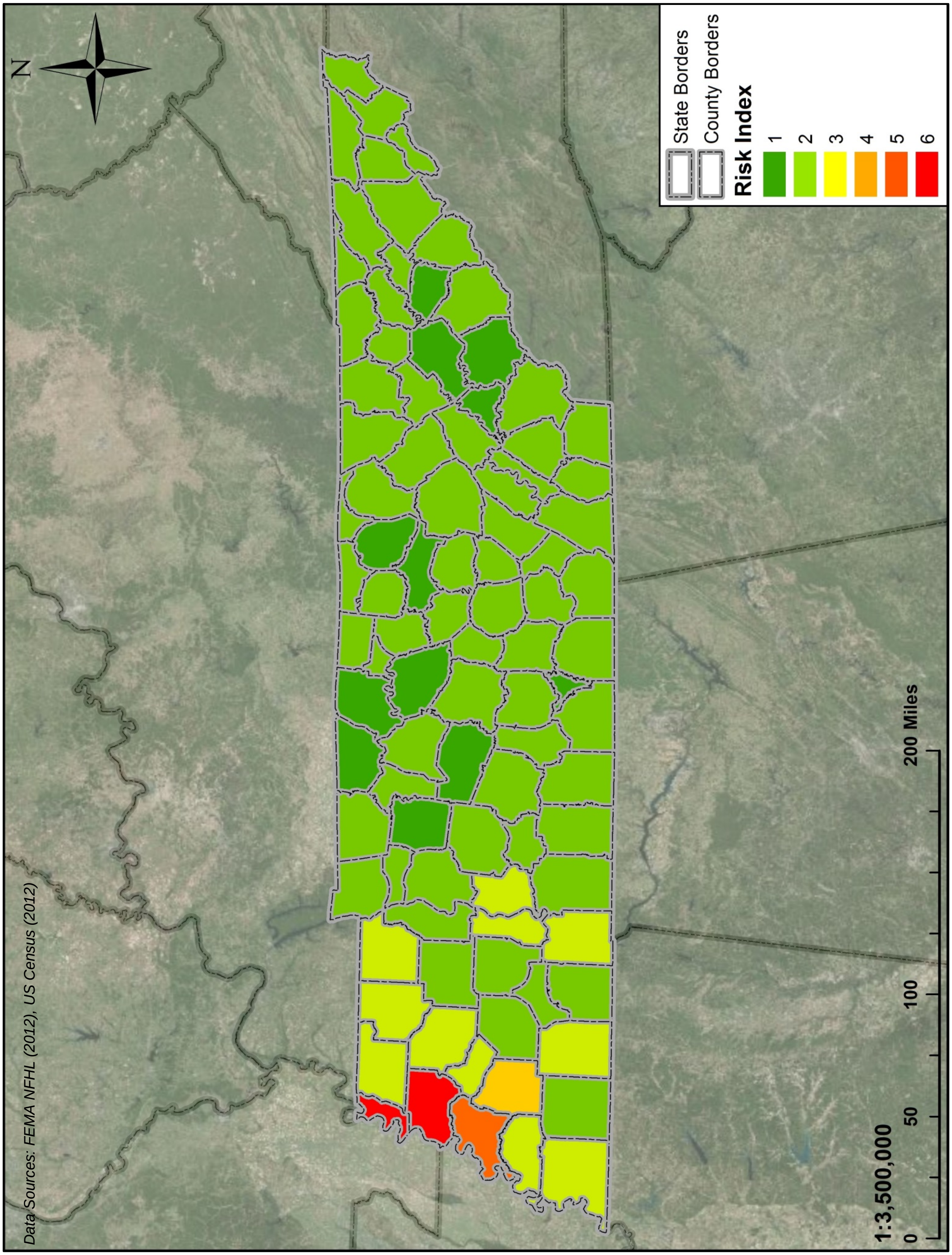


Map 121 – Hazard Risk Index, Landslides

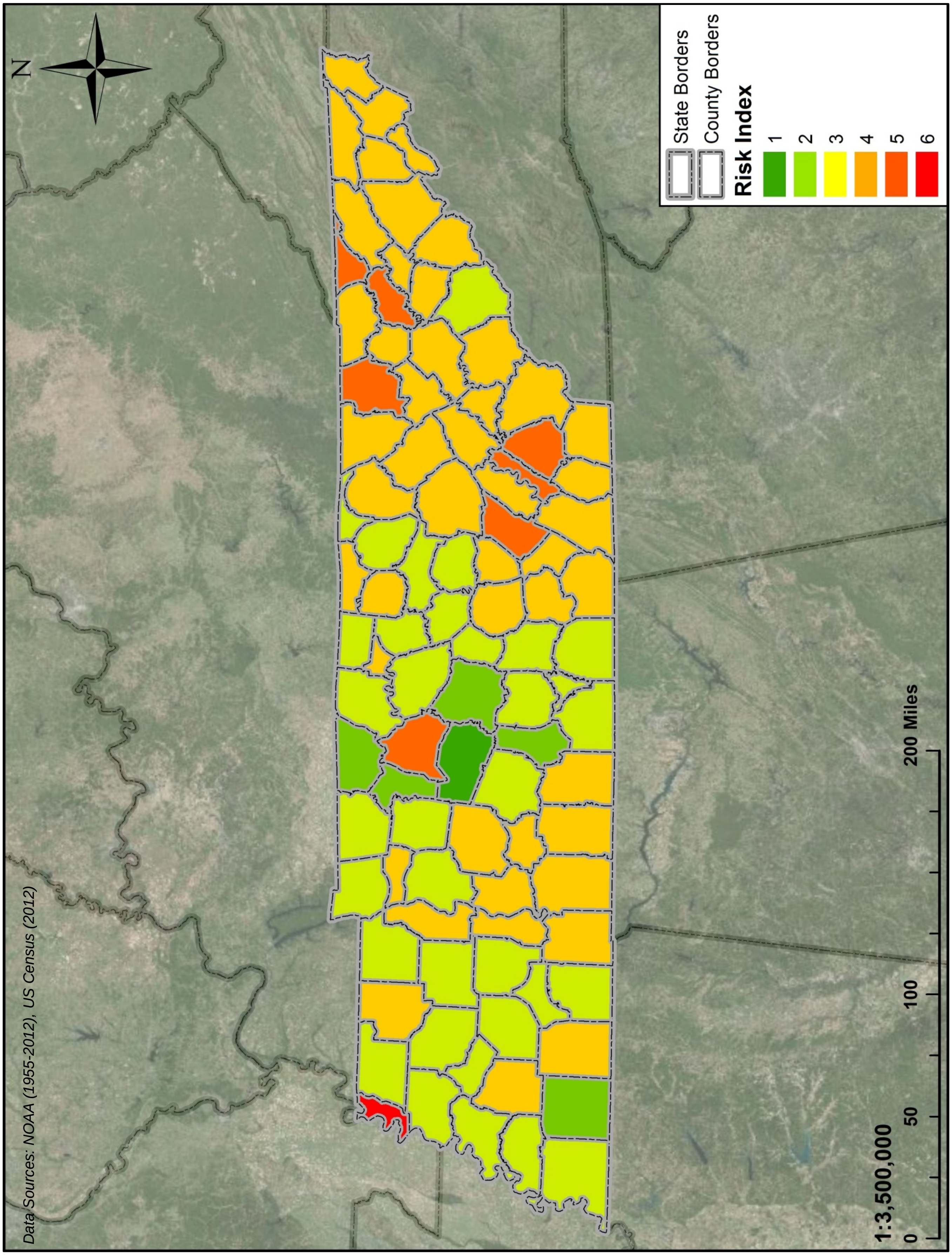
Map 122 – Hazard Risk Index, Lightning



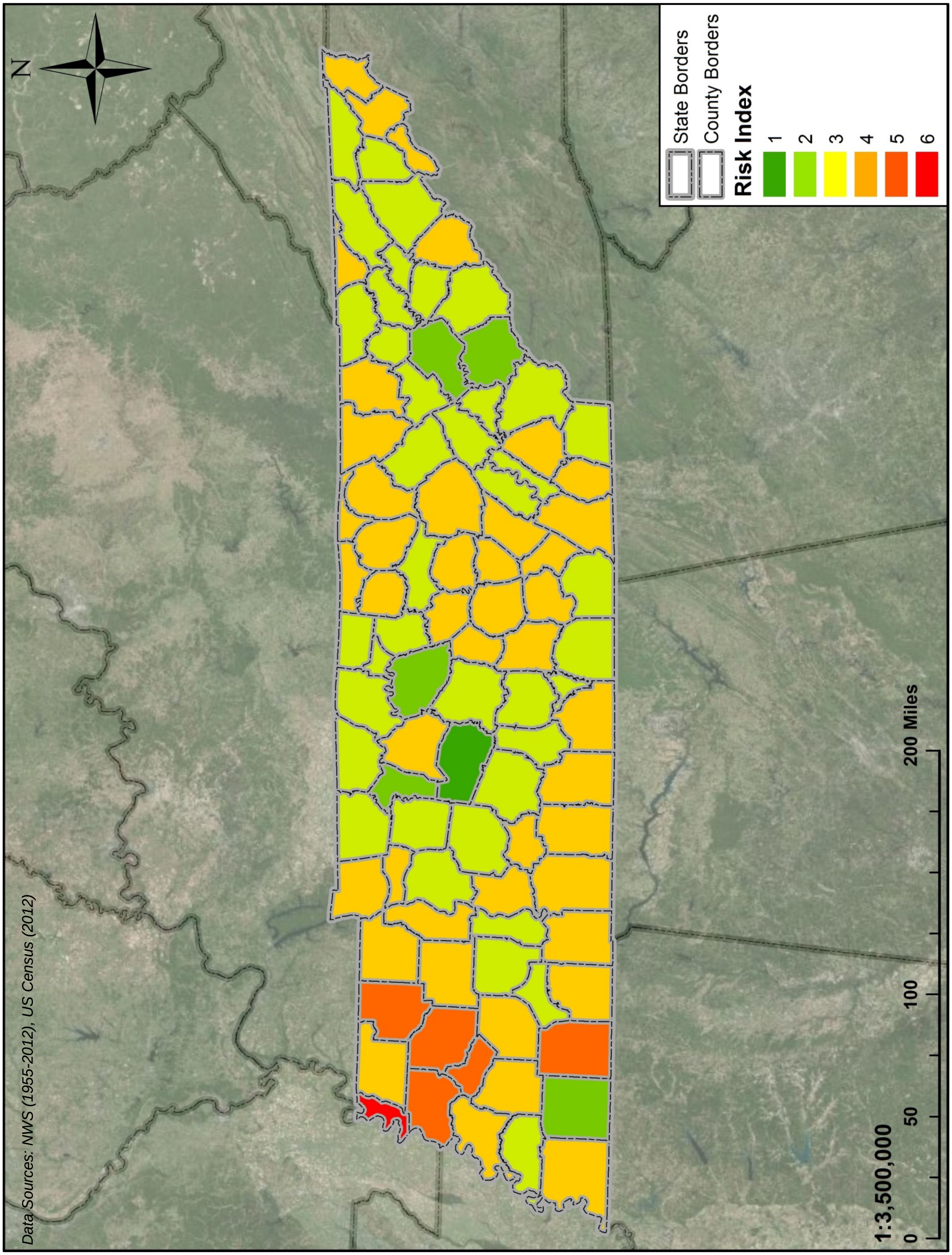
Map 123 – Hazard Risk Index, Riverine Floods



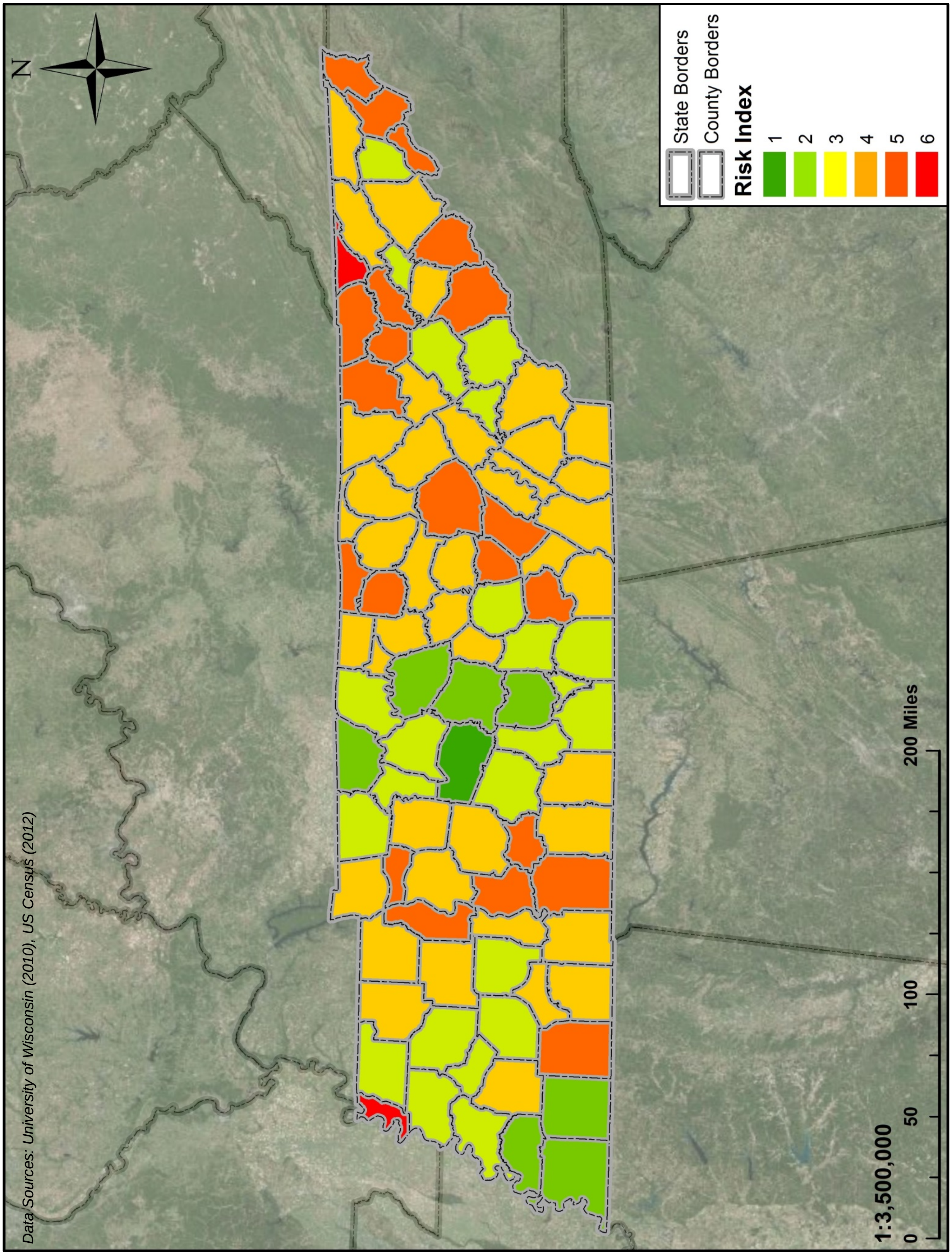
Map 124 – Hazard Risk Index, Thunderstorm Winds



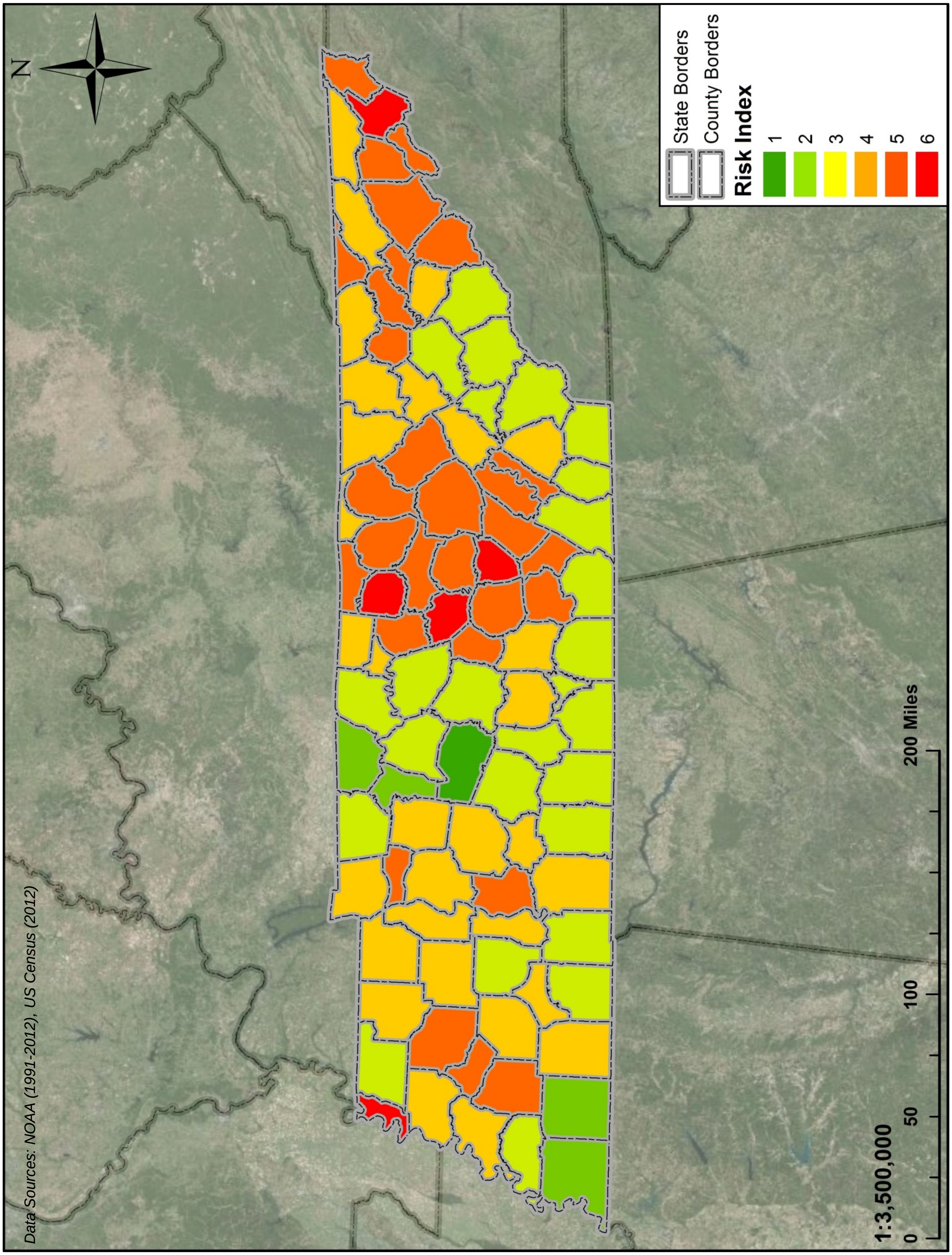
Map 125 – Hazard Risk Index, Tornadoes



Map 126 – Hazard Risk Index, Wildfire



Map 127 – Hazard Risk Index, Winter Storms



4.2.4 – Potential Losses by GIS Analysis

As in the loss estimation based on local hazard mitigation plan risk assessments, the state analysis uses the exported structural inventory from FEMA's HAZUS-MH v2.1. Each county's structural inventory was then cross referenced by the hazard risk index as described in the beginning of Section 4.2. Tables 67 through 80 below show the loss estimate results by county per hazard risk index. Drought and Extreme Temperatures were not profiled as they do not pose a risk to buildings and inventory. All values shown are in thousands.

Table 67 – Loss Estimation by GIS Analysis

Hazard	Risk Index by GIS Analysis					
	1	2	3	4	5	6
Earthquakes	$10,568,905,000	$135,729,830,000	$137,732,343,000	$20,820,820,000	$3,870,527,000	$573,379,000
Expansive Soils	$828,101,000	$76,883,862,000	$198,900,867,000	$32,109,595,000	$0	$573,379,000
Flash Floods	$828,101,000	$15,038,268,000	$133,813,956,000	$154,554,795,000	$4,487,305,000	$573,379,000
Floods	$38,629,205,000	$186,055,876,000	$79,386,038,000	$780,779,000	$1,676,186,000	$2,767,720,000
Hail	$828,101,000	$19,761,887,000	$86,162,364,000	$161,205,507,000	$40,764,566,000	$573,379,000
High & Strong Winds	$828,101,000	$11,174,194,000	$149,048,619,000	$94,110,685,000	$40,583,418,000	$13,550,787,000
Land Subsidence	$828,101,000	$140,104,935,000	$137,449,111,000	$17,848,505,000	$12,055,618,000	$1,009,534,000
Landslides	$13,498,790,000	$78,024,473,000	$156,686,551,000	$46,939,083,000	$11,428,063,000	$2,718,844,000
Lightning	$36,747,456,000	$89,487,338,000	$107,925,265,000	$72,221,895,000	$2,340,471,000	$573,379,000
Thunderstorm Winds	$828,101,000	$15,738,718,000	$129,699,810,000	$117,707,789,000	$44,748,007,000	$573,379,000
Tornadoes	$828,101,000	$25,971,907,000	$101,264,325,000	$171,452,554,000	$9,205,538,000	$573,379,000
Wildfires	$828,101,000	$81,072,981,000	$107,228,632,000	$94,367,356,000	$24,623,769,000	$1,174,965,000
Winter Storms	$828,101,000	$64,799,640,000	$141,958,792,000	$59,604,749,000	$36,994,997,000	$5,109,525,000

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 68 – Loss Estimation by GIS Analysis, Earthquakes

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Rutherford	$5,323,121	Bedford	$1,742,550	Anderson	$4,947,581	Benton	$932,359	Dyer	$2,194,341	Lake	$573,379
Williamson	$828,101	Blount	$6,109,706	Bledsoe	$506,717	Carroll	$1,230,667	Lauderdale	$1,676,186		
Wilson	$4,417,683	Bradley	$6,839,962	Campbell	$2,986,882	Crockett	$811,710				
		Cannon	$731,478	Carter	$2,497,728	Gibson	$3,075,817				
		Cheatham	$586,467	Chester	$837,092	Hardeman	$2,178,327				
		Coffee	$2,338,029	Claiborne	$1,746,971	Haywood	$780,779				
		Davidson	$38,079,522	Clay	$377,975	Henry	$1,935,167				
		DeKalb	$724,172	Cocke	$131,260	Houston	$430,177				
		Dickson	$1,032,642	Cumberland	$466,261	Obion	$2,091,659				
		Franklin	$1,902,441	Decatur	$462,436	Perry	$270,866				
		Giles	$1,321,101	Fayette	$1,190,307	Stewart	$761,495				
		Greene	$3,655,855	Fentress	$703,483	Tipton	$5,376,454				
		Hawkins	$3,615,928	Grainger	$589,101	Weakley	$945,343				
		Knox	$13,667,744	Grundy	$750,625						
		Lawrence	$1,516,070	Hamblen	$3,705,824						
		Lincoln	$1,632,692	Hamilton	$17,798,170						
		Macon	$864,479	Hancock	$601,586						
		Marion	$3,764,107	Hardin	$1,044,060						
		Marshall	$1,252,721	Henderson	$1,475,278						
		Maury	$4,972,875	Hickman	$1,642,658						
		Montgomery	$6,415,642	Humphreys	$1,179,269						
		Moore	$189,223	Jackson	$1,170,727						
		Overton	$2,017,695	Jefferson	$1,499,816						
		Pickett	$183,509	Johnson	$677,573						
		Putnam	$3,087,547	Lewis	$553,559						
		Robertson	$1,828,667	Loudon	$1,606,963						
		Smith	$1,289,364	Madison	$6,810,156						
		Sullivan	$12,889,708	McMinn	$1,239,308						
		Sumner	$2,343,418	McNairy	$1,044,059						
		Trousdale	$736,985	Meigs	$731,478						
		Warren	$1,735,696	Monroe	$1,353,139						
		Washington	$3,971,952	Morgan	$813,867						
		White	$866,015	Polk	$1,117,100						
				Rhea	$973,404						
				Roane	$3,143,674						

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Scott	$1,289,364						
				Sequatchie	$339,900						
				Sevier	$3,926,027						
				Shelby	$61,194,199						
				Unicoi	$1,467,892						
				Union	$1,433,100						
				Van Buren	$143,519						
				Wayne	$1,386,123						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 69 – Loss Estimation by GIS Analysis, Expansive Soils

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Cheatham	$586,467	Anderson	$4,947,581	Benton	$932,359	Lake	$573,379		
		Fayette	$1,190,307	Bedford	$1,742,550	Bledsoe	$506,717				
		Robertson	$1,828,667	Blount	$6,109,706	Campbell	$2,986,882				
		Rutherford	$5,323,121	Bradley	$6,839,962	Carter	$2,497,728				
		Shelby	$61,194,199	Cannon	$731,478	Claiborne	$1,746,971				
		Sumner	$2,343,418	Carroll	$1,230,667	Clay	$377,975				
		Wilson	$4,417,683	Chester	$837,092	Cocke	$131,260				
				Coffee	$2,338,029	Cumberland	$466,261				
				Crockett	$811,710	Decatur	$462,436				
				Davidson	$38,079,522	Greene	$3,655,855				
				DeKalb	$724,172	Grundy	$750,625				
				Dickson	$1,032,642	Hancock	$601,586				
				Dyer	$2,194,341	Hardeman	$2,178,327				
				Fentress	$703,483	Hardin	$1,044,060				
				Franklin	$1,902,441	Haywood	$780,779				
				Gibson	$3,075,817	Houston	$430,177				
				Giles	$1,321,101	Jackson	$1,170,727				
				Grainger	$589,101	Johnson	$677,573				
				Hamblen	$3,705,824	Lauderdale	$1,676,186				
				Hamilton	$17,798,170	Lewis	$553,559				
				Hawkins	$3,615,928	Meigs	$731,478				
				Henderson	$1,475,278	Morgan	$813,867				
				Henry	$1,935,167	Perry	$270,866				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Hickman	$1,642,658	Scott	$1,289,364				
				Humphreys	$1,179,269	Unicoi	$1,467,892				
				Jefferson	$1,499,816	Union	$1,433,100				
				Knox	$13,667,744	Van Buren	$143,519				
				Lawrence	$1,516,070	Wayne	$1,386,123				
				Lincoln	$1,632,692	Weakley	$945,343				
				Loudon	$1,606,963						
				Macon	$864,479						
				Madison	$6,810,156						
				Marion	$3,764,107						
				Marshall	$1,252,721						
				Maury	$4,972,875						
				McMinn	$1,239,308						
				McNairy	$1,044,059						
				Monroe	$1,353,139						
				Montgomery	$6,415,642						
				Moore	$189,223						
				Obion	$2,091,659						
				Overton	$2,017,695						
				Pickett	$183,509						
				Polk	$1,117,100						
				Putnam	$3,087,547						
				Rhea	$973,404						
				Roane	$3,143,674						
				Sequatchie	$339,900						
				Sevier	$3,926,027						
				Smith	$1,289,364						
				Stewart	$761,495						
				Sullivan	$12,889,708						
				Tipton	$5,376,454						
				Trousdale	$736,985						
				Warren	$1,735,696						
				Washington	$3,971,952						
				White	$866,015						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 70 – Loss Estimation by GIS Analysis, Flash Floods

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Blount	$6,109,706	Anderson	$4,947,581	Benton	$932,359	Jackson	$1,170,727	Lake	$573,379
		Cheatham	$586,467	Bedford	$1,742,550	Bledsoe	$506,717	Lawrence	$1,516,070		
		Fayette	$1,190,307	Bradley	$6,839,962	Campbell	$2,986,882	Perry	$270,866		
		Robertson	$1,828,667	Carroll	$1,230,667	Cannon	$731,478	Van Buren	$143,519		
		Rutherford	$5,323,121	Chester	$837,092	Carter	$2,497,728	Wayne	$1,386,123		
				Dickson	$1,032,642	Claiborne	$1,746,971				
				Dyer	$2,194,341	Clay	$377,975				
				Franklin	$1,902,441	Cocke	$131,260				
				Grainger	$589,101	Coffee	$2,338,029				
				Greene	$3,655,855	Crockett	$811,710				
				Hamblen	$3,705,824	Cumberland	$466,261				
				Hamilton	$17,798,170	Davidson	$38,079,522				
				Hawkins	$3,615,928	Decatur	$462,436				
				Henderson	$1,475,278	DeKalb	$724,172				
				Hickman	$1,642,658	Fentress	$703,483				
				Humphreys	$1,179,269	Gibson	$3,075,817				
				Jefferson	$1,499,816	Giles	$1,321,101				
				Knox	$13,667,744	Grundy	$750,625				
				Loudon	$1,606,963	Hancock	$601,586				
				Madison	$6,810,156	Hardeman	$2,178,327				
				Marion	$3,764,107	Hardin	$1,044,060				
				Marshall	$1,252,721	Haywood	$780,779				
				Maury	$4,972,875	Henry	$1,935,167				
				McNairy	$1,044,059	Houston	$430,177				
				Monroe	$1,353,139	Johnson	$677,573				
				Montgomery	$6,415,642	Lauderdale	$1,676,186				
				Obion	$2,091,659	Lewis	$553,559				
				Overton	$2,017,695	Lincoln	$1,632,692				
				Pickett	$183,509	Macon	$864,479				
				Polk	$1,117,100	McMinn	$1,239,308				
				Sequatchie	$339,900	Meigs	$731,478				
				Sevier	$3,926,027	Moore	$189,223				
				Smith	$1,289,364	Morgan	$813,867				
				Sullivan	$12,889,708	Putnam	$3,087,547				
				Sumner	$2,343,418	Rhea	$973,404				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Tipton	$5,376,454	Roane	$3,143,674				
				Union	$1,433,100	Scott	$1,289,364				
				Wilson	$4,417,683	Shelby	$61,194,199				
						Stewart	$761,495				
						Trousdale	$736,985				
						Unicoi	$1,467,892				
						Warren	$1,735,696				
						Washington	$3,971,952				
						Weakley	$945,343				
						White	$866,015				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 71 – Loss Estimation by GIS Analysis, Floods

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Blount	$6,109,706	Anderson	$4,947,581	Crockett	$811,710	Haywood	$780,779	Lauderdale	$1,676,186	Dyer	$2,194,341
Dickson	$1,032,642	Bedford	$1,742,550	Decatur	$462,436					Lake	$573,379
Jefferson	$1,499,816	Benton	$932,359	Gibson	$3,075,817						
Knox	$13,667,744	Bledsoe	$506,717	Hardeman	$2,178,327						
Loudon	$1,606,963	Bradley	$6,839,962	Hardin	$1,044,060						
Moore	$189,223	Campbell	$2,986,882	Henry	$1,935,167						
Overton	$2,017,695	Cannon	$731,478	Obion	$2,091,659						
Putnam	$3,087,547	Carroll	$1,230,667	Perry	$270,866						
Robertson	$1,828,667	Carter	$2,497,728	Shelby	$61,194,199						
Sumner	$2,343,418	Cheatham	$586,467	Tipton	$5,376,454						
Williamson	$828,101	Chester	$837,092	Weakley	$945,343						
Wilson	$4,417,683	Claiborne	$1,746,971								
		Clay	$377,975								
		Cocke	$131,260								
		Coffee	$2,338,029								
		Cumberland	$466,261								
		Davidson	$38,079,522								
		DeKalb	$724,172								
		Fayette	$1,190,307								
		Fentress	$703,483								
		Franklin	$1,902,441								

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Giles	$1,321,101								
		Grainger	$589,101								
		Greene	$3,655,855								
		Grundy	$750,625								
		Hamblen	$3,705,824								
		Hamilton	$17,798,170								
		Hancock	$601,586								
		Hawkins	$3,615,928								
		Henderson	$1,475,278								
		Hickman	$1,642,658								
		Houston	$430,177								
		Humphreys	$1,179,269								
		Jackson	$1,170,727								
		Johnson	$677,573								
		Lawrence	$1,516,070								
		Lewis	$553,559								
		Lincoln	$1,632,692								
		Macon	$864,479								
		Madison	$6,810,156								
		Marion	$3,764,107								
		Marshall	$1,252,721								
		Maury	$4,972,875								
		McMinn	$1,239,308								
		McNairy	$1,044,059								
		Meigs	$731,478								
		Monroe	$1,353,139								
		Montgomery	$6,415,642								
		Morgan	$813,867								
		Pickett	$183,509								
		Polk	$1,117,100								
		Rhea	$973,404								
		Roane	$3,143,674								
		Rutherford	$5,323,121								
		Scott	$1,289,364								
		Sequatchie	$339,900								
		Sevier	$3,926,027								
		Smith	$1,289,364								

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Stewart	$761,495								
		Sullivan	$12,889,708								
		Trousdale	$736,985								
		Unicoi	$1,467,892								
		Union	$1,433,100								
		Van Buren	$143,519								
		Warren	$1,735,696								
		Washington	$3,971,952								
		Wayne	$1,386,123								
		White	$866,015								

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 72 – Loss Estimation by GIS Analysis, Hail

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Cheatham	$586,467	Bedford	$1,742,550	Anderson	$4,947,581	Bledsoe	$506,717	Lake	$573,379
		Fayette	$1,190,307	Benton	$932,359	Bradley	$6,839,962	Davidson	$38,079,522		
		Montgomery	$6,415,642	Blount	$6,109,706	Campbell	$2,986,882	Hardeman	$2,178,327		
		Robertson	$1,828,667	Cannon	$731,478	Carter	$2,497,728				
		Rutherford	$5,323,121	Carroll	$1,230,667	Chester	$837,092				
		Wilson	$4,417,683	Claiborne	$1,746,971	Cocke	$131,260				
				Clay	$377,975	Cumberland	$466,261				
				Coffee	$2,338,029	Decatur	$462,436				
				Crockett	$811,710	Gibson	$3,075,817				
				DeKalb	$724,172	Grainger	$589,101				
				Dickson	$1,032,642	Grundy	$750,625				
				Dyer	$2,194,341	Hamilton	$17,798,170				
				Fentress	$703,483	Hancock	$601,586				
				Franklin	$1,902,441	Hardin	$1,044,060				
				Giles	$1,321,101	Henry	$1,935,167				
				Greene	$3,655,855	Hickman	$1,642,658				
				Hamblen	$3,705,824	Houston	$430,177				
				Hawkins	$3,615,928	Jackson	$1,170,727				
				Haywood	$780,779	Johnson	$677,573				
				Henderson	$1,475,278	Knox	$13,667,744				
				Humphreys	$1,179,269	Lauderdale	$1,676,186				
				Jefferson	$1,499,816	Lawrence	$1,516,070				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Lincoln	$1,632,692	Lewis	$553,559				
				Macon	$864,479	Loudon	$1,606,963				
				Marshall	$1,252,721	Madison	$6,810,156				
				Maury	$4,972,875	Marion	$3,764,107				
				Monroe	$1,353,139	McMinn	$1,239,308				
				Moore	$189,223	McNairy	$1,044,059				
				Obion	$2,091,659	Meigs	$731,478				
				Overton	$2,017,695	Morgan	$813,867				
				Pickett	$183,509	Perry	$270,866				
				Polk	$1,117,100	Rhea	$973,404				
				Putnam	$3,087,547	Roane	$3,143,674				
				Scott	$1,289,364	Sequatchie	$339,900				
				Sevier	$3,926,027	Shelby	$61,194,199				
				Smith	$1,289,364	Sullivan	$12,889,708				
				Stewart	$761,495	Unicoi	$1,467,892				
				Sumner	$2,343,418	Van Buren	$143,519				
				Tipton	$5,376,454	Wayne	$1,386,123				
				Trousdale	$736,985	Weakley	$945,343				
				Union	$1,433,100	White	$866,015				
				Warren	$1,735,696						
				Washington	$3,971,952						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 73 – Loss Estimation by GIS Analysis, High & Strong Winds

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Cheatham	$586,467	Cannon	$731,478	Anderson	$4,947,581	Bledsoe	$506,717	Carter	$2,497,728
		Montgomery	$6,415,642	Clay	$377,975	Bedford	$1,742,550	Bradley	$6,839,962	Cocke	$131,260
		Robertson	$1,828,667	Davidson	$38,079,522	Benton	$932,359	Carroll	$1,230,667	Greene	$3,655,855
		Sumner	$2,343,418	Dickson	$1,032,642	Blount	$6,109,706	Crockett	$811,710	Lake	$573,379
				Fayette	$1,190,307	Campbell	$2,986,882	Gibson	$3,075,817	McMinn	$1,239,308
				Franklin	$1,902,441	Chester	$837,092	Grundy	$750,625	Unicoi	$1,467,892
				Giles	$1,321,101	Claiborne	$1,746,971	Hardeman	$2,178,327	Washington	$3,971,952
				Henderson	$1,475,278	Coffee	$2,338,029	Jefferson	$1,499,816		
				Humphreys	$1,179,269	Cumberland	$466,261	Johnson	$677,573		
				Lawrence	$1,516,070	Decatur	$462,436	Loudon	$1,606,963		
				Lincoln	$1,632,692	DeKalb	$724,172	Meigs	$731,478		

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Macon	$864,479	Dyer	$2,194,341	Monroe	$1,353,139		
				Marion	$3,764,107	Fentress	$703,483	Perry	$270,866		
				Maury	$4,972,875	Grainger	$589,101	Polk	$1,117,100		
				McNairy	$1,044,059	Hamblen	$3,705,824	Rhea	$973,404		
				Obion	$2,091,659	Hamilton	$17,798,170	Sevier	$3,926,027		
				Overton	$2,017,695	Hancock	$601,586	Sullivan	$12,889,708		
				Pickett	$183,509	Hardin	$1,044,060	Van Buren	$143,519		
				Putnam	$3,087,547	Hawkins	$3,615,928				
				Rutherford	$5,323,121	Haywood	$780,779				
				Scott	$1,289,364	Henry	$1,935,167				
				Shelby	$61,194,199	Hickman	$1,642,658				
				Smith	$1,289,364	Houston	$430,177				
				Stewart	$761,495	Jackson	$1,170,727				
				Tipton	$5,376,454	Knox	$13,667,744				
				Trousdale	$736,985	Lauderdale	$1,676,186				
				Wilson	$4,417,683	Lewis	$553,559				
						Madison	$6,810,156				
						Marshall	$1,252,721				
						Moore	$189,223				
						Morgan	$813,867				
						Roane	$3,143,674				
						Sequatchie	$339,900				
						Union	$1,433,100				
						Warren	$1,735,696				
						Wayne	$1,386,123				
						Weakley	$945,343				
						White	$866,015				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 74 – Loss Estimation by GIS Analysis, Land Subsidence

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Bedford	$1,742,550	Anderson	$4,947,581	Campbell	$2,986,882	Bledsoe	$506,717	Van Buren	$143,519
		Cheatham	$586,467	Benton	$932,359	Carter	$2,497,728	Claiborne	$1,746,971	White	$866,015
		Davidson	$38,079,522	Blount	$6,109,706	Clay	$377,975	Cumberland	$466,261		
		Dickson	$1,032,642	Bradley	$6,839,962	Cocke	$131,260	Grundy	$750,625		

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Fayette	$1,190,307	Cannon	$731,478	DeKalb	$724,172	Jackson	$1,170,727		
		Marshall	$1,252,721	Carroll	$1,230,667	Fentress	$703,483	Lake	$573,379		
		Maury	$4,972,875	Chester	$837,092	Franklin	$1,902,441	Overton	$2,017,695		
		Montgomery	$6,415,642	Coffee	$2,338,029	Grainger	$589,101	Putnam	$3,087,547		
		Robertson	$1,828,667	Crockett	$811,710	Hancock	$601,586	Warren	$1,735,696		
		Rutherford	$5,323,121	Decatur	$462,436	Hardeman	$2,178,327				
		Shelby	$61,194,199	Dyer	$2,194,341	Johnson	$677,573				
		Sumner	$2,343,418	Gibson	$3,075,817	Marion	$3,764,107				
		Tipton	$5,376,454	Giles	$1,321,101	Perry	$270,866				
		Wilson	$4,417,683	Greene	$3,655,855	Pickett	$183,509				
				Hamblen	$3,705,824	Sequatchie	$339,900				
				Hamilton	$17,798,170	Union	$1,433,100				
				Hardin	$1,044,060	Wayne	$1,386,123				
				Hawkins	$3,615,928						
				Haywood	$780,779						
				Henderson	$1,475,278						
				Henry	$1,935,167						
				Hickman	$1,642,658						
				Houston	$430,177						
				Humphreys	$1,179,269						
				Jefferson	$1,499,816						
				Knox	$13,667,744						
				Lauderdale	$1,676,186						
				Lawrence	$1,516,070						
				Lewis	$553,559						
				Lincoln	$1,632,692						
				Loudon	$1,606,963						
				Macon	$864,479						
				Madison	$6,810,156						
				McMinn	$1,239,308						
				McNairy	$1,044,059						
				Meigs	$731,478						
				Monroe	$1,353,139						
				Moore	$189,223						
				Morgan	$813,867						
				Obion	$2,091,659						
				Polk	$1,117,100						

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Rhea	$973,404						
				Roane	$3,143,674						
				Scott	$1,289,364						
				Sevier	$3,926,027						
				Smith	$1,289,364						
				Stewart	$761,495						
				Sullivan	$12,889,708						
				Trousdale	$736,985						
				Unicoi	$1,467,892						
				Washington	$3,971,952						
				Weakley	$945,343						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 75 – Loss Estimation by GIS Analysis, Landslides

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Cheatham	$586,467	Bedford	$1,742,550	Benton	$932,359	Anderson	$4,947,581	Campbell	$2,986,882	Johnson	$677,573
Rutherford	$5,323,121	Chester	$837,092	Blount	$6,109,706	Bledsoe	$506,717	Carter	$2,497,728	Lake	$573,379
Sumner	$2,343,418	Coffee	$2,338,029	Bradley	$6,839,962	Clay	$377,975	Claiborne	$1,746,971	Unicoi	$1,467,892
Williamson	$828,101	Davidson	$38,079,522	Cannon	$731,478	Dyer	$2,194,341	Cocke	$131,260		
Wilson	$4,417,683	Dickson	$1,032,642	Carroll	$1,230,667	Fentress	$703,483	Cumberland	$466,261		
		Fayette	$1,190,307	Crockett	$811,710	Grainger	$589,101	Grundy	$750,625		
		Henderson	$1,475,278	Decatur	$462,436	Hamblen	$3,705,824	Hancock	$601,586		
		Humphreys	$1,179,269	DeKalb	$724,172	Hawkins	$3,615,928	Morgan	$813,867		
		Lawrence	$1,516,070	Franklin	$1,902,441	Jackson	$1,170,727	Scott	$1,289,364		
		Lincoln	$1,632,692	Gibson	$3,075,817	Lauderdale	$1,676,186	Van Buren	$143,519		
		Macon	$864,479	Giles	$1,321,101	Monroe	$1,353,139				
		Madison	$6,810,156	Greene	$3,655,855	Obion	$2,091,659				
		Marshall	$1,252,721	Hamilton	$17,798,170	Pickett	$183,509				
		Maury	$4,972,875	Hardeman	$2,178,327	Polk	$1,117,100				
		McNairy	$1,044,059	Hardin	$1,044,060	Rhea	$973,404				
		Montgomery	$6,415,642	Haywood	$780,779	Roane	$3,143,674				
		Moore	$189,223	Henry	$1,935,167	Sequatchie	$339,900				
		Robertson	$1,828,667	Hickman	$1,642,658	Sevier	$3,926,027				
		Trousdale	$736,985	Houston	$430,177	Sullivan	$12,889,708				
				Jefferson	$1,499,816	Union	$1,433,100				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Knox	$13,667,744						
				Lewis	$553,559						
				Loudon	$1,606,963						
				Marion	$3,764,107						
				McMinn	$1,239,308						
				Meigs	$731,478						
				Overton	$2,017,695						
				Perry	$270,866						
				Putnam	$3,087,547						
				Shelby	$61,194,199						
				Smith	$1,289,364						
				Stewart	$761,495						
				Tipton	$5,376,454						
				Warren	$1,735,696						
				Washington	$3,971,952						
				Wayne	$1,386,123						
				Weakley	$945,343						
				White	$866,015						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 76 – Loss Estimation by GIS Analysis, Lightning

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Anderson	$4,947,581	Bedford	$1,742,550	Benton	$932,359	Bledsoe	$506,717	Cumberland	$466,261	Jackson	$1,170,727
Blount	$6,109,706	Bradley	$6,839,962	Campbell	$2,986,882	Carter	$2,497,728	Fentress	$703,483	Lake	$573,379
Cheatham	$586,467	Chester	$837,092	Cannon	$731,478	Clay	$377,975				
Dickson	$1,032,642	Decatur	$462,436	Carroll	$1,230,667	Cocke	$131,260				
Fayette	$1,190,307	Giles	$1,321,101	Claiborne	$1,746,971	Hardeman	$2,178,327				
Knox	$13,667,744	Greene	$3,655,855	Coffee	$2,338,029	Henry	$1,935,167				
Loudon	$1,606,963	Hamblen	$3,705,824	Crockett	$811,710	Macon	$864,479				
McMinn	$1,239,308	Hamilton	$17,798,170	Davidson	$38,079,522	Overton	$2,017,695				
Monroe	$1,353,139	Hardin	$1,044,060	DeKalb	$724,172	Shelby	$61,194,199				
Robertson	$1,828,667	Hawkins	$3,615,928	Dyer	$2,194,341	Van Buren	$143,519				
Sumner	$2,343,418	Henderson	$1,475,278	Franklin	$1,902,441						
Williamson	$828,101	Hickman	$1,642,658	Gibson	$3,075,817						
		Humphreys	$1,179,269	Grainger	$589,101						

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Jefferson	$1,499,816	Grundy	$750,625						
		Marion	$3,764,107	Hancock	$601,586						
		Marshall	$1,252,721	Haywood	$780,779						
		McNairy	$1,044,059	Houston	$430,177						
		Meigs	$731,478	Johnson	$677,573						
		Obion	$2,091,659	Lauderdale	$1,676,186						
		Polk	$1,117,100	Lawrence	$1,516,070						
		Rhea	$973,404	Lewis	$553,559						
		Roane	$3,143,674	Lincoln	$1,632,692						
		Rutherford	$5,323,121	Madison	$6,810,156						
		Sequatchie	$339,900	Maury	$4,972,875						
		Sevier	$3,926,027	Montgomery	$6,415,642						
		Smith	$1,289,364	Moore	$189,223						
		Tipton	$5,376,454	Morgan	$813,867						
		Warren	$1,735,696	Perry	$270,866						
		Washington	$3,971,952	Pickett	$183,509						
				Putnam	$3,087,547						
				Scott	$1,289,364						
				Stewart	$761,495						
				Sullivan	$12,889,708						
				Trousdale	$736,985						
				Unicoi	$1,467,892						
				Union	$1,433,100						
				Wayne	$1,386,123						
				Weakley	$945,343						
				White	$866,015						
				Wilson	$4,417,683						

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 77 – Loss Estimation by GIS Analysis, Thunderstorm Winds

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Cheatham	$586,467	Bedford	$1,742,550	Anderson	$4,947,581	Bledsoe	$506,717	Lake	$573,379
		Fayette	$1,190,307	Cannon	$731,478	Benton	$932,359	Campbell	$2,986,882		
		Marshall	$1,252,721	Carroll	$1,230,667	Blount	$6,109,706	Davidson	$38,079,522		
		Robertson	$1,828,667	Chester	$837,092	Bradley	$6,839,962	Grainger	$589,101		

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
		Rutherford	$5,323,121	Coffee	$2,338,029	Carter	$2,497,728	Hancock	$601,586		
				Crockett	$811,710	Claiborne	$1,746,971	McMinn	$1,239,308		
				DeKalb	$724,172	Clay	$377,975	Meigs	$731,478		
				Dickson	$1,032,642	Cocke	$131,260				
				Dyer	$2,194,341	Cumberland	$466,261				
				Franklin	$1,902,441	Decatur	$462,436				
				Gibson	$3,075,817	Fentress	$703,483				
				Henderson	$1,475,278	Giles	$1,321,101				
				Henry	$1,935,167	Greene	$3,655,855				
				Humphreys	$1,179,269	Grundy	$750,625				
				Lauderdale	$1,676,186	Hamblen	$3,705,824				
				Lincoln	$1,632,692	Hamilton	$17,798,170				
				Macon	$864,479	Hardeman	$2,178,327				
				Madison	$6,810,156	Hardin	$1,044,060				
				Maury	$4,972,875	Hawkins	$3,615,928				
				McNairy	$1,044,059	Haywood	$780,779				
				Montgomery	$6,415,642	Hickman	$1,642,658				
				Moore	$189,223	Houston	$430,177				
				Obion	$2,091,659	Jackson	$1,170,727				
				Overton	$2,017,695	Jefferson	$1,499,816				
				Pickett	$183,509	Johnson	$677,573				
				Putnam	$3,087,547	Knox	$13,667,744				
				Sevier	$3,926,027	Lawrence	$1,516,070				
				Shelby	$61,194,199	Lewis	$553,559				
				Smith	$1,289,364	Loudon	$1,606,963				
				Stewart	$761,495	Marion	$3,764,107				
				Sumner	$2,343,418	Monroe	$1,353,139				
				Tipton	$5,376,454	Morgan	$813,867				
				White	$866,015	Perry	$270,866				
				Wilson	$4,417,683	Polk	$1,117,100				
						Rhea	$973,404				
						Roane	$3,143,674				
						Scott	$1,289,364				
						Sequatchie	$339,900				
						Sullivan	$12,889,708				
						Trousdale	$736,985				
						Unicoi	$1,467,892				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
						Union	$1,433,100				
						Van Buren	$143,519				
						Warren	$1,735,696				
						Washington	$3,971,952				
						Wayne	$1,386,123				
						Weakley	$945,343				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 78 – Loss Estimation by GIS Analysis, Tornadoes

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Blount	$6,109,706	Anderson	$4,947,581	Benton	$932,359	Crockett	$811,710	Lake	$573,379
		Cheatham	$586,467	Bedford	$1,742,550	Bledsoe	$506,717	Dyer	$2,194,341		
		Fayette	$1,190,307	Chester	$837,092	Bradley	$6,839,962	Gibson	$3,075,817		
		Knox	$13,667,744	Claiborne	$1,746,971	Campbell	$2,986,882	Hardeman	$2,178,327		
		Wilson	$4,417,683	Decatur	$462,436	Cannon	$731,478	Weakley	$945,343		
				Dickson	$1,032,642	Carroll	$1,230,667				
				Franklin	$1,902,441	Carter	$2,497,728				
				Grainger	$589,101	Clay	$377,975				
				Greene	$3,655,855	Cocke	$131,260				
				Hamblen	$3,705,824	Coffee	$2,338,029				
				Hawkins	$3,615,928	Cumberland	$466,261				
				Henderson	$1,475,278	Davidson	$38,079,522				
				Hickman	$1,642,658	DeKalb	$724,172				
				Humphreys	$1,179,269	Fentress	$703,483				
				Jefferson	$1,499,816	Giles	$1,321,101				
				Loudon	$1,606,963	Grundy	$750,625				
				Macon	$864,479	Hamilton	$17,798,170				
				Marion	$3,764,107	Hancock	$601,586				
				Marshall	$1,252,721	Hardin	$1,044,060				
				Maury	$4,972,875	Haywood	$780,779				
				Meigs	$731,478	Henry	$1,935,167				
				Monroe	$1,353,139	Houston	$430,177				
				Montgomery	$6,415,642	Jackson	$1,170,727				
				Moore	$189,223	Johnson	$677,573				
				Morgan	$813,867	Lauderdale	$1,676,186				

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Polk	$1,117,100	Lawrence	$1,516,070				
				Putnam	$3,087,547	Lewis	$553,559				
				Rhea	$973,404	Lincoln	$1,632,692				
				Roane	$3,143,674	Madison	$6,810,156				
				Robertson	$1,828,667	McMinn	$1,239,308				
				Rutherford	$5,323,121	McNairy	$1,044,059				
				Sevier	$3,926,027	Obion	$2,091,659				
				Smith	$1,289,364	Overton	$2,017,695				
				Sullivan	$12,889,708	Perry	$270,866				
				Sumner	$2,343,418	Pickett	$183,509				
				Tipton	$5,376,454	Scott	$1,289,364				
				Trousdale	$736,985	Sequatchie	$339,900				
				Union	$1,433,100	Shelby	$61,194,199				
				Washington	$3,971,952	Stewart	$761,495				
						Unicoi	$1,467,892				
						Van Buren	$143,519				
						Warren	$1,735,696				
						Wayne	$1,386,123				
						White	$866,015				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 79 – Loss Estimation by GIS Analysis, Wildfires

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Bedford	$1,742,550	Blount	$6,109,706	Anderson	$4,947,581	Benton	$932,359	Hancock	$601,586
		Fayette	$1,190,307	Cheatham	$586,467	Bradley	$6,839,962	Bledsoe	$506,717	Lake	$573,379
		Robertson	$1,828,667	Coffee	$2,338,029	Cannon	$731,478	Campbell	$2,986,882		
		Rutherford	$5,323,121	Crockett	$811,710	Carroll	$1,230,667	Carter	$2,497,728		
		Shelby	$61,194,199	Davidson	$38,079,522	Chester	$837,092	Claiborne	$1,746,971		
		Tipton	$5,376,454	Dyer	$2,194,341	Decatur	$462,436	Clay	$377,975		
		Wilson	$4,417,683	Franklin	$1,902,441	DeKalb	$724,172	Cocke	$131,260		
				Gibson	$3,075,817	Dickson	$1,032,642	Cumberland	$466,261		
				Hamblen	$3,705,824	Fentress	$703,483	Grainger	$589,101		
				Henderson	$1,475,278	Giles	$1,321,101	Grundy	$750,625		
				Knox	$13,667,744	Greene	$3,655,855	Hardeman	$2,178,327		
				Lauderdale	$1,676,186	Hamilton	$17,798,170	Houston	$430,177		

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
				Lincoln	$1,632,692	Hardin	$1,044,060	Jackson	$1,170,727		
				Loudon	$1,606,963	Hawkins	$3,615,928	Johnson	$677,573		
				Madison	$6,810,156	Haywood	$780,779	Lewis	$553,559		
				Marshall	$1,252,721	Henry	$1,935,167	Perry	$270,866		
				Maury	$4,972,875	Hickman	$1,642,658	Sevier	$3,926,027		
				Montgomery	$6,415,642	Humphreys	$1,179,269	Unicoi	$1,467,892		
				Moore	$189,223	Jefferson	$1,499,816	Union	$1,433,100		
				Obion	$2,091,659	Lawrence	$1,516,070	Van Buren	$143,519		
				Sumner	$2,343,418	Macon	$864,479	Wayne	$1,386,123		
				Warren	$1,735,696	Marion	$3,764,107				
				Washington	$3,971,952	McMinn	$1,239,308				
						McNairy	$1,044,059				
						Meigs	$731,478				
						Monroe	$1,353,139				
						Morgan	$813,867				
						Overton	$2,017,695				
						Pickett	$183,509				
						Polk	$1,117,100				
						Putnam	$3,087,547				
						Rhea	$973,404				
						Roane	$3,143,674				
						Scott	$1,289,364				
						Sequatchie	$339,900				
						Smith	$1,289,364				
						Stewart	$761,495				
						Sullivan	$12,889,708				
						Trousdale	$736,985				
						Weakley	$945,343				
						White	$866,015				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

Table 80 – Loss Estimation by GIS Analysis, Winter Storms

Risk Rank 1	Loss Estimate	Risk Rank 2	Loss Estimate	Risk Rank 3	Loss Estimate	Risk Rank 4	Loss Estimate	Risk Rank 5	Loss Estimate	Risk Rank 6	Loss Estimate
Williamson	$828,101	Cheatham	$586,467	Blount	$6,109,706	Anderson	$4,947,581	Bledsoe	$506,717	Carter	$2,497,728
		Fayette	$1,190,307	Bradley	$6,839,962	Bedford	$1,742,550	Cannon	$731,478	DeKalb	$724,172
		Robertson	$1,828,667	Davidson	$38,079,522	Benton	$932,359	Clay	$377,975	Jackson	$1,170,727
		Shelby	$61,194,199	Franklin	$1,902,441	Campbell	$2,986,882	Cocke	$131,260	Lake	$573,379
				Giles	$1,321,101	Carroll	$1,230,667	Crockett	$811,710	Van Buren	$143,519
				Hamilton	$17,798,170	Chester	$837,092	Cumberland	$466,261		
				Hardin	$1,044,060	Claiborne	$1,746,971	Fentress	$703,483		
				Henderson	$1,475,278	Coffee	$2,338,029	Gibson	$3,075,817		
				Knox	$13,667,744	Decatur	$462,436	Grainger	$589,101		
				Lawrence	$1,516,070	Dickson	$1,032,642	Greene	$3,655,855		
				Lincoln	$1,632,692	Dyer	$2,194,341	Grundy	$750,625		
				Loudon	$1,606,963	Hardeman	$2,178,327	Hamblen	$3,705,824		
				Marion	$3,764,107	Hawkins	$3,615,928	Hancock	$601,586		
				Marshall	$1,252,721	Henry	$1,935,167	Haywood	$780,779		
				Maury	$4,972,875	Hickman	$1,642,658	Houston	$430,177		
				McNairy	$1,044,059	Humphreys	$1,179,269	Johnson	$677,573		
				Monroe	$1,353,139	Jefferson	$1,499,816	Meigs	$731,478		
				Montgomery	$6,415,642	Lauderdale	$1,676,186	Morgan	$813,867		
				Moore	$189,223	Lewis	$553,559	Overton	$2,017,695		
				Obion	$2,091,659	Macon	$864,479	Perry	$270,866		
				Polk	$1,117,100	Madison	$6,810,156	Putnam	$3,087,547		
				Rutherford	$5,323,121	McMinn	$1,239,308	Rhea	$973,404		
				Sevier	$3,926,027	Pickett	$183,509	Sequatchie	$339,900		
				Sumner	$2,343,418	Roane	$3,143,674	Smith	$1,289,364		
				Tipton	$5,376,454	Scott	$1,289,364	Unicoi	$1,467,892		
				Wilson	$4,417,683	Stewart	$761,495	Union	$1,433,100		
						Sullivan	$12,889,708	Warren	$1,735,696		
						Trousdale	$736,985	Washington	$3,971,952		
						Wayne	$1,386,123	White	$866,015		
						Weakley	$945,343				

**The structure values are estimates extracted from FEMA's HAZUS-MH v2.1 inventory database.*

4.3 – Population Growth, Development Trends, & Land Use Changes

More often than not, mitigation projects address current or previous hazard vulnerabilities and are static in location. Additionally, it may take years for a mitigation project to mature from inception, grant application, construction, completion, and grant close out. In contrast, populations grow and shrink, private industry develops and constructs, and land use changes at a far quicker pace. It's imperative that this risk assessment addresses recent changes and attempts to predict the impact of future developments, since population growth, development trends, and land use changes can significantly alter a state's hazard vulnerability landscape. Specific examples of how vulnerabilities can quickly change are as follows:

- Unrestricted residential growth can increase a population's exposure to identified hazard prone areas.
- Increased population growth can outpace a local community's capability to protect itself from hazards such as providing reserve water resources during a drought.
- Rapid development can put a strain on a community's vulnerable resources such as its energy infrastructure.
- Residential development constructed quickly and inexpensively to meet consumer demand will often lack long term mitigation measures and resiliency.
- Rapid development under pressure to meet consumer demand can alter the landscape in ways affecting urban runoff, drainage, or other environmental considerations which have drastic effects on floodplains.
- An increase in businesses can increase the amount of hazardous materials being transported throughout the state to be used in the production of other goods of the maintenance of manufacturing equipment.
- An increase in businesses producing chemicals and other hazardous materials can increase a community's risk based on the new stockpiles as well as the materials being transported away from a site.

In this section, development changes and trends that effluence potential loss estimates are broken down into 3 categories: Land Use, Demographics, and Business & Industry.

Land Use

Land use changes have been broken down into zoning, floodplain management, wildfire mitigation, and building code changes.

Zoning Changes

Since the previous State Hazard Mitigation Plan was approved in 2010, Tennessee has experienced extensive changes to how the state administers land use and zoning assistance for local governments. In 2011, the Department of Economic and Community Development's Local Planning Assistance Office was eliminated. The Local Planning Assistance Office, which housed 6 regional offices and a staff of approximately 60 persons, was the state's center for providing land use, zoning, and community planning assistance to local governments. As part of the office's duties, local governments could receive state assistance in identifying areas in their communities that were more vulnerable to hazards impacts. This assistance would also include guidance on how to use land use and zoning procedures to reduce a community's vulnerability to flooding, wildfires, landslides, earthquakes, and other hazard events. With the elimination of the Local Planning Assistance Office, numerous communities no longer receive the technical expertise needed to help make land use discussions in hazard-prone areas. Many believe that this decision will affect Tennessee's hazard vulnerability in the future because there will be less pressure to not build in hazard-prone areas, especially for the state's more rural communities.

Floodplain Management Changes

Since the previous State Hazard Mitigation Plan was approved in 2010, state legislature passed Public Chapter No. 1091 which amends State Code T.C.A. 12-4-109. Public Chapter No. 1091 requires all communities with FEMA identified special flood hazard areas in Tennessee to adopt into FEMA's National Flood Insurance Program (NFIP). This Public Chapter has drastically increased statewide participation in the NFIP. Currently, 393 communities have joined the NFIP in Tennessee and only 18 haven't joined. Additionally, in 2010 the Tennessee Association of Floodplain Managers (TN AFPM) was created to support local floodplain managers, in August 2013 the Tennessee Department of Economic & Community Development contracted with the Tennessee Development Districts to start providing statewide floodplain management trainings, and in September 2013 Tennessee was the 40th state to join the Army Corps of Engineers' flood risk reduction initiative known as the Silver Jackets Program. Many believe that these initiatives will help drastically reduce the development in floodplains, thereby reducing future potential losses. Additionally the areas with the highest forecasted growth rates also now have some of the state's strongest floodplain management programs.

Wildfire Mitigation Changes

Since the 2010 plan, the Tennessee Division of Forestry has increased participation in the State's Firewise program and in Community Wildfire Protection Planning efforts. The Division of Forestry now has 2 "mitigation" specialists on staff to assist communities in determining approaches to reduce their vulnerabilities to wildfire threats. Because of the trend of retirees moving to the state's more forested areas, especially in the Upper Cumberland, Highland Rim, and Appalachian regions, these increased wildfire mitigation capabilities should help reduce some future wildfire vulnerabilities.

Building Code Changes

Since the 2010 plan, the state continues to utilize the 2009 International Residential Code. Meetings have been had to identify when the State should update to a newer set of building codes, but that is still to be determined. One amendment that was made in 2011 is the requirement for additions over 30 square feet to existing homes will now require a building permit. Also Memphis/Shelby County, which is considered Tennessee's greatest vulnerability in terms of a large-scale New Madrid earthquake event, adopted stronger seismic provisions into their building codes on October 1, 2013.

Demographics

Although, the State of Tennessee has been experiencing drastic population changes since 2000, very little has changed demographically since the approval and adoption of its previous plan. What changes have occurred are addressed in this risk assessment through the incorporation of the best available data. Exposure and impacts of hazards on changing communities is addressed by using the most up to date NOAA NCDC data. In terms of Tennessee's growing population, the risk assessment addresses these changes by using the latest SoVI© data which was published in 2010, post approval of the previously approved HMP. Map 12 depicts the population growth changes in Tennessee from 2000 to 2011.

Tables on the following pages display the US Census Bureau's predictions for Tennessee's future population growth. The higher a county's population growth, the greater the chance their hazard vulnerability will increase as well. Counties highlighted in red or orange will require the greatest predicted attention. This information is highly speculative, but it's the best available indicator.

Business & Industry

A group of 500 CEOs convening annually for "Chief Executive" magazine rated Tennessee the 4th most business friendly state, a position it has held since 2010, when it was 3rd. In 2011, the latest complete business growth statistics, Tennessee ranked 6th in the nation for economic growth. It is of no surprise, that with this reputation, Tennessee has managed to attract business and remain prosperous throughout the past decade's economic fluctuations. Tennessee is a main transportation route for rail, truck, and air transit, and hosts one of the county's major oil and natural gas pipelines. It is home to a number of national corporations including FedEx, AutoZone, International Paper, Pilot, Regal Entertainment, Eastman Chemical, Caterpillar Financial, and the North American headquarters of Nissan.

Tennessee's continued economic growth has similar impacts on its vulnerability as does its population growth. Vulnerability can be increased in 2 ways, first, by location based growth in identified hazard prone areas as in the case of manufacturing requiring river or lake access, or by the industry type itself as is the case with chemical manufacturing or mining. Table 84 illustrates Tennessee's GDP growth per industry over the past 3 years.

Table 81 – East Tennessee Population Growth Projections (2010 – 2030)						
% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)
County	**2010 Population**	**2020 Population**	**2030 Population**	**2010 - 2020 % Growth**	**2020 - 2030 % Growth**	**2010 - 2030 % Growth**
Anderson	75,129	77,949	80,367	3.75%	3.10%	6.97%
Bledsoe	12,876	12,674	13,150	-1.57%	3.76%	2.13%
Blount	123,010	137,001	155,543	11.37%	13.53%	26.45%
Bradley	98,963	108,423	117,834	9.56%	8.68%	19.07%
Campbell	40,716	43,036	44,846	5.70%	4.21%	10.14%
Carter	57,424	58,978	61,831	2.71%	4.84%	7.67%
Claiborne	32,213	34,843	38,784	8.16%	11.31%	20.40%
Cocke	35,662	40,302	47,868	13.01%	18.77%	34.23%
Cumberland	56,053	60,395	69,955	7.75%	15.83%	24.80%
Fentress	17,959	19,160	20,578	6.69%	7.40%	14.58%
Grainger	22,657	23,778	25,922	4.95%	9.02%	14.41%
Greene	68,831	71,574	75,163	3.99%	5.01%	9.20%
Hamblen	62,544	66,262	70,693	5.94%	6.69%	13.03%
Hamilton	336,463	352,163	355,597	4.67%	0.98%	5.69%
Hancock	6,819	6,606	6,360	-3.12%	-3.72%	-6.73%
Hawkins	56,833	58,149	56,744	2.32%	-2.42%	-0.16%
Jefferson	51,407	57,983	65,990	12.79%	13.81%	28.37%
Johnson	18,244	18,164	18,782	-0.44%	3.40%	2.95%
Knox	432,226	480,538	527,740	11.18%	9.82%	22.10%
Loudon	48,556	53,056	57,095	9.27%	7.61%	17.59%
Marion	28,237	28,014	27,406	-0.79%	-2.17%	-2.94%
McMinn	52,266	54,984	59,288	5.20%	7.83%	13.44%
Meigs	11,753	12,742	13,148	8.41%	3.19%	11.87%
Monroe	44,519	48,508	52,916	8.96%	9.09%	18.86%
Morgan	21,987	22,265	22,992	1.26%	3.27%	4.57%
Pickett	5,077	4,790	4,579	-5.65%	-4.41%	-9.81%
Polk	16,825	16,350	15,885	-2.82%	-2.84%	-5.59%
Rhea	31,809	35,062	37,252	10.23%	6.25%	17.11%
Roane	54,181	54,246	54,059	0.12%	-0.34%	-0.23%
Scott	22,228	22,244	23,215	0.07%	4.37%	4.44%
Sequatchie	14,112	16,230	18,669	15.01%	15.03%	32.29%
Sevier	89,889	101,102	116,428	12.47%	15.16%	29.52%
Sullivan	156,823	159,275	158,532	1.56%	-0.47%	1.09%
Unicoi	18,313	18,470	18,696	0.86%	1.22%	2.09%
Union	19,109	19,743	20,391	3.32%	3.28%	6.71%
Washington	122,979	139,679	154,511	13.58%	10.62%	25.64%
East Tennessee	**2,364,692**	**2,534,738**	**2,708,809**	**5.29%**	**5.85%**	**14.55%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 82 – Middle Tennessee Population Growth Projections (2010 – 2030)						
% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)
County	**2010 Population**	**2020 Population**	**2030 Population**	**2010 - 2020 % Growth**	**2020 - 2030 % Growth**	**2010 - 2030 % Growth**
Bedford	45,058	52,145	62,095	15.73%	19.08%	37.81%
Cannon	13,801	14,713	15,526	6.61%	5.53%	12.50%
Cheatham	39,105	41,002	42,004	4.85%	2.44%	7.41%
Clay	7,861	7,623	7,424	-3.03%	-2.61%	-5.56%
Coffee	52,796	58,054	67,137	9.96%	15.65%	27.16%
Davidson	626,681	691,339	736,581	10.32%	6.54%	17.54%
DeKalb	18,723	19,875	21,559	6.15%	8.47%	15.15%
Dickson	49,666	51,766	53,611	4.23%	3.56%	7.94%
Franklin	41,052	42,765	46,437	4.17%	8.59%	13.12%
Giles	29,485	29,097	28,328	-1.32%	-2.64%	-3.92%
Grundy	13,703	13,271	12,883	-3.15%	-2.92%	-5.98%
Hickman	24,690	25,171	25,633	1.95%	1.84%	3.82%
Houston	8,426	8,594	8,695	1.99%	1.18%	3.19%
Humphreys	18,538	18,650	18,855	0.60%	1.10%	1.71%
Jackson	11,638	11,544	11,258	-0.81%	-2.48%	-3.27%
Lawrence	41,869	42,169	42,030	0.72%	-0.33%	0.38%
Lewis	12,161	12,030	11,927	-1.08%	-0.86%	-1.92%
Lincoln	33,361	37,681	44,505	12.95%	18.11%	33.40%
Macon	22,248	23,813	25,707	7.03%	7.95%	15.55%
Marshall	30,617	33,622	36,912	9.81%	9.79%	20.56%
Maury	80,956	94,620	109,023	16.88%	15.22%	34.67%
Montgomery	172,331	202,325	227,710	17.40%	12.55%	32.14%
Moore	6,362	6,382	6,618	0.31%	3.70%	4.02%
Overton	22,083	23,043	24,376	4.35%	5.78%	10.38%
Perry	7,915	7,954	7,729	0.49%	-2.83%	-2.35%
Putnam	72,321	84,511	97,154	16.86%	14.96%	34.34%
Robertson	66,283	74,995	82,447	13.14%	9.94%	24.39%
Rutherford	262,604	339,867	434,009	29.42%	27.70%	65.27%
Smith	19,166	20,598	22,402	7.47%	8.76%	16.88%
Stewart	13,324	14,175	15,019	6.39%	5.95%	12.72%
Sumner	160,645	184,643	210,015	14.94%	13.74%	30.73%
Trousdale	7,870	8,772	9,640	11.46%	9.90%	22.49%
Van Buren	5,548	5,409	5,151	-2.51%	-4.77%	-7.16%
Warren	39,839	41,698	44,321	4.67%	6.29%	11.25%
Wayne	17,021	16,647	16,008	-2.20%	-3.84%	-5.95%
White	25,841	28,071	31,355	8.63%	11.70%	21.34%
Williamson	183,182	226,297	280,804	23.54%	24.09%	53.29%
Wilson	113,993	133,998	154,117	17.55%	15.01%	35.20%
Middle Tennessee	**2,418,763**	**2,748,929**	**3,097,005**	**7.28%**	**7.15%**	**28.04%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 83 – West Tennessee Population Growth Projections (2010 – 2030)

% Growth Categories						
(X < 0%)	(0% < 5%)	(5% < 10%)	(10% < 15%)	(15% < 20%)	(20% < 25%)	(25% < X)

County	2010 Population	2020 Population	2030 Population	2010 - 2020 % Growth	2020 - 2030 % Growth	2010 - 2030 % Growth
Benton	16,489	15,896	15,307	-3.60%	-3.71%	-7.17%
Carroll	28,522	27,692	26,933	-2.91%	-2.74%	-5.57%
Chester	17,131	18,305	19,523	6.85%	6.65%	13.96%
Crockett	14,586	14,815	15,186	1.57%	2.50%	4.11%
Decatur	11,757	11,502	11,397	-2.17%	-0.91%	-3.06%
Dyer	38,335	38,493	38,405	0.41%	-0.23%	0.18%
Fayette	38,413	46,260	56,903	20.43%	23.01%	48.13%
Gibson	49,683	52,072	53,740	4.81%	3.20%	8.17%
Hardeman	27,253	26,212	25,532	-3.82%	-2.59%	-6.31%
Hardin	26,026	26,440	27,040	1.59%	2.27%	3.90%
Haywood	18,787	18,437	18,707	-1.86%	1.46%	-0.43%
Henderson	27,769	28,611	29,611	3.03%	3.50%	6.63%
Henry	32,330	32,905	33,516	1.78%	1.86%	3.67%
Lake	7,832	7,399	6,952	-5.53%	-6.04%	-11.24%
Lauderdale	27,815	27,388	27,702	-1.54%	1.15%	-0.41%
Madison	98,294	102,228	106,390	4.00%	4.07%	8.24%
McNairy	26,075	26,917	27,454	3.23%	2.00%	5.29%
Obion	31,807	31,082	30,628	-2.28%	-1.46%	-3.71%
Shelby	927,644	953,346	960,700	2.77%	0.77%	3.56%
Tipton	61,081	68,999	77,508	12.96%	12.33%	26.89%
Weakley	35,021	36,042	36,729	2.92%	1.91%	4.88%
West Tennessee	**1,562,650**	**1,611,041**	**1,645,863**	**2.03%**	**2.33%**	**5.33%**
Tennessee	**6,346,105**	**6,894,708**	**7,451,677**	**8.64%**	**8.08%**	**17.42%**

**The data are from the U.S. Census Bureau.*

Table 84 – Industrial Growth, Tennessee (2010 – 2012)						
% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 – 2011 GDP Growth**	**2011 – 2012 GDP Growth**	**2010 – 2012 GDP Growth**
All industry total	$227,360	$232,891	$240,523	2.43%	3.28%	5.79%
Private industries	$201,164	$206,964	$214,557	2.88%	3.67%	6.66%
Agriculture, forestry, fishing, and hunting	$1,276	$1,122	$1,140	-12.07%	1.60%	-10.66%
Crop and animal production (Farms)	$929	$771	N/A	-17.01%	N/A	N/A
Forestry, fishing, and related activities	$321	$334	N/A	4.05%	N/A	N/A
Mining	$195	$165	$188	-15.38%	13.94%	-3.59%
Oil and gas extraction	$20	$17	N/A	-15.00%	N/A	N/A
Mining (except oil and gas)	$128	$115	N/A	-10.16%	N/A	N/A
Support activities for mining	$43	$27	N/A	-37.21%	N/A	N/A
Utilities	$1,441	$1,495	$1,486	3.75%	-0.60%	3.12%
Construction	$7,443	$7,638	$7,794	2.62%	2.04%	4.72%
Manufacturing	$33,486	$35,357	$38,211	5.59%	8.07%	14.11%
Durable goods	$18,414	$21,056	$24,028	14.35%	14.11%	30.49%
Wood product manufacturing	$844	$942	N/A	11.61%	N/A	N/A
Nonmetallic mineral product manufacturing	$741	$850	N/A	14.71%	N/A	N/A
Primary metal manufacturing	$895	$947	N/A	5.81%	N/A	N/A
Fabricated metal product manufacturing	$2,894	$2,995	N/A	3.49%	N/A	N/A
Machinery manufacturing	$2,262	$2,419	N/A	6.94%	N/A	N/A
Computer and electronic product manufacturing	$2,330	$2,848	N/A	22.23%	N/A	N/A
Electrical equipment, appliance, and component manufacturing	$1,790	$2,252	N/A	25.81%	N/A	N/A
Motor vehicle, body, trailer, and parts manufacturing	$2,956	$4,142	N/A	40.12%	N/A	N/A
Other transportation equipment manufacturing	$328	$364	N/A	10.98%	N/A	N/A
Furniture and related product manufacturing	$393	$379	N/A	-3.56%	N/A	N/A
Miscellaneous manufacturing	$2,227	$2,228	N/A	0.04%	N/A	N/A
Nondurable goods	$14,753	$14,273	$14,429	-3.25%	1.09%	-2.20%
Food and beverage and tobacco product manufacturing	$5,990	$5,797	N/A	-3.22%	N/A	N/A

% Growth Categories							
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)	
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 - 2011 GDP Growth**	**2011 - 2012 GDP Growth**	**2010 - 2012 GDP Growth**	
Textile mills and textile product mills	$434	$361	N/A	-16.82%	N/A	N/A	
Apparel and leather and allied product manufacturing	$264	$238	N/A	-9.85%	N/A	N/A	
Paper manufacturing	$2,089	$1,940	N/A	-7.13%	N/A	N/A	
Printing and related support activities	$837	$843	N/A	0.72%	N/A	N/A	
Petroleum and coal products manufacturing	$418	$325	N/A	-22.25%	N/A	N/A	
Chemical manufacturing	$3,103	$3,124	N/A	0.68%	N/A	N/A	
Plastics and rubber products manufacturing	$1,659	$1,700	N/A	2.47%	N/A	N/A	
Wholesale trade	$13,765	$14,082	$14,768	2.30%	4.87%	7.29%	
Retail trade	$18,503	$18,497	$18,957	-0.03%	2.49%	2.45%	
Transportation and warehousing	$11,112	$11,697	$11,941	5.26%	2.09%	7.46%	
Air transportation	$523	$543	N/A	3.82%	N/A	N/A	
Rail transportation	$513	$530	N/A	3.31%	N/A	N/A	
Water transportation	$466	$609	N/A	30.69%	N/A	N/A	
Truck transportation	$4,283	$4,370	N/A	2.03%	N/A	N/A	
Transit and ground passenger transportation	$331	$316	N/A	-4.53%	N/A	N/A	
Pipeline transportation	$42	$41	N/A	-2.38%	N/A	N/A	
Other transportation and support activities	$4,177	$4,407	N/A	5.51%	N/A	N/A	
Warehousing and storage	$811	$969	N/A	19.48%	N/A	N/A	
Information	$7,551	$7,926	$8,316	4.97%	4.92%	10.13%	
Publishing industries, except Internet	$1,163	$1,150	N/A	-1.12%	N/A	N/A	
Motion picture and sound recording industries	$1,006	$923	N/A	-8.25%	N/A	N/A	
Broadcasting and telecommunications	$4,520	$4,911	N/A	8.65%	N/A	N/A	
Information and data processing services	$886	$993	N/A	12.08%	N/A	N/A	
Finance and insurance	$15,322	$15,033	$15,829	-1.89%	5.30%	3.31%	
Federal Reserve banks, credit intermediation and related services	$7,610	$7,415	N/A	-2.56%	N/A	N/A	
Securities, commodity contracts, investments	$1,639	$1,496	N/A	-8.72%	N/A	N/A	
Insurance carriers and related activities	$5,915	$5,903	N/A	-0.20%	N/A	N/A	
Funds, trusts, and other financial vehicles	$173	$225	N/A	30.06%	N/A	N/A	

% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)

Industrial Sector	2010 GDP	2011 GDP	2012 GDP	2010 - 2011 GDP Growth	2011 - 2012 GDP Growth	2010 - 2012 GDP Growth
Real estate and rental and leasing	$25,516	$25,652	$25,522	0.53%	-0.51%	0.02%
Real estate	$22,382	$22,502	N/A	0.54%	N/A	N/A
Rental and leasing services and lessors of intangible assets	$3,132	$3,148	N/A	0.51%	N/A	N/A
Professional, scientific, and technical services	$12,981	$13,542	$13,744	4.32%	1.49%	5.88%
Legal services	$1,678	$1,653	N/A	-1.49%	N/A	N/A
Computer systems design and related services	$1,467	$1,572	N/A	7.16%	N/A	N/A
Other professional, scientific and technical services	$9,907	$10,412	N/A	5.10%	N/A	N/A
Management of companies and enterprises	$2,516	$2,607	$3,298	3.62%	26.51%	31.08%
Administrative and waste management services	$9,459	$10,187	$10,677	7.70%	4.81%	12.88%
Administrative and support services	$8,514	$9,282	N/A	9.02%	N/A	N/A
Waste management and remediation services	$941	$908	N/A	-3.51%	N/A	N/A
Educational services	$1,927	$1,927	$1,948	0.00%	1.09%	1.09%
Health care and social assistance	$22,788	$23,570	$23,841	3.43%	1.15%	4.62%
Ambulatory health care services	$11,750	$11,877	N/A	1.08%	N/A	N/A
Hospitals and nursing and residential care facilities	$9,835	$10,453	N/A	6.28%	N/A	N/A
Social assistance	$1,191	$1,215	N/A	2.02%	N/A	N/A
Arts, entertainment, and recreation	$2,289	$2,438	$2,615	6.51%	7.26%	14.24%
Performing arts, spectator sports, museums, and related services	$1,596	$1,717	N/A	7.58%	N/A	N/A
Amusement, gambling, and recreation	$692	$719	N/A	3.90%	N/A	N/A
Accommodation and food services	$7,227	$7,612	$7,863	5.33%	3.30%	8.80%
Accommodation	$1,721	$1,919	N/A	11.50%	N/A	N/A
Food services and drinking places	$5,491	$5,691	N/A	3.64%	N/A	N/A
Other services, except government	$6,195	$6,303	$6,308	1.74%	0.08%	1.82%
Government	$26,175	$25,966	$26,066	-0.80%	0.39%	-0.42%
Federal civilian	$5,393	$5,249	N/A	-2.67%	N/A	N/A
Federal military	$1,278	$1,164	N/A	-8.92%	N/A	N/A
State and local	$19,492	$19,540	N/A	0.25%	N/A	N/A
Natural resources and mining	$1,459	$1,275	$1,321	-12.61%	3.61%	-9.46%

% Growth Categories						
(X < -15%)	(-10% < -5%)	(-5% < 0%)	(0% < 5%)	(5% < 15%)	(15 < 25%)	(25% < X)
Industrial Sector	**2010 GDP**	**2011 GDP**	**2012 GDP**	**2010 - 2011 GDP Growth**	**2011 - 2012 GDP Growth**	**2010 - 2012 GDP Growth**
Trade	$32,198	$32,527	$33,690	1.02%	3.58%	4.63%
Transportation and utilities	$12,584	$13,221	$13,451	5.06%	1.74%	6.89%
Financial activities	$40,842	$40,682	$41,372	-0.39%	1.70%	1.30%
Professional and business services	$24,991	$26,358	$27,834	5.47%	5.60%	11.38%
Education and health services	$24,682	$25,453	$25,744	3.12%	1.14%	4.30%
Leisure and hospitality	$9,515	$10,048	$10,473	5.60%	4.23%	10.07%
Information, Communication, and Technology (ICT)	$6,173	$6,829	N/A	10.63%	N/A	N/A
Private goods-producing industries	$42,385	$44,200	$47,195	4.28%	6.78%	11.35%
Private services-providing industries	$158,660	$162,659	$167,291	2.52%	2.85%	5.44%

**The data are from the U.S. Bureau of Economic Analysis.*

***The GDP data are displayed as millions of 2005 chained dollars.*

4.4 – Potential Losses by HAZUS Simulation

Included in the risk assessment are comprehensive simulations conducted in FEMA's HAZUS-MH v2.1. To properly display Tennessee's risk to earthquakes this plan conducted 2 earthquake simulations and 4 riverine flood simulations.

The first simulation model is in accordance the USGS's NMSZ prediction detailed in Section 3.3EQ (50% chance in the next 50 years). A historic epicenter was chosen from the 1811/1812 earthquakes at the coordinates: 36.300000, -89.600000. An average depth of 6 kilometers was chosen based on historical earthquake patterns around this epicenter. Per the USGS's prediction, the simulation models an earthquake of magnitude 6.5.

The second simulation model is based on the largely unknown and studied risk in East Tennessee. A historical epicenter was chosen based on the largest recorded earthquake in the area. Its coordinates are: 34.695232, -82.969903. The historic depth of 3 kilometers was chosen based on the previous occurrence. Selecting a magnitude was difficult as the greatest in the area was a 4.6 and there is little seismological research for the area. A 6.0 magnitude earthquake was selected as it is a reasonable increase from 4.6, but does not make claim that there is a catastrophic risk in the area.

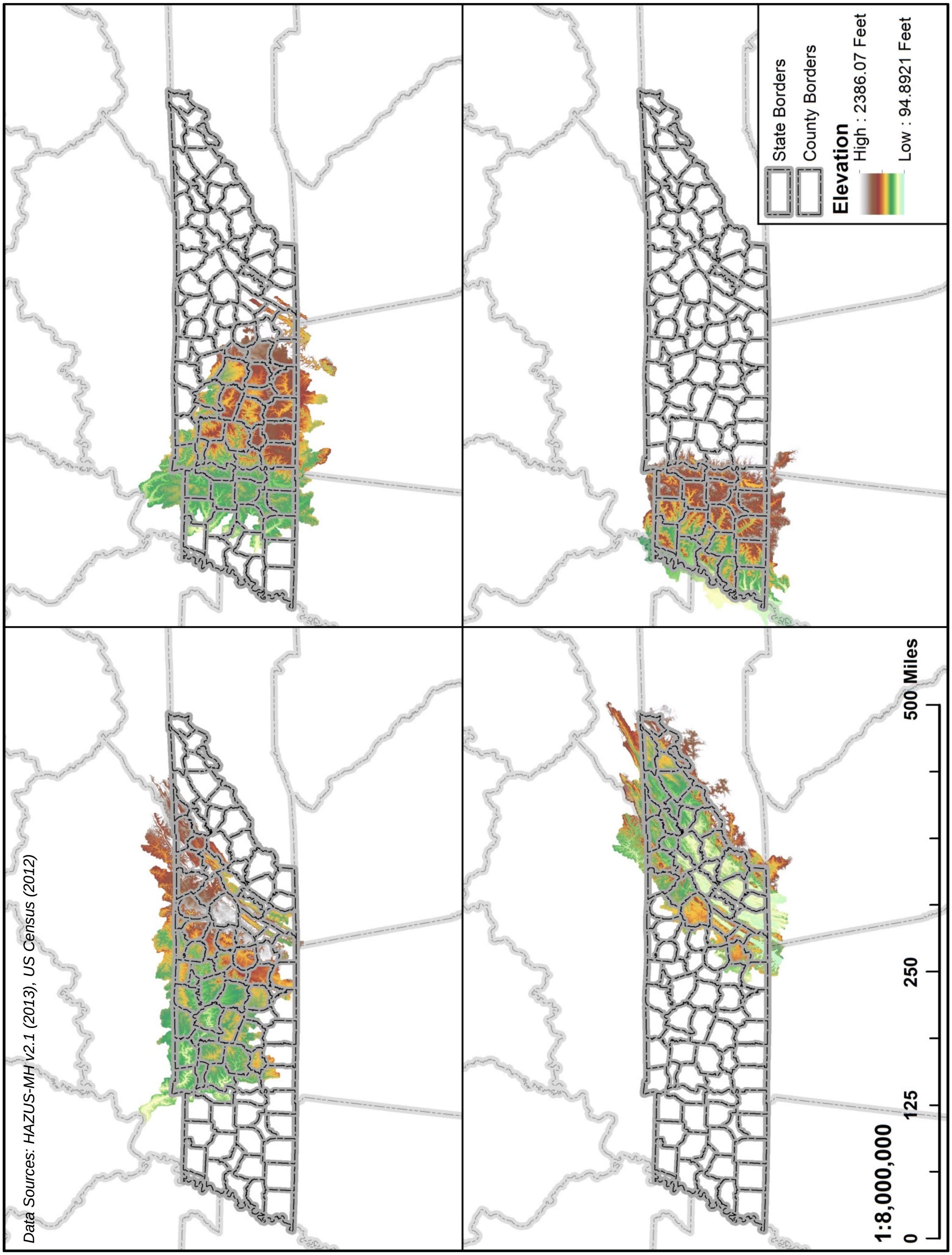
Both earthquake simulation models incorporated a NEHRP soil classification dataset and a soil liquefaction dataset. These datasets enhanced the accuracy of the simulation models.

The third through sixth simulation models utilize the USGS's National Elevation Database (at 1 arc second) as the baseline for determining stream basins, hydrology, and drainage. As it is unlikely multiple major river sheds will flood at the same time, 1 HAZUS model, calculating flood impacts simultaneously across the state did not make the most sense. Instead, 4 models were developed, each representing 1 of Tennessee's major river basins: the Cumberland, the lower Tennessee, the Mississippi, and the upper Tennessee River. Map 128 on the following page displays the river basin study regions.

A 50 square mile stream drainage setting was used to calculate each models hydrology functions. Increasing the accuracy of the stream drainage setting was not appropriate for modeling at such a large scale. None of the 4 models contains any failed hydrological reaches. Each scenario models the effects of a 500 year flood.

The following sub sections depict the simulation models' casualty estimates, debris generation, economic losses, shelter requirements, and structural damage. Maps have been included to display flood boundaries, epicenters, shake contours, and economic losses.

Map 128 – HAZUS Flood Model Study Regions



4.4.1 – HAZUS Model 1 – Earthquake – New Madrid Seismic Zone

Table 85 – HAZUS Earthquake Model 1, Casualty Report				
County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Anderson	0	0	0	0
Bedford	0	0	0	0
Benton	1	1	1	1
Bledsoe	0	0	0	0
Blount	0	0	0	0
Bradley	0	0	0	0
Campbell	0	0	0	0
Cannon	0	0	0	0
Carroll	6	5	5	5
Carter	0	0	0	0
Cheatham	0	0	0	0
Chester	3	2	2	2
Claiborne	0	0	0	0
Clay	0	0	0	0
Cocke	0	0	0	0
Coffee	0	0	0	0
Crockett	6	5	4	5
Cumberland	0	0	0	0
Davidson	1	1	1	1
Decatur	1	1	1	1
DeKalb	0	0	0	0
Dickson	0	0	0	0
Dyer	57	123	88	89
Fayette	7	6	6	6
Fentress	0	0	0	0
Franklin	0	0	0	0
Gibson	16	15	13	15
Giles	0	0	0	0
Grainger	0	0	0	0
Greene	0	0	0	0
Grundy	0	0	0	0
Hamblen	0	0	0	0
Hamilton	0	0	0	0
Hancock	0	0	0	0
Hardeman	7	7	5	6
Hardin	3	2	2	2
Hawkins	0	0	0	0
Haywood	7	6	6	6
Henderson	4	3	3	3
Henry	6	6	5	6
Hickman	0	0	0	0
Houston	0	0	0	0

County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Humphreys	1	1	1	1
Jackson	0	0	0	0
Jefferson	0	0	0	0
Johnson	0	0	0	0
Knox	0	0	0	0
Lake	139	144	116	133
Lauderdale	13	11	10	11
Lawrence	0	0	0	0
Lewis	0	0	0	0
Lincoln	0	0	0	0
Loudon	0	0	0	0
Macon	0	0	0	0
Madison	25	33	26	28
Marion	0	0	0	0
Marshall	0	0	0	0
Maury	0	0	0	0
McMinn	0	0	0	0
McNairy	2	2	2	2
Meigs	0	0	0	0
Monroe	0	0	0	0
Montgomery	0	0	0	0
Moore	0	0	0	0
Morgan	0	0	0	0
Obion	25	26	22	24
Overton	0	0	0	0
Perry	1	1	0	1
Pickett	0	0	0	0
Polk	0	0	0	0
Putnam	0	0	0	0
Rhea	0	0	0	0
Roane	0	0	0	0
Robertson	0	0	0	0
Rutherford	0	0	0	0
Scott	0	0	0	0
Sequatchie	0	0	0	0
Sevier	0	0	0	0
Shelby	127	168	133	143
Smith	0	0	0	0
Stewart	1	0	0	0
Sullivan	0	0	0	0
Sumner	0	0	0	0
Tipton	10	8	8	9
Trousdale	0	0	0	0
Unicoi	0	0	0	0
Union	0	0	0	0
Van Buren	0	0	0	0

County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Warren	0	0	0	0
Washington	0	0	0	0
Wayne	0	0	0	0
Weakley	12	10	10	11
White	0	0	0	0
Williamson	0	0	0	0
Wilson	0	0	0	0
Total =	**481**	**587**	**470**	**513**

Table 86 – HAZUS Model 1, Debris & Shelter Report					
County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Anderson	0	0	0	0	0
Bedford	0	0	0	0	0
Benton	1,290	480	1,770	1	0
Bledsoe	0	0	0	0	0
Blount	0	0	0	0	0
Bradley	0	0	0	0	0
Campbell	0	0	0	0	0
Cannon	0	0	0	0	0
Carroll	5,390	2,730	8,120	6	4
Carter	0	0	0	0	0
Cheatham	0	0	0	0	0
Chester	2,270	1,090	3,360	3	2
Claiborne	0	0	0	0	0
Clay	0	0	0	0	0
Cocke	0	0	0	0	0
Coffee	0	0	0	0	0
Crockett	4,130	2,530	6,660	5	4
Cumberland	0	0	0	0	0
Davidson	1,110	390	1,500	2	2
Decatur	790	300	1,090	0	0
Dekalb	0	0	0	0	0
Dickson	0	0	0	0	0
Dyer	47,120	85,400	132,510	122	87
Fayette	6,370	3,760	10,130	6	5
Fentress	0	0	0	0	0
Franklin	0	0	0	0	0
Gibson	14,780	10,540	25,320	23	16
Giles	0	0	0	0	0
Grainger	0	0	0	0	0
Greene	0	0	0	0	0
Grundy	0	0	0	0	0
Hamblen	0	0	0	0	0

County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Hamilton	0	0	0	0	0
Hancock	0	0	0	0	0
Hardeman	4,810	2,460	7,270	5	5
Hardin	2,710	1,150	3,860	2	1
Hawkins	0	0	0	0	0
Haywood	5,430	3,710	9,140	11	10
Henderson	3,530	1,630	5,170	3	2
Henry	5,890	3,010	8,890	7	5
Hickman	80	30	110	0	0
Houston	270	90	350	0	0
Humphreys	1,000	370	1,380	1	0
Jackson	0	0	0	0	0
Jefferson	0	0	0	0	0
Johnson	0	0	0	0	0
Knox	0	0	0	0	0
Lake	30,900	40,170	71,060	280	283
Lauderdale	9,090	7,670	16,760	15	12
Lawrence	0	0	0	0	0
Lewis	0	0	0	0	0
Lincoln	0	0	0	0	0
Loudon	0	0	0	0	0
McMinn	0	0	0	0	0
McNairy	2,590	1,140	3,730	1	1
Macon	0	0	0	0	0
Madison	24,630	14,760	39,390	50	39
Marion	0	0	0	0	0
Marshall	0	0	0	0	0
Maury	0	0	0	0	0
Meigs	0	0	0	0	0
Monroe	0	0	0	0	0
Montgomery	280	100	370	0	0
Moore	0	0	0	0	0
Morgan	0	0	0	0	0
Obion	17,850	14,610	32,460	31	22
Overton	0	0	0	0	0
Perry	610	240	850	0	0
Pickett	0	0	0	0	0
Polk	0	0	0	0	0
Putnam	0	0	0	0	0
Rhea	0	0	0	0	0
Roane	0	0	0	0	0
Robertson	0	0	0	0	0
Rutherford	0	0	0	0	0
Scott	0	0	0	0	0
Sequatchie	0	0	0	0	0
Sevier	0	0	0	0	0

County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Shelby	144,590	65,370	209,950	268	208
Smith	0	0	0	0	0
Stewart	500	160	660	0	0
Sullivan	0	0	0	0	0
Sumner	0	0	0	0	0
Tipton	8,690	4,030	12,730	8	7
Trousdale	0	0	0	0	0
Unicoi	0	0	0	0	0
Union	0	0	0	0	0
Van Buren	0	0	0	0	0
Warren	0	0	0	0	0
Washington	0	0	0	0	0
Wayne	90	30	120	0	0
Weakley	9,160	5,550	14,700	19	15
White	0	0	0	0	0
Williamson	220	70	290	0	0
Wilson	0	0	0	0	0
Total =	**356,170**	**273,570**	**629,700**	**869**	**730**

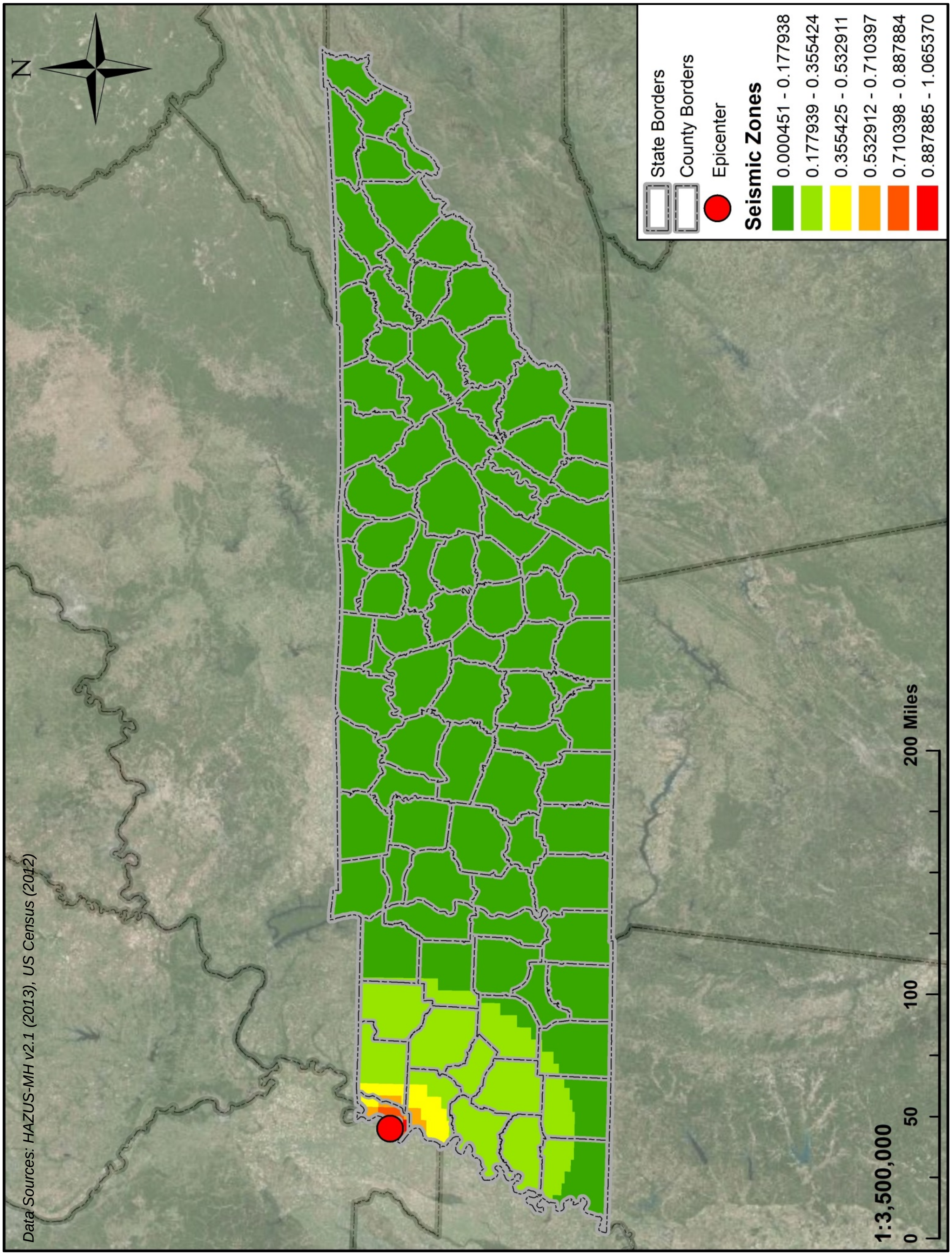
Table 87 – HAZUS Model 1, Economic Loss Report

County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Anderson	$0	$0	$0	$0	0.00%	$0	$0
Bedford	$0	$0	$0	$0	0.00%	$0	$0
Benton	$573,910	$1,092,690	$189,100	$9,210	0.18%	$936,090	$2,800,990
Bledsoe	$0	$0	$0	$0	0.00%	$0	$0
Blount	$0	$0	$0	$0	0.00%	$0	$0
Bradley	$0	$0	$0	$0	0.00%	$0	$0
Campbell	$0	$0	$0	$0	0.00%	$0	$0
Cannon	$0	$0	$0	$0	0.00%	$0	$0
Carroll	$2,555,150	$5,960,310	$1,620,430	$80,720	0.55%	$4,553,680	$14,770,290
Carter	$0	$0	$0	$0	0.00%	$0	$0
Cheatham	$0	$0	$0	$0	0.00%	$0	$0
Chester	$1,136,880	$2,566,940	$606,830	$27,040	0.44%	$1,864,320	$6,202,010
Claiborne	$0	$0	$0	$0	0.00%	$0	$0
Clay	$0	$0	$0	$0	0.00%	$0	$0
Cocke	$0	$0	$0	$0	0.00%	$0	$0
Coffee	$0	$0	$0	$0	0.00%	$0	$0
Crockett	$2,345,830	$6,017,500	$1,967,480	$93,410	1.03%	$3,509,200	$13,933,410
Cumberland	$0	$0	$0	$0	0.00%	$0	$0
Davidson	$501,270	$772,140	$91,100	$4,040	0.00%	$898,940	$2,267,500
Decatur	$339,860	$619,610	$99,830	$6,760	0.14%	$583,500	$1,649,550
Dekalb	$0	$0	$0	$0	0.00%	$0	$0
Dickson	$0	$0	$0	$0	0.00%	$0	$0

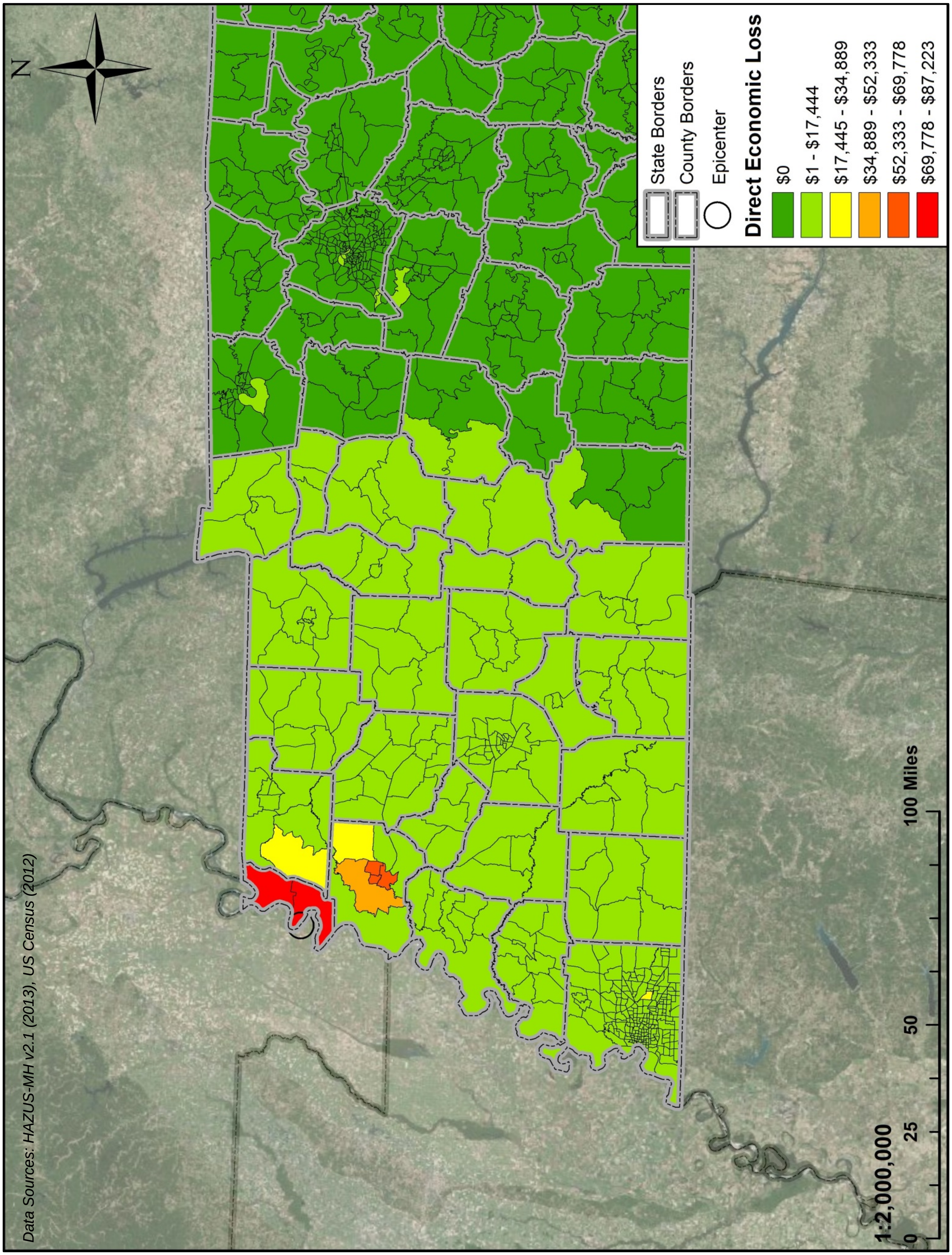
County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Dyer	$40,624,340	$120,221,770	$51,766,280	$4,163,640	5.97%	$77,682,000	$294,458,020
Fayette	$3,856,460	$8,868,160	$2,701,670	$159,740	0.62%	$5,278,030	$20,864,050
Fentress	$0	$0	$0	$0	0.00%	$0	$0
Franklin	$0	$0	$0	$0	0.00%	$0	$0
Gibson	$8,021,350	$20,089,440	$7,091,760	$542,870	0.89%	$14,881,260	$50,626,670
Giles	$0	$0	$0	$0	0.00%	$0	$0
Grainger	$0	$0	$0	$0	0.00%	$0	$0
Greene	$0	$0	$0	$0	0.00%	$0	$0
Grundy	$0	$0	$0	$0	0.00%	$0	$0
Hamblen	$0	$0	$0	$0	0.00%	$0	$0
Hamilton	$0	$0	$0	$0	0.00%	$0	$0
Hancock	$0	$0	$0	$0	0.00%	$0	$0
Hardeman	$2,447,790	$5,553,370	$1,453,080	$56,570	0.58%	$4,262,470	$13,773,290
Hardin	$1,193,450	$2,353,900	$487,240	$27,070	0.24%	$2,291,940	$6,353,600
Hawkins	$0	$0	$0	$0	0.00%	$0	$0
Haywood	$2,805,910	$7,042,650	$2,502,080	$179,900	0.91%	$4,883,390	$17,413,910
Henderson	$1,610,540	$3,334,760	$770,070	$49,040	0.34%	$2,746,530	$8,510,950
Henry	$2,878,490	$6,391,520	$1,711,070	$89,280	0.48%	$5,731,620	$16,801,990
Hickman	$36,270	$55,810	$4,990	$190	0.01%	$50,690	$147,940
Houston	$117,400	$205,580	$21,890	$1,020	0.08%	$170,290	$516,190
Humphreys	$482,400	$933,290	$162,330	$11,390	0.12%	$741,780	$2,331,180
Jackson	$0	$0	$0	$0	0.00%	$0	$0
Jefferson	$0	$0	$0	$0	0.00%	$0	$0
Johnson	$0	$0	$0	$0	0.00%	$0	$0
Knox	$0	$0	$0	$0	0.00%	$0	$0
Lake	$21,318,310	$78,879,060	$26,927,200	$819,600	28.67%	$33,548,590	$161,492,760
Lauderdale	$5,244,450	$16,878,860	$6,590,700	$472,700	1.66%	$9,013,410	$38,200,120
Lawrence	$0	$0	$0	$0	0.00%	$0	$0
Lewis	$0	$0	$0	$0	0.00%	$0	$0
Lincoln	$0	$0	$0	$0	0.00%	$0	$0
Loudon	$0	$0	$0	$0	0.00%	$0	$0
Macon	$0	$0	$0	$0	0.00%	$0	$0
Madison	$13,419,410	$32,975,160	$10,349,210	$567,050	0.69%	$26,299,090	$83,609,930
Marion	$0	$0	$0	$0	0.00%	$0	$0
Marshall	$0	$0	$0	$0	0.00%	$0	$0
Maury	$0	$0	$0	$0	0.00%	$0	$0
McMinn	$0	$0	$0	$0	0.00%	$0	$0
McNairy	$1,141,360	$2,196,490	$482,190	$31,260	0.22%	$1,918,280	$5,769,580
Meigs	$0	$0	$0	$0	0.00%	$0	$0
Monroe	$0	$0	$0	$0	0.00%	$0	$0
Montgomery	$137,630	$236,550	$36,610	$410	0.00%	$227,350	$638,560
Moore	$0	$0	$0	$0	0.00%	$0	$0
Morgan	$0	$0	$0	$0	0.00%	$0	$0
Obion	$10,592,410	$33,758,460	$12,775,890	$542,620	2.09%	$19,593,790	$77,263,170
Overton	$0	$0	$0	$0	0.00%	$0	$0
Perry	$278,160	$519,050	$88,700	$3,070	0.19%	$425,450	$1,314,440

County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Pickett	$0	$0	$0	$0	0.00%	$0	$0
Polk	$0	$0	$0	$0	0.00%	$0	$0
Putnam	$0	$0	$0	$0	0.00%	$0	$0
Rhea	$0	$0	$0	$0	0.00%	$0	$0
Roane	$0	$0	$0	$0	0.00%	$0	$0
Robertson	$0	$0	$0	$0	0.00%	$0	$0
Rutherford	$0	$0	$0	$0	0.00%	$0	$0
Scott	$0	$0	$0	$0	0.00%	$0	$0
Sequatchie	$0	$0	$0	$0	0.00%	$0	$0
Sevier	$0	$0	$0	$0	0.00%	$0	$0
Shelby	$76,045,280	$235,048,620	$69,726,630	$2,481,550	0.44%	$135,349,200	$518,651,290
Smith	$0	$0	$0	$0	0.00%	$0	$0
Stewart	$235,440	$419,200	$49,680	$2,080	0.08%	$325,160	$1,031,560
Sullivan	$0	$0	$0	$0	0.00%	$0	$0
Sumner	$0	$0	$0	$0	0.00%	$0	$0
Tipton	$4,606,330	$15,402,370	$4,943,720	$214,190	0.67%	$6,868,300	$32,034,920
Trousdale	$0	$0	$0	$0	0.00%	$0	$0
Unicoi	$0	$0	$0	$0	0.00%	$0	$0
Union	$0	$0	$0	$0	0.00%	$0	$0
Van Buren	$0	$0	$0	$0	0.00%	$0	$0
Warren	$0	$0	$0	$0	0.00%	$0	$0
Washington	$0	$0	$0	$0	0.00%	$0	$0
Wayne	$36,400	$56,670	$5,540	$160	0.01%	$71,430	$170,200
Weakley	$4,535,850	$11,630,630	$3,631,810	$193,900	0.87%	$8,055,690	$28,047,880
White	$0	$0	$0	$0	0.00%	$0	$0
Williamson	$125,620	$214,750	$22,700	$590	0.00%	$189,240	$552,900
Wilson	$0	$0	$0	$0	0.00%	$0	$0
Total =	**$209,243,950**	**$620,295,310**	**$208,877,810**	**$10,831,070**	**-**	**$372,950,710**	**$1,422,198,850**

Map 129 – HAZUS Model 1 – NMSZ 6.5 Mag. Seismic Zones



Map 130 – HAZUS Model 1 – NMSZ 6.5 Mag. Direct Economic Loss



4.4.2 – HAZUS Model 2 – Earthquake – East Tennessee

Table 88 – HAZUS Model 2, Casualty Report				
County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Anderson	52	77	59	63
Bedford	0	0	0	0
Benton	0	0	0	0
Bledsoe	0	0	0	0
Blount	101	137	112	117
Bradley	3	3	3	3
Campbell	9	7	6	7
Cannon	0	0	0	0
Carroll	0	0	0	0
Carter	1	1	1	1
Cheatham	0	0	0	0
Chester	0	0	0	0
Claiborne	2	2	2	2
Clay	0	0	0	0
Cocke	2	2	1	2
Coffee	0	0	0	0
Crockett	0	0	0	0
Cumberland	2	2	2	2
Davidson	0	0	0	0
Decatur	0	0	0	0
DeKalb	1	0	0	0
Dickson	0	0	0	0
Dyer	0	0	0	0
Fayette	0	0	0	0
Fentress	1	1	0	1
Franklin	0	0	0	0
Gibson	0	0	0	0
Giles	0	0	0	0
Grainger	4	3	3	3
Greene	2	2	2	2
Grundy	0	0	0	0
Hamblen	4	4	3	4
Hamilton	7	10	8	8
Hancock	0	0	0	0
Hardeman	0	0	0	0
Hardin	0	0	0	0
Hawkins	2	1	1	1
Haywood	0	0	0	0
Henderson	0	0	0	0
Henry	0	0	0	0
Hickman	0	0	0	0
Houston	0	0	0	0

County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Humphreys	0	0	0	0
Jackson	0	0	0	0
Jefferson	11	9	9	10
Johnson	0	0	0	0
Knox	3,285	5,877	4,465	4,542
Lake	0	0	0	0
Lauderdale	0	0	0	0
Lawrence	0	0	0	0
Lewis	0	0	0	0
Lincoln	0	0	0	0
Loudon	10	10	8	9
Macon	0	0	0	0
Madison	0	0	0	0
Marion	0	0	0	0
Marshall	0	0	0	0
Maury	0	0	0	0
McMinn	2	2	2	2
McNairy	0	0	0	0
Meigs	1	0	0	0
Monroe	3	3	2	3
Montgomery	0	0	0	0
Moore	0	0	0	0
Morgan	2	1	1	1
Obion	0	0	0	0
Overton	1	0	0	0
Perry	0	0	0	0
Pickett	0	0	0	0
Polk	1	0	0	0
Putnam	2	2	2	2
Rhea	1	1	1	1
Roane	7	6	5	6
Robertson	0	0	0	0
Rutherford	0	0	0	0
Scott	1	1	1	1
Sequatchie	0	0	0	0
Sevier	28	27	24	26
Shelby	0	0	0	0
Smith	0	0	0	0
Stewart	0	0	0	0
Sullivan	3	3	3	3
Sumner	0	0	0	0
Tipton	0	0	0	0
Trousdale	0	0	0	0
Unicoi	0	1	1	1
Union	7	4	4	5

County	Casualties by Incident Time			Average Casualties
	2:00 AM (Nighttime)	2:00 PM (Workday)	5:00 PM (Traffic)	
Van Buren	0	0	0	0
Warren	0	0	0	0
Washington	3	3	3	3
Wayne	0	0	0	0
Weakley	0	0	0	0
White	1	1	0	1
Williamson	0	0	0	0
Wilson	0	0	0	0
Total =	**3,562**	**6,203**	**4,734**	**4,833**

Table 89 – HAZUS Model 2, Debris & Shelter Report

County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Anderson	40,880	37,010	77,890	88	55
Bedford	0	0	0	0	0
Benton	0	0	0	0	0
Bledsoe	350	110	450	0	0
Blount	70,890	66,390	137,280	199	124
Bradley	3,470	1,210	4,680	4	3
Campbell	7,010	4,290	11,300	8	6
Cannon	0	0	0	0	0
Carroll	0	0	0	0	0
Carter	1,000	290	1,300	1	1
Cheatham	0	0	0	0	0
Chester	0	0	0	0	0
Claiborne	2,040	850	2,890	1	1
Clay	140	40	180	0	0
Cocke	1,950	760	2,710	2	1
Coffee	0	0	0	0	0
Crockett	0	0	0	0	0
Cumberland	2,060	750	2,810	1	1
Davidson	0	0	0	0	0
Decatur	0	0	0	0	0
Dekalb	620	240	860	0	0
Dickson	0	0	0	0	0
Dyer	0	0	0	0	0
Fayette	0	0	0	0	0
Fentress	580	190	770	0	0
Franklin	290	100	390	0	0
Gibson	0	0	0	0	0
Giles	0	0	0	0	0
Grainger	2,600	1,180	3,780	2	1
Greene	2,720	1,130	3,850	2	1
Grundy	60	10	70	0	0

County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Hamblen	4,840	2,330	7,170	6	4
Hamilton	11,190	3,960	15,150	13	9
Hancock	240	70	300	0	0
Hardeman	0	0	0	0	0
Hardin	0	0	0	0	0
Hawkins	1,860	630	2,490	2	1
Haywood	0	0	0	0	0
Henderson	0	0	0	0	0
Henry	0	0	0	0	0
Hickman	0	0	0	0	0
Houston	0	0	0	0	0
Humphreys	0	0	0	0	0
Jackson	230	70	300	70	300
Jefferson	8,690	5,440	14,130	5,440	14,130
Johnson	0	0	0	0	0
Knox	1,380,040	1,755,070	3,135,110	1,755,070	3,135,110
Lake	0	0	0	0	0
Lauderdale	0	0	0	0	0
Lawrence	0	0	0	0	0
Lewis	0	0	0	0	0
Lincoln	0	0	0	0	0
Loudon	9,350	5,070	14,420	5,070	14,420
McMinn	2,490	980	3,470	980	3,470
McNairy	0	0	0	0	0
Macon	0	0	0	0	0
Madison	0	0	0	0	0
Marion	160	40	200	40	200
Marshall	0	0	0	0	0
Maury	0	0	0	0	0
Meigs	390	120	520	120	520
Monroe	2,720	1,230	3,960	1,230	3,960
Montgomery	0	0	0	0	0
Moore	0	0	0	0	0
Morgan	1,400	560	1,960	560	1,960
Obion	0	0	0	0	0
Overton	610	200	810	200	810
Perry	0	0	0	0	0
Pickett	200	60	270	60	270
Polk	480	140	620	140	620
Putnam	2,070	750	2,830	750	2,830
Rhea	1,110	390	1,500	390	1,500
Roane	6,310	2,440	8,750	2,440	8,750
Robertson	0	0	0	0	0
Rutherford	0	0	0	0	0
Scott	1,000	390	1,400	390	1,400
Sequatchie	270	80	350	80	350

County	Brick, Wood & Others (Tons)	Concrete & Steel (Tons)	Total Debris (Tons)	Displaced Households	People Requiring Short Term Shelter
Sevier	22,570	12,500	35,080	12,500	35,080
Shelby	0	0	0	0	0
Smith	230	90	320	90	320
Stewart	0	0	0	0	0
Sullivan	3,540	1,140	4,680	1,140	4,680
Sumner	0	0	0	0	0
Tipton	0	0	0	0	0
Trousdale	0	0	0	0	0
Unicoi	440	140	580	140	580
Union	4,020	2,150	6,170	2,150	6,170
Van Buren	120	40	160	40	160
Warren	610	220	840	220	840
Washington	3,770	1,270	5,050	1,270	5,050
Wayne	0	0	0	0	0
Weakley	0	0	0	0	0
White	690	240	930	240	930
Williamson	0	0	0	0	0
Wilson	0	0	0	0	0
Total =	**1,567,420**	**1,875,350**	**3,442,840**	**1,791,061**	**3,244,563**

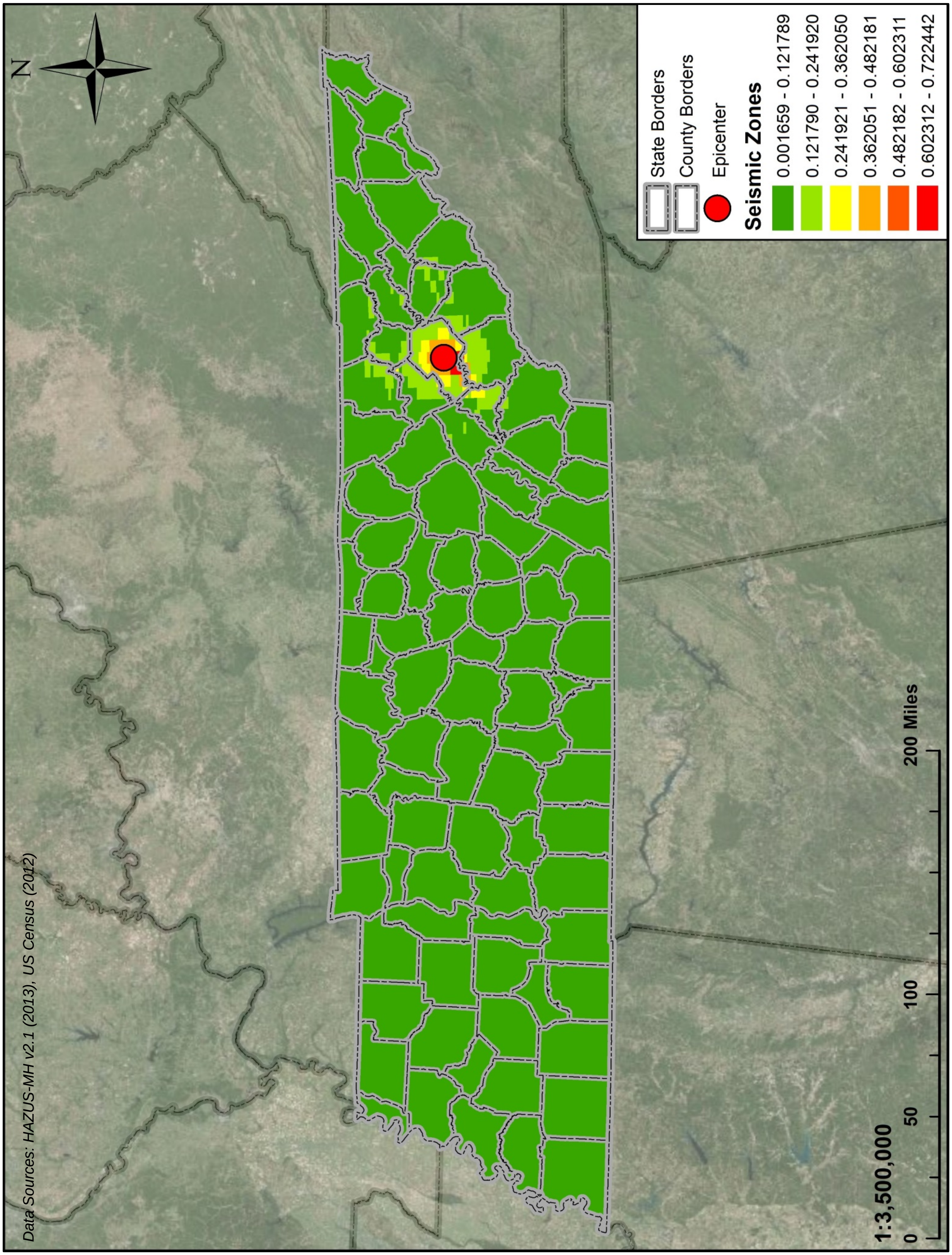
Table 90 – HAZUS Model 2, Economic Loss Report

County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Anderson	$25,110,580	$78,244,920	$32,865,850	$1,960,660	2.06%	$51,258,110	$189,440,110
Bedford	$0	$0	$0	$0	0.00%	$0	$0
Benton	$0	$0	$0	$0	0.00%	$0	$0
Bledsoe	$136,810	$232,680	$28,440	$1,260	0.07%	$201,300	$600,480
Blount	$42,858,780	$135,510,850	$55,854,920	$2,585,300	2.62%	$90,229,650	$327,039,500
Bradley	$1,363,030	$2,339,900	$350,830	$17,970	0.07%	$2,420,820	$6,492,550
Campbell	$3,424,990	$9,135,530	$3,139,280	$238,040	0.64%	$6,053,160	$21,991,010
Cannon	$0	$0	$0	$0	0.00%	$0	$0
Carroll	$0	$0	$0	$0	0.00%	$0	$0
Carter	$347,280	$552,210	$54,420	$2,250	0.04%	$649,060	$1,605,210
Cheatham	$0	$0	$0	$0	0.00%	$0	$0
Chester	$0	$0	$0	$0	0.00%	$0	$0
Claiborne	$796,140	$1,604,650	$403,560	$25,570	0.18%	$1,406,180	$4,236,090
Clay	$53,910	$85,940	$8,690	$270	0.04%	$106,480	$255,290
Cocke	$769,050	$1,497,010	$361,230	$25,830	0.14%	$1,532,300	$4,185,420
Coffee	$0	$0	$0	$0	0.00%	$0	$0
Crockett	$0	$0	$0	$0	0.00%	$0	$0
Cumberland	$842,940	$1,519,930	$267,990	$16,020	0.09%	$1,656,190	$4,303,080
Davidson	$0	$0	$0	$0	0.00%	$0	$0
Decatur	$0	$0	$0	$0	0.00%	$0	$0
Dekalb	$257,780	$430,080	$67,440	$4,050	0.06%	$390,850	$1,150,200

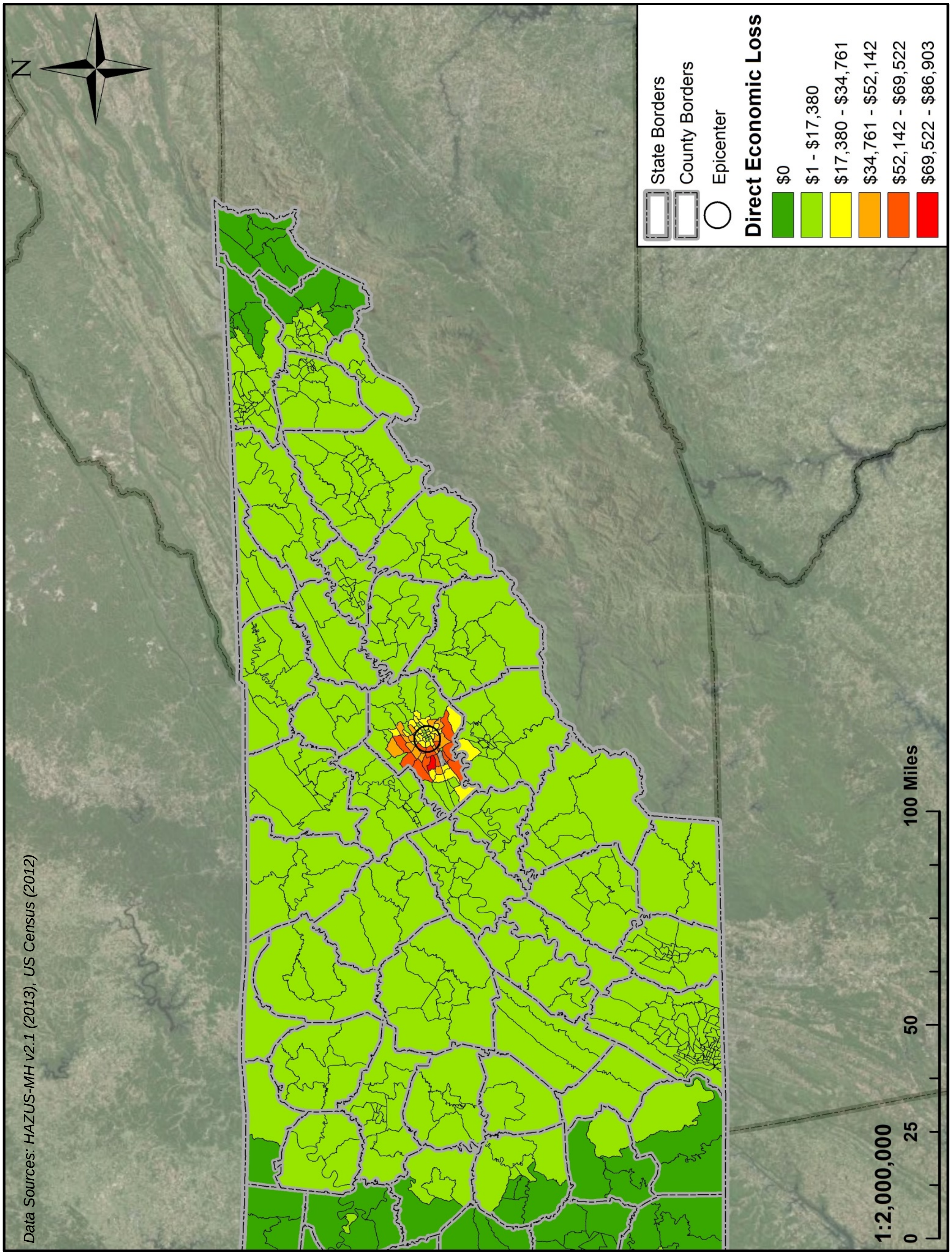
County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Dickson	$0	$0	$0	$0	0.00%	$0	$0
Dyer	$0	$0	$0	$0	0.00%	$0	$0
Fayette	$0	$0	$0	$0	0.00%	$0	$0
Fentress	$218,950	$391,420	$61,420	$2,400	0.09%	$431,280	$1,105,460
Franklin	$114,640	$168,600	$22,570	$1,290	0.01%	$208,270	$515,370
Gibson	$0	$0	$0	$0	0.00%	$0	$0
Giles	$0	$0	$0	$0	0.00%	$0	$0
Grainger	$1,208,250	$3,047,810	$884,690	$65,430	0.46%	$1,697,270	$6,903,440
Greene	$1,134,970	$1,916,400	$348,570	$30,220	0.08%	$2,048,270	$5,478,430
Grundy	$22,900	$37,910	$2,720	$60	0.01%	$26,960	$90,560
Hamblen	$2,083,310	$4,496,740	$1,359,210	$138,910	0.18%	$3,959,560	$12,037,740
Hamilton	$4,571,230	$7,311,210	$922,410	$46,720	0.05%	$9,220,820	$22,072,380
Hancock	$86,410	$171,980	$27,010	$560	0.09%	$143,460	$429,430
Hardeman	$0	$0	$0	$0	0.00%	$0	$0
Hardin	$0	$0	$0	$0	0.00%	$0	$0
Hawkins	$736,290	$1,306,030	$202,820	$12,550	0.08%	$1,177,520	$3,435,190
Haywood	$0	$0	$0	$0	0.00%	$0	$0
Henderson	$0	$0	$0	$0	0.00%	$0	$0
Henry	$0	$0	$0	$0	0.00%	$0	$0
Hickman	$0	$0	$0	$0	0.00%	$0	$0
Houston	$0	$0	$0	$0	0.00%	$0	$0
Humphreys	$0	$0	$0	$0	0.00%	$0	$0
Jackson	$86,310	$134,680	$12,800	$700	0.05%	$137,110	$371,600
Jefferson	$4,503,620	$12,592,250	$4,404,390	$280,510	0.70%	$7,987,690	$29,768,470
Johnson	$0	$0	$0	$0	0.00%	$0	$0
Knox	$929,070,200	$3,508,001,380	$1,461,633,960	$56,627,900	15.40%	$1,860,075,120	$7,815,408,570
Lake	$0	$0	$0	$0	0.00%	$0	$0
Lauderdale	$0	$0	$0	$0	0.00%	$0	$0
Lawrence	$0	$0	$0	$0	0.00%	$0	$0
Lewis	$0	$0	$0	$0	0.00%	$0	$0
Lincoln	$0	$0	$0	$0	0.00%	$0	$0
Loudon	$4,902,460	$14,425,860	$5,302,770	$248,390	0.72%	$10,332,670	$35,212,130
Macon	$0	$0	$0	$0	0.00%	$0	$0
Madison	$0	$0	$0	$0	0.00%	$0	$0
Marion	$62,660	$101,360	$7,640	$160	0.01%	$86,710	$258,520
Marshall	$0	$0	$0	$0	0.00%	$0	$0
Maury	$0	$0	$0	$0	0.00%	$0	$0
McMinn	$1,018,850	$1,875,820	$385,080	$27,980	0.10%	$1,856,550	$5,164,270
McNairy	$0	$0	$0	$0	0.00%	$0	$0
Meigs	$155,910	$291,180	$41,870	$1,680	0.10%	$245,840	$736,480
Monroe	$1,165,110	$2,484,520	$712,410	$66,070	0.19%	$2,246,430	$6,674,550
Montgomery	$0	$0	$0	$0	0.00%	$0	$0
Moore	$0	$0	$0	$0	0.00%	$0	$0
Morgan	$601,710	$1,427,430	$397,320	$19,610	0.25%	$969,350	$3,415,420
Obion	$0	$0	$0	$0	0.00%	$0	$0
Overton	$225,970	$366,630	$47,340	$2,720	0.06%	$419,830	$1,062,500

County	Capital Stock Losses					Income Losses	Total
	Structural	Infrastructure	Contents	Inventory	Ratio		
Perry	$0	$0	$0	$0	0.00%	$0	$0
Pickett	$74,260	$125,490	$16,640	$780	0.07%	$120,670	$337,840
Polk	$186,730	$331,180	$42,310	$1,470	0.07%	$341,750	$903,460
Putnam	$759,180	$1,168,360	$153,110	$9,630	0.05%	$1,638,770	$3,729,060
Rhea	$446,220	$809,880	$129,630	$6,400	0.08%	$787,310	$2,179,460
Roane	$2,971,810	$7,965,670	$2,336,320	$53,180	0.36%	$5,229,320	$18,556,300
Robertson	$0	$0	$0	$0	0.00%	$0	$0
Rutherford	$0	$0	$0	$0	0.00%	$0	$0
Scott	$392,860	$735,690	$158,340	$11,500	0.13%	$732,260	$2,030,640
Sequatchie	$110,700	$173,300	$17,380	$760	0.05%	$166,990	$469,140
Sevier	$11,144,480	$34,506,970	$12,516,300	$441,670	0.81%	$25,297,660	$83,907,070
Shelby	$0	$0	$0	$0	0.00%	$0	$0
Smith	$96,050	$150,020	$26,770	$1,010	0.02%	$193,670	$467,520
Stewart	$0	$0	$0	$0	0.00%	$0	$0
Sullivan	$1,352,790	$2,143,440	$257,460	$12,550	0.04%	$2,696,560	$6,462,800
Sumner	$0	$0	$0	$0	0.00%	$0	$0
Tipton	$0	$0	$0	$0	0.00%	$0	$0
Trousdale	$0	$0	$0	$0	0.00%	$0	$0
Unicoi	$161,000	$268,270	$29,620	$1,410	0.05%	$296,940	$757,250
Union	$1,956,850	$5,622,550	$1,876,380	$95,340	0.97%	$3,194,820	$12,745,930
Van Buren	$48,160	$77,390	$8,000	$590	0.05%	$68,160	$202,320
Warren	$246,550	$338,310	$38,460	$2,110	0.02%	$517,880	$1,143,310
Washington	$1,421,100	$2,333,060	$297,940	$14,320	0.05%	$2,959,110	$7,025,520
Wayne	$0	$0	$0	$0	0.00%	$0	$0
Weakley	$0	$0	$0	$0	0.00%	$0	$0
White	$273,700	$425,420	$53,820	$2,820	0.06%	$464,120	$1,219,870
Williamson	$0	$0	$0	$0	0.00%	$0	$0
Wilson	$0	$0	$0	$0	0.00%	$0	$0
Total =	**$1,049,573,480**	**$3,848,877,910**	**$1,588,138,130**	**$63,106,620**	**-**	**$2,103,880,800**	**$8,653,576,940**

Map 131 – HAZUS Model 2 – East Tennessee 6.0 Mag. Seismic Zones



Map 132 – HAZUS Model 2 – East Tennessee 6.0 Mag. Direct Economic Loss



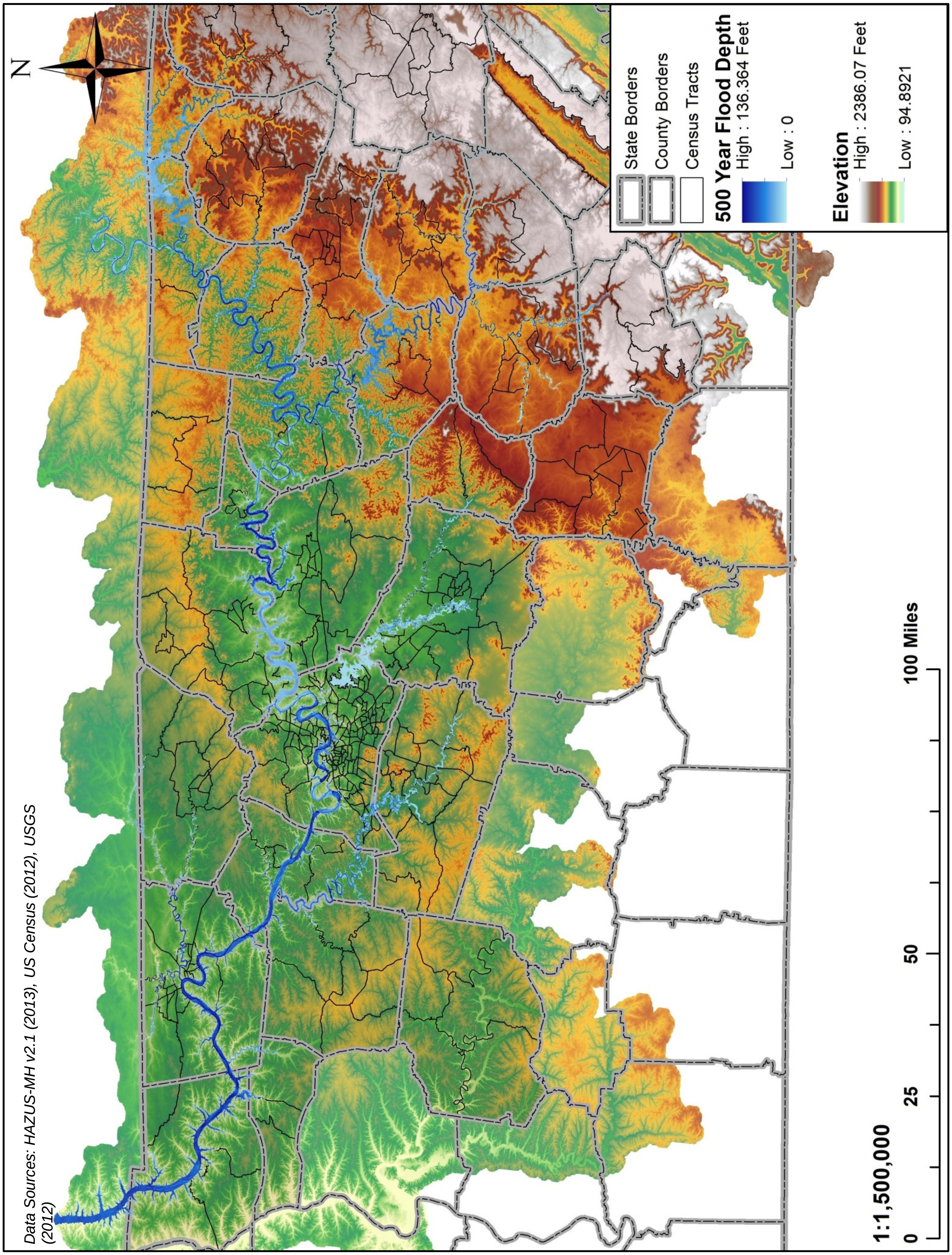
4.4.3 – HAZUS Model 3 – Flood – Cumberland River Basin

Table 91 – HAZUS Model 3, Debris & Shelter Report						
County	**Finishes (Tons)**	**Structures (Tons)**	**Foundations (Tons)**	**Total Debris (Tons)**	**Displaced People**	**People Requiring Short Term Shelter**
Bledsoe	0	0	0	0	0	0
Cannon	85	113	103	302	36	5
Cheatham	9,053	27,540	22,238	58,831	3,829	2,780
Clay	3,371	9,157	7,676	20,204	917	617
Cumberland	12	20	22	54	4	0
Davidson	133,304	488,264	369,156	990,724	37,608	34,598
Dekalb	2,052	4,216	3,894	10,161	666	193
Dickson	598	1,312	1,320	3,229	245	102
Fentress	209	471	467	1,147	46	1
Grundy	337	1,855	1,301	3,493	54	7
Houston	102	158	158	418	29	1
Jackson	2,129	5,621	4,986	12,736	850	385
Montgomery	16,272	43,050	36,130	95,451	6,914	5,511
Overton	143	295	301	739	35	0
Pickett	706	1,454	1,395	3,556	131	6
Putnam	303	666	637	1,606	78	8
Robertson	344	798	623	1,765	161	16
Rutherford	5,454	8,871	7,041	21,366	4,881	4,087
Smith	4,382	13,297	10,273	27,952	1,505	639
Stewart	4,835	12,429	10,491	27,754	1,031	307
Sumner	6,390	6,094	5,105	17,588	3,605	2,710
Trousdale	1,364	2,592	2,799	6,755	468	259
Van Buren	435	731	777	1,943	101	9
Warren	2,208	5,251	4,574	12,032	898	430
White	1,462	3,222	3,058	7,742	368	103
Williamson	5,945	7,715	6,764	20,424	4,060	3,417
Wilson	3,713	5,985	5,477	15,175	2,176	1,326
Total =	**205,206**	**651,177**	**506,765**	**1,363,148**	**70,696**	**57,517**

Table 92 – HAZUS Model 3, Economic Loss Report						
County	Capital Stock Losses				Income Losses	Total
	Structural	Contents	Inventory	Ratio		
Bledsoe	$0	$0	$0	0.00%	$0	$0
Clay	$27,093,000	$23,779,000	$753,000	13.30%	$269,000	$51,894,000
Grundy	$3,945,000	$4,812,000	$256,000	31.00%	$317,000	$9,330,000
Van Buren	$2,110,000	$1,265,000	$10,000	5.80%	$5,000	$3,390,000
Sumner	$93,396,000	$90,296,000	$2,043,000	4.60%	$590,000	$186,325,000
Dickson	$7,675,000	$5,038,000	$120,000	6.20%	$55,000	$12,888,000
Overton	$709,000	$405,000	$1,000	1.90%	$0	$1,115,000
Dekalb	$19,617,000	$15,150,000	$385,000	5.00%	$55,000	$35,207,000
Jackson	$26,090,000	$28,404,000	$2,316,000	10.00%	$258,000	$57,068,000
Trousdale	$16,358,000	$11,056,000	$322,000	12.10%	$74,000	$27,810,000
Cumberland	$61,000	$30,000	$0	2.50%	$0	$91,000
Putnam	$1,562,000	$1,022,000	$16,000	2.30%	$8,000	$2,608,000
Cheatham	$167,189,000	$150,559,000	$8,878,000	14.60%	$808,000	$327,434,000
Cannon	$791,000	$545,000	$12,000	2.70%	$0	$1,348,000
Rutherford	$153,427,000	$210,873,000	$14,616,000	5.90%	$2,717,000	$381,633,000
Wilson	$67,974,000	$52,303,000	$1,038,000	6.40%	$223,000	$121,538,000
Davidson	$2,061,226,000	$2,308,531,000	$124,677,000	20.40%	$26,165,000	$4,520,599,000
Smith	$66,045,000	$75,085,000	$6,001,000	10.90%	$661,000	$147,792,000
Fentress	$1,147,000	$767,000	$11,000	2.70%	$1,000	$1,926,000
Montgomery	$276,380,000	$214,471,000	$3,807,000	11.70%	$1,656,000	$496,314,000
Pickett	$4,132,000	$3,365,000	$146,000	2.80%	$2,000	$7,645,000
Robertson	$4,764,000	$3,779,000	$101,000	3.40%	$1,000	$8,645,000
Warren	$24,462,000	$21,049,000	$832,000	6.60%	$77,000	$46,420,000
Stewart	$44,660,000	$41,489,000	$3,172,000	9.10%	$158,000	$89,479,000
Houston	$617,000	$399,000	$1,000	1.80%	$0	$1,017,000
White	$10,561,000	$8,459,000	$128,000	5.20%	$29,000	$19,177,000
Williamson	$138,310,000	$105,768,000	$1,472,000	7.00%	$583,000	$246,133,000
Total =	**$3,220,301,000**	**$3,378,699,000**	**$171,114,000**	**-**	**$34,712,000**	**$6,804,826,000**

Table 93 – HAZUS Model 3, Aggregate Losses					
Building Losses	**Residential**	**Commercial**	**Industrial**	**Other**	**Total**
Building	$1,773,420,000	$984,280,000	$291,370,000	$171,240,000	$3,220,310,000
Content	$1,013,360,000	$1,417,980,000	$651,220,000	$296,130,000	$3,378,690,000
Inventory	$0	$40,510,000	$128,100,000	$2,510,000	$171,120,000
Subtotal =	$2,786,780,000	$2,442,770,000	$1,070,690,000	$469,880,000	$6,770,120,000
Business Losses					
Income	$300,000	$8,770,000	$120,000	$740,000	$9,930,000
Relocation	$2,030,000	$2,240,000	$150,000	$380,000	$4,800,000
Rental Income	$960,000	$1,510,000	$30,000	$50,000	$2,550,000
Wages	$760,000	$8,350,000	$170,000	$8,160,000	$17,440,000
Subtotal =	$4,050,000	$20,870,000	$470,000	$9,330,000	$34,720,000
Total =	**$2,790,830,000**	**$2,463,640,000**	**$1,071,160,000**	**$479,210,000**	**$6,804,840,000**

Map 133 – HAZUS Model 3 – Cumberland River Basin, 500 Year Flood



4.4.4 – HAZUS Model 4 – Flood – Lower Tennessee River Basin

Table 94 – HAZUS Model 4, Debris & Shelter Report						
County	**Finishes (Tons)**	**Structures (Tons)**	**Foundations (Tons)**	**Total Debris (Tons)**	**Displaced People**	**People Requiring Short Term Shelter**
Bedford	5,849	11,220	9,986	27,054	1,026	571
Benton	2,550	2,091	2,499	7,141	289	56
Carroll	1,124	1,700	1,649	4,474	211	55
Chester	3,406	6,139	5,898	15,442	0	0
Coffee	5,367	9,119	9,003	23,489	588	381
Decatur	6	10	9	26	612	168
Dickson	3,535	4,159	4,284	11,978	1	0
Hardin	1,884	2,160	2,248	6,293	688	183
Henderson	620	385	536	1,541	453	86
Henry	3,410	10,537	7,507	21,454	141	11
Hickman	1,056	1,411	1,632	4,099	707	231
Houston	3,902	6,223	6,246	16,371	52	2
Humphreys	223	388	381	992	472	146
Lawrence	1,209	2,277	2,260	5,747	32	0
Lewis	590	1,057	1,036	2,683	143	15
Marshall	8,621	21,237	17,515	47,373	319	55
Maury	121	62	86	269	1,884	955
McNairy	8,144	22,335	20,327	50,806	37	2
Perry	501	339	445	1,285	771	119
Stewart	1,135	1,751	1,783	4,669	22	1
Wayne	53,251	104,601	95,332	253,184	216	17
Total =	**106,503**	**209,202**	**190,663**	**506,368**	**8,664**	**3,054**

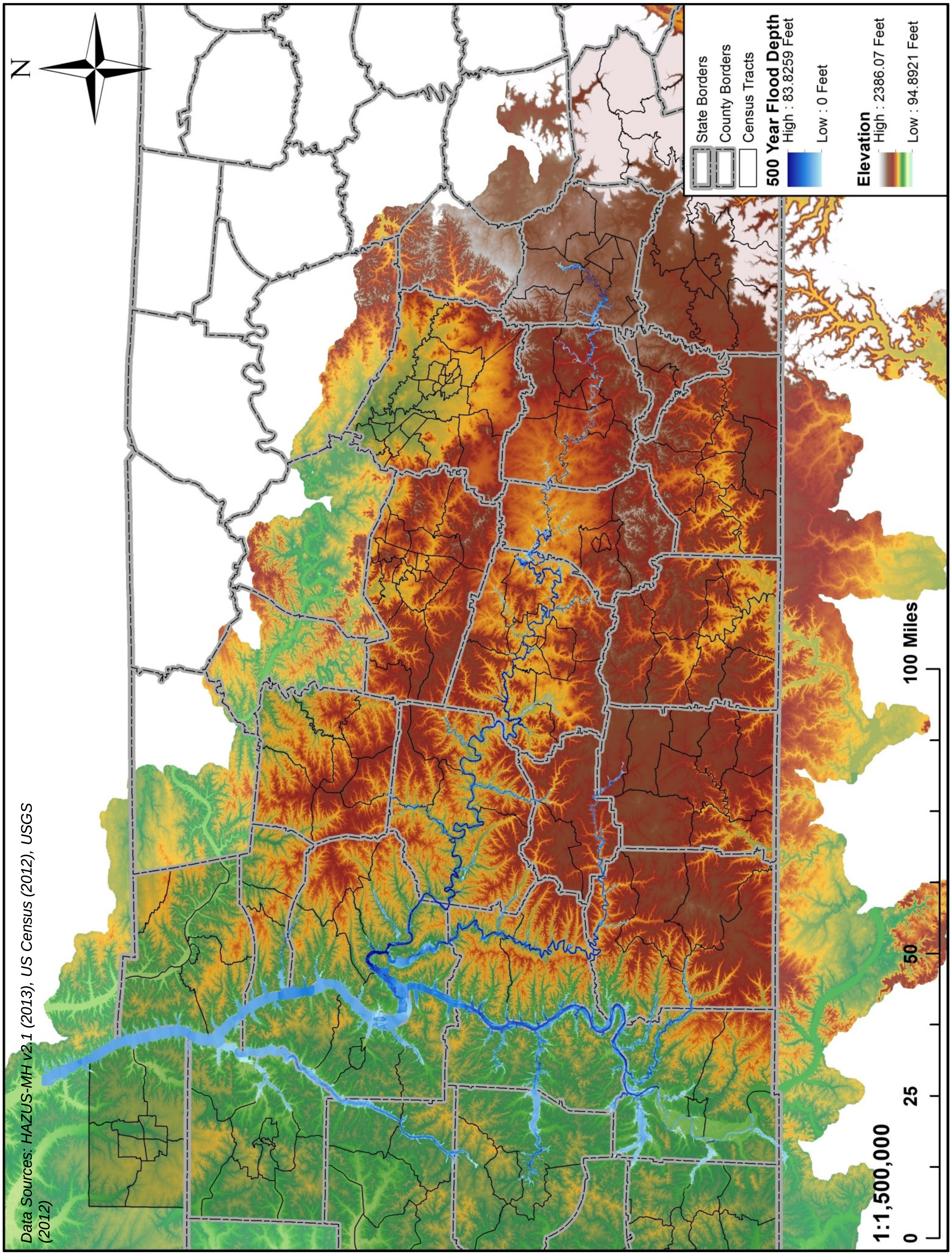
Table 95 – HAZUS Model 4, Economic Loss Report

County	Capital Stock Losses				Income Losses	Total
	Structural	Contents	Inventory	Ratio		
Bedford	$26,534,000	$32,584,000	$2,206,000	6.40%	$146,000	$61,470,000
Benton	$7,062,000	$5,549,000	$220,000	4.10%	$18,000	$12,849,000
Carroll	$3,292,000	$2,510,000	$18,000	6.80%	$4,000	$5,824,000
Chester	$0	$0	$0	0.00%	$0	$0
Coffee	$14,826,000	$10,985,000	$148,000	5.90%	$63,000	$26,022,000
Decatur	$26,606,000	$17,296,000	$260,000	13.40%	$49,000	$44,211,000
Dickson	$44,000	$31,000	$0	0.90%	$0	$75,000
Hardin	$13,895,000	$13,025,000	$477,000	5.30%	$60,000	$27,457,000
Henderson	$10,621,000	$16,301,000	$1,772,000	3.90%	$71,000	$28,765,000
Henry	$2,264,000	$1,838,000	$7,000	1.40%	$3,000	$4,112,000
Hickman	$24,542,000	$22,817,000	$652,000	9.20%	$190,000	$48,201,000
Houston	$2,586,000	$1,406,000	$0	9.20%	$5,000	$3,997,000
Humphreys	$13,630,000	$10,823,000	$462,000	5.40%	$43,000	$24,958,000
Lawrence	$593,000	$376,000	$8,000	3.20%	$0	$977,000
Lewis	$3,687,000	$2,379,000	$31,000	7.10%	$3,000	$6,100,000
Marshall	$7,873,000	$6,050,000	$143,000	5.20%	$17,000	$14,083,000
Maury	$64,975,000	$63,139,000	$1,916,000	8.10%	$572,000	$130,602,000
McNairy	$305,000	$373,000	$19,000	1.20%	$0	$697,000
Perry	$28,179,000	$23,975,000	$718,000	10.60%	$170,000	$53,042,000
Stewart	$1,236,000	$764,000	$10,000	4.10%	$0	$2,010,000
Wayne	$3,708,000	$3,345,000	$155,000	4.30%	$13,000	$7,221,000
Total =	**$256,458,000**	**$235,566,000**	**$9,222,000**	-	**$1,427,000**	**$502,673,001**

Table 96 – HAZUS Model 4, Aggregate Losses

Building Losses	Residential	Commercial	Industrial	Other	Total
Building	$189,640,000	$43,570,000	$13,180,000	$10,570,000	$256,960,000
Content	$106,670,000	$77,980,000	$28,440,000	$22,820,000	$235,910,000
Inventory	$0	$2,690,000	$6,010,000	$520,000	$9,220,000
Subtotal =	$296,310,000	$124,240,000	$47,630,000	$33,910,000	$502,090,000
Business Losses					
Income	$10,000	$300,000	$0	$30,000	$340,000
Relocation	$100,000	$70,000	$0	$10,000	$180,000
Rental Income	$20,000	$40,000	$0	$0	$60,000
Wages	$30,000	$380,000	$10,000	$420,000	$840,000
Subtotal =	$170,000	$790,000	$10,000	$460,000	$1,430,000
Total =	**$296,480,000**	**$125,030,000**	**$47,640,000**	**$34,370,000**	**$503,520,000**

Map 134 – HAZUS Model 4 – Lower Tennessee River Basin, 500 Year Flood



4.4.5 – HAZUS Model 5 – Flood – Mississippi River Basin

Table 97 – HAZUS Model 5, Debris & Shelter Report						
County	**Finishes (Tons)**	**Structures (Tons)**	**Foundations (Tons)**	**Total Debris (Tons)**	**Displaced People**	**People Requiring Short Term Shelter**
Carroll	865.95	203.32	332.59	1401.86	469	149
Chester	620.54	341.84	387.04	1349.42	342	115
Crockett	956.84	192.51	282.82	1432.18	405	240
Dyer	1963.5	750.6	966.3	3680.4	1,238	773
Fayette	1083.51	582.22	565.53	2231.27	851	404
Gibson	1255.91	272.14	440.79	1968.84	812	279
Hardeman	2859.36	3554.08	3426.07	9839.5	867	322
Haywood	946.42	575.23	585.26	2106.91	501	182
Henderson	133.32	83.98	116.12	333.43	82	9
Henry	70.76	27.22	46.32	144.3	36	0
Lake	61.94	10.73	15.37	88.03	91	11
Lauderdale	813.03	582.22	718.44	2113.69	418	101
Madison	2408.05	999.99	1045.34	4453.37	1,132	651
McNairy	1674.96	3093.95	2198.56	6967.47	420	127
Obion	1411.31	307.63	525.17	2244.11	730	284
Shelby	47788.93	53766.13	40781.43	142336.49	38,262	35,953
Tipton	834.52	1385.89	1280.48	3500.89	395	183
Weakley	998.64	258.61	445.05	1702.3	608	129
Total =	**66,747**	**66,988**	**54,159**	**187,894**	**47,659**	**39,912**

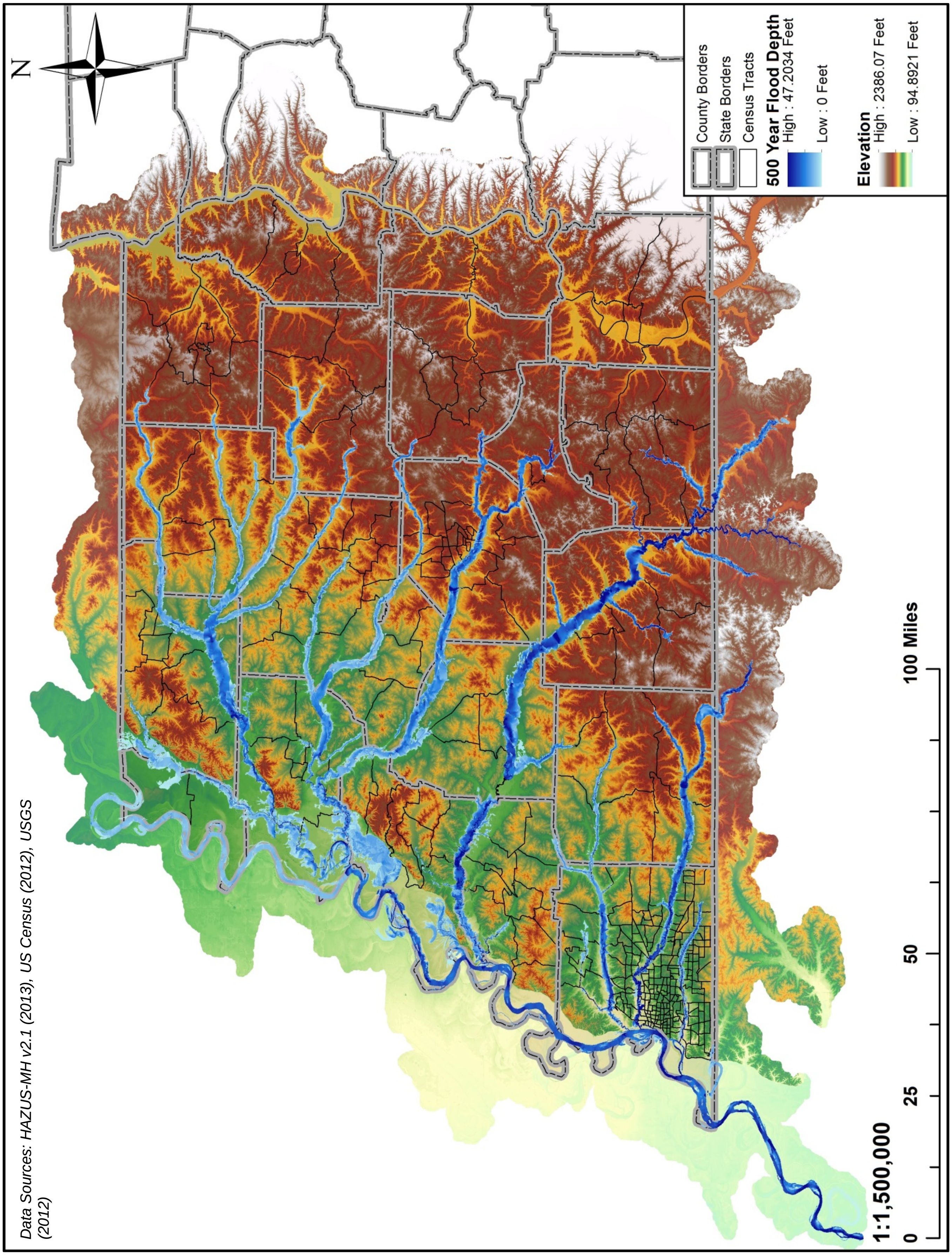
Table 98 – HAZUS Model 5, Economic Loss Report

County	Capital Stock Losses				Income Losses	Total
	Structural	Contents	Inventory	Ratio		
Carroll	$5,473,000	$7,406,000	$200,000	4.30%	$36,000	$13,115,000
Chester	$5,535,000	$7,054,000	$313,000	5.50%	$30,000	$12,932,000
Crockett	$5,467,000	$5,056,000	$243,000	7.60%	$9,000	$10,775,000
Dyer	$16,678,000	$20,048,000	$909,000	5.60%	$291,000	$37,926,000
Fayette	$17,417,000	$21,748,000	$1,211,000	5.00%	$149,000	$40,525,000
Gibson	$9,305,000	$11,842,000	$620,000	5.20%	$87,000	$21,854,000
Hardeman	$21,285,000	$28,266,000	$1,758,000	8.80%	$165,000	$51,474,000
Haywood	$7,084,000	$6,325,000	$300,000	10.30%	$8,000	$13,717,000
Henderson	$1,031,000	$1,025,000	$2,000	4.50%	$5,000	$2,063,000
Henry	$402,000	$380,000	$15,000	3.20%	$0	$797,000
Lake	$303,000	$217,000	$2,000	0.90%	$0	$522,000
Lauderdale	$6,377,000	$6,360,000	$147,000	5.70%	$412,000	$13,296,000
Madison	$34,199,000	$57,632,000	$5,304,000	7.00%	$471,000	$97,606,000
McNairy	$19,367,000	$38,735,000	$2,401,000	7.70%	$361,000	$60,864,000
Obion	$8,351,000	$11,517,000	$419,000	3.90%	$72,000	$20,359,000
Shelby	$868,522,000	$1,148,286,000	$39,624,000	10.10%	$14,421,000	$2,070,853,000
Tipton	$8,607,000	$10,353,000	$1,487,000	5.80%	$5,000	$20,452,000
Weakley	$5,656,000	$6,075,000	$227,000	4.60%	$23,000	$11,981,000
Total =	**$1,041,059,000**	**$1,388,325,000**	**$55,182,000**	**-**	**$16,545,000**	**$2,501,111,000**

Table 99 – HAZUS Model 5, Aggregate Losses

Building Losses	Residential	Commercial	Industrial	Other	Total
Building	$645,360,000	$304,350,000	$60,820,000	$30,520,000	$1,041,050,000
Content	$403,450,000	$723,690,000	$138,110,000	$123,080,000	$1,388,330,000
Inventory	$0	$24,980,000	$27,420,000	$2,780,000	$55,180,000
Subtotal =	$1,048,810,000	$1,053,020,000	$226,350,000	$156,380,000	$2,484,560,000
Business Losses					
Income	$100,000	$3,870,000	$20,000	$260,000	$4,250,000
Relocation	$1,070,000	$1,390,000	$20,000	$110,000	$2,590,000
Rental Income	$440,000	$680,000	$0	$10,000	$1,130,000
Wages	$270,000	$5,400,000	$30,000	$2,890,000	$8,580,000
Subtotal =	$1,880,000	$11,340,000	$70,000	$3,270,000	$16,550,000
Total =	**$1,050,690,000**	**$1,064,360,000**	**$226,420,000**	**$159,650,000**	**$2,501,110,000**

Map 135 – HAZUS Model 5 – Mississippi River Basin, 500 Year Flood



Data Sources: HAZUS-MH v2.1 (2013), US Census (2012), USGS (2012)

4.4.6 – HAZUS Model 6 – Flood – Upper Tennessee River Basin

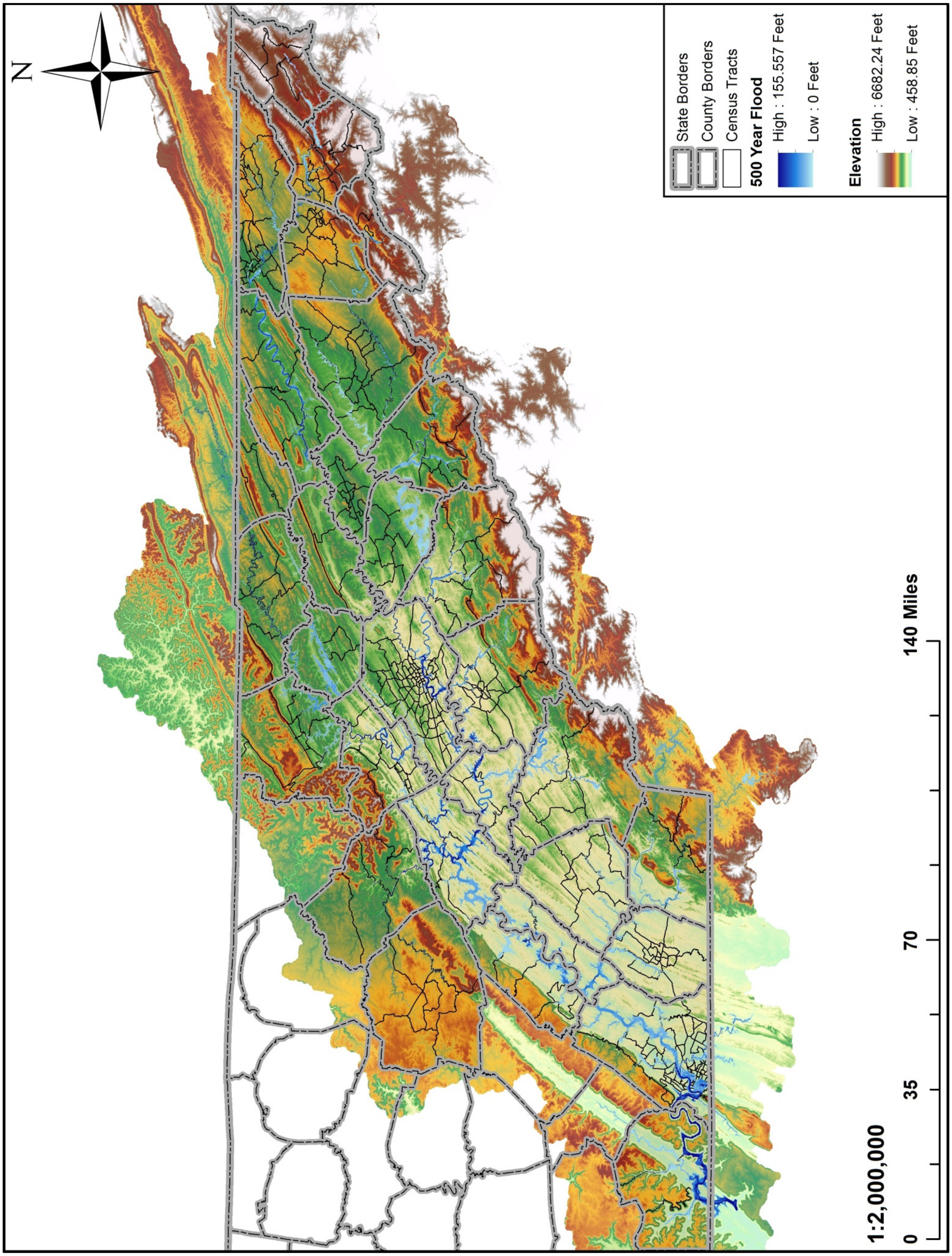
Table 100 – HAZUS Model 6, Debris & Shelter Report						
County	Finishes (Tons)	Structures (Tons)	Foundations (Tons)	Total Debris (Tons)	Displaced People	People Requiring Short Term Shelter
Anderson	12,246	43,317	34,682	90,246	4,524	3,360
Blount	16,732	38,936	31,677	87,345	3,340	1,675
Bradley	3,898	5,656	5,217	14,770	1,738	1,080
Campbell	438	429	449	1,316	223	20
Carter	11,788	25,795	21,270	58,852	4,298	3,214
Claiborne	815	2,686	2,311	5,812	406	132
Cocke	3,668	13,701	10,742	28,111	1,278	690
Cumberland	216	526	492	1,234	85	10
Grainger	111	186	189	486	36	1
Greene	1,265	2,132	2,102	5,500	750	123
Hamblen	247	224	228	698	107	24
Hamilton	125,792	447,062	354,776	927,630	28,197	23,783
Hancock	136	255	265	656	40	4
Hawkins	4,513	10,474	9,868	24,855	1,661	931
Jefferson	885	578	692	2,155	399	68
Johnson	234	317	318	869	105	16
Knox	30,403	77,929	64,344	172,675	12,208	8,528
Loudon	4,044	15,268	12,745	32,058	2,154	1,058
Marion	7,398	18,465	14,278	40,141	3,010	1,834
McMinn	1,662	2,963	2,770	7,394	699	121
Meigs	2,931	4,814	5,230	12,975	1,190	385
Monroe	1,066	1,676	1,627	4,370	362	44
Morgan	722	1,271	1,313	3,307	283	76
Polk	1,400	3,479	3,116	7,994	520	150
Rhea	6,962	8,291	8,247	23,501	2,899	1,540
Roane	19,843	44,632	40,387	104,862	7,334	4,555
Sevier	7,754	17,519	12,859	38,132	3,299	2,326
Sullivan	11,977	30,799	25,238	68,013	3,528	2,256
Unicoi	1,266	5,142	4,846	11,254	566	289
Union	815	1,338	1,384	3,537	233	57
Washington	3,305	5,031	4,952	13,288	1,513	745
Total =	**284,534**	**830,888**	**678,613**	**1,794,035**	**86,985**	**59,095**

Table 101 – HAZUS Model 6, Economic Loss Report

County	Capital Stock Losses				Income Losses	Total
	Structural	Contents	Inventory	Ratio		
Anderson	$185,563,000	$213,304,000	$15,309,000	12.60%	$414,176,000	$416,218,000
Blount	$121,113,000	$99,869,000	$3,228,000	9.30%	$224,210,000	$224,942,000
Bradley	$39,221,000	$37,811,000	$1,038,000	7.00%	$78,070,000	$78,559,000
Campbell	$5,432,000	$5,363,000	$70,000	1.50%	$10,865,000	$10,915,000
Carter	$94,917,000	$104,949,000	$3,863,000	11.10%	$203,729,000	$205,050,000
Claiborne	$10,637,000	$8,340,000	$295,000	4.20%	$19,272,000	$19,325,000
Cocke	$77,019,000	$129,130,000	$14,920,000	14.60%	$221,069,000	$222,665,000
Cumberland	$2,018,000	$1,432,000	$43,000	2.40%	$3,493,000	$3,496,000
Grainger	$667,000	$617,000	$45,000	1.30%	$1,329,000	$1,336,000
Greene	$14,526,000	$14,780,000	$1,486,000	5.30%	$30,792,000	$30,817,000
Hamblen	$1,947,000	$1,297,000	$49,000	10.40%	$3,293,000	$3,293,000
Hamilton	$1,667,429,000	$2,408,681,000	$188,902,000	20.40%	$4,265,012,000	$4,293,660,000
Hancock	$643,000	$317,000	$0	7.80%	$960,000	$960,000
Hawkins	$41,193,000	$34,047,000	$2,671,000	6.90%	$77,911,000	$78,012,000
Jefferson	$8,950,000	$10,978,000	$310,000	2.10%	$20,238,000	$20,397,000
Johnson	$1,950,000	$2,391,000	$121,000	2.60%	$4,462,000	$4,472,000
Knox	$521,050,000	$527,912,000	$27,350,000	9.00%	$1,076,312,000	$1,080,309,000
Loudon	$100,242,000	$128,768,000	$12,722,000	8.50%	$241,732,000	$243,202,000
Marion	$97,280,000	$102,270,000	$4,932,000	17.80%	$204,482,000	$205,326,000
McMinn	$15,399,000	$15,795,000	$962,000	5.20%	$32,156,000	$32,205,000
Meigs	$29,940,000	$21,341,000	$399,000	14.90%	$51,680,000	$51,814,000
Monroe	$7,640,000	$9,201,000	$858,000	2.90%	$17,699,000	$17,820,000
Morgan	$6,378,000	$4,571,000	$213,000	3.90%	$11,162,000	$11,166,000
Polk	$17,429,000	$20,265,000	$719,000	7.80%	$38,413,000	$38,609,000
Rhea	$62,998,000	$74,463,000	$2,297,000	10.30%	$139,758,000	$140,307,000
Roane	$258,210,000	$249,803,000	$3,795,000	16.10%	$511,808,000	$515,449,000
Sevier	$165,022,000	$265,043,000	$10,337,000	10.30%	$440,402,000	$445,575,000
Sullivan	$119,655,000	$147,881,000	$7,731,000	7.80%	$275,267,000	$276,611,000
Unicoi	$18,957,000	$26,979,000	$3,646,000	14.10%	$49,582,000	$49,677,000
Union	$6,167,000	$4,214,000	$44,000	4.40%	$10,425,000	$10,439,000
Washington	$35,709,000	$27,208,000	$1,215,000	8.20%	$64,132,000	$64,212,000
Total =	**$3,735,301,000**	**$4,699,020,000**	**$309,570,000**	**-**	**$8,743,891,000**	**$8,796,838,000**

Table 102 – HAZUS Model 6, Aggregate Losses					
Building Losses	**Residential**	**Commercial**	**Industrial**	**Other**	**Total**
Building	$1,819,520,000	$1,218,060,000	$496,910,000	$200,810,000	$3,735,300,000
Content	$1,056,750,000	$2,114,890,000	$1,047,910,000	$479,470,000	$4,699,020,000
Inventory	$0	$72,920,000	$233,640,000	$3,000,000	$309,570,000
Subtotal =	$2,876,270,000	$3,405,870,000	$1,778,460,000	$683,290,000	$8,743,890,000
Business Losses					
Income	$480,000	$12,620,000	$140,000	$1,340,000	$14,580,000
Relocation	$1,760,000	$3,500,000	$180,000	$630,000	$6,080,000
Rental Income	$1,130,000	$2,120,000	$20,000	$50,000	$3,310,000
Wages	$1,240,000	$13,420,000	$200,000	$14,120,000	$28,980,000
Subtotal =	$4,610,000	$31,660,000	$540,000	$16,140,000	$52,950,000
Total =	**$2,880,880,000**	**$3,437,530,000**	**$1,779,000,000**	**$699,430,000**	**$8,796,840,000**

Map 136 – HAZUS Model 6 – Upper Tennessee River Basin, 500 Year Flood



4.5 – Vulnerability Assessment of State Property

The State of Tennessee owns and operates 7,555 properties and structures covering 96,641,959 square feet. The Tennessee Department of the Treasury reports these properties and structures are worth $15,422,764,100 with a total content value of $3,793,355,000. Maps 137 through 140 depict the locations of all state owned and operated properties.

Of these properties and structures, the vast majority of their worth is located in hazard areas ranked 3 or lower. However, due to the high threat level in West Tennessee along the Mississippi River, there is a sizable worth of property and structures located in a high threat hazard area.

The State of Tennessee Department of the Treasury has broken down state owned and operated properties by the following classifications:

> ***Administrative:*** This classification includes any non-chemical, communications, power, or healthcare facilities used for administrative and bureaucratic functions under any number of state agencies and departments.
> ***Chemical:*** This classification includes facilities that handle significant amount of chemicals such water and sewage treatment facilities. The state does not own or operate any chemical production facilities.
> ***Communications:*** This classification is for any radio or telecommunications purposed structure.
> ***Corrections:*** This classification includes any non-chemical, communications, power, or healthcare facilities under the Tennessee correctional system.
> **Education:** This classification includes any non-chemical, communications, power, or healthcare facilities under any number of Tennessee's college and/or university systems.
> ***Healthcare:*** Any state owned or operated facilities associated with a healthcare practice. These are typically mental healthcare, rehabilitation, or therapy associated facilities. The state does not own or operate any hospitals.
> ***Military:*** This classification includes any non-chemical, communications, power, or healthcare facilities under the Tennessee National Guard.
> ***Power:*** Any steam, coal, natural gas, nuclear, or other power producing facility owned or operated by the state.

The table on the following pages breaks down the number, structure sizes, structure values, contents values, and total value of all state owned and operated property located in each hazard's threat zone, 1 through 6. Due to their nature, neither drought nor extreme temperatures pose a threat to structures. For dam failure, each of the dams of prime concern is listed along with the values that are within their failure inundation.

Table 103 – Loss Estimates, State of Tennessee Properties					
Hazard Threat Zone	**Structure Count**	**Size (Sq. Ft.)**	**Structure Value**	**Content Value**	**Total Value**
Dam Failures					
Center Hill Dam	128	3,444,400	$318,056,600	$175,051,400	$493,108,000
Administrative	54	2,374,700	$193,699,000	$58,747,300	$252,446,300
Chemical	0	0	$0	$0	$0
Communications	1	100	$8,000	$200,000	$208,000
Corrections	24	436,700	$79,570,500	$5,167,100	$84,737,600
Education	46	615,000	$43,341,200	$110,719,000	$154,060,200
Healthcare	0	0	$0	$0	$0
Military	3	17,900	$1,437,900	$218,000	$1,655,900
Power	0	0	$0	$0	$0
Tellico Dam	1	1,500	$187,500	$5,000	$192,500
Administrative	1	1,500	$187,500	$5,000	$192,500
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Wolf Creek Dam	155	3,682,200	$360,277,400	$182,499,000	$542,776,400
Administrative	61	2,403,800	$195,025,700	$59,680,300	$254,706,000
Chemical	0	0	$0	$0	$0
Communications	2	100	$148,000	$200,000	$348,000
Corrections	48	590,100	$110,272,000	$7,449,800	$117,721,800
Education	40	593,300	$39,695,300	$109,841,400	$149,536,700
Healthcare	1	76,400	$13,752,200	$5,112,000	$18,864,200
Military	3	18,500	$1,384,200	$215,500	$1,599,700
Power	0	0	$0	$0	$0
Droughts	No Threat	No Threat	No Threat	No Threat	No Threat
Earthquakes					
Earthquake 1	3,706	42,103,384	$6,387,066,500	$1,731,029,000	$8,118,095,500
Administrative	1,925	17,447,627	$2,220,972,200	$509,461,200	$2,730,433,400
Chemical	20	34,700	$8,773,800	$341,500	$9,115,300
Communications	37	145,900	$20,536,000	$11,025,500	$31,561,500
Corrections	395	4,355,100	$736,660,100	$96,691,700	$833,351,800
Education	1,124	17,594,657	$2,994,458,300	$1,029,130,400	$4,023,588,700
Healthcare	77	1,093,800	$199,576,300	$26,637,800	$226,214,100
Military	126	1,429,500	$206,089,800	$57,115,900	$263,205,700
Power	2	2,100	$0	$625,000	$625,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Earthquake 2	1,837	29,222,700	$5,351,361,600	$1,169,940,300	$6,521,301,900
Administrative	958	7,493,658	$1,225,605,500	$362,632,900	$1,588,238,400
Chemical	13	14,300	$3,150,200	$111,000	$3,261,200
Communications	18	107,900	$19,399,100	$9,834,100	$29,233,200
Corrections	108	1,924,470	$389,253,400	$131,315,600	$520,569,000
Education	640	17,962,772	$3,373,030,700	$616,237,400	$3,989,268,100
Healthcare	32	621,300	$109,585,100	$36,379,700	$145,964,800
Military	64	1,067,400	$147,176,000	$11,030,200	$158,206,200
Power	4	30,900	$84,161,600	$2,399,400	$86,561,000
Earthquake 3	78	264,520	$19,254,800	$8,180,100	$27,434,900
Administrative	55	152,020	$10,974,100	$2,876,700	$13,850,800
Chemical	0	0	$0	$0	$0
Communications	4	3,500	$198,800	$703,300	$902,100
Corrections	2	2,600	$139,200	$302,500	$441,700
Education	8	47,900	$278,000	$3,887,600	$4,165,600
Healthcare	0	0	$0	$0	$0
Military	8	57,500	$7,664,700	$240,000	$7,904,700
Power	1	1,000	$0	$170,000	$170,000
Earthquake 4	1,223	18,504,297	$2,677,385,300	$745,013,700	$3,422,399,000
Administrative	609	4,971,372	$605,418,400	$269,492,700	$874,911,100
Chemical	4	5,900	$1,383,200	$52,000	$1,435,200
Communications	19	13,070	$4,075,000	$4,895,400	$8,970,400
Corrections	46	1,432,500	$177,931,200	$20,090,300	$198,021,500
Education	457	10,913,400	$1,669,475,800	$400,180,000	$2,069,655,800
Healthcare	46	568,700	$100,669,200	$15,828,100	$116,497,300
Military	41	598,155	$118,432,500	$34,385,200	$152,817,700
Power	1	1,200	$0	$90,000	$90,000
Earthquake 5	401	4,225,993	$594,712,800	$79,019,800	$673,732,600
Administrative	159	1,423,280	$175,718,500	$22,261,700	$197,980,200
Chemical	2	6,500	$3,115,600	$335,000	$3,450,600
Communications	1	1,800	$225,000	$71,000	$296,000
Corrections	90	683,813	$139,082,300	$26,414,500	$165,496,800
Education	127	1,943,000	$252,529,600	$28,002,600	$280,532,200
Healthcare	10	51,600	$4,113,700	$503,000	$4,616,700
Military	11	109,400	$16,879,500	$432,000	$17,311,500
Power	1	6,600	$3,048,600	$1,000,000	$4,048,600
Earthquake 6	181	1,193,065	$213,606,500	$21,699,200	$235,305,700
Administrative	77	356,500	$48,589,400	$7,635,000	$56,224,400
Chemical	1	4,500	$454,200	$0	$454,200
Communications	4	400	$141,200	$1,100,000	$1,241,200
Corrections	60	507,465	$107,965,000	$5,073,100	$113,038,100
Education	34	302,500	$53,153,500	$7,720,500	$60,874,000
Healthcare	2	0	$0	$105,600	$105,600
Military	3	21,700	$3,303,200	$65,000	$3,368,200
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Extreme Temperatures	No Threat	No Threat	No Threat	No Threat	No Threat
Floods - Flash Floods					
Flash Flood 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Flash Flood 2	2,516	15,905,836	$2,212,645,200	$327,934,600	$2,540,579,800
Administrative	1,461	5,919,418	$665,477,800	$114,341,400	$779,819,200
Chemical	25	49,100	$12,436,300	$722,600	$13,158,900
Communications	29	38,470	$8,651,400	$9,316,700	$17,968,100
Corrections	384	3,227,848	$609,406,400	$61,135,900	$670,542,300
Education	495	5,580,200	$788,626,600	$132,436,600	$921,063,200
Healthcare	55	565,000	$71,103,100	$6,606,500	$77,709,600
Military	64	517,200	$53,890,900	$1,849,900	$55,740,800
Power	3	8,600	$3,052,700	$1,525,000	$4,577,700
Flash Flood 3	3,387	44,747,661	$8,025,691,300	$1,955,229,000	$9,980,920,300
Administrative	1,734	12,617,177	$2,013,534,400	$498,379,600	$2,511,914,000
Chemical	11	14,100	$3,393,600	$86,900	$3,480,500
Communications	35	169,200	$28,901,000	$11,068,600	$39,969,600
Corrections	177	2,702,800	$483,456,600	$174,323,400	$657,780,000
Education	1,232	26,382,429	$4,900,187,800	$1,191,745,800	$6,091,933,600
Healthcare	57	1,052,100	$212,179,900	$47,620,300	$259,800,200
Military	135	1,776,655	$299,880,500	$29,245,000	$329,125,500
Power	6	33,200	$84,157,500	$2,759,400	$86,916,900
Flash Flood 4	492	10,942,372	$1,445,265,600	$404,431,300	$1,849,696,900
Administrative	225	2,549,372	$268,253,200	$199,085,700	$467,338,900
Chemical	4	2,700	$1,047,100	$30,000	$1,077,100
Communications	10	30,500	$6,432,300	$3,479,700	$9,912,000
Corrections	14	730,700	$68,750,600	$6,398,700	$75,149,300
Education	218	7,203,200	$1,016,939,900	$168,470,900	$1,185,410,800
Healthcare	10	294,700	$64,361,300	$12,617,000	$76,978,300
Military	11	131,200	$19,481,200	$14,349,300	$33,830,500
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Flash Flood 5	559	8,395,420	$1,173,443,300	$293,497,800	$1,466,941,100
Administrative	220	2,526,820	$262,285,100	$72,457,000	$334,742,100
Chemical	0	0	$0	$0	$0
Communications	6	200	$378,600	$1,450,000	$1,828,600
Corrections	85	1,398,200	$232,498,800	$19,950,200	$252,449,000
Education	185	3,676,200	$584,354,400	$175,348,300	$759,702,700
Healthcare	34	386,000	$61,699,800	$9,554,000	$71,253,800
Military	29	408,000	$32,226,600	$14,738,300	$46,964,900
Power	0	0	$0	$0	$0
Flash Flood 6	471	15,479,970	$2,373,842,100	$773,789,400	$3,147,631,500
Administrative	142	8,188,970	$1,065,227,600	$290,096,500	$1,355,324,100
Chemical	0	0	$0	$0	$0
Communications	3	34,200	$211,800	$2,314,300	$2,526,100
Corrections	41	846,400	$156,918,800	$18,079,500	$174,998,300
Education	260	5,922,200	$1,052,817,200	$417,156,900	$1,469,974,100
Healthcare	11	37,600	$4,600,200	$3,056,400	$7,656,600
Military	14	450,600	$94,066,500	$43,085,800	$137,152,300
Power	0	0	$0	$0	$0
Floods - Riverine Floods					
Riverine Floods (100 Year)	320	2,325,964	$344,848,900	$42,201,100	$387,050,000
Administrative	162	625,594	$65,250,700	$9,290,800	$74,541,500
Chemical	3	900	$726,100	$33,000	$759,100
Communications	1	100	$8,000	$200,000	$208,000
Corrections	63	929,070	$175,764,300	$11,635,300	$187,399,600
Education	75	649,200	$86,303,700	$19,101,900	$105,405,600
Healthcare	1	1,400	$89,000	$4,500	$93,500
Military	14	118,400	$16,707,100	$1,435,600	$18,142,700
Power	1	1,300	$0	$500,000	$500,000
Riverine Floods (500 Year)	89	2,167,600	$140,178,500	$43,066,500	$183,245,000
Administrative	63	1,679,100	$100,522,200	$37,505,100	$138,027,300
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	2	174,800	$23,800,000	$900,000	$24,700,000
Education	22	281,600	$12,393,200	$4,611,400	$17,004,600
Healthcare	0	0	$0	$0	$0
Military	1	31,400	$3,459,000	$25,000	$3,484,000
Power	1	700	$4,100	$25,000	$29,100

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Riverine Floods (100 & 500)	409	4,493,564	$485,027,400	$85,267,600	$570,295,000
Administrative	225	2,304,694	$165,772,900	$46,795,900	$212,568,800
Chemical	3	900	$726,100	$33,000	$759,100
Communications	1	100	$8,000	$200,000	$208,000
Corrections	65	1,103,870	$199,564,300	$12,535,300	$212,099,600
Education	97	930,800	$98,696,900	$23,713,300	$122,410,200
Healthcare	1	1,400	$89,000	$4,500	$93,500
Military	15	149,800	$20,166,100	$1,460,600	$21,626,700
Power	2	2,000	$4,100	$525,000	$529,100
Geologic - Expansive Soils					
Expansive Soils 1	776	19,809,016	$3,754,113,500	$882,967,500	$4,637,081,000
Administrative	315	4,964,544	$904,601,300	$297,238,200	$1,201,839,500
Chemical	1	300	$277,800	$0	$277,800
Communications	5	77,700	$14,549,300	$6,117,100	$20,666,400
Corrections	38	807,800	$175,575,700	$109,576,800	$285,152,500
Education	348	12,586,272	$2,353,033,100	$429,706,000	$2,782,739,100
Healthcare	31	791,200	$129,212,000	$34,917,500	$164,129,500
Military	36	551,500	$92,706,800	$3,192,500	$95,899,300
Power	2	29,700	$84,157,500	$2,219,400	$86,376,900
Expansive Soils 2	4,371	50,598,666	$7,247,118,600	$1,896,468,100	$9,143,586,700
Administrative	2,253	18,824,406	$2,241,092,500	$680,953,700	$2,922,046,200
Chemical	34	63,100	$15,050,300	$816,600	$15,866,900
Communications	51	142,870	$21,843,600	$13,776,000	$35,619,600
Corrections	555	6,587,648	$1,129,873,300	$119,727,000	$1,249,600,300
Education	1,247	22,381,887	$3,441,383,700	$981,229,900	$4,422,613,600
Healthcare	80	724,400	$129,431,100	$21,767,600	$151,198,700
Military	146	1,863,555	$265,391,400	$76,412,300	$341,803,700
Power	5	10,800	$3,052,700	$1,785,000	$4,837,700
Expansive Soils 3	2,144	24,261,227	$4,131,082,300	$945,754,200	$5,076,836,500
Administrative	1,140	7,706,607	$1,093,827,000	$192,337,600	$1,286,164,600
Chemical	5	2,500	$1,548,900	$22,900	$1,571,800
Communications	25	48,000	$7,312,200	$7,636,200	$14,948,400
Corrections	101	1,474,100	$244,557,000	$50,151,900	$294,708,900
Education	748	13,442,220	$2,504,543,900	$651,303,000	$3,155,846,900
Healthcare	53	767,800	$146,678,100	$22,159,100	$168,837,200
Military	70	818,700	$132,615,200	$21,863,500	$154,478,700
Power	2	1,300	$0	$280,000	$280,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Expansive Soils 4	126	812,650	$105,396,100	$29,573,300	$134,969,400
Administrative	69	322,400	$42,794,200	$3,755,700	$46,549,900
Chemical	0	0	$0	$0	$0
Communications	2	4,000	$870,000	$100,000	$970,000
Corrections	7	36,400	$1,025,200	$432,000	$1,457,200
Education	44	347,950	$43,251,300	$22,875,600	$66,126,900
Healthcare	3	52,000	$8,623,100	$610,000	$9,233,100
Military	1	49,900	$8,832,300	$1,800,000	$10,632,300
Power	0	0	$0	$0	$0
Expansive Soils 5	10	36,800	$6,090,500	$119,000	$6,209,500
Administrative	7	30,900	$5,376,600	$75,000	$5,451,600
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	3	5,900	$713,900	$44,000	$757,900
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Expansive Soils 6	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Geologic - Land Subsidence					
Land Subsidence 1	5,489	70,255,501	$10,642,302,300	$2,687,220,000	$13,329,522,300
Administrative	2,715	24,868,691	$3,151,604,600	$837,768,000	$3,989,372,600
Chemical	26	48,300	$10,343,600	$728,000	$11,071,600
Communications	67	159,270	$26,450,800	$24,446,900	$50,897,700
Corrections	561	7,622,948	$1,284,070,000	$151,559,900	$1,435,629,900
Education	1,781	33,396,137	$5,494,575,500	$1,532,974,700	$7,027,550,200
Healthcare	136	1,921,500	$328,269,400	$47,370,400	$375,639,800
Military	198	2,228,555	$343,939,800	$90,832,100	$434,771,900
Power	5	10,100	$3,048,600	$1,540,000	$4,588,600

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Land Subsidence 2	974	19,382,188	$3,643,412,300	$888,883,200	$4,532,295,500
Administrative	482	4,889,816	$853,915,400	$291,789,700	$1,145,705,100
Chemical	6	4,700	$1,661,500	$22,900	$1,684,400
Communications	7	84,500	$12,033,600	$1,905,600	$13,939,200
Corrections	50	804,000	$180,633,400	$117,436,300	$298,069,700
Education	367	12,412,772	$2,321,588,300	$437,050,900	$2,758,639,200
Healthcare	19	297,300	$65,971,000	$29,850,200	$95,821,200
Military	39	857,400	$123,447,500	$8,083,200	$131,530,700
Power	4	31,700	$84,161,600	$2,744,400	$86,906,000
Land Subsidence 3	440	1,388,450	$179,629,300	$29,422,500	$209,051,800
Administrative	264	569,650	$63,094,800	$14,770,800	$77,865,600
Chemical	5	7,600	$3,294,400	$38,600	$3,333,000
Communications	4	19,800	$4,233,100	$521,500	$4,754,600
Corrections	75	324,800	$57,724,900	$6,319,900	$64,044,800
Education	82	429,400	$47,016,000	$6,690,500	$53,706,500
Healthcare	7	18,100	$2,757,700	$1,051,200	$3,808,900
Military	3	19,100	$1,508,400	$30,000	$1,538,400
Power	0	0	$0	$0	$0
Land Subsidence 4	174	615,800	$90,236,100	$12,819,300	$103,055,400
Administrative	119	209,300	$22,274,700	$4,088,700	$26,363,400
Chemical	1	100	$650,000	$0	$650,000
Communications	2	0	$450,000	$130,400	$580,400
Corrections	6	11,400	$1,319,000	$599,900	$1,918,900
Education	41	351,200	$55,485,400	$4,940,300	$60,425,700
Healthcare	2	3,400	$275,000	$30,000	$305,000
Military	3	40,400	$9,782,000	$3,030,000	$12,812,000
Power	0	0	$0	$0	$0
Land Subsidence 5	207	3,432,120	$637,202,400	$130,613,500	$767,815,900
Administrative	93	997,600	$158,116,000	$21,611,300	$179,727,300
Chemical	1	1,000	$650,000	$0	$650,000
Communications	3	9,000	$1,407,600	$624,900	$2,032,500
Corrections	7	140,600	$27,183,100	$3,951,700	$31,134,800
Education	94	2,077,020	$416,131,000	$102,103,600	$518,234,600
Healthcare	2	92,100	$16,580,100	$1,074,000	$17,654,100
Military	7	114,800	$17,134,600	$1,248,000	$18,382,600
Power	0	0	$0	$0	$0
Land Subsidence 6	139	435,600	$49,955,100	$5,888,600	$55,843,700
Administrative	108	306,400	$37,772,600	$4,321,700	$42,094,300
Chemical	1	4,200	$277,500	$50,000	$327,500
Communications	0	0	$0	$0	$0
Corrections	2	2,200	$100,800	$20,000	$120,800
Education	24	96,400	$7,979,700	$1,373,500	$9,353,200
Healthcare	1	3,000	$91,100	$78,400	$169,500
Military	3	23,400	$3,733,400	$45,000	$3,778,400
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Geologic - Landslides					
Landslide 1	3,671	48,574,611	$6,963,377,200	$1,918,799,700	$8,882,176,900
Administrative	1,882	19,383,859	$2,332,563,700	$681,537,400	$3,014,101,100
Chemical	16	26,200	$5,961,900	$445,900	$6,407,800
Communications	48	85,570	$11,490,200	$15,652,000	$27,142,200
Corrections	299	4,641,370	$724,485,000	$78,809,100	$803,294,100
Education	1,197	21,839,957	$3,489,721,100	$1,038,565,900	$4,528,287,000
Healthcare	88	1,124,700	$192,263,600	$32,903,800	$225,167,400
Military	138	1,464,555	$203,843,100	$69,590,600	$273,433,700
Power	3	8,400	$3,048,600	$1,295,000	$4,343,600
Landslide 2	1,411	28,122,586	$5,023,839,700	$1,183,167,600	$6,207,007,300
Administrative	659	7,768,814	$1,266,565,100	$348,401,700	$1,614,966,800
Chemical	4	7,300	$1,120,400	$20,000	$1,140,400
Communications	12	33,700	$4,097,700	$3,652,300	$7,750,000
Corrections	48	1,139,300	$218,337,000	$132,945,300	$351,282,300
Education	582	17,236,372	$3,119,367,000	$643,072,100	$3,762,439,100
Healthcare	46	876,700	$181,431,900	$40,664,900	$222,096,800
Military	57	1,030,000	$148,759,000	$12,166,900	$160,925,900
Power	3	30,400	$84,161,600	$2,244,400	$86,406,000
Landslide 3	614	4,783,620	$780,155,000	$128,913,300	$909,068,300
Administrative	316	1,115,220	$161,986,700	$31,992,300	$193,979,000
Chemical	8	9,100	$4,960,800	$34,600	$4,995,400
Communications	6	58,200	$12,675,700	$5,015,500	$17,691,200
Corrections	89	498,900	$82,587,200	$9,008,100	$91,595,300
Education	167	2,747,400	$476,109,100	$77,140,500	$553,249,600
Healthcare	15	235,600	$26,374,700	$5,076,900	$31,451,600
Military	13	119,200	$15,460,800	$645,400	$16,106,200
Power	0	0	$0	$0	$0
Landslide 4	572	1,980,115	$310,630,200	$35,820,300	$346,450,500
Administrative	391	924,250	$123,910,100	$19,091,400	$143,001,500
Chemical	3	4,800	$723,100	$54,000	$777,100
Communications	8	22,800	$4,533,200	$897,900	$5,431,100
Corrections	63	503,565	$108,967,500	$4,811,200	$113,778,700
Education	93	481,900	$66,833,700	$10,562,700	$77,396,400
Healthcare	5	5,000	$378,100	$178,100	$556,200
Military	8	36,600	$5,284,500	$135,000	$5,419,500
Power	1	1,200	$0	$90,000	$90,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Landslide 5	832	10,559,593	$1,951,099,000	$459,218,900	$2,410,317,900
Administrative	330	2,124,980	$337,607,400	$81,441,600	$419,049,000
Chemical	3	6,700	$2,682,000	$65,000	$2,747,000
Communications	6	71,600	$11,540,700	$1,611,600	$13,152,300
Corrections	139	1,566,813	$320,325,000	$45,103,700	$365,428,700
Education	314	6,184,000	$1,157,356,700	$309,651,100	$1,467,007,800
Healthcare	11	68,200	$8,596,000	$380,500	$8,976,500
Military	27	535,500	$112,991,200	$20,310,400	$133,301,600
Power	2	1,800	$0	$655,000	$655,000
Landslide 6	326	1,493,434	$214,286,400	$28,962,300	$243,248,700
Administrative	205	527,334	$64,645,100	$11,895,800	$76,540,900
Chemical	6	11,800	$1,428,800	$220,000	$1,648,800
Communications	3	700	$237,600	$800,000	$1,037,600
Corrections	63	556,000	$96,329,500	$9,210,300	$105,539,800
Education	37	274,600	$33,538,300	$6,166,200	$39,704,500
Healthcare	2	25,200	$4,900,000	$250,000	$5,150,000
Military	10	97,800	$13,207,100	$420,000	$13,627,100
Power	0	0	$0	$0	$0
Severe Storms - Hail					
Hail 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Hail 2	1,720	8,817,380	$1,281,534,400	$190,628,200	$1,472,162,600
Administrative	1,126	3,552,545	$390,727,600	$68,224,600	$458,952,200
Chemical	17	33,000	$5,727,400	$223,000	$5,950,400
Communications	25	89,100	$17,368,400	$7,842,000	$25,210,400
Corrections	191	1,974,235	$393,705,900	$26,315,400	$420,021,300
Education	280	2,413,100	$367,810,500	$77,769,300	$445,579,800
Healthcare	36	401,300	$50,980,000	$5,814,900	$56,794,900
Military	44	353,100	$55,214,600	$4,269,000	$59,483,600
Power	1	1,000	$0	$170,000	$170,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Hail 3	2,899	22,431,549	$3,372,992,000	$646,252,000	$4,019,244,000
Administrative	1,596	7,647,621	$965,206,800	$158,614,000	$1,123,820,800
Chemical	19	30,000	$10,341,300	$586,500	$10,927,800
Communications	27	35,370	$6,484,200	$6,449,100	$12,933,300
Corrections	315	2,600,913	$439,499,000	$81,689,800	$521,188,800
Education	798	10,747,290	$1,698,846,200	$372,340,500	$2,071,186,700
Healthcare	43	597,900	$123,788,800	$13,319,000	$137,107,800
Military	96	762,555	$125,773,000	$11,448,100	$137,221,100
Power	5	9,900	$3,052,700	$1,805,000	$4,857,700
Hail 4	991	13,214,809	$2,293,679,300	$622,776,100	$2,916,455,400
Administrative	419	4,287,942	$641,799,100	$128,699,700	$770,498,800
Chemical	4	2,900	$808,300	$30,000	$838,300
Communications	18	35,000	$5,014,200	$4,285,100	$9,299,300
Corrections	26	443,100	$58,847,400	$9,518,300	$68,365,700
Education	471	7,813,767	$1,489,911,600	$455,079,100	$1,944,990,700
Healthcare	25	245,400	$37,831,500	$4,823,300	$42,654,800
Military	28	386,700	$59,467,200	$20,340,600	$79,807,800
Power	0	0	$0	$0	$0
Hail 5	929	24,491,576	$4,784,329,900	$1,134,393,300	$5,918,723,200
Administrative	324	5,493,904	$1,002,108,800	$335,175,800	$1,337,284,600
Chemical	0	0	$0	$0	$0
Communications	9	78,900	$15,456,500	$6,738,800	$22,195,300
Corrections	107	1,889,400	$399,783,800	$133,354,800	$533,138,600
Education	420	15,451,272	$3,028,720,200	$599,658,100	$3,628,378,300
Healthcare	32	634,200	$120,929,700	$40,408,000	$161,337,700
Military	34	913,000	$133,173,400	$16,748,400	$149,921,800
Power	3	30,900	$84,157,500	$2,309,400	$86,466,900
Hail 6	886	26,515,945	$3,498,351,900	$1,160,832,500	$4,659,184,400
Administrative	317	10,819,745	$1,274,935,800	$483,646,100	$1,758,581,900
Chemical	0	0	$0	$0	$0
Communications	4	34,200	$251,800	$2,314,300	$2,566,100
Corrections	62	1,998,300	$259,195,100	$29,009,400	$288,204,500
Education	421	12,338,800	$1,757,637,400	$580,311,500	$2,337,948,900
Healthcare	31	456,600	$80,414,300	$15,089,000	$95,503,300
Military	51	868,300	$125,917,500	$50,462,200	$176,379,700
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Severe Storms - High/Strong Winds					
High/Strong Winds 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
High/Strong Winds 2	379	1,887,613	$300,244,600	$35,145,200	$335,389,800
Administrative	244	612,548	$71,249,300	$13,613,700	$84,863,000
Chemical	2	300	$949,400	$5,000	$954,400
Communications	5	3,800	$194,000	$1,203,300	$1,397,300
Corrections	63	635,465	$128,242,000	$7,161,200	$135,403,200
Education	48	469,200	$80,834,100	$11,243,200	$92,077,300
Healthcare	11	138,400	$14,399,500	$1,718,800	$16,118,300
Military	5	26,700	$4,376,300	$110,000	$4,486,300
Power	1	1,200	$0	$90,000	$90,000
High/Strong Winds 3	3,859	50,264,473	$7,684,457,400	$1,907,850,100	$9,592,307,500
Administrative	1,916	17,675,620	$2,252,698,900	$631,704,100	$2,884,403,000
Chemical	24	43,400	$12,114,800	$711,600	$12,826,400
Communications	41	215,700	$35,896,200	$17,296,500	$53,192,700
Corrections	470	5,534,783	$980,079,900	$101,054,600	$1,081,134,500
Education	1,240	24,561,470	$4,004,506,800	$1,061,184,900	$5,065,691,700
Healthcare	58	867,800	$159,511,400	$28,700,600	$188,212,000
Military	106	1,356,800	$236,600,800	$65,747,800	$302,348,600
Power	4	8,900	$3,048,600	$1,450,000	$4,498,600
High/Strong Winds 4	2,079	18,582,283	$2,657,347,900	$743,072,200	$3,400,420,100
Administrative	1,153	7,196,771	$872,582,500	$208,299,000	$1,080,881,500
Chemical	10	15,100	$2,242,400	$52,900	$2,295,300
Communications	28	35,770	$7,254,700	$7,175,500	$14,430,200
Corrections	118	1,603,700	$222,061,100	$38,460,100	$260,521,200
Education	609	8,210,887	$1,354,815,500	$451,820,600	$1,806,636,100
Healthcare	59	501,800	$66,720,000	$9,666,600	$76,386,600
Military	101	1,016,955	$131,671,700	$27,097,500	$158,769,200
Power	1	1,300	$0	$500,000	$500,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
High/Strong Winds 5	760	18,992,805	$3,587,536,100	$862,848,200	$4,450,384,300
Administrative	325	4,643,633	$819,287,700	$288,962,700	$1,108,250,400
Chemical	3	600	$570,400	$50,000	$620,400
Communications	6	14,300	$829,000	$894,000	$1,723,000
Corrections	32	769,500	$169,587,100	$114,873,000	$284,460,100
Education	342	12,222,772	$2,310,708,800	$415,898,900	$2,726,607,700
Healthcare	22	569,000	$98,143,000	$31,806,200	$129,949,200
Military	27	742,600	$104,248,500	$8,119,000	$112,367,500
Power	3	30,400	$84,161,600	$2,244,400	$86,406,000
High/Strong Winds 6	348	5,744,085	$1,001,301,500	$205,966,400	$1,207,267,900
Administrative	144	1,673,185	$258,959,700	$31,780,700	$290,740,400
Chemical	1	6,500	$1,000,000	$20,000	$1,020,000
Communications	3	3,000	$401,200	$1,060,000	$1,461,200
Corrections	18	362,500	$51,061,100	$18,338,800	$69,399,900
Education	151	3,299,900	$592,060,700	$145,010,900	$737,071,600
Healthcare	17	258,400	$75,170,400	$7,562,000	$82,732,400
Military	14	140,600	$22,648,400	$2,194,000	$24,842,400
Power	0	0	$0	$0	$0
Severe Storms - Lightning					
Lightning 1	1,634	24,262,262	$4,498,482,300	$987,252,700	$5,485,735,000
Administrative	848	6,438,820	$1,058,397,500	$322,807,600	$1,381,205,100
Chemical	8	14,500	$2,659,800	$276,000	$2,935,800
Communications	21	108,900	$19,904,400	$7,315,300	$27,219,700
Corrections	183	2,645,270	$553,126,800	$142,253,000	$695,379,800
Education	466	13,435,272	$2,525,008,800	$462,944,500	$2,987,953,300
Healthcare	31	458,600	$91,356,900	$33,616,900	$124,973,800
Military	74	1,130,700	$163,870,600	$15,665,000	$179,535,600
Power	3	30,200	$84,157,500	$2,374,400	$86,531,900
Lightning 2	2,735	22,727,633	$3,352,622,100	$619,584,900	$3,972,207,000
Administrative	1,534	7,824,835	$978,692,900	$160,913,100	$1,139,606,000
Chemical	20	40,700	$10,889,800	$506,600	$11,396,400
Communications	24	72,500	$13,717,800	$10,219,500	$23,937,300
Corrections	287	2,386,478	$414,277,800	$66,401,100	$480,678,900
Education	728	10,870,620	$1,691,149,100	$357,287,100	$2,048,436,200
Healthcare	65	911,300	$151,318,400	$17,630,500	$168,948,900
Military	72	610,400	$89,523,600	$4,842,000	$94,365,600
Power	5	10,800	$3,052,700	$1,785,000	$4,837,700

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Lightning 3	1,111	17,168,485	$2,489,216,200	$712,726,800	$3,201,943,000
Administrative	599	9,380,690	$1,155,959,700	$294,951,600	$1,450,911,300
Chemical	2	800	$312,600	$0	$312,600
Communications	15	53,970	$2,615,100	$2,563,500	$5,178,600
Corrections	132	1,720,600	$316,534,400	$29,660,000	$346,194,400
Education	291	5,063,070	$853,524,400	$361,762,700	$1,215,287,100
Healthcare	27	462,000	$86,415,500	$12,976,700	$99,392,200
Military	44	486,555	$73,854,500	$10,687,300	$84,541,800
Power	1	800	$0	$125,000	$125,000
Lightning 4	1,272	22,251,979	$3,317,407,300	$1,007,041,300	$4,324,448,600
Administrative	534	5,820,212	$741,459,200	$301,911,700	$1,043,370,900
Chemical	6	7,000	$1,971,700	$30,000	$2,001,700
Communications	19	34,300	$7,959,800	$6,759,500	$14,719,300
Corrections	50	1,312,200	$155,138,500	$24,871,800	$180,010,300
Education	586	13,967,067	$2,249,801,000	$606,300,000	$2,856,101,000
Healthcare	30	470,500	$80,847,400	$14,866,900	$95,714,300
Military	47	640,700	$80,229,700	$52,301,400	$132,531,100
Power	0	0	$0	$0	$0
Lightning 5	354	2,295,400	$234,691,000	$77,003,700	$311,694,700
Administrative	205	1,082,900	$86,916,700	$32,778,500	$119,695,200
Chemical	4	2,900	$1,043,100	$26,900	$1,070,000
Communications	3	2,900	$291,500	$471,500	$763,000
Corrections	30	474,300	$37,654,700	$7,698,800	$45,353,500
Education	93	661,000	$97,242,700	$33,660,800	$130,903,500
Healthcare	11	25,500	$3,428,100	$285,200	$3,713,300
Military	8	45,900	$8,114,200	$2,082,000	$10,196,200
Power	0	0	$0	$0	$0
Lightning 6	318	6,720,100	$1,331,658,600	$351,247,700	$1,682,906,300
Administrative	61	1,208,900	$246,542,100	$60,972,700	$307,514,800
Chemical	0	0	$0	$0	$0
Communications	1	0	$86,500	$300,000	$386,500
Corrections	19	367,100	$74,299,000	$9,003,000	$83,302,000
Education	226	4,767,200	$926,199,900	$263,203,400	$1,189,403,300
Healthcare	3	7,500	$578,000	$78,000	$656,000
Military	8	369,400	$83,953,100	$17,690,600	$101,643,700
Power	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Severe Storms - Thunderstorm Winds					
Thunderstorm Winds 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Thunderstorm Winds 2	2,138	12,001,282	$1,755,660,800	$235,550,200	$1,991,211,000
Administrative	1,302	4,808,964	$568,410,100	$84,009,500	$652,419,600
Chemical	20	36,200	$8,729,800	$572,000	$9,301,800
Communications	26	21,870	$6,386,400	$6,418,900	$12,805,300
Corrections	273	2,644,748	$536,025,100	$51,626,200	$587,651,300
Education	430	3,954,700	$558,721,000	$84,127,000	$642,848,000
Healthcare	28	188,200	$24,233,800	$2,813,100	$27,046,900
Military	57	339,000	$50,106,000	$4,813,500	$54,919,500
Power	2	7,600	$3,048,600	$1,170,000	$4,218,600
Thunderstorm Winds 3	2,471	19,706,991	$3,125,369,700	$773,513,300	$3,898,883,000
Administrative	1,298	6,675,479	$883,147,600	$180,739,200	$1,063,886,800
Chemical	17	26,500	$7,287,200	$257,500	$7,544,700
Communications	30	29,100	$6,890,100	$7,106,100	$13,996,200
Corrections	229	1,924,500	$300,766,100	$42,821,800	$343,587,900
Education	745	9,384,057	$1,672,736,700	$505,523,900	$2,178,260,600
Healthcare	71	805,700	$112,027,300	$12,199,900	$124,227,200
Military	80	860,355	$142,514,700	$24,364,900	$166,879,600
Power	1	1,300	$0	$500,000	$500,000
Thunderstorm Winds 4	1,259	15,859,641	$2,656,801,800	$549,381,200	$3,206,183,000
Administrative	670	4,652,541	$615,507,300	$110,148,000	$725,655,300
Chemical	3	3,200	$860,000	$10,000	$870,000
Communications	15	98,800	$15,628,100	$5,732,200	$21,360,300
Corrections	61	1,049,000	$163,188,200	$34,856,600	$198,044,800
Education	430	9,137,900	$1,687,991,300	$377,996,300	$2,065,987,600
Healthcare	25	488,900	$103,854,000	$12,316,700	$116,170,700
Military	51	426,100	$69,768,800	$7,926,400	$77,695,200
Power	4	3,200	$4,100	$395,000	$399,100

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Thunderstorm Winds 5	815	20,051,635	$3,054,220,300	$879,482,300	$3,933,702,600
Administrative	223	4,167,735	$596,916,900	$276,066,000	$872,982,900
Chemical	0	0	$0	$0	$0
Communications	6	84,000	$14,760,900	$5,532,800	$20,293,700
Corrections	92	1,749,600	$253,490,100	$23,100,900	$276,591,000
Education	467	12,944,800	$1,993,821,800	$533,694,100	$2,527,515,900
Healthcare	11	500,500	$101,815,800	$20,943,200	$122,759,000
Military	16	605,000	$93,414,800	$20,145,300	$113,560,100
Power	0	0	$0	$0	$0
Thunderstorm Winds 6	743	27,894,410	$4,651,334,900	$1,316,955,100	$5,968,290,000
Administrative	290	11,539,738	$1,623,296,200	$523,397,500	$2,146,693,700
Chemical	0	0	$0	$0	$0
Communications	6	38,800	$909,600	$2,839,300	$3,748,900
Corrections	46	1,538,100	$297,561,700	$127,482,200	$425,043,900
Education	318	13,342,772	$2,429,655,100	$583,817,200	$3,013,472,300
Healthcare	32	352,100	$72,013,400	$31,181,300	$103,194,700
Military	49	1,053,200	$143,741,400	$46,018,200	$189,759,600
Power	2	29,700	$84,157,500	$2,219,400	$86,376,900
Severe Storms - Winter Storms					
Winter Storm 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Winter Storm 2	185	6,774,475	$719,625,500	$270,219,600	$989,845,100
Administrative	1,302	1,351,475	$118,174,800	$164,541,300	$282,716,100
Chemical	20	100	$450,000	$5,000	$455,000
Communications	26	0	$0	$0	$0
Corrections	273	788,300	$77,538,900	$7,876,000	$85,414,900
Education	430	4,363,500	$464,670,400	$87,427,400	$552,097,800
Healthcare	28	257,400	$57,282,500	$10,279,900	$67,562,400
Military	57	12,500	$1,508,900	$0	$1,508,900
Power	2	1,200	$0	$90,000	$90,000

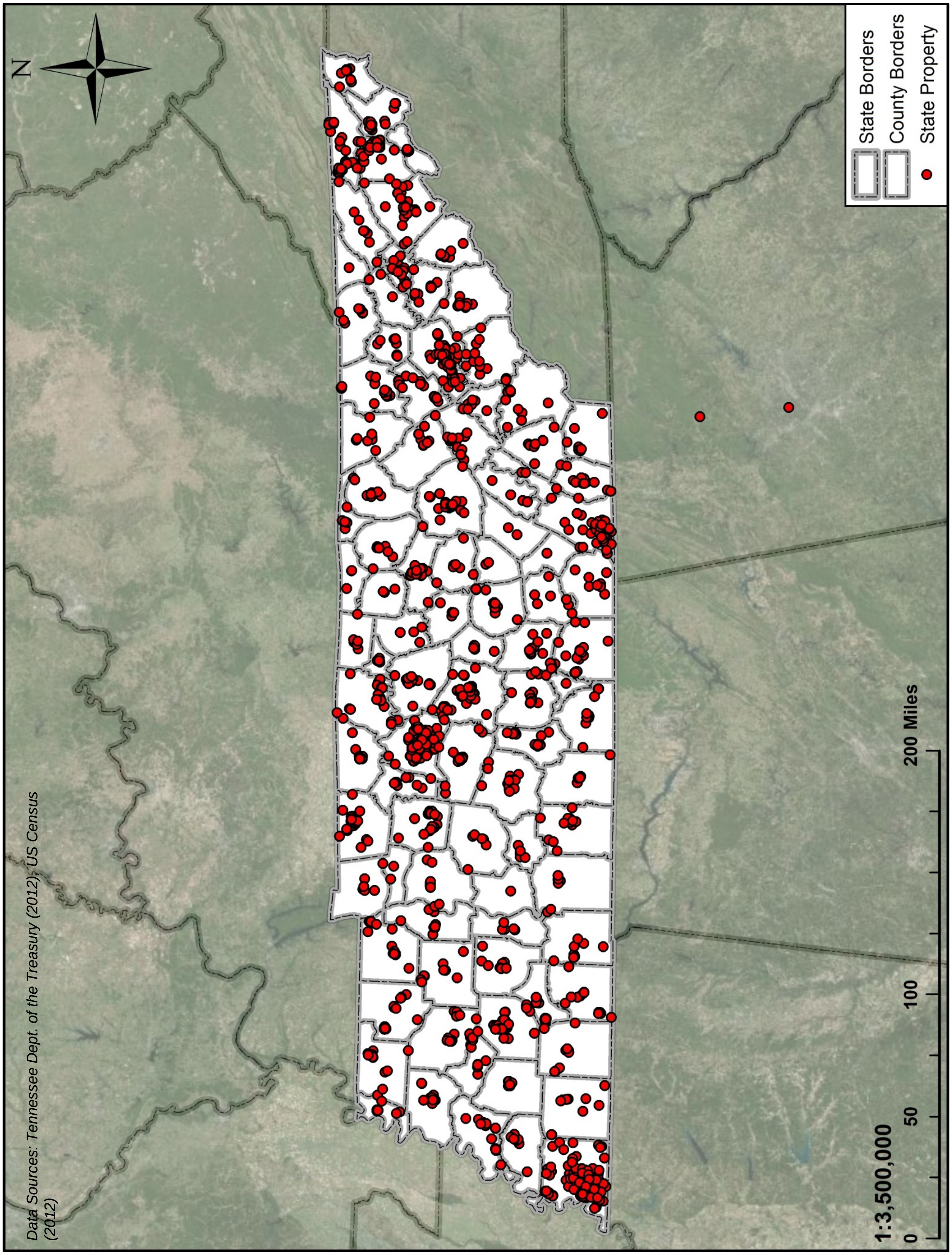
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Winter Storm 3	993	10,885,651	$1,897,193,500	$427,811,200	$2,325,004,700
Administrative	1,298	2,489,316	$374,816,000	$85,791,700	$460,607,700
Chemical	17	14,900	$2,062,600	$51,000	$2,113,600
Communications	30	5,600	$1,042,700	$4,130,300	$5,173,000
Corrections	229	1,533,235	$292,878,000	$20,262,900	$313,140,900
Education	745	6,037,900	$1,085,873,800	$292,132,600	$1,378,006,400
Healthcare	71	227,200	$24,941,200	$5,199,700	$30,140,900
Military	80	577,500	$115,579,200	$20,243,000	$135,822,200
Power	1	0	$0	$0	$0
Winter Storm 4	3,433	52,660,907	$8,473,630,400	$2,085,666,500	$10,559,296,900
Administrative	670	19,965,347	$2,638,679,700	$717,449,600	$3,356,129,300
Chemical	3	13,100	$4,776,800	$432,000	$5,208,800
Communications	15	250,370	$39,333,500	$17,155,400	$56,488,900
Corrections	61	3,948,113	$740,030,300	$182,951,100	$922,981,400
Education	430	25,867,522	$4,583,339,100	$1,054,764,900	$5,638,104,000
Healthcare	25	809,500	$150,024,700	$47,340,500	$197,365,200
Military	51	1,770,155	$230,240,200	$62,198,600	$292,438,800
Power	4	36,800	$87,206,100	$3,374,400	$90,580,500
Winter Storm 5	2,203	15,811,606	$2,492,345,800	$634,169,700	$3,126,515,500
Administrative	223	5,098,119	$693,957,200	$146,142,500	$840,099,700
Chemical	0	25,000	$7,170,800	$331,500	$7,502,300
Communications	6	4,600	$2,390,100	$4,658,700	$7,048,800
Corrections	92	2,255,000	$375,908,800	$48,342,900	$424,251,700
Education	467	7,106,287	$1,221,819,600	$413,183,500	$1,635,003,100
Healthcare	11	716,400	$92,685,700	$6,671,900	$99,357,600
Military	16	602,400	$98,409,500	$14,018,700	$112,428,200
Power	0	3,800	$4,100	$820,000	$824,100
Winter Storm 6	611	9,338,620	$1,648,092,300	$337,015,100	$1,985,107,400
Administrative	290	2,897,500	$449,150,400	$60,435,100	$509,585,500
Chemical	0	12,800	$2,416,800	$20,000	$2,436,800
Communications	6	12,000	$1,808,800	$1,684,900	$3,493,700
Corrections	46	381,300	$64,675,200	$20,454,800	$85,130,000
Education	318	5,389,020	$987,223,000	$237,650,100	$1,224,873,100
Healthcare	32	324,900	$89,010,200	$9,962,200	$98,972,400
Military	49	321,100	$53,807,900	$6,808,000	$60,615,900
Power	2	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Tornadoes					
Tornado 1	0	0	$0	$0	$0
Administrative	0	0	$0	$0	$0
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Education	0	0	$0	$0	$0
Healthcare	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Power	0	0	$0	$0	$0
Tornado 2	2,370	32,949,584	$5,888,980,400	$1,272,533,000	$7,161,513,400
Administrative	1,153	8,903,027	$1,428,542,000	$370,993,400	$1,799,535,400
Chemical	16	27,400	$5,607,500	$400,600	$6,008,100
Communications	21	111,200	$17,249,200	$4,865,600	$22,114,800
Corrections	337	3,782,935	$754,277,000	$168,407,900	$922,684,900
Education	707	17,988,322	$3,213,683,100	$666,332,600	$3,880,015,700
Healthcare	46	948,000	$194,513,900	$41,712,500	$236,226,400
Military	85	1,156,500	$190,946,100	$16,921,000	$207,867,100
Power	5	32,200	$84,161,600	$2,899,400	$87,061,000
Tornado 3	2,381	12,790,650	$1,850,951,600	$379,947,300	$2,230,898,900
Administrative	1,526	5,365,127	$618,939,400	$109,460,100	$728,399,500
Chemical	17	27,800	$8,421,400	$103,900	$8,525,300
Communications	31	29,670	$7,566,900	$8,767,100	$16,334,000
Corrections	161	1,277,213	$223,443,500	$51,554,200	$274,997,700
Education	534	5,037,840	$849,312,700	$194,173,400	$1,043,486,100
Healthcare	39	315,300	$44,997,800	$6,762,100	$51,759,900
Military	72	736,700	$98,269,900	$8,956,500	$107,226,400
Power	1	1,000	$0	$170,000	$170,000
Tornado 4	1,937	27,802,880	$4,330,681,400	$1,047,272,300	$5,377,953,700
Administrative	834	9,118,458	$1,083,723,900	$259,087,100	$1,342,811,000
Chemical	6	6,200	$2,393,900	$335,000	$2,728,900
Communications	26	97,500	$19,422,000	$10,782,300	$30,204,300
Corrections	147	2,079,500	$346,883,200	$32,778,000	$379,661,200
Education	803	15,047,867	$2,668,411,400	$696,950,900	$3,365,362,300
Healthcare	60	760,700	$110,138,900	$17,426,300	$127,565,200
Military	59	685,255	$96,659,500	$28,787,700	$125,447,200
Power	2	7,400	$3,048,600	$1,125,000	$4,173,600

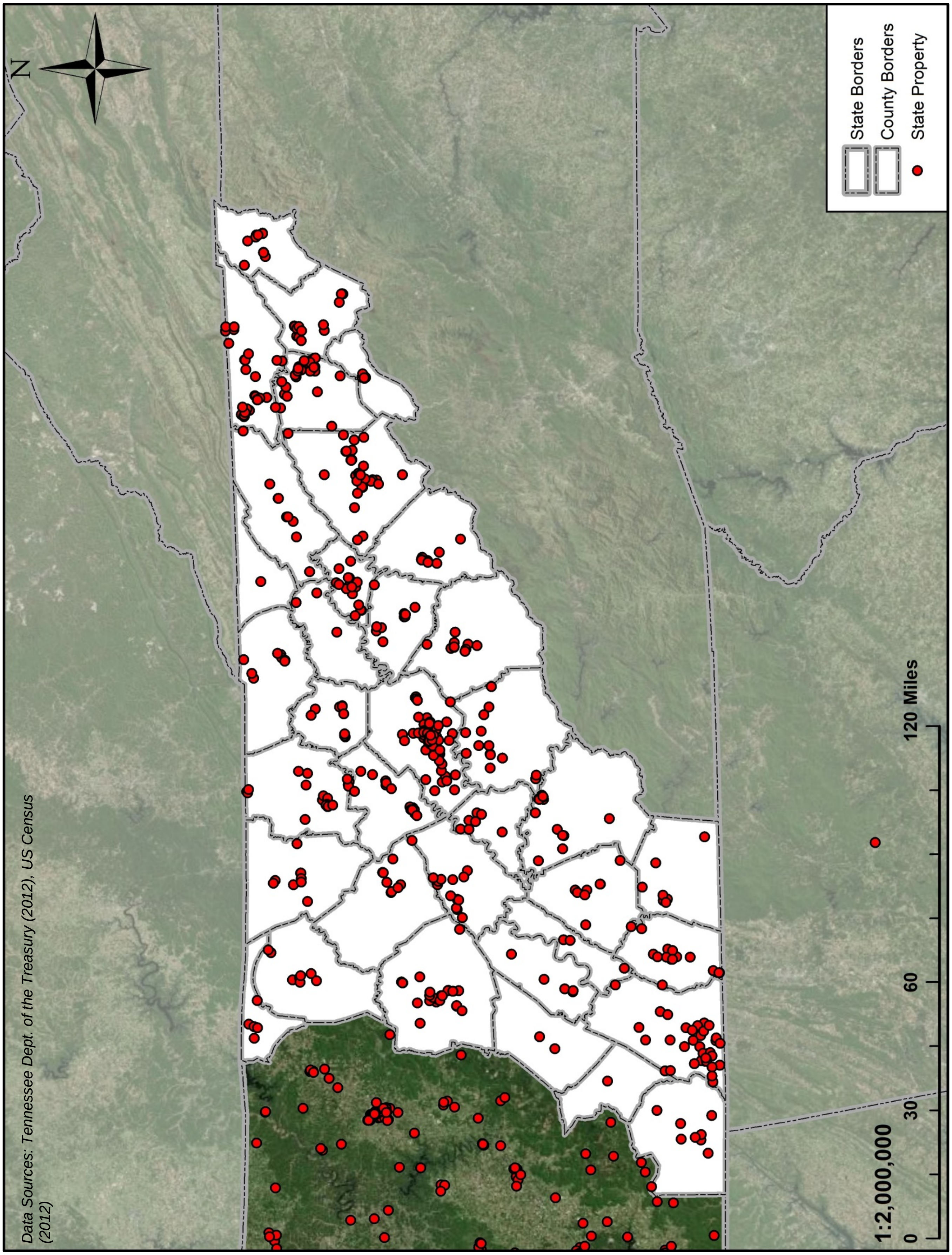
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Tornado 5	335	9,316,770	$1,305,876,200	$450,449,000	$1,756,325,200
Administrative	165	6,120,370	$833,777,900	$217,456,300	$1,051,234,200
Chemical	1	4,500	$454,200	$0	$454,200
Communications	5	34,200	$337,000	$3,214,300	$3,551,300
Corrections	42	918,300	$150,688,100	$16,995,900	$167,684,000
Education	81	1,866,800	$285,399,600	$180,499,400	$465,899,000
Healthcare	15	51,500	$7,011,200	$3,215,900	$10,227,100
Military	26	321,100	$28,208,200	$29,067,200	$57,275,400
Power	0	0	$0	$0	$0
Tornado 6	403	12,654,075	$1,866,897,900	$604,680,500	$2,471,578,400
Administrative	105	2,337,475	$322,294,900	$217,363,300	$539,658,200
Chemical	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	14	848,000	$75,739,400	$10,151,700	$85,891,100
Education	265	8,823,400	$1,326,119,100	$347,202,200	$1,673,321,300
Healthcare	7	259,900	$57,282,500	$10,337,400	$67,619,900
Military	11	384,100	$85,462,000	$19,535,900	$104,997,900
Power	1	1,200	$0	$90,000	$90,000
Wildfires					
Wildfire (WUI)	2,277	11,616,916	$1,565,228,400	$275,344,200	$1,840,572,600
Administrative	1,428	4,689,546	$492,066,300	$91,213,100	$583,279,400
Chemical	27	36,100	$9,097,900	$419,500	$9,517,400
Communications	25	93,400	$17,623,700	$4,625,100	$22,248,800
Corrections	255	2,214,870	$398,252,600	$40,168,700	$438,421,300
Education	436	3,732,600	$519,780,800	$119,751,900	$639,532,700
Healthcare	35	416,300	$58,958,000	$10,976,700	$69,934,700
Military	69	432,100	$69,445,000	$7,664,200	$77,109,200
Power	2	2,000	$4,100	$525,000	$529,100

**The compiled data are from the Tennessee Department of the Treasury.*

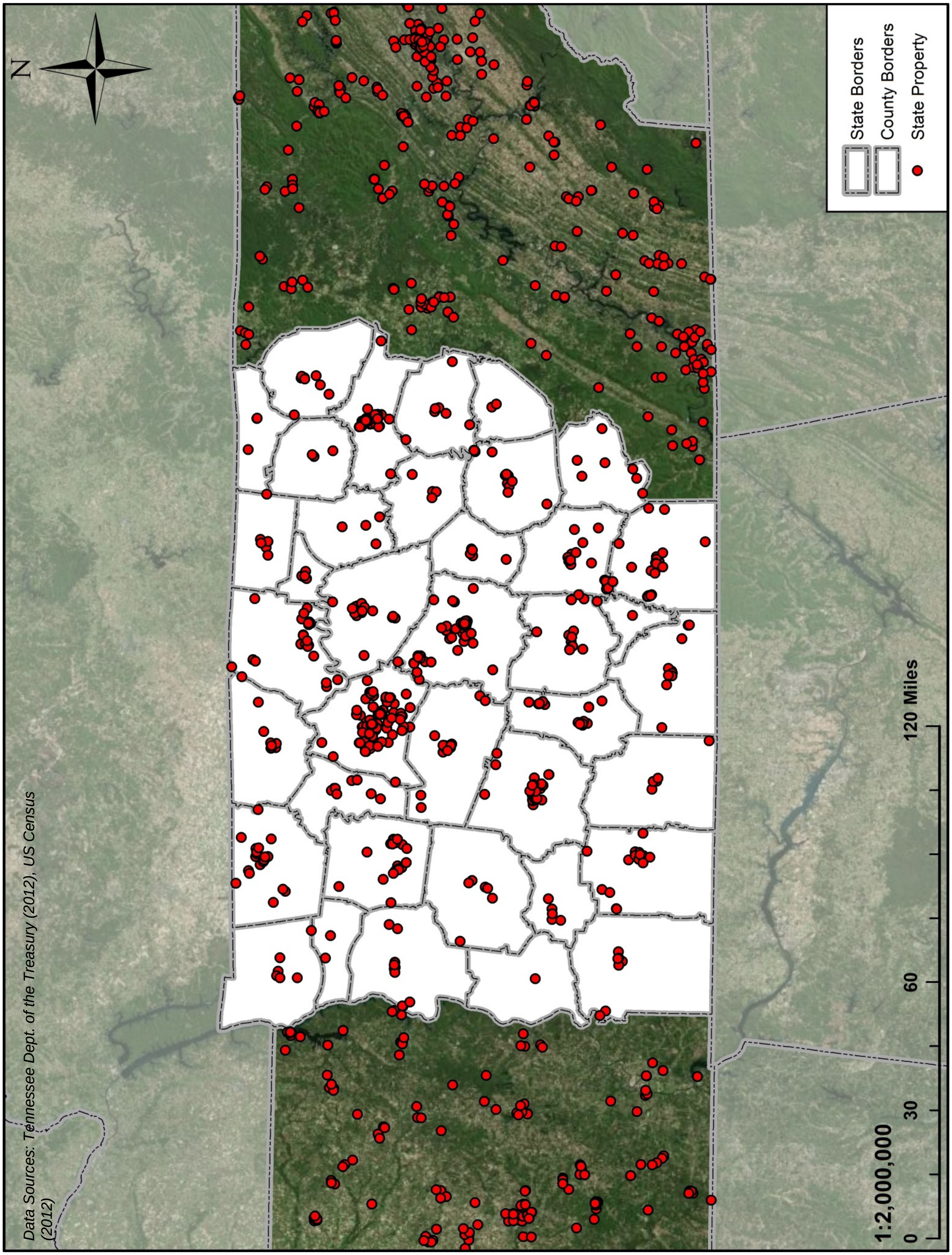
Map 137 – State of Tennessee Properties



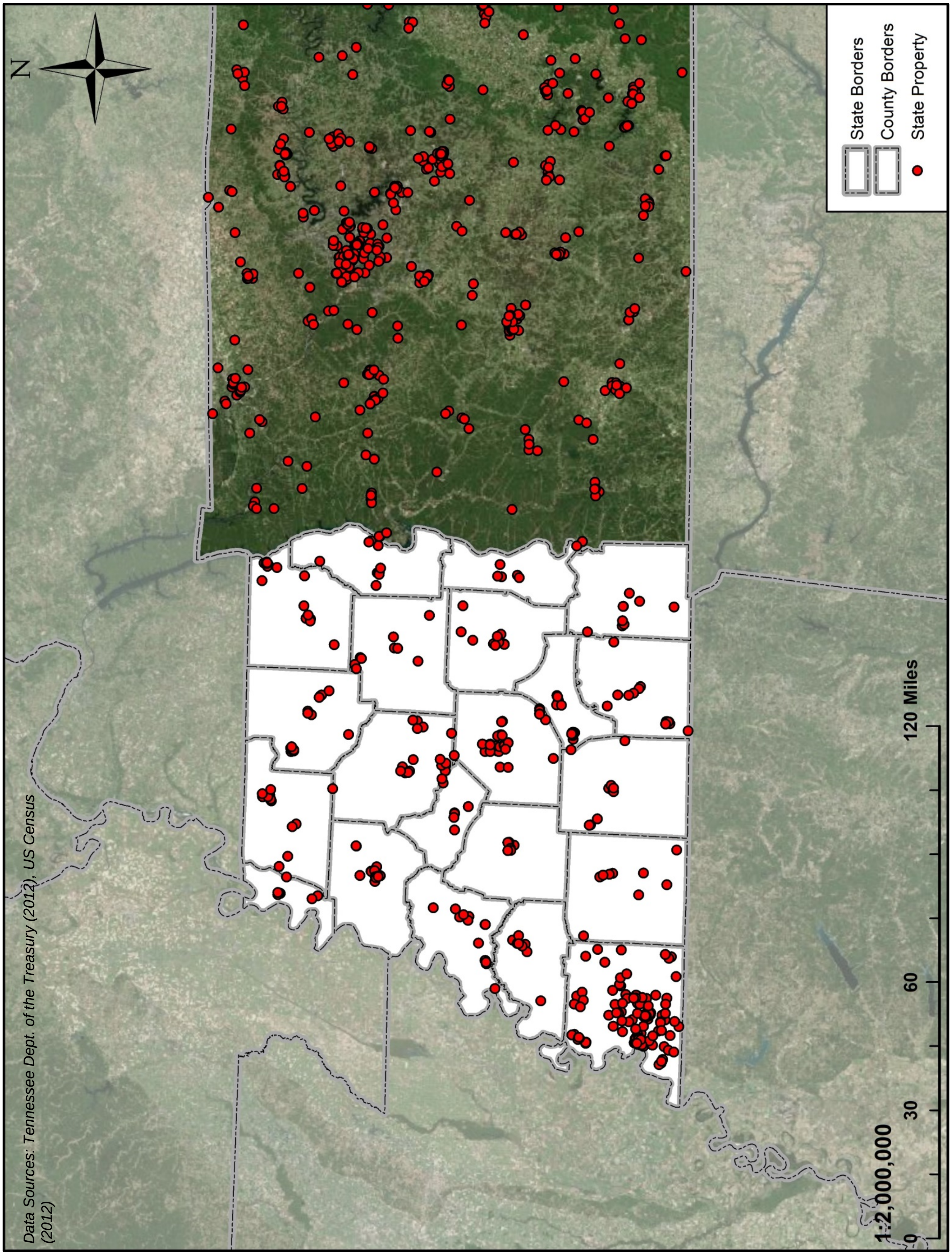
Map 138 – State of Tennessee Properties, East Tennessee



Map 139 – State of Tennessee Properties, Middle Tennessee



Map 140 – State of Tennessee Properties, West Tennessee



4.5.1 – Vulnerability Assessment of Critical Facilities

The State of Tennessee owns and operates 1190 critical facilities covering 13,042,650 square feet. The Tennessee Department of the Treasury reports these properties and structures are worth $2,140,994,000 with a total content value of $231,741,300. These are depicted in Maps 141 through 144. TEMA has designed its critical facilities as state owned and operated property under the direction of the Tennessee Department of the Military, the Tennessee Bureau of Investigation, the Tennessee Department of Safety, and the Tennessee Department of Corrections, with the primary functions of corrections, communications, medical, or health services.

Of these properties and structures, the vast majority of their worth is located in hazard areas ranked 3 or lower. However, due to the high threat level in West Tennessee along the Mississippi River, there is a sizable worth of property and structures located in a high threat hazard area.

Out of the State of Tennessee's Department of the Treasury's property list, TEMA has defined its state critical facilities under the following classifications:

Communications: This classification is for any radio or telecommunications purposed structure.
Corrections: This classification includes any non-communications facilities under the Tennessee correctional system.
Medical: Any state owned or operated facilities associated with a healthcare practice. These are typically mental healthcare, rehabilitation, or therapy associated facilities. The state does not own or operate any hospitals.
Military: This classification includes any non-communications facilities under the Tennessee National Guard..
Safety: This classification includes and structures used by the Tennessee Department of Safety.
Tennessee Bureau of Investigation (TBI): This classification includes and structures used by the Tennessee Bureau of Investigation.

The following table breaks down the number, size, structure value, contents value, and total value all critical facilities located in each hazard's threat zone, 1 through 6. Due to their nature, neither drought nor extreme temperatures pose a threat to critical facilities. For dam failure, each of the dams of prime concern is listed along with the values that are within their failure inundation.

Table 104 – Loss Estimates, State of Tennessee Critical Facilities					
Hazard Threat Zone	**Structure Count**	**Size (Sq. Ft.)**	**Structure Value**	**Content Value**	**Total Value**
Dam Failures					
Center Hill Dam	23	312,000	$71,615,500	$7,809,800	$79,425,300
Communications	1	100	$350,000	$0	$350,000
Corrections	20	307,700	$6,834,800	$404,000	$7,238,800
Medical	0	0	$0	$0	$0
Military	2	4,200	$20,800	$1,500	$22,300
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Tellico Dam	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Wolf Creek Dam	48	451,200	$100,709,000	$10,187,000	$110,896,000
Communications	2	100	$148,000	$200,000	$348,000
Corrections	45	448,100	$100,561,000	$9,887,000	$110,448,000
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	1	3,000	$0	$100,000	$100,000
Droughts	No Threat	No Threat	No Threat	No Threat	No Threat
Earthquakes					
Earthquake 1	613	6,532,400	$1,026,558,800	$124,195,300	$1,150,754,100
Communications	59	231,500	$37,696,500	$24,823,700	$62,520,200
Corrections	285	2,887,900	$0	$48,384,600	$48,384,600
Medical	80	977,500	$0	$7,950,500	$7,950,500
Military	109	1,528,400	$0	$5,718,600	$5,718,600
Safety	30	103,500	$0	$12,252,700	$12,252,700
TBI	5	157,200	$0	$16,786,200	$16,786,200
Earthquake 2	209	2,535,070	$413,583,900	$35,465,700	$449,049,600
Communications	24	113,600	$20,484,100	$10,890,600	$31,374,700
Corrections	69	868,570	$189,025,800	$5,634,300	$194,660,100
Medical	21	378,900	$37,039,700	$3,220,200	$40,259,900
Military	55	546,200	$87,197,400	$752,700	$87,950,100
Safety	13	30,700	$412,800	$4,575,000	$4,987,800
TBI	2	43,300	$0	$5,250,000	$5,250,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Earthquake 3	14	77,900	$11,059,100	$1,778,300	$12,837,400
Communications	7	4,600	$367,300	$1,368,300	$1,735,600
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	6	73,100	$10,616,800	$110,000	$10,726,800
Safety	1	200	$75,000	$300,000	$375,000
TBI	0	0	$0	$0	$0
Earthquake 4	148	1,657,767	$282,419,400	$23,521,000	$305,940,400
Communications	30	42,970	$8,163,200	$6,485,000	$14,648,200
Corrections	18	208,900	$42,071,300	$1,331,000	$43,402,300
Medical	38	644,400	$122,789,800	$7,987,200	$130,777,000
Military	35	386,000	$58,600,000	$781,000	$59,381,000
Safety	9	38,400	$350,000	$2,800,000	$3,150,000
TBI	2	24,497	$0	$2,157,200	$2,157,200
Earthquake 5	100	1,097,913	$215,256,300	$28,554,800	$243,811,100
Communications	6	102,613	$15,181,100	$2,883,800	$18,064,900
Corrections	70	760,800	$167,117,000	$22,935,400	$190,052,400
Medical	3	16,900	$2,176,700	$0	$2,176,700
Military	9	149,200	$22,978,300	$235,600	$23,213,900
Safety	2	3,900	$0	$125,000	$125,000
TBI	0	0	$0	$0	$0
Earthquake 6	77	749,000	$155,577,300	$11,926,200	$167,503,500
Communications	6	70,700	$14,287,400	$3,705,000	$17,992,400
Corrections	62	608,300	$130,518,800	$7,671,700	$138,190,500
Medical	0	0	$0	$0	$0
Military	2	45,800	$7,544,000	$70,000	$7,614,000
Safety	1	1,400	$0	$125,000	$125,000
TBI	0	0	$0	$0	$0
Extreme Temperatures	No Threat	No Threat	No Threat	No Threat	No Threat
Floods - Flash Floods					
Flash Flood 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Flash Flood 2	559	5,572,753	$1,028,207,000	$94,109,100	$1,122,316,100
Communications	49	218,383	$39,643,100	$17,775,200	$57,418,300
Corrections	321	3,150,270	$637,540,000	$49,597,700	$687,137,700
Medical	50	808,100	$135,427,400	$8,047,300	$143,474,700
Military	60	704,200	$109,130,400	$1,110,000	$110,240,400
Safety	23	22,300	$1,561,100	$7,450,000	$9,011,100
TBI	0	0	$0	$0	$0
Flash Flood 3	315	3,295,200	$510,995,200	$58,222,100	$569,217,300
Communications	53	235,300	$42,378,900	$23,222,900	$65,601,800
Corrections	68	835,000	$165,937,900	$15,876,000	$181,813,900
Medical	24	373,300	$37,608,700	$3,429,200	$41,037,900
Military	116	1,268,700	$200,007,300	$2,915,300	$202,922,600
Safety	18	50,900	$212,600	$4,275,000	$4,487,600
TBI	5	52,200	$0	$5,518,000	$5,518,000
Flash Flood 4	31	349,697	$61,083,700	$6,125,700	$67,209,400
Communications	12	31,800	$6,765,700	$3,479,700	$10,245,400
Corrections	0	0	$0	$0	$0
Medical	5	35,100	$5,031,000	$300,000	$5,331,000
Military	9	161,900	$24,087,000	$171,000	$24,258,000
Safety	3	9,900	$200,000	$975,000	$1,175,000
TBI	1	7,997	$0	$200,000	$200,000
Flash Flood 5	198	2,767,900	$399,426,500	$39,188,400	$438,614,900
Communications	13	58,500	$4,430,000	$4,069,500	$8,499,500
Corrections	79	916,300	$210,865,500	$16,122,300	$226,987,800
Medical	56	783,600	$92,095,000	$7,335,900	$99,430,900
Military	31	593,900	$59,228,300	$3,471,600	$62,699,900
Safety	7	72,400	$75,000	$4,327,700	$4,402,700
TBI	0	0	$0	$0	$0
Flash Flood 6	58	664,500	$104,742,400	$27,796,000	$132,538,400
Communications	5	22,000	$2,961,900	$1,609,100	$4,571,000
Corrections	36	432,900	$95,320,000	$4,361,000	$99,681,000
Medical	7	17,600	$1,706,500	$45,500	$1,752,000
Military	0	0	$0	$0	$0
Safety	5	22,600	$4,000,000	$3,150,000	$7,150,000
TBI	3	164,800	$0	$18,475,400	$18,475,400
Floods - Riverine Floods					
Riverine Flood (100 Year)	63	900,270	$187,704,200	$12,423,800	$200,128,000
Communications	1	100	$8,000	$200,000	$208,000
Corrections	47	716,370	$160,448,200	$8,252,000	$168,700,200
Medical	1	1,400	$89,000	$4,500	$93,500
Military	10	102,800	$15,249,500	$977,000	$16,226,500
Safety	0	0	$0	$0	$0
TBI	1	3,800	$0	$150,000	$150,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Riverine Flood (500 Year)	2	30,400	$4,355,800	$220,000	$4,575,800
Communications	1	4,000	$0	$200,000	$200,000
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	1	26,400	$4,355,800	$20,000	$4,375,800
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Riverine Flood (100 & 500)	65	930,670	$192,060,000	$12,643,800	$204,703,800
Communications	2	4,100	$8,000	$400,000	$408,000
Corrections	47	716,370	$160,448,200	$8,252,000	$168,700,200
Medical	1	1,400	$89,000	$4,500	$93,500
Military	11	129,200	$19,605,300	$997,000	$20,602,300
Safety	0	0	$0	$0	$0
TBI	1	3,800	$0	$150,000	$150,000
Geologic - Expansive Soils					
Expansive Soils 1	119	1,314,400	$179,265,600	$17,174,900	$196,440,500
Communications	9	80,300	$15,674,300	$6,338,800	$22,013,100
Corrections	17	74,600	$15,226,600	$765,500	$15,992,100
Medical	34	551,200	$59,152,600	$4,150,900	$63,303,500
Military	35	340,500	$53,377,900	$391,500	$53,769,400
Safety	13	23,100	$487,800	$3,875,000	$4,362,800
TBI	2	6,400	$0	$400,000	$400,000
Expansive Soils 2	839	8,989,650	$1,599,170,500	$170,042,600	$1,769,213,100
Communications	83	421,683	$69,940,600	$32,701,400	$102,642,000
Corrections	463	4,896,770	$1,012,496,800	$77,047,400	$1,089,544,200
Medical	58	729,800	$132,350,000	$8,517,200	$140,867,200
Military	120	1,701,000	$229,865,100	$5,740,200	$235,605,300
Safety	32	134,000	$5,250,200	$13,477,700	$18,727,900
TBI	5	176,797	$0	$18,775,400	$18,775,400
Expansive Soils 3	196	2,249,600	$309,936,000	$37,961,800	$347,897,800
Communications	38	60,000	$9,694,700	$11,016,200	$20,710,900
Corrections	23	360,300	$81,436,000	$8,142,100	$89,578,100
Medical	50	736,700	$80,366,000	$6,489,800	$86,855,800
Military	57	597,600	$94,501,300	$1,376,200	$95,877,500
Safety	11	21,000	$310,700	$2,825,000	$3,135,700
TBI	2	41,800	$0	$5,018,000	$5,018,000
Expansive Soils 4	5	69,600	$11,622,100	$210,000	$11,832,100
Communications	2	4,000	$870,000	$100,000	$970,000
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	3	65,600	$10,752,100	$110,000	$10,862,100
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Expansive Soils 5	2	26,800	$4,460,600	$52,000	$4,512,600
Communications	0	0	$0	$0	$0
Corrections	1	2,800	$504,000	$2,000	$506,000
Medical	0	0	$0	$0	$0
Military	1	24,000	$3,956,600	$50,000	$4,006,600
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Expansive Soils 6	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Geologic - Land Subsidence					
Land Subsidence 1	978	11,160,750	$1,899,198,500	$201,330,300	$2,100,528,800
Communications	108	448,283	$77,162,300	$45,491,500	$122,653,800
Corrections	433	4,920,270	$1,032,141,000	$78,696,700	$1,110,837,700
Medical	134	1,822,600	$253,755,100	$18,005,100	$271,760,200
Military	171	2,312,700	$333,626,800	$7,024,100	$340,650,900
Safety	46	151,200	$5,825,400	$16,677,700	$22,503,100
TBI	7	180,297	$0	$19,093,400	$19,093,400
Land Subsidence 2	91	961,600	$112,489,000	$14,469,900	$126,958,900
Communications	13	87,900	$12,751,600	$2,558,100	$15,309,700
Corrections	21	136,500	$22,721,100	$3,217,600	$25,938,700
Medical	8	195,100	$18,113,500	$1,152,800	$19,266,300
Military	30	252,500	$33,219,600	$353,800	$33,573,400
Safety	4	14,900	$23,100	$1,050,000	$1,073,100
TBI	1	40,700	$0	$5,000,000	$5,000,000
Land Subsidence 3	72	388,000	$72,262,600	$7,090,800	$79,353,400
Communications	5	19,800	$4,333,100	$1,106,500	$5,439,600
Corrections	50	277,700	$54,801,300	$4,042,700	$58,844,000
Medical	0	0	$0	$0	$0
Military	5	49,600	$7,034,500	$90,000	$7,124,500
Safety	3	200	$200,200	$1,200,000	$1,400,200
TBI	0	0	$0	$0	$0
Land Subsidence 4	7	35,900	$6,013,700	$350,400	$6,364,100
Communications	3	800	$450,000	$200,400	$650,400
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	3	33,700	$5,563,700	$100,000	$5,663,700
Safety	1	1,400	$0	$50,000	$50,000
TBI	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Land Subsidence 5	11	82,200	$10,937,600	$2,169,900	$13,107,500
Communications	3	9,200	$1,482,600	$799,900	$2,282,500
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	5	58,600	$9,455,000	$70,000	$9,525,000
Safety	2	10,400	$0	$1,200,000	$1,200,000
TBI	1	4,000	$0	$100,000	$100,000
Military	0	0	$0	$0	$0
Land Subsidence 6	2	21,600	$3,553,400	$30,000	$3,583,400
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	2	21,600	$3,553,400	$30,000	$3,583,400
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Geologic - Landslides					
Landslide 1	542	6,500,337	$1,069,346,500	$119,412,500	$1,188,759,000
Communications	78	303,170	$48,820,600	$33,873,200	$82,693,800
Corrections	187	2,186,570	$482,318,100	$28,989,600	$511,307,700
Medical	77	1,148,400	$174,755,900	$12,226,200	$186,982,100
Military	121	1,653,000	$223,586,800	$6,030,200	$229,617,000
Safety	29	116,700	$4,712,600	$11,552,700	$16,265,300
TBI	5	161,397	$0	$16,836,200	$16,836,200
Landslide 2	141	1,633,100	$193,041,500	$18,265,200	$211,306,700
Communications	16	37,400	$5,167,700	$3,876,500	$9,044,200
Corrections	1	12,400	$1,202,100	$47,300	$1,249,400
Medical	46	684,800	$76,764,500	$4,591,300	$81,355,800
Military	53	576,000	$84,782,100	$776,500	$85,558,600
Safety	10	22,500	$350,200	$3,100,000	$3,450,200
TBI	2	44,500	$0	$5,150,000	$5,150,000
Landslide 3	104	805,900	$138,230,100	$17,043,400	$155,273,500
Communications	11	60,400	$13,048,700	$5,985,500	$19,034,200
Corrections	50	277,700	$54,801,300	$4,042,700	$58,844,000
Medical	11	161,000	$16,595,200	$2,067,400	$18,662,600
Military	12	116,100	$24,580,300	$161,200	$24,741,500
Safety	7	9,700	$337,800	$3,000,000	$3,337,800
TBI	1	2,600	$0	$250,000	$250,000
Landslide 4	78	714,800	$147,544,100	$8,318,100	$155,862,200
Communications	6	21,300	$4,300,200	$171,900	$4,472,100
Corrections	62	608,300	$130,518,800	$7,671,700	$138,190,500
Medical	0	0	$0	$0	$0
Military	5	62,400	$9,527,100	$120,000	$9,647,100
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Landslide 5	202	2,157,513	$422,255,700	$48,651,300	$470,907,000
Communications	14	139,513	$24,017,200	$4,205,300	$28,222,500
Corrections	135	1,635,800	$348,073,500	$36,385,800	$384,459,300
Medical	7	19,500	$2,853,000	$173,000	$3,026,000
Military	16	198,800	$30,731,300	$330,000	$31,061,300
Safety	9	29,000	$573,100	$2,225,000	$2,798,100
TBI	1	16,500	$0	$1,957,200	$1,957,200
Landslide 6	94	838,400	$134,036,900	$13,750,800	$147,787,700
Communications	7	4,200	$825,200	$2,044,000	$2,869,200
Corrections	69	613,700	$92,749,600	$8,819,900	$101,569,500
Medical	1	4,000	$900,000	$100,000	$1,000,000
Military	9	122,400	$19,245,400	$250,000	$19,495,400
Safety	1	200	$75,000	$300,000	$375,000
TBI	0	0	$0	$0	$0
Severe Storms - Hail					
Hail 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Hail 2	330	3,483,770	$651,612,400	$49,523,700	$701,136,100
Communications	40	167,200	$33,734,900	$13,922,700	$47,657,600
Corrections	166	1,870,170	$406,816,100	$21,391,100	$428,207,200
Medical	40	498,500	$59,987,500	$3,538,500	$63,526,000
Military	43	516,300	$79,631,500	$830,600	$80,462,100
Safety	12	8,000	$923,300	$3,075,000	$3,998,300
TBI	0	0	$0	$0	$0
Hail 3	427	4,076,283	$722,271,600	$72,271,000	$794,542,600
Communications	41	184,683	$31,208,800	$11,157,700	$42,366,500
Corrections	222	2,102,700	$395,459,700	$44,035,300	$439,495,000
Medical	15	345,400	$80,095,900	$4,708,800	$84,804,700
Military	80	972,400	$151,420,000	$1,500,000	$152,920,000
Safety	20	33,900	$712,800	$5,500,000	$6,212,800
TBI	3	8,900	$0	$268,000	$268,000
Hail 4	83	831,897	$113,610,700	$26,217,700	$139,828,400
Communications	27	52,900	$8,381,100	$14,356,100	$22,737,200
Corrections	0	0	$0	$0	$0
Medical	17	310,200	$43,022,100	$3,064,400	$46,086,500
Military	22	309,800	$53,618,300	$607,200	$54,225,500
Safety	9	24,800	$275,000	$2,475,000	$2,750,000
TBI	2	48,697	$0	$5,200,000	$5,200,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Hail 5	162	1,895,800	$323,446,500	$32,099,000	$355,545,500
Communications	15	86,400	$16,789,200	$7,410,800	$24,200,000
Corrections	79	927,000	$208,786,700	$15,819,600	$224,606,300
Medical	22	359,500	$35,373,700	$3,249,700	$38,623,400
Military	28	218,900	$29,150,700	$1,155,800	$30,306,500
Safety	6	23,900	$137,600	$2,800,000	$2,937,600
TBI	1	2,600	$0	$250,000	$250,000
Hail 6	159	2,362,300	$293,513,600	$45,329,900	$338,843,500
Communications	9	74,800	$6,065,600	$3,309,100	$9,374,700
Corrections	37	434,600	$98,600,900	$4,711,000	$103,311,900
Medical	48	504,100	$53,389,400	$4,596,500	$57,985,900
Military	43	711,300	$78,632,500	$3,574,300	$82,206,800
Safety	9	87,500	$4,000,000	$6,327,700	$10,327,700
TBI	3	164,800	$0	$18,475,400	$18,475,400
Severe Storms - High/Strong Winds					
High/Strong Winds 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
High/Strong Winds 2	94	988,400	$180,923,900	$13,396,400	$194,320,300
Communications	5	4,500	$236,000	$563,300	$799,300
Corrections	62	608,300	$130,518,800	$7,671,700	$138,190,500
Medical	12	163,600	$16,995,200	$2,071,900	$19,067,100
Military	5	61,200	$9,793,100	$120,000	$9,913,100
Safety	3	8,100	$137,600	$1,750,000	$1,887,600
TBI	0	0	$0	$0	$0
High/Strong Winds 3	644	6,674,483	$1,279,614,300	$117,724,200	$1,397,338,500
Communications	69	429,813	$79,170,800	$27,864,400	$107,035,200
Corrections	385	4,182,870	$864,768,000	$66,586,300	$931,354,300
Medical	33	412,900	$84,836,800	$4,746,300	$89,583,100
Military	76	933,100	$145,263,400	$1,427,700	$146,691,100
Safety	21	59,200	$448,300	$5,400,000	$5,848,300
TBI	4	24,200	$0	$2,325,200	$2,325,200
High/Strong Winds 4	303	3,802,567	$489,151,700	$76,730,200	$565,881,900
Communications	42	107,670	$13,885,000	$18,646,500	$32,531,500
Corrections	51	537,200	$111,172,200	$11,605,200	$122,777,400
Medical	57	942,500	$110,086,600	$8,801,200	$118,887,800
Military	98	1,345,800	$176,289,600	$5,435,200	$181,724,800
Safety	21	99,800	$4,562,600	$9,927,700	$14,490,300
TBI	3	156,297	$0	$16,718,200	$16,718,200

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
High/Strong Winds 5	79	844,800	$96,657,300	$14,403,300	$111,060,600
Communications	13	21,000	$2,486,600	$2,022,200	$4,508,800
Corrections	6	6,100	$3,204,400	$93,800	$3,298,200
Medical	23	390,400	$42,431,400	$2,083,500	$44,514,900
Military	21	171,100	$21,332,300	$283,800	$21,616,100
Safety	9	8,200	$900,200	$3,000,000	$3,900,200
TBI	1	40,700	$0	$5,000,000	$5,000,000
High/Strong Winds 6	41	339,800	$58,107,600	$3,187,200	$61,294,800
Communications	3	3,000	$401,200	$1,060,000	$1,461,200
Corrections	0	0	$0	$0	$0
Medical	17	108,300	$17,518,600	$1,455,000	$18,973,600
Military	16	217,500	$39,774,600	$401,200	$40,175,800
Safety	2	2,800	$0	$100,000	$100,000
TBI	1	3,800	$0	$150,000	$150,000
Severe Storms - Lightning					
Lightning 1	347	4,189,870	$746,038,700	$53,346,300	$799,385,000
Communications	31	159,300	$30,040,300	$8,533,600	$38,573,900
Corrections	182	2,211,070	$426,821,400	$27,561,800	$454,383,200
Medical	20	505,600	$96,001,700	$6,161,600	$102,163,300
Military	64	745,500	$115,231,400	$1,005,000	$116,236,400
Safety	13	20,400	$837,600	$4,075,000	$4,912,600
TBI	0	0	$0	$0	$0
Lightning 2	417	3,948,213	$678,777,600	$78,610,000	$757,387,600
Communications	43	252,113	$44,860,000	$18,734,000	$63,594,000
Corrections	187	1,650,100	$355,137,500	$34,741,600	$389,879,100
Medical	54	679,800	$78,259,400	$5,505,900	$83,765,300
Military	69	800,600	$125,093,400	$1,353,300	$126,446,700
Safety	21	25,200	$1,011,100	$6,625,000	$7,636,100
TBI	3	47,100	$0	$5,400,000	$5,400,000
Lightning 3	185	2,033,070	$365,646,900	$47,369,100	$413,016,000
Communications	21	23,770	$2,968,100	$2,503,700	$5,471,800
Corrections	95	1,110,800	$255,794,300	$19,142,300	$274,936,600
Medical	14	298,000	$41,048,100	$2,864,400	$43,912,500
Military	31	298,600	$48,535,000	$1,507,000	$50,042,000
Safety	9	35,700	$4,000,000	$3,950,000	$7,950,000
TBI	4	153,400	$0	$16,636,200	$16,636,200
Lightning 4	139	1,973,597	$231,113,700	$36,060,300	$267,174,000
Communications	31	106,500	$15,158,100	$18,669,500	$33,827,600
Corrections	3	62,500	$12,750,500	$550,000	$13,300,500
Medical	43	503,100	$52,610,000	$4,409,500	$57,019,500
Military	45	815,200	$93,200,100	$3,642,600	$96,842,700
Safety	8	71,000	$200,000	$4,352,700	$4,552,700
TBI	1	7,997	$0	$200,000	$200,000

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Lightning 5	42	263,900	$40,895,000	$5,037,800	$45,932,800
Communications	3	2,700	$316,500	$756,500	$1,073,000
Corrections	20	124,100	$21,519,000	$3,170,300	$24,689,300
Medical	9	26,200	$3,371,400	$196,000	$3,567,400
Military	5	64,200	$10,219,500	$100,000	$10,319,500
Safety	1	12,600	$0	$100,000	$100,000
TBI	0	0	$0	$0	$0
Lightning 6	31	241,400	$41,982,900	$5,017,800	$47,000,700
Communications	3	21,600	$2,836,600	$959,100	$3,795,700
Corrections	17	175,900	$37,640,700	$791,000	$38,431,700
Medical	2	5,000	$578,000	$20,500	$598,500
Military	2	4,600	$173,600	$60,000	$233,600
Safety	4	13,200	$0	$1,075,000	$1,075,000
TBI	1	16,500	$0	$1,957,200	$1,957,200
Severe Storms - Thunderstorm Winds					
Thunderstorm Winds 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Thunderstorm Winds 2	389	4,199,253	$849,932,600	$72,610,100	$922,542,700
Communications	40	128,283	$22,468,300	$10,562,700	$33,031,000
Corrections	236	2,663,370	$578,264,700	$44,865,500	$623,130,200
Medical	14	327,400	$78,201,400	$4,708,800	$82,910,200
Military	45	488,600	$74,766,400	$750,600	$75,517,000
Safety	9	3,800	$500,200	$2,500,000	$3,000,200
TBI	0	0	$0	$0	$0
Thunderstorm Winds 3	389	3,500,497	$534,309,200	$63,100,400	$597,409,600
Communications	52	163,300	$34,708,800	$23,403,600	$58,112,400
Corrections	152	1,309,500	$224,011,100	$20,560,900	$244,572,000
Medical	56	800,300	$102,263,100	$6,607,400	$108,870,500
Military	69	873,600	$135,125,600	$1,536,000	$136,661,600
Safety	25	49,400	$1,335,900	$7,625,000	$8,960,900
TBI	3	13,097	$0	$318,000	$318,000
Thunderstorm Winds 4	142	1,421,700	$219,475,100	$18,487,200	$237,962,300
Communications	17	108,500	$15,926,200	$6,151,200	$22,077,400
Corrections	17	175,900	$37,640,700	$791,000	$38,431,700
Medical	23	211,100	$22,979,200	$2,276,900	$25,256,100
Military	59	681,800	$114,386,700	$1,825,900	$116,212,600
Safety	15	51,300	$212,600	$3,975,000	$4,187,600
TBI	3	22,900	$0	$2,357,200	$2,357,200

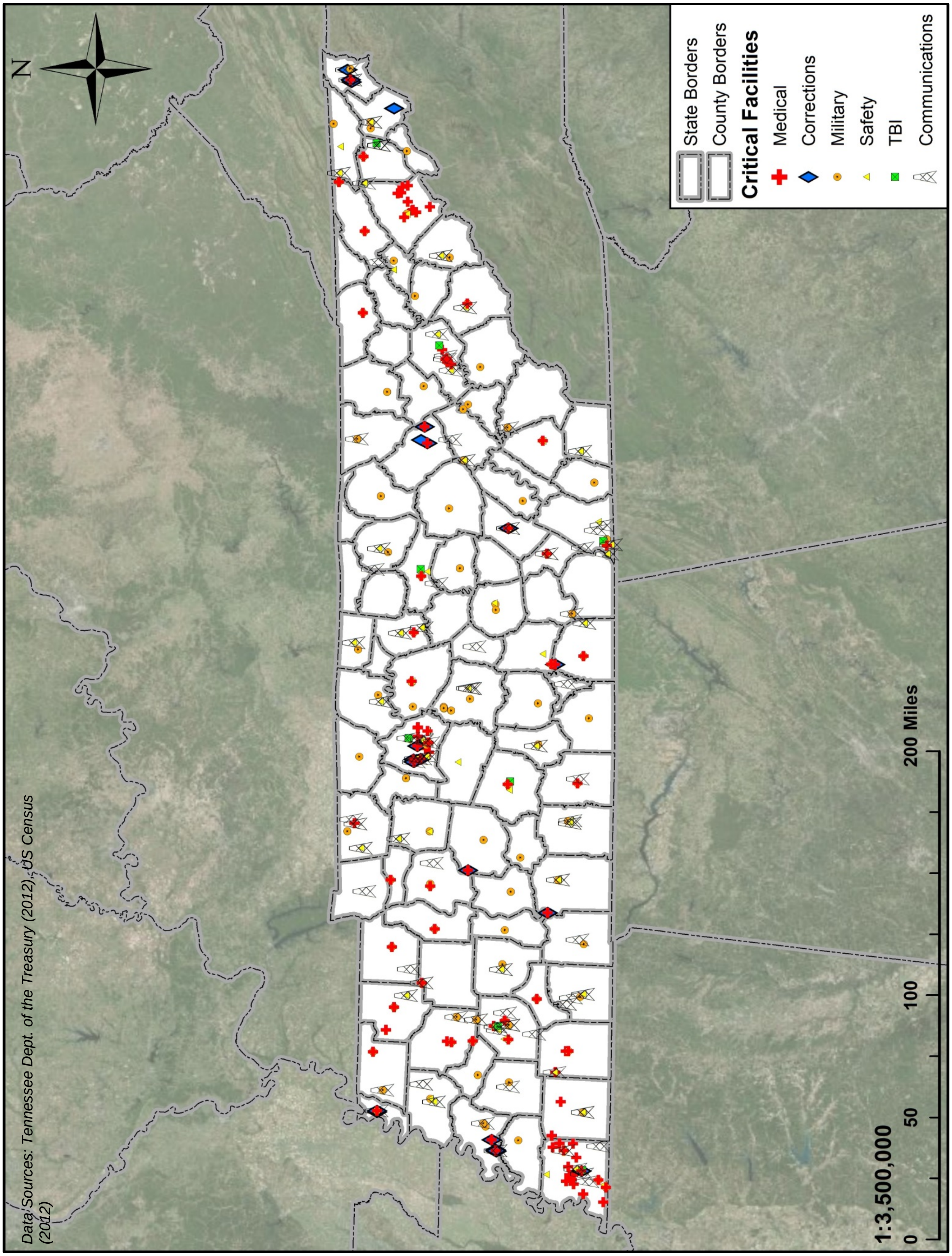
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Thunderstorm Winds 5	96	1,206,300	$257,524,900	$28,621,700	$286,146,600
Communications	11	107,000	$18,623,000	$6,513,900	$25,136,900
Corrections	78	914,600	$207,584,600	$15,772,300	$223,356,900
Medical	1	5,000	$399,000	$0	$399,000
Military	0	0	$0	$0	$0
Safety	1	3,000	$0	$100,000	$100,000
TBI	1	40,700	$0	$5,000,000	$5,000,000
Thunderstorm Winds 6	145	2,322,300	$243,213,000	$42,621,900	$285,834,900
Communications	12	58,900	$4,453,300	$3,525,000	$7,978,300
Corrections	21	271,100	$62,162,300	$3,967,300	$66,129,600
Medical	48	673,900	$68,025,900	$5,564,800	$73,590,700
Military	43	684,700	$68,174,300	$3,555,400	$71,729,700
Safety	6	70,600	$4,000,000	$5,977,700	$9,977,700
TBI	2	148,300	$0	$16,518,200	$16,518,200
Severe Storms - Winter Storms					
Winter Storm 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Winter Storm 2	6	176,400	$34,407,400	$1,164,500	$35,571,900
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	1	2,600	$400,000	$4,500	$404,500
Military	3	58,200	$9,007,400	$60,000	$9,067,400
Safety	1	12,600	$0	$100,000	$100,000
TBI	0	0	$0	$0	$0
Winter Storm 3	196	2,013,270	$371,379,100	$26,934,900	$398,314,000
Communications	17	26,000	$3,728,800	$4,668,400	$8,397,200
Corrections	107	1,215,170	$261,124,300	$9,169,900	$270,294,200
Medical	22	192,100	$20,737,200	$2,276,900	$23,014,100
Military	26	304,700	$48,181,600	$472,700	$48,654,300
Safety	10	27,100	$287,600	$4,175,000	$4,462,600
TBI	1	16,500	$0	$1,957,200	$1,957,200
Winter Storm 4	525	6,152,780	$1,025,759,500	$120,965,500	$1,146,725,000
Communications	74	341,283	$58,549,900	$22,275,400	$80,825,300
Corrections	209	2,403,000	$532,872,500	$47,744,800	$580,617,300
Medical	53	904,300	$144,859,900	$9,063,000	$153,922,900
Military	112	1,536,600	$204,856,100	$4,667,600	$209,523,700
Safety	21	106,100	$4,625,200	$9,952,700	$14,577,900
TBI	6	200,697	$0	$21,986,200	$21,986,200

Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Winter Storm 5	399	4,098,000	$643,152,800	$71,106,500	$714,259,300
Communications	31	184,900	$31,743,900	$20,382,700	$52,126,600
Corrections	188	1,716,300	$315,666,600	$29,042,300	$344,708,900
Medical	66	918,700	$105,871,500	$7,813,500	$113,685,000
Military	58	654,800	$102,958,900	$2,202,600	$105,161,500
Safety	18	18,700	$985,900	$4,025,000	$5,010,900
TBI	0	0	$0	$0	$0
Winter Storm 6	35	209,600	$29,756,000	$5,269,900	$35,025,900
Communications	10	13,800	$2,157,000	$2,829,900	$4,986,900
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	17	174,400	$27,449,000	$265,000	$27,714,000
Safety	6	13,600	$150,000	$1,925,000	$2,075,000
TBI	2	7,800	$0	$250,000	$250,000
Tornadoes					
Tornado 1	0	0	$0	$0	$0
Communications	0	0	$0	$0	$0
Corrections	0	0	$0	$0	$0
Medical	0	0	$0	$0	$0
Military	0	0	$0	$0	$0
Safety	0	0	$0	$0	$0
TBI	0	0	$0	$0	$0
Tornado 2	505	5,421,370	$925,026,500	$68,826,600	$993,853,100
Communications	32	164,700	$28,505,200	$6,494,600	$34,999,800
Corrections	298	3,067,370	$610,411,300	$38,828,000	$649,239,300
Medical	31	584,500	$61,045,900	$3,336,300	$64,382,200
Military	70	829,600	$121,780,700	$1,338,800	$123,119,500
Safety	16	28,000	$1,060,900	$4,975,000	$6,035,900
TBI	3	45,600	$0	$5,168,000	$5,168,000
Tornado 3	269	2,358,483	$448,724,800	$54,790,300	$503,515,100
Communications	47	35,883	$8,830,700	$13,295,900	$22,126,600
Corrections	91	917,900	$193,066,600	$26,645,700	$219,712,300
Medical	27	414,800	$92,643,300	$6,063,800	$98,707,100
Military	64	709,300	$117,479,000	$1,011,200	$118,490,200
Safety	16	20,000	$575,200	$4,225,000	$4,800,200
TBI	1	4,000	$0	$100,000	$100,000
Tornado 4	270	3,359,597	$528,507,900	$66,897,800	$595,405,700
Communications	43	342,600	$55,106,600	$27,056,800	$82,163,400
Corrections	79	916,300	$210,865,500	$16,122,300	$226,987,800
Medical	61	936,600	$110,717,900	$9,518,300	$120,236,200
Military	50	571,300	$89,943,100	$1,806,300	$91,749,400
Safety	17	93,500	$412,600	$7,602,700	$8,015,300
TBI	2	10,597	$0	$450,000	$450,000

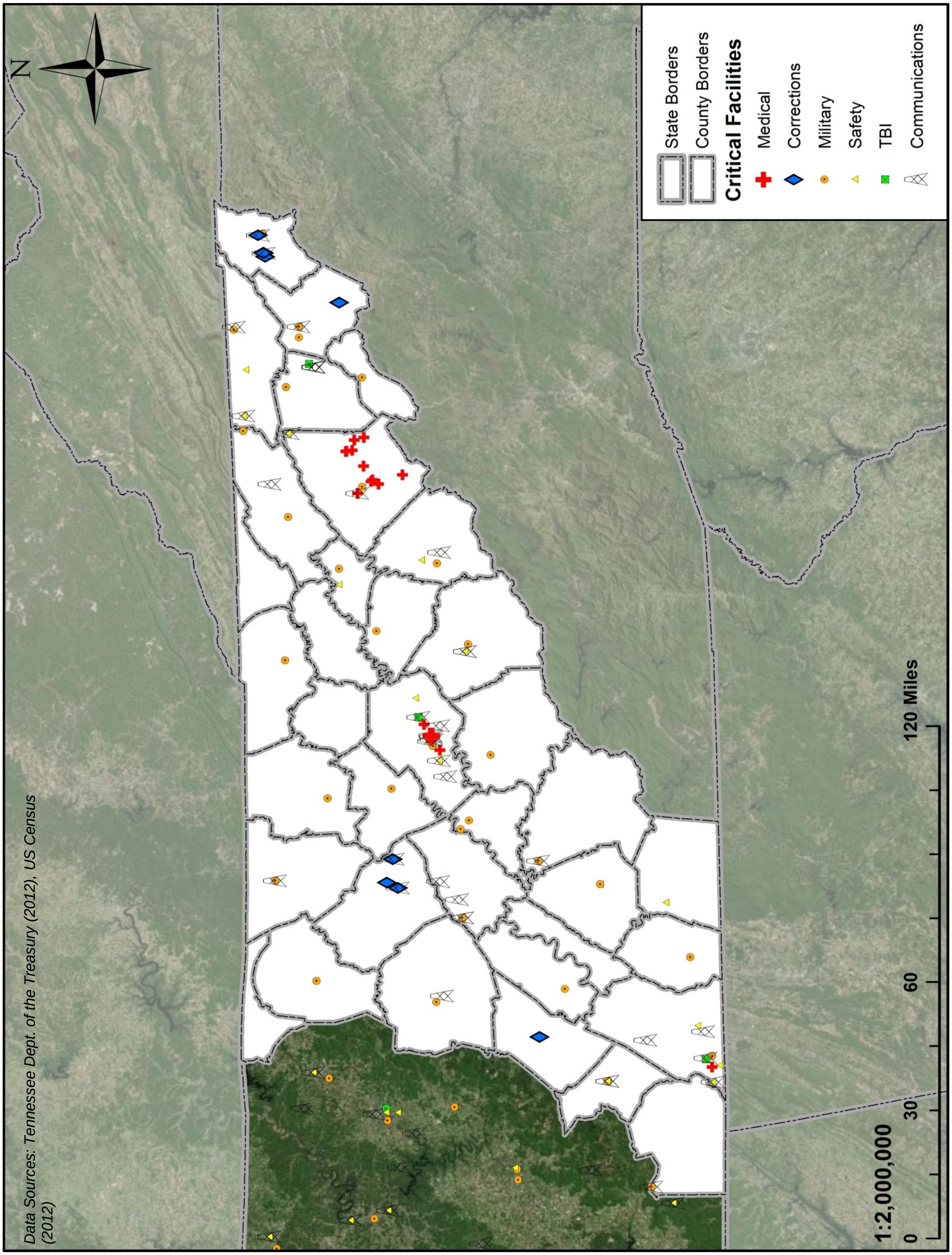
Hazard Threat Zone	Structure Count	Size (Sq. Ft.)	Structure Value	Content Value	Total Value
Tornado 5	107	1,308,000	$164,864,500	$33,043,000	$197,907,500
Communications	8	1,200	$987,000	$2,650,000	$3,637,000
Corrections	36	432,900	$95,320,000	$4,361,000	$99,681,000
Medical	22	79,200	$7,061,500	$235,000	$7,296,500
Military	27	555,700	$54,069,200	$3,391,600	$57,460,800
Safety	6	24,000	$4,000,000	$3,275,000	$7,275,000
TBI	3	164,800	$0	$18,475,400	$18,475,400
Tornado 6	10	202,600	$37,331,100	$1,883,600	$39,214,700
Communications	2	21,600	$2,750,100	$659,100	$3,409,200
Corrections	0	0	$0	$0	$0
Medical	1	2,600	$400,000	$4,500	$404,500
Military	5	62,800	$9,181,000	$120,000	$9,301,000
Safety	1	12,600	$0	$100,000	$100,000
TBI	0	0	$0	$0	$0
Wildfires					
Wildfire (WUI)	385	3,927,570	$708,071,500	$53,314,700	$761,386,200
Communications	44	152,400	$28,791,400	$9,033,400	$37,824,800
Corrections	242	2,405,670	$453,995,000	$30,296,000	$484,291,000
Medical	29	726,900	$126,071,400	$8,570,200	$134,641,600
Military	57	626,200	$98,552,800	$1,015,100	$99,567,900
Safety	13	16,400	$660,900	$4,400,000	$5,060,900
TBI	0	0	$0	$0	$0

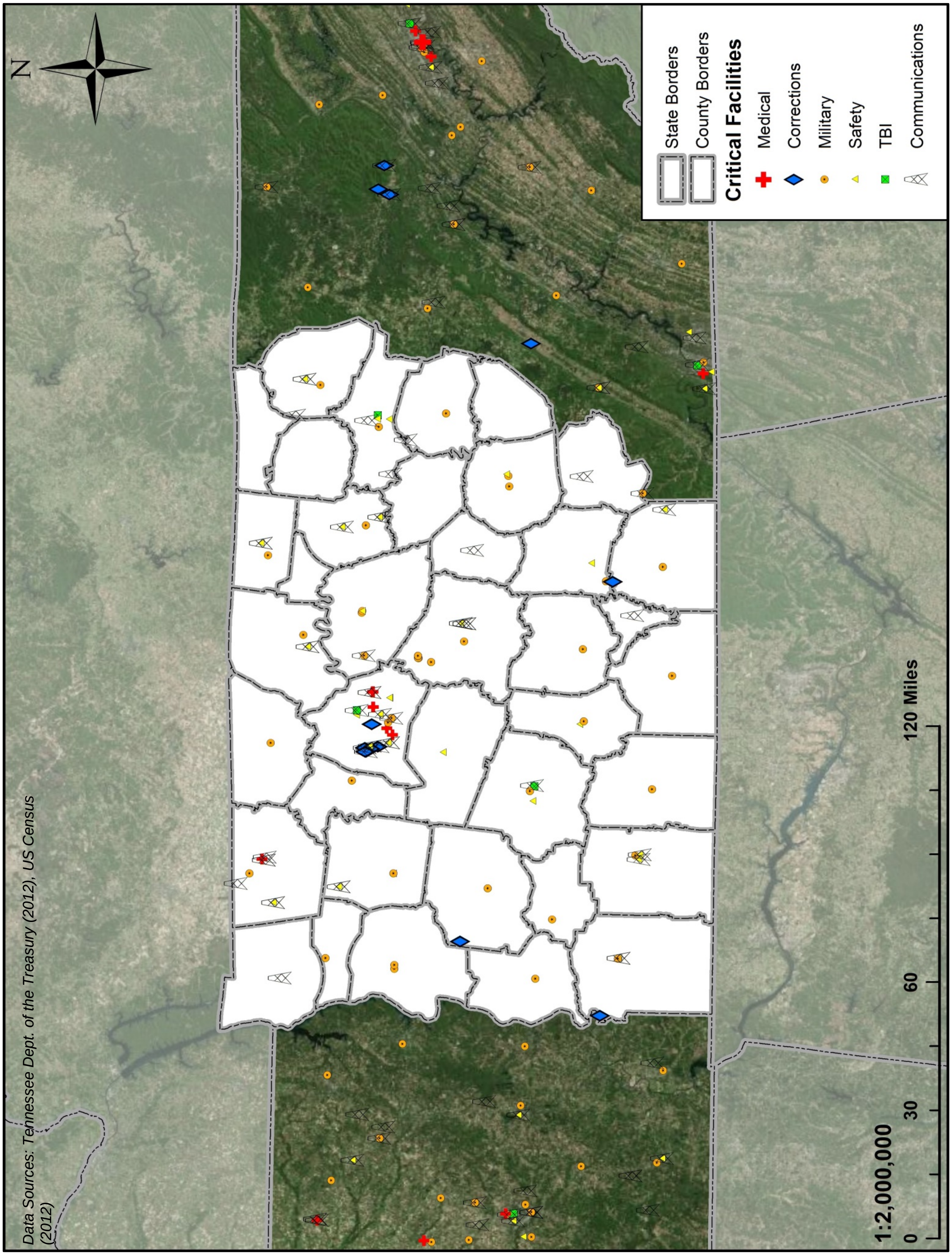
**The compiled data are from the Tennessee Department of the Treasury.*

Map 141 – State of Tennessee Critical Facilities



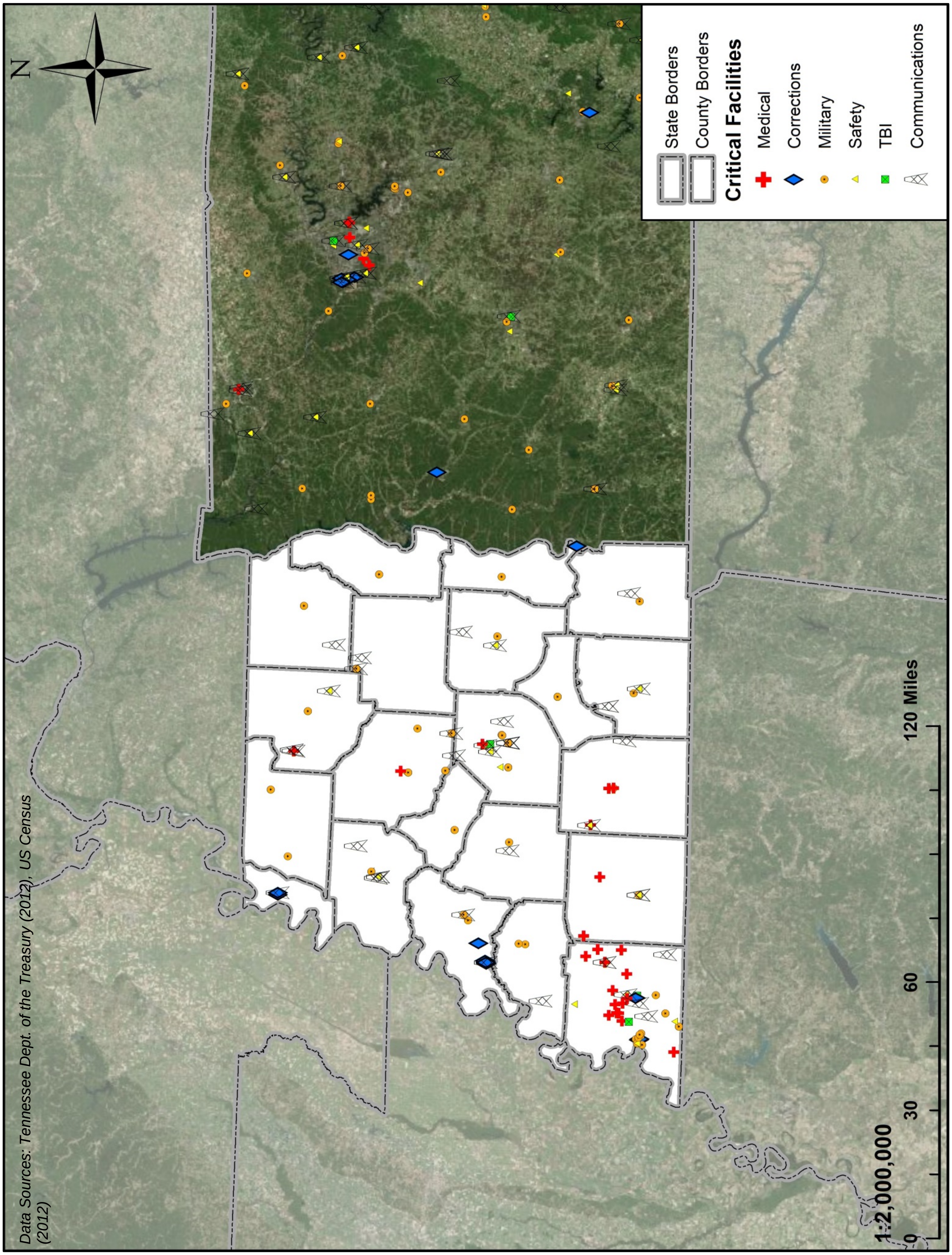
Map 142 – State of Tennessee Critical Facilities, East Tennessee





Map 143 – State of Tennessee Critical Facilities, Middle Tennessee

Map 144 – State of Tennessee Critical Facilities, West Tennessee



Section 5 – Mitigation Strategy

The State of Tennessee's mitigation strategy outlines TEMA's approach and methods to addressing its hazard risks over the next state mitigation plan cycle. Staff members from all branches of TEMA involved in mitigation planning and grants participated in the review, evaluation, and revision of their mitigation strategy. The subjects discussed included their goals, objectives, strategies, actions, capabilities, local coordination and assistance, and funding resources.

5.1 – Mitigation Goals & Objectives

The assessment of TEMA's previous mitigation goals and objectives concluded that they were too focused on specific actions and projects while not enhancing the overall capabilities of the state and local governments. Thus, this plan's updates to TEMA's mitigation goals and objectives focuses on the empowerment of local capabilities while enhancing TEMA's capabilities to provide support and outreach to local jurisdictions. It is designed to do so by enhancing statewide programs, improving local and state planning capabilities, professional development, and increased utilization of existing federal and state programs.

Goal I: Maintain and increase Tennessee's grant capabilities.

Objective 1: Comply with DMA2000 and other federal mitigation related programs.

Strategy 1.1: Continue to develop a FEMA approved state hazard mitigation plan to ensure state and local eligibility for federal grants.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 1.2: Continue to maintain and improve a FEMA approved THIRA.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 1.3: Develop a FEMA approved enhanced state hazard mitigation plan to increase total grant funding.
Potential Funding Sources: EMPG, HMGP, PDM

Goal II: Maintain and increase TEMA staff capabilities.

Objective 2*: Maintain and increase TEMA's staff grants capabilities.*

Strategy 2.1: Continue to maintain a professional, trained, and effective, grant program staff at TEMA to ensure a continual grant cycle.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 2.2: Continue to maintain a professional, trained, and effective, State Hazard Mitigation Office to ensure a continual grant cycle.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 2.3: Expand TEMA's professional development program by training its grants staff in FEMA's Cost Benefit Analysis Methodology, the State of Tennessee Historic Site Review process, and the State of Tennessee's Environmental Review process to decrease the grant application process timeframe while improving its effectiveness.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 3: *Maintain and increase TEMA's staff mitigation capabilities.*

Strategy 3.1: Support and encourage TEMA's professional development program among mitigation staff.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 3.2: Encourage participation in the training and testing in mitigation related courses such as the Certified Floodplain Managers program and FEMA's HAZUS loss estimation program.
Potential Funding Sources: EMPG, HMGP, PDM

Goal III: Enhance state assistance to local jurisdictions.

Objective 4: Improve grant program awareness to local jurisdictions.

Strategy 4.1: Continue to develop a grant information outreach program for local jurisdictions.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 5: Enhance state assistance to local jurisdictional mitigation planning efforts.

Strategy 5.1: Ensure Tennessee Mitigation Initiative's sustainability by expanding the size of TEMA's mitigation planning outreach program.
Potential Funding Sources: EMPG, HMGP, PDM

Goal IV: Build the mitigation capabilities of local governments throughout Tennessee in establishing and implementing effective and sustainable mitigation plans, policies, and programs.

Objective 6: Develop a common operating picture for statewide mitigation efforts.

Strategy 6.1: Distribute the HMP's state risk assessment to local jurisdictions.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 6.2: Work with local jurisdictions to develop better prioritized mitigation goals, objectives, and strategies.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 6.3: Grant local jurisdictions access to TEMA-maintained databases to improve mitigation plans and mitigation project planning.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 7: Develop and distribute mitigation best practices to local jurisdictions.

Strategy 7.1: Develop a best practices guide by collecting mitigation success stories from local jurisdictions.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 7.2: Develop a public awareness campaign designed to encourage the public's practice of individual mitigation activities through local emergency management agencies.
Potential Funding Sources: CDBG, EMPG, HMGP, NEHRP, PDM

Objective 8: Increase local participation in statewide and federally-sponsored programs.

Strategy 8.1: Develop a cost benefit analysis for local communities encouraging their participation in the CRS and NFIP programs to increase the number of CRS and NFIP participating communities.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 8.2: Develop a cost benefit analysis for local communities encouraging their participation in the FireWise program and the Community Wildfire Protection Plan to increase the number of participating communities.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 9: Encourage local jurisdiction's participation in regulatory mitigation activities.

Strategy 9.1: Develop a cost benefit analysis for local communities encouraging enforcement of current state established building codes and outline the benefits of enacting enhanced local codes.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 9.2: Engage in outreach to local planning commissioners and zoning officials to spread awareness of assistance options, available grant programs, current and future development in hazard prone areas, and mitigation approaches.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 9.3: Encourage the establishment of pre-approved debris storage areas.
Potential Funding Sources: CDBG, EMPG, HMEP, HMGP, NEHRP, PDM

Goal V: Capitalize on mitigation opportunities during post disaster, long-term recovery operations.

Objective 10: Develop a process for incorporating new mitigation measures into post disaster long term recovery operations.

Strategy 10.1: Develop a quick assessment tool to be used by the planning & recovery branches to assess mitigation opportunities post disaster.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 10.2: Develop a coordinated group to make decisions on mitigation opportunities post disaster.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 10.3: Assist in the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program to ensure capitalization of post disaster long-term recovery operations.
Potential Funding Sources: CDBG, EMPG, HMGP, PDM

Goal VI: Develop TEMA programs, plans, policies, and projects toward the hazards of prime concern addressing current mitigation gaps.

Objective 11: Reduce Repetitive Loss and Severe Repetitive Loss properties and costs across Tennessee.

Strategy 11.1: Identify high property count jurisdictions and prioritize RL/SRL properties by cost.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 11.2: Accelerate the RL/SRL buyout program by targeting the prioritized jurisdictions and properties.
Potential Funding Sources: CDBG, EMPG, FMA, HMGP, PDM

Objective 12: Develop a comprehensive flash flooding mitigation program for identified hazard prone communities.

Strategy 12.1: Conduct a study of flash flooding damages, their causes, and assess measures that could have mitigated their impacts.
Potential Funding Sources: EMPG, FMA, HMGP, PDM
Strategy 12.2: Distribute flash flooding information and mitigation best practices to the identified hazard-prone communities.
Potential Funding Sources: EMPG, FMA, HMGP, PDM
Strategy 12.3: Based on the flash flooding study, develop flash flooding mitigation projects for local jurisdictions.
Potential Funding Sources: CDBG, EMPG, FMA, HMGP, PDM

Objective 13: Develop a comprehensive severe storm mitigation program for identified hazard prone communities.

Strategy 13.1: Conduct a study of severe storm damages, their causes, and assess measures that could have mitigated their impacts.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 13.2: Distribute severe storm information and mitigation best practices to the identified hazard-prone communities.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 13.3: Based on the severe storm study, develop severe storm mitigation projects for local jurisdictions.
Potential Funding Sources: CDBG, EMPG, FMA, HMGP, PDM

Objective 14: Further develop the State of Tennessee Drought Management Plan by implementing mitigation projects protecting identified hazard prone communities.

Strategy 14.1: Promote local and state legislation mitigating the impacts of droughts through water use restrictions and burning prohibitions during declared events.
Potential Funding Sources: EMPG, HMGP, PDM

Strategy 14.2: Directly and/or indirectly establish secondary and reserve water supplies to mitigate the effects of a drought on identified hazard prone communities.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 15: Increase the State of Tennessee's resiliency to seismic events.

Strategy 15.1: Develop cost benefit analysis on increasing the use of seismic building codes and distribute it to local governments and private construction companies doing business in Tennessee.
Potential Funding Sources: EMPG, HMGP, NEHRP, PDM
Strategy 15.2: Support, assist, and encourage local governments to provide incentives for private construction companies to voluntarily build higher than the minimum seismic standards.
Potential Funding Sources: EMPG, HMGP, NEHRP, PDM
Strategy 15.3: Continue to seismically retrofit bridges and transportation infrastructure in West Tennessee.
Potential Funding Sources: CDBG, EMPG, HMGP, NEHRP, PDM
Strategy 15.4: Continue to support, assist, and encourage local governments to perform seismic retrofit studies and seismic retrofit projects.
Potential Funding Sources: CDBG, EMPG, HMGP, NEHRP, PDM

Objective 16: Increase the State of Tennessee's resiliency to geologic hazards.

Strategy 16.1: Encourage state and local governments to perform increased site level soil testing in identified hazard prone areas.
Potential Funding Sources: CDBG, EMPG, HMGP, PDM
Strategy 16.2: Implement slope stabilizing mitigation measures protecting infrastructure in identified landslide prone areas.
Potential Funding Sources: CDBG, EMPG, HMGP, PDM

Objective 17: Increase the State of Tennessee's resiliency to tornado and high-speed winds.

Strategy 17.1: Assist, support, and encourage the construction of FEMA 361 tornado safe rooms throughout Tennessee.
Potential Funding Sources: CDBG, EMPG, HMGP, PDM
Strategy 17.2: Assist, support, and encourage communities to require or implement the installation of anchoring systems at mobile home parks.
Potential Funding Sources: CDBG, EMPG, HMGP, PDM

Objective 18: Increase the State of Tennessee's resiliency to infrastructure incidents.

Strategy 18.1: Coordinate with the Tennessee Department of Transportation to identify transportation infrastructure in hazard-prone areas.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 18.2: Coordinate with the Tennessee Department of Transportation to implement mitigation projects for transportation infrastructure in the identified hazard prone areas.
Potential Funding Sources: CDBG, EMPG, FMA, HMEP, HMGP, NEHRP, PDM
Strategy 18.3: Coordinate with state agencies and local governments to install backup generators for critical facilities in identified hazard prone areas.
Potential Funding Sources: CDBG, EMPG, HMGP, NEHRP, PDM
Strategy 18.4: Coordinate with state agencies and local governments to backup software and database systems.
Potential Funding Sources: EMPG, SHSGP

Objective 19: Increase the State of Tennessee's resiliency to terrorism events.

Strategy 19.1: Install firewall and other hardware system protective measures in critical network systems to prevent cyber-attacks.
Potential Funding Sources: EMPG, SHSGP

Goal VII: Enhance TEMA's capabilities to perform accurate risk assessments.

Objective 20: Collect and maintain comprehensive databases pertinent to mitigation.

Strategy 20.1: Develop and maintain a comprehensive statewide GIS database of state property, in collaboration with the State of Tennessee Office of Information Resources, to identify, GPS locate, geocode, and build polygon files of all state property.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 20.2: Collect and maintain a database of local jurisdictions' building codes, zoning, and subdivision regulations by adopting the maintenance of the State of Tennessee's "Status of Planning and Land Use Control Report for Tennessee" from the now disbanded Local Planning Assistance Office (LPAO) under the Department of Economic & Community Development.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 20.3: Pursue and promote LiDAR mapping opportunities in at risk areas throughout Tennessee.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 21: Enhance the statewide risk assessment by conducting local and regional studies and assessments in potential high-impact areas.

Strategy 21.1: Identify and assess community risk from potential dam failures by studying the impact potential of non-profiled dams.
Potential Funding Sources: EMPG, FMA, HMGP, PDM
Strategy 21.2: In coordination with the USACE, improve and refine flood inundation mapping throughout the state based on river depth measurements.
Potential Funding Sources: EMPG, FMA, HMGP, PDM
Strategy 21.3: Conduct a statewide, multiple scenario assessment of chemical spills and plume models for chemical and radiological facilities.
Potential Funding Sources: EMPG, HMEP, HMGP, PDM

Goal VIII: Improve and Coordinate mitigation activities among federal agencies, state agencies, non-profit organizations, and private businesses.

Objective 22: Foster and increase all Tennessee agencies' and departments' participation and coordination with TEMA mitigation activities.

Strategy 22.1: Maintain TEMA's ESC program and keep the ESCs informed on mitigation efforts, progress, and successes throughout the state.
Potential Funding Sources: EMPG, HMGP, PDM

Objective 23: Foster and increase federal agencies', state agencies', non-profits' and private businesses' participation and coordination with TEMA mitigation activities.

Strategy 23.1: Work with state agencies, federal agencies, and non-profits to promote mitigation practices at historic and culturally significant locations and properties.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 23.2: Promote the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program.
Potential Funding Sources: EMPG, HMGP, PDM
Strategy 23.3: Continue to support mitigation planning efforts with non-profits such as the Red Cross, Salvation Army, and Volunteer Organization Active in Disasters.
Potential Funding Sources: EMPG, HMGP, PDM

5.2 – State Capabilities

This assessment evaluates existing mitigation capabilities of state agencies and organizations. It covers pre and post disaster hazard management policies, programs, regulations, development in hazard prone areas, and funding sources. Specifically:

- Identification of agencies and statewide organizations that have mitigation programs.
- Identification of agencies and statewide organizations that have mitigation funding capabilities.
- Identification of state statutes, regulations, policies, and programs relating to mitigation.
- Identification of state restrictions on development in hazard prone areas.
- Assess strengths and gaps among the identified agencies and statewide organizations.

The HMPC determined a set number of interviews to be conducted with primary stakeholders. These primary interviews would be the focal point of assessing state capabilities and changes in state capabilities. Additional research and correspondence was conducted on more minor and less active programs and capabilities.

The following subsections list state agencies that engage in mitigation and mitigation-related activities, their points of contact, and a description of their involvement. Tables 105 and 106 at the end of this section categorically summarize each agency's capabilities.

5.2.1 – Tennessee Commission on Aging and Disability

Elderly and disabled people are often the most vulnerable in times of disaster or emergency. The Tennessee Commission on Aging and Disability offers workshops by appointment where a representative will come to a group, organization, or home and provide general and specific disaster preparedness and mitigation advice.

> ***Agency Contact:*** Laverdia McCullough
> laverdia.mccullough@tn.gov

5.2.2 – Tennessee Department of Agriculture

Agricultural Enhancement Program (TAEP)

TAEP was established in 2005 to increase farm income by helping farmers invest in better farming practices and by encouraging diversification and innovation. Through TAEP farmers can qualify for a 35% to 50% cost share, ranging from a maximum of $1,200 to $15,000 depending on the project. The TAEP provides cost-share funds for long-term investments in livestock and farming operations.

> ***Agency Contact:*** N/A
> taep.online@tn.gov

Agricultural Resources Conservation Fund (ARCF)

The Agricultural Resources Conservation Fund was established in 1991 and is funded through a portion of the real estate transfer tax that also funds state land acquisition programs. The ARCF grants help landowners install conservation practices that prevent soil erosion and farm runoff and improve water quality. The grants also help support soil conservation districts with administrative costs, educational projects and technical assistance. Landowners can apply through county soil conservation district offices for up to 75% of the cost of implementing conservation practices. Conservation practices include projects such as streamside restoration and planting, alternative livestock watering systems, terracing and pasture management.

> ***Agency Contact:*** John McClurkan
> john.mcclurkan@tn.gov

Animal Disease Risk Assessment, Prevention, & Control Act

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) provides leadership in ensuring the health and care of animals and plants. The agency improves agricultural productivity and competitiveness and contributes to the national economy and the public health. Tennessee is a full participant in the various programs from APHIS especially related to potential biological hazards that could impact its agricultural industries. Results are available for public review via hard copy and postings on the Internet.

> ***Agency Contact:*** Dr. K. Mark Krause
> vstn@aphis.usda.gov

Disaster Animal Response Team (DART)

The Tennessee Disaster Animal Response Team is a statewide program under the authority of the State Veterinarian, Tennessee Department of Agriculture. The DART program was created in the 1990's and has been expanded since both the 9/11 and Hurricane Katrina disasters, as these 2 events showed deficiencies in emergency response in regard to responding to the needs of animals. By coordinating the efforts of credentialed responders, as well as registered volunteers, DART is an integral part of animal disaster preparedness and response. Responders are volunteers from many backgrounds and include veterinarians, animal health technicians, County Extension Agents, Animal Control Officers, exotic animal specialists, livestock producers and the general public. Additionally, DART members also include local Emergency Management Agency personnel, health department, law enforcement, and fire/HAZMAT personnel. The ideal DART should include a wide variety of expertise that could provide a multi-layered response to any animal/agricultural disaster that might impact a local community.

Agency Contact: Dr. Douglas Balthaser
douglas.balthaser@tn.gov

National Animal Health Monitoring System (NAHMS)

The National Animal Health Monitoring System was initiated in 1983 for the purpose of collecting, analyzing, and disseminating data on animal health, management, and productivity across the United States. The NAHMS unit conducts national studies on the health and health management of America's domestic livestock populations. These studies are designed to meet the information needs of the industries associated with these commodities, as identified by people within those industries. Tennessee's Department of Agriculture participates in the NAHMS by supplying data on its animal health and production.

Agency Contact: Dr. K. Mark Krause
vstn@aphis.usda.gov

National Surveillance Unit (NSU)

The National Surveillance Unit, established by the Veterinarian Services (VS) branch of the USDA in 2003, is the first unit within VS to have personnel devoted solely to animal disease surveillance and surveillance enhancement. The NSU was established to coordinate activities related to U.S. animal health surveillance, to address the recommendations regarding surveillance in the Animal Health Safeguarding Review, and to facilitate the development of a National Animal Health Surveillance system. The NSU works under the direction of the Veterinary Services National Surveillance Coordinator and in collaboration with the National Center for Animal Health Programs, which continues to be responsible for managing and implementing program disease surveillance. The Tennessee's Department of Agriculture participates in the NSU by supplying information and data on its animal diseases, health, and production

Agency Contact: Dr. K. Mark Krause
vstn@aphis.usda.gov

USDA Rural Development Grant

The program is targeted toward serving rural communities, with populations less than 10,000 that have the greatest financial need. Facilities financed by Rural Utilities Services may be located in non-rural areas; however, loan and grant funds may only be used to finance that portion of the facility serving rural areas. Loan and grant funds may be used to construct, enlarge, extend, or otherwise improve rural water facilities. There appear to be few restrictions on how funds are used, with construction, land acquisition, legal fees, engineering fees, capitalized interest, equipment, initial operation and maintenance cost, and project contingencies all identified as eligible expenses.

5.2.3 – Tennessee Department of Agriculture – Division of Forestry

The Tennessee Forestry Commission, established in 1985, serves in an advisory capacity on forestry policy to the Tennessee Department of Agriculture and the governor. The commission's role is to formulate and recommend programs relating to: fire protection; reforestation and seedling production; forestry assistance to private landowners; educational and informational functions that enhance understanding of the value and management of the forest resource; management of state forests; urban tree management; development of markets for Tennessee forest products; protection from insect and disease epidemics; and protection of the soil and water quality.

FireWise Communities Program

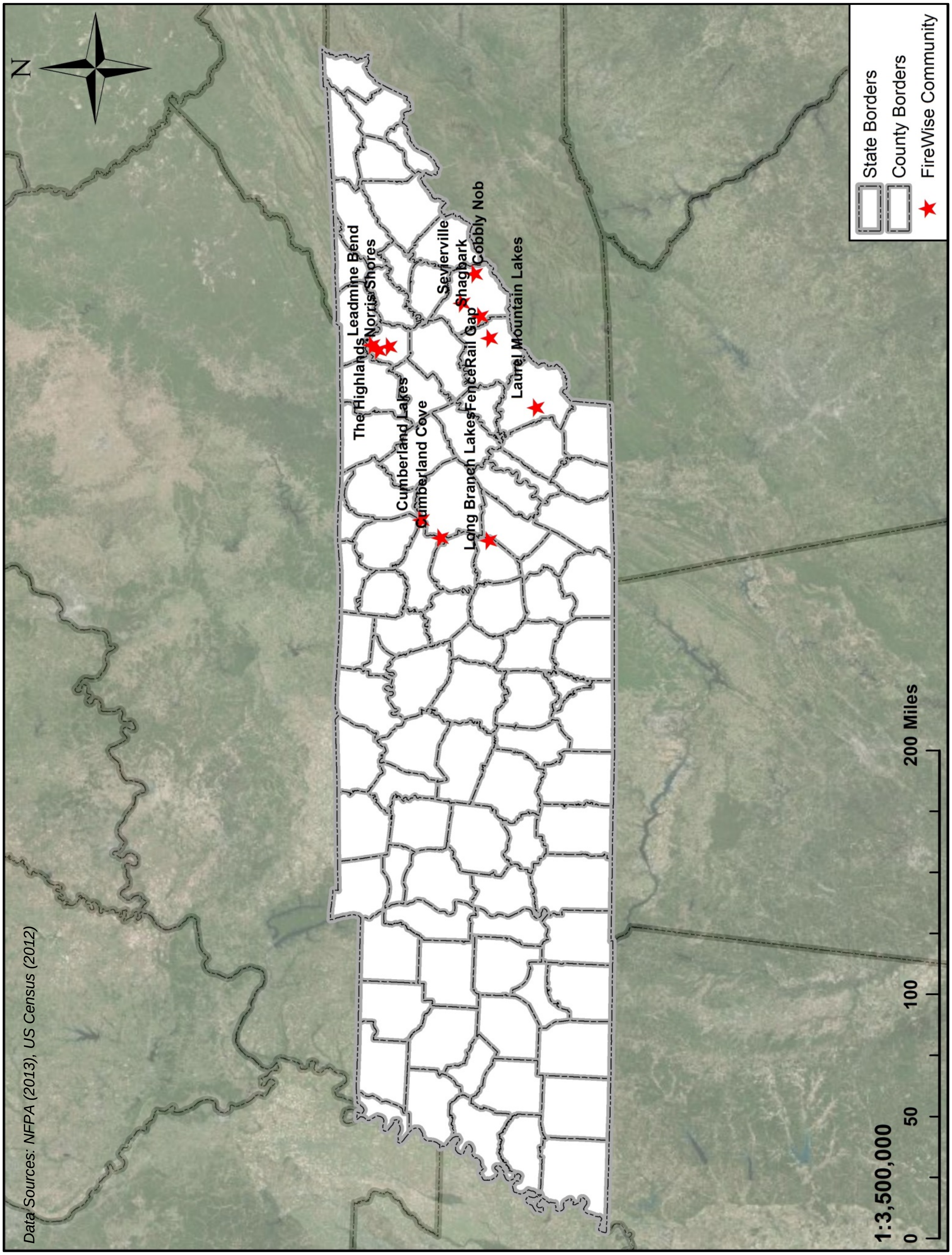
The FireWise Communities program is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of a wildland fire before a fire starts. The FireWise Communities approach emphasizes community responsibility for planning in the design of a safe community as well as effective emergency response, and individual responsibility for safer home construction and design, landscaping, and maintenance. The Tennessee Division of Forestry, in partnership with the USDA Forest Service, provides funding, training and technical assistance to rural communities and volunteer fire departments in conducting community wildfire hazard risk assessments, development of mitigation projects to reduce the risk from wildfires, and the development of Community Wildfire Protection Plans. Please see Map 145 on the following page for the locations of Tennessee's FireWise participants.

Currently, Tennessee has 8 certified FireWise Communities:

- Cobbly Nob , Knoxville, 2011
- Cumberland Cove, Crossville, 2003
- Cumberland Lakes in Cumberland County, Monterey, 2006
- FenceRail Gap, Walland, 2009
- Leadmine Bend, Sharps Chapel, 2010
- Norris Shores, Sharps Chapel, 2008
- Shagbark, Sevierville, 2011
- The Highlands, Sharps Chapel, 2010

Agency Contact: John Kirksey
john.kirksey@tn.gov

Map 145 – FireWise Communities, Tennessee



Forest Action Plan

The purpose of the Tennessee Forest Action Plan is to determine the status of the forest resource through an assessment— what's there, who owns it, what are its threats, and how can federal funds help to manage it. Strategies are developed to address issues raised from the assessment. The completion of the assessment and strategy enable the states eligibility to apply and compete for federal funds through an annual grant cycle.

Agency Contact: Herb Paugh
herb.paugh@tn.gov

Forest Legacy Program

The Tennessee Forest Legacy Program currently conserves 35,000 acres across Tennessee and is growing. Its mission is to protect environmentally important, working private forestlands threatened with conversion to non-forest uses. Delivered through Forest Service Cooperative Forestry, Tennessee and most other states qualify as a participant and compete nationally for 75% grant funding each year. Tennessee's State Forest Legacy Committee consists of experienced officials, professionals, and landowners, of diverse environmental and conservation interests who grade and rank proposals annually for consideration. Forest Legacy in Tennessee specifically targets and perpetuates traditional forestland values and benefits on environmentally valuable forest lands by requiring each tract to have a detailed forest management plan, known as a Forest Stewardship Plan, to address all resource elements and land management objectives.

Agency Contact: Herb Paugh
herb.paugh@tn.gov

Forest Stewardship Program

The Forest Stewardship program makes forestry assistance available to private forest landowners and increases public awareness about wise forest use and management. The program focuses on developing detailed plans for privately-owned forestland based on specific objectives of the owner. Free, on-the-ground planning assistance is provided by natural resource specialists under the leadership of the Tennessee Department of Agriculture, Forestry Division.

Depending upon landowners' objectives, stewardship plans may contain detailed recommendations for improvement of wildlife habitats and the development of recreational opportunities, as well as for timber establishment, stand improvement and harvesting. Guidelines for prevention of soil erosion, protection of water quality, and preservation of visual values are included in all stewardship plans. To qualify, landowners must: have 10 acres or more of forestland, obtain and implement a forest stewardship plan, have at least 1 secondary management objective in addition to their primary objective, protect the land from erosion and prevent pollution of streams and lakes, and carry out the plan according to standards that maintain the productivity of forest resources and protect the environment.

Agency Contact: David Arnold, Assistant State Forester
david.arnold@tn.gov

5.2.4 – Tennessee Department of Children's Services (DCS)

The Department of Children's Services central office and each division, regional, and field office have written emergency response preparedness plans to establish operations during emergency situations and to recover from damages/disruption in a reasonable time period. ERPPs are developed to include and provide preparation, response, and recovery efforts from emergencies and disasters. Key objectives of the emergency response preparedness plans include: provisions for safety and well-being, minimize immediate damage and losses, establish management succession, provisions for immediate response to critical tasks and functions and timely resumption of business, coordinate services and share information, and facilitate effective coordination of recovery tasks.

Agency Contact: Carla Aaron, Executive Director
carla.aaron@tn.gov

5.2.5 – Tennessee Department of Commerce & Insurance – Emergency Communications Board

The Emergency Communications Board is a self-funded, nine-member agency administratively attached to the Department of Commerce and Insurance, created to provide assistance to emergency communications district (ECDs) boards of directors in the areas of management, operations, and accountability, and to establish emergency communications for all citizens of Tennessee. The board is funded through a monthly emergency telephone service charge on users and subscribers of non-wire line communications services.

By statute, the board exercises financial and operational oversight over the state's 100 ECDs that administer or facilitate local E-911 call taking and/or dispatching services across the state. The Board establishes technical, operational and dispatcher training standards, and administers grants and reimbursement programs which distribute funds to ECDs. It also provides advisory technical assistance to ECDs upon request.

The board works on many fronts to facilitate the technical, financial, and operational advancement of the state's ECDs. A major focus has been to implement and maintain wireless Enhanced 911 for the state, as set forth by the Federal Communications Commission in orders and regulations it has issued on 911-related matters since 1994. Tennessee was the third state in the nation to fully deploy the equipment and technology needed to automatically locate 911 calls from properly equipped cellphones and has received national recognition for its leadership in 911 related matters.

Agency Contact: Lynn Questell, Executive Director
lynn.questell@tn.gov

Tennessee Department of Commerce & Insurance – Fire Prevention Division – Manufactured Housing Section

Under State of Tennessee Law, the Manufactured Housing Section is responsible for: licensing HUD labeled manufactured home manufacturers, retailers, and installers; monitoring used manufactured homes safety standards; performing manufactured home installation inspections in accordance with state law; and Investigating and taking appropriate action against violators of the Tennessee Acts referenced above.

Under its current agreement with HUD, the Manufactured Housing Section administers parts of the federal laws pertaining to manufactured housing, such as: monitoring manufacturers' home construction quality control program; investigating and monitoring consumer complaints under the Standards Act; searching for and when warranted, initiating class action cases through HUD; performing post-production monitoring of manufactured homes produced in and/or shipped to Tennessee; and investigating and taking appropriate action against violators of the federal act referenced above.

Agency Contact: Gary L. West, Assistant Commissioner
gary.west@tn.gov

5.2.6 – Tennessee Department of Economic and Community Development

Community Development Block Grant Program (CDBG)

The primary purpose of the Community Development Block Grant program is the development of viable urban communities, by providing decent housing, suitable living environments, and expanding economic opportunities, principally for persons of low and moderate income. The CDBG program is sponsored by the U.S. Department of Housing & Urban Development. Grant dollars are available to communities with a population of fewer than 50,000 residents for the purpose of attracting new or expanding existing companies, as long as the projects align with 1 of 3 national objectives: 1. Principally benefit low and/or moderate income people, 2. Eliminate or prevent slums and/or blight, 3. Address imminent health and/or safety problems.

Agency Contact: Brooxie Carlton
brooxie.Carlton@tn.gov

Community Rating System (CRS)

The Community Rating System, originally instituted by FEMA in 1990, allows states another tool in delineating between those communities that are making a notable effort at risk reduction and those that are not. It incentivizes those in the NFIP to meet 18 specific goals and objectives, which then qualify them for insurance rate reductions. These goals are in addition to the primary objectives of the NFIP which are insurance assessment, floodplain management, and hazard mapping. Those communities that are eligible for CRS reductions are listed below: Of those, 6 are classified as a Class 10 which qualifies them for no reduction in their insurance rates, and 5 as a Class 9 with the minimum reduction granted. These 11 counties at zero or minimal rate reduction represent 61% of eligible communities, and over 85% of square miles in designated NFIP zones.

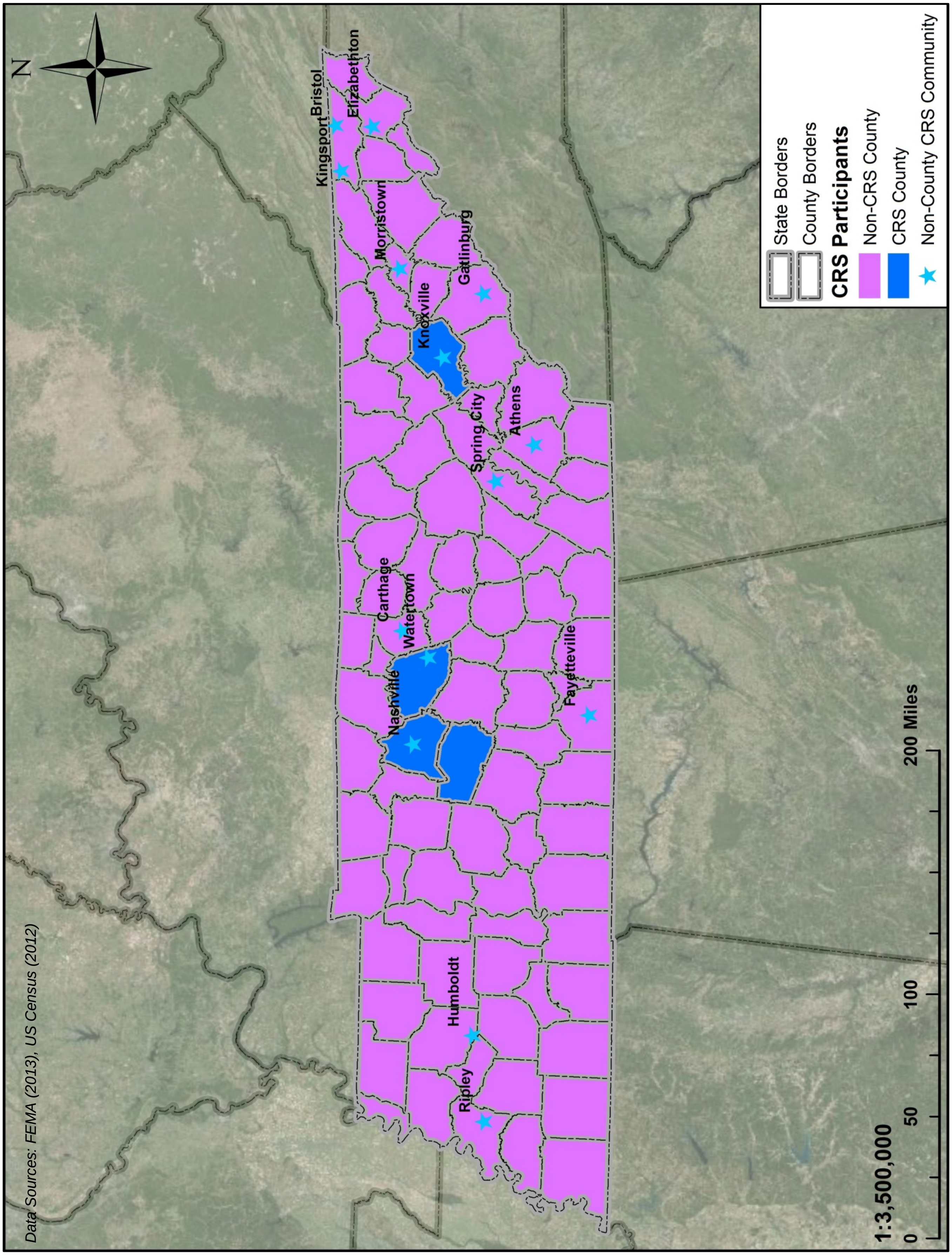
For the 21,000 miles of waterways and CRS eligible communities that are currently identified as flood hazard zones, the Director of Special Projects is responsible for scheduling and completing Assistance Visits and meeting with local zoning regulators to assure timely assessment of structures and planning inside of hazard zones. These visits are to be scheduled on an annual basis, along with reports generated in the director's office in conjunction with the OIR. Map 146 on the following page depicts Tennessee's CRS participants.

- Athens, City of
- Bristol, City of
- Carthage, City of
- **Elizabethton, City of
- *Fayetteville, City of
- Gatlinburg, City of
- *Humboldt, City of
- *Kingsport, City of
- **Knox County
- Knoxville, City of
- *Morristown, City of
- Nashville, City of
- Davidson County
- *Ripley, Town of
- *Spring City, Town of
- **Watertown, City of
- **Williamson County
- **Wilson County

**Class 10 with no rate reduction*
*** Class 9 with the minimum rate reduction*

Agency Contact: Stanley Harrison, Director of Special Projects
stanley.harrison@tn.gov

Map 146 – CRS Participants, Tennessee



National Flood Insurance Program (NFIP)
Created in 1968, the NFIP is a federal program that allows citizens in participating communities to purchase insurance coverage for potential property damage as a result of flooding. The NFIP in Tennessee works closely with private insurance companies to offer flood insurance to property owners and renters. In order to qualify for flood insurance, a community must join the NFIP and agree to enforce sound floodplain management standards. In return for a local community adopting and enforcing local floodplain management regulations, flood insurance is available in the community. Currently, nearly 400 Tennessee communities participate in the NFIP.

> ***Agency Contact:*** Stanley Harrison, Director of Special Projects
> stanley.harrison@tn.gov

5.2.7 – Tennessee Department of Environment & Conservation

The Tennessee Department of Environment and Conservation is a diverse, dynamic department that: safeguards the health and safety of Tennessee citizens from environmental hazards; protects and improves the quality of Tennessee's land, air and water; and manages the Tennessee State Parks system.

TDEC has an extensive permitting program for air and water discharges and maintains Tennessee's compliance with all federal environmental laws, such as the Clean Air Act, the Clean Water Act, the Solid Waste Disposal Act, the Resource Conservation and Recovery Act and others. It also maintains the state's historical and archaeological resources, as well as its significant land holdings.

> ***Agency Contact:*** Brenda Apple
> brenda.apple@tn.gov

Archaeological Advisory Council
The Advisory Council works with the Tennessee Division of Archeology, which is responsible for the protection of archaeological sites and artifacts on all lands owned or controlled by the state, coordinates with all state agencies to ensure activities do not destroy significant sites, and reviews all federal projects to determine the impact on archaeological resources. It also provides expertise to the State Historic Preservation Office and prepares nominations to the National Register of Historic Places.

> ***Agency Contact:*** Jennifer Barnett
> jennifer.barnett@tn.gov

Clean Tennessee Energy Grants
Clean Tennessee Energy Program provides grants to municipal governments, county governments, utility districts and other entities created by statute in Tennessee to purchase, install, and construct energy projects that result in a reduction of emissions and pollutants and fit into one of the following eligible project categories below.

> ***Award Range:*** The funding maximum is $250,000 with a minimum project cost share of 50%.

Division of Geology

The Division of Geology promotes the prudent development and conservation of Tennessee's geological, energy and mineral resources by developing and maintaining data bases, maps, and technical services that provide accurate geologic hazard assessments and information through publications and outreach activities. The division advises other state agencies and federal and local organizations on matters relating to Tennessee geology.

> ***Agency Contact:*** Ron Zurawski, State Geologist
> ronald.zurawski@tn.gov

Drinking Water State Revolving Fund (DWSRF)

U.S. Environmental Protection Agency awards annual capitalization grants to fund the program, and the State of Tennessee provides a twenty-percent funding match. The program provides grants at the local level for the planning, design, and construction of drinking water facilities, with priority given to projects associated with the greatest health risk, existing water problems, and community need. DWSRF provides funding to the following categories of projects: water quality problems, source or capacity, water storage, leakage problems, pressure problems, replacement or rehabilitation projects, and water line extensions. Projects that are not eligible for DWSRF loan funding include dams, reservoirs, purchase of water rights, laboratory fees for monitoring, operation and maintenance expenses, and projects primarily intended for future growth, economic development, and fire protection.

Historical Commission

The mission of the Tennessee Historical Commission is to encourage the inclusive diverse study of Tennessee's history for the benefit of future generations; to protect, preserve, interpret, operate, maintain, and administer historic sites; to mark important locations, persons, and events in Tennessee history; to assist in worthy publication projects; to review, comment on and identify projects that will potentially impact state-owned and non-state-owned historic properties; to locate, identify, record and nominate to the National Register of Historic Places all properties that meet National Register criteria, and to implement other programs of the National Historic Preservation Act.

> ***Agency Contact:*** E. Patrick McIntyre Jr.
> patrick.mcintyre@tn.gov

Multi-Purpose Pilot Grants

The EPA is piloting a new grant program that will provide a single grant to an eligible entity for both assessment and cleanup work at a specific brownfield site owned by the applicant.

> ***Award Range:*** An applicant may request up to $200,000 ($350,000 with a waiver) for assessment activities and $200,000 for direct clean-up activities at the same site.

Natural Heritage Inventory Program

The Natural Heritage Inventory Program operates under authority of the Rare Plant Protection and Conservation Act of 1985, and the Rare Plant Protection and Conservation Regulations. The program maintains a GIS database with information on the distribution and ecology of rare plants, animals, and ecological communities across Tennessee. The database currently contains over 14,000 rare species and plant community occurrence records as well as information on hundreds of conservation sites. Information gathered by program biologists, assists in directing conservation, restoration, and management activities of other programs in the division.

> ***Agency Contact:*** David Lincicome
> david.lincicome@tn.gov

Office of Sustainable Practices

The Tennessee Department of Environment and Conservation operates a statewide indoor radon program as part of the Office of Sustainable Practices. The program offers a myriad of services and assistance such as: test kits for homeowners, technical information for universities, and specific materials for targeted audiences such as real estate professionals, home builders, building code officials, home inspectors, and school officials.

Agency Contact: Lori Munkeboe
lori.munkeboe@tn.gov

Safe Dams Program

The purpose of the Safe Dams Program is to provide for the comprehensive regulation and supervision of dams for the protection of the health, safety, and welfare of the citizens of Tennessee, and to assure proper planning, design, construction, maintenance, monitoring, and supervision of dams. The Safe Dams Program is responsible for conducting inspections, plan reviews, and permitting of dam and reservoir projects as required in the Safe Dams Act of 1973. The purpose of the program is to protect the public from dam failures. All non-federal dam owners are required to have a certificate of approval from the Commissioner to construct, alter, remove, or operate a dam.

Agency Contact: Alan Schwendimann
alan.schwendimann@tn.gov

State Revolving Fund Loan Program

The Tennessee Clean Water and Drinking Water Revolving Fund Loan Programs provide low-interest loans to cities, counties, utility districts, and water/wastewater authorities for the planning, design, and construction of wastewater and drinking water facilities. The U.S. Environmental Protection Agency awards annual capitalization grants to fund the program, and the State of Tennessee provides a twenty-percent funding match.

Agency Contact: Sherwin Smith
sherwin.smith@tn.gov

Targeted Brownfield Assessment Grants (TBA)

The TBA program is designed to help states, tribes, and municipalities especially those without EPA Brownfields Assessment Pilots/Grants minimize the uncertainties of contamination often associated with brownfields. No projected grant cycles at this time.

Training, Research & Technical Assistance Grants

Training, Research, and Technical Assistance Grants provide funding to eligible organizations to provide training, research, and technical assistance to facilitate brownfield revitalization. No projected grant cycles at this time.

Waste Tire Cleanup Grants

The waste tire cleanup grant is designed to assist local governments in the cleanup of un-permitted waste tire sites. Eligibility for this grant is determined by priority as established by the 8 Environmental Field Offices. Each grant cycle, 2 sites from each field office are invited to compete for funds to assist in the cleanup of these un-permitted waste tire sites. Lien on property is required equal to cleanup costs.

Watershed and Protection Strategy (WRAPS)

WRAPS offers a framework that engages citizens and other stakeholders in a teamwork environment aimed at protecting and restoring Tennessee watersheds. The WRAPS framework consists of identifying watershed restoration and protection needs, establishing watershed goals, creating plans to achieve established goals, and implementing plans. Each watershed served by a WRAPS team completing the program framework is eligible for WRAPS grant funding. The WRAPS funds are administered by the Tennessee Department of Health and Environment in collaboration with an interagency work group that consists of representatives from a number of state and federal agencies.

5.2.8 – Tennessee Department of Finance & Administration – Office of Information Resources & Geographic Information Services

In conjunction with the Tennessee Emergency Communications Board, OIR GIS Services helps to create, maintain, and sustain a statewide GIS dataset to support implementation of Next Generation 911 (NG911). Using the core GIS data developed through the initial production efforts of the Tennessee Base Mapping Program, local authoritative GIS data, and enhancements that were made through a contract with TeleAtlas, the Tennessee Information for Public Safety GIS dataset is being implemented throughout all 100 emergency communication districts. Having a statewide standardized GIS dataset for street centerlines, address points, and ESN boundaries is essential for NG911 implementation.

LiDAR Business Plan

As part of the National States Geographic Information Council's (NSGIC) "50 States Initiative," OIR GIS Services has been awarded a grant by the Federal Geographic Data Committee (FGDC). The intent of this project is to develop a business plan in support of developing an enhanced elevation dataset for the State of Tennessee. The project will involve soliciting input through contractor led regional meetings throughout the state. The final product will be a written business plan that identifies the requirements, costs, and products necessary for building a statewide high resolution elevation dataset. OIR GIS Services will use the information provided in the business plan to educate the Information Systems Council on the significance and benefits of this data with the intent to obtain funding to support the data acquisition efforts.

Agency Contact: Dennis Pedersen
dennis.pedersen@tn.gov

TNMap Portal

Through the TNMap portal, OIR GIS Services is hosting a variety of geospatial content that can be consumed through ArcGIS, mobile devices, and custom web GIS applications by all Tennessee state agencies and groups.

Agency Contact: Dennis Pedersen
dennis.pedersen@tn.gov

5.2.9 – Tennessee Department of Health

Bioterrorism Preparedness and Response

The CDC has assumed responsibility for the national effort for preparedness related to biological hazards, and has funded the State of Tennessee's Bioterrorism Preparedness Program with federal grant funding. This preparedness effort is focused on potential terrorism agents such as anthrax and small pox, but these efforts are also mitigating the potential effects of naturally occurring diseases such as West Nile Virus, Influenza, and the Avian Flu. This program supports the development and funding of regional plans to purchase training, equipment, and supplies that enhance preparedness to respond to disease outbreaks involving 500 or more citizens.

Agency Contact: Greg Galfano
greg.galfano@tn.gov

Countermeasures Response Network (TNCRN)

The TNCRN is collaboration among the Emergency Preparedness Program, emergency managers, emergency responders, health care providers, pharmacies, and private entities. This web-based system assists the health community in making fast, well-informed decisions during public health emergencies. Before, during, and after an emergency, TNCRN allows emergency managers and planners to manage patient flow, medication allocation and dispensing, and other resources.

Agency Contact: N/A

Disaster Support Network (TDSN)

The Tennessee Disaster Support Network is a web-based resource to assist Tennessee communities in meeting their needs before, during, and after a disaster. While the Tennessee Department of Health is working to ensure that all Tennessee citizens are prepared to respond to a wide range of emergencies, there is evidence that individuals with special needs may be disproportionately affected by a disaster. To close this gap, the TDSN was designed to specifically reach out to populations that have unique needs, as well as the agencies that serve them.

Agency Contact: N/A
ep.response@tn.gov

Division of Communicable and Environmental Diseases and Emergency Preparedness (CEDEP)

The Division of Communicable and Environmental Diseases and Emergency Preparedness works to discover and eliminate the threat of communicable diseases and to educate people how to protect themselves from illnesses. They also conduct surveillance activities in order to monitor new emerging infections or identify clusters of cases that could be related. Investigations are conducted to pinpoint the source of disease to prevent dangerous outbreaks.

The division is also responsible for developing plans for the Tennessee Department of Health to protect the health of residents and visitors from the effects of man-made and naturally occurring events. The EP program coordinates with federal, state, and regional partner agencies such as the CDC, the Tennessee Emergency Management Agency and local health departments to identify resource and planning needs.

Agency Contact: Greg Galfano
greg.galfano@tn.gov

Emergency Medical Awareness, Response and Resources (TEMARR)
These systems ensure secure electronic data exchange among public health partners' computer systems. These systems include the Tennessee Health Alert Network, the Healthcare Resource Tracking System, the Tennessee Volunteer Mobilizer, and the Tennessee Countermeasure Response Network. 8 Regional Medical Communication Centers serve as a statewide medical communication system.

Agency Contact: N/A

Emergency Medical Services, Disaster Planning and Operations
The EMS Division has an important role in state government disaster planning and operations. The division's responsibilities are delineated in the Tennessee Emergency Management Plan, which is developed by the Tennessee Emergency Management Agency.
EMS Division responsibilities include:

- Developing casualty reports. When deaths or injuries occur in a disaster, TEMA tasks EMS with the responsibility of verifying deaths and injuries, determining where patients were transported and by what means. Official state casualty reports are produced by EMS Division staff.
- Health care facility damage assessment and assistance. EMS staff provides initial damage assessment and help to any health care facility damaged or disabled in a disaster. This includes reporting to TEMA and the Division of Health Care Facilities.
- Assistance to county EMS agencies. When a mass casualty incident occurs, regional EMS staff can assist local ambulance services manage the consequences. This includes contacting other services for help, identifying staging areas for responding ambulances and distributing patients to hospitals within the region. The emergency evacuation of health care facilities is part of this responsibility.
- Participation in disaster meetings, planning development workshops, training sessions and exercises. The division regularly participates in TEMA coordinated planning sessions and exercises, which include TVA nuclear plants, the Oak Ridge/Dept. of Energy facilities and earthquake exercises.
- To ensure that these emergency management responsibilities can be carried out rapidly, EMS Division management and all regional staff are on call 24 hours a day, 7 days a week.

Agency Contact: Donna Tidwell
donna.g.tidwell@state.tn.us

Emerging Infections Program (EIP)
The Emerging Infections Program is a population-based network including the Centers for Disease Control and Prevention and state health departments, working with collaborators (academic centers, local health departments, infection control practitioners, and other federal agencies) to assess the public health impact of emerging infections and to evaluate methods for their prevention and control. Currently, the EIP Network consists of 10 sites: California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee.

The EIP is a collaborative effort of the Communicable and Environmental Disease Services section of the Tennessee Department of Health, the Vanderbilt University School of Medicine Department of Preventive Medicine, and the Centers for Disease Control and Prevention. The core activity of the EIP is active surveillance of laboratory-confirmed cases of reportable pathogens. Laboratory directors and staff, physicians, nurses, infection control practitioners, and medical records personnel are key participants in EIP. Components of the EIP in Tennessee investigate foodborne infections, invasive bacterial infections, and human papillomavirus.

Agency Contact: Greg Galfano
greg.galfano@tn.gov

Emergency Preparedness Program, Strategic National Stockpile
In 1999 Congress charged the Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC) with the establishment of the National Pharmaceutical Stockpile. The mission was to provide a re-supply of large quantities of essential medical material to states and communities during an emergency within 12 hours of the federal decision to deploy. The Emergency Preparedness program distributes medicine and medical supplies in the event of a disaster. These items often come from the Strategic National Stockpile, a supply of emergency items. The SNS supplies antibiotics, vaccines, antitoxins, chemical antidotes and medical/surgical items. SNS materials are designed to supplement and re-supply state and local public health resources, as well as other health care agencies in the event of a national emergency. The Tennessee program continues to receive high ratings from the CDC for its level of preparedness to receive the stockpile during an act of bioterrorism or a mass casualty event.

Agency Contact: Paul Peterson, Program Coordinator
paul.peterson@tn.gov

Health Alert Network (TNHAN)
The TNHAN is a secure, web based site, consisting of 2 redundant systems, co-located at 2 different sites. The system is administrated and utilized both statewide and locally in the 13 public health regions. There are currently 3,000 professionals from police, fire, hospital, public health, and other emergency response agencies, that are maintained in specific roles, within the TNHAN system. These responders can be alerted through multiple media methods in the event of an emergency and their response can be tracked. The system is also used as a document repository for the purpose of storing information pertaining to specific events.

Agency Contact: N/A

Healthcare Resource Tracking System (HRTS)
HRTS is a secure website used by Tennessee healthcare facilities and emergency managers to direct ill or injured patients to appropriate healthcare facilities in the event of an emergency or disaster. HRTS allows healthcare facilities to record and continually update their current availability of beds, specialty services, and resources providing statewide awareness for emergency managers.

Agency Contact: N/A

Hospital Preparedness
The Tennessee Hospital Association serves as an advocate for hospitals, health systems, and other healthcare organizations and the patients they serve. It also provides education and information for its members, and informs the public about hospitals and healthcare issues at the state and national levels. This association is now involved in a variety of disaster preparedness initiatives especially relating to biological hazards but also related to delivering mass care during large scale natural events.

Agency Contact: Donna Tidwell
donna.g.tidwell@state.tn.us

Medical Reserve Corps (MRC)

This MRC program is established in each of the state's 4 major metropolitan areas. The MRC is designed as a volunteer pool of active and retired health care professionals (physicians, pharmacists, veterinarians, and others) ready to support and augment workforce capabilities during large-scale local emergencies. The Medical Reserve Corps program also works to promote community public health. The MRC serves as the department's volunteer organization. Regional MRC units recruit and train medical and general volunteers to support the Tennessee Department of Health, hospitals, and medical care providers in a public health emergency.

> ***Agency Contact:*** Sonda Finley, MRC Coordinator
> sonda.finley@tn.gov

Volunteer Mobilizer (TNVM)

The TNVM provides the Emergency Preparedness program the capability to alert volunteers and public health staff via automated e-mail, phone, pager, or text message notification. Registered users can edit profile information, upload and maintain training records, access shared calendars, and view posted messages. The system allows for simplified registration for health professionals through an automated process linked to state and national licensure agencies. By registering with the site, individuals can be part of an alert system and respond, when activated, to a significant disaster or public health emergency. The site generally serves to improve volunteer coordination during an emergency.

> ***Agency Contact:*** N/A
> vm.mrcadmin@tn.gov

Tennessee Department of Human Services – Technology Access Program

The Tennessee Technology Access Program (TTAP) is a statewide program designed to increase access to, and acquisition of, assistive technology devices and services. Through its 4 core programs: Funding Assistance, Device Demonstration, Device Loan, and Device Reutilization, TTAP and a network of 5 assistive technology centers help people with disabilities and their families find and get the tools that they need to live independent, productive lives where and how they choose. Each of TTAP's core programs is designed to both maximize limited resources and improve the understanding of, and to gain better access to, assistive technology devices and services. TTAP provides funding to 5 regional assistive technology centers across Tennessee. The centers provide training, evaluation, minority outreach and advocacy services. The staff at each of the centers works closely with businesses, school systems, vocational rehabilitation and the medical community to increase the independence and productivity of persons with disabilities through the use of assistive technology devices and services.

> ***Agency Contact:*** Kevin Wright, Executive Director
> tn.ttap@tn.gov

5.2.10 – Tennessee Department of Transportation (TDOT)

Maintenance Division – Office of Emergency Operations
TDOT's Office of Emergency Operations is responsible for TDOT's emergency preparedness program (Including planning, training, and exercises) and for coordinating TDOT's statewide emergency response activities. TDOT's Office of Emergency Operations is equipped with a primary ESC and alternate ESC's. The departmental ESC's coordinate responses to incidents which may include earthquakes, floods, tornados, nuclear reactor emergencies, hazardous material spills, and any other situations that the Tennessee Emergency Management Association may request assistance from TDOT to provide traffic control, manpower, or equipment. TDOT's primary ESC is embedded at the TEMA complex. The ESC's primary duty is to coordinate field personnel during emergencies that require the department's resources.

> ***Agency Contact:*** Derial Bivens, Operations Specialist
> derail.bivens@tn.gov

Environmental Division, Natural Resources Office - ***Wetland Mitigation and Wetland Banking Program***
The Tennessee Department of Transportation replaces unavoidable wetland impacts through a process referred to as compensatory mitigation, whereby wetlands that are impacted through permitted activities are replaced by restoration or enhancement of a wetland site. Compensatory mitigation typically occurs in advance of or concurrent with the impact and may be comprised of on-site mitigation, off-site mitigation or a combination of the two. On-site mitigation attempts to replace the wetlands functional capacity lost as a result of the highway project on the same site or in the immediate vicinity of the impacts; however, on-site mitigation is not always possible due to lack of suitable restoration sites. If mitigation cannot be accomplished on-site, the impact may be mitigated off-site at a mitigation site or a formal mitigation bank, pending approval by the regulatory agencies and/or Mitigation Banking Review Team. The mitigation sites and mitigation banks are typically larger former wetland sites that have been restored with the purpose of being used to offset wetland losses from multiple projects. Currently, TDOT uses 7 mitigation sites/banks, which are located throughout the state.

> ***Agency Contact:*** Mike Williams, Supervisor
> mike.williams@tn.gov

Federal Transportation Enhancement Program for Tennessee Roadways
These funds are used for a variety of safety, functional mitigation, hazard reduction and aesthetic enhancement to local, state and federal roadways. A 20% non-federal share of the proposed project must now be provided by the local agency as a hard cash match. The option of providing these funds as a soft (in-kind) match through the use of the value of preliminary engineering services, donated land, or materials and equipment is no longer available.

> ***Award Range:*** The number varies from year to year. For 2012, the total was: $12,075,017.

5.2.11 – Tennessee Emergency Management Agency (TEMA)

The Tennessee Code Annotated (TCA 58-2-104) established the Tennessee Emergency Management Agency and its authority to develop, plan, analyze, conduct, provide, implement, and maintain programs for disaster mitigation, preparedness, response, and recovery. Furthermore, the Tennessee Code Annotated restates the TEMA mandate to prepare the State of Tennessee to deal with disasters, preserve the lives and property of the people of the state, and protect the public peace, health, and safety in the event of a disaster.

Emergency Management Performance Grant (EMPG)

The EMPG is designed to sustain and improve state and local emergency management programs from all-hazard events through mitigation, preparedness, response, and recovery activities. In Tennessee, a large amount of this funding helps pay for state and local emergency management staff salaries.

> ***Award Range:*** Varies; the amount awarded to each county is based on population and other factors. This grant requires a 50%, non-federal match.
>
> ***Agency Contact:*** Jill Tokarsky, EMPG Program Manager
> jtokarsky@tnema.org

Flood Mitigation Assistance Program (FMA)

FMA was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. It provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. Annual program funding of $20 million, nationally, is provided through the National Flood Insurance Fund. Please see Appendix C for more information on the FMA program in Tennessee.

> ***Award Range:*** NFIRA limits the amount of project funding under FMA any 1 state or community can receive in a 5 year period. The combined total of the grants for projects and technical assistance awarded to any state is $20 million. This grant has a match ratio of 75% federal share and 25% local share.
>
> ***Agency Contact:*** Doug Worden, State Hazard Mitigation Officer
> dworden@tnema.org

Hazard Mitigation Grant Program (HMGP)

HMPG was created in November 1988 by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288 as amended by Public Law 100-707, Public Law 103-181, the Hazard Mitigation and Relocation Assistance Act (1993), and Public Law 106-390, and Disaster Mitigation Act of 2000. The purpose of the program is to reduce the (long-term) loss of life and property due to natural disasters and enable mitigation measures to be implemented during the immediate recovery from a disaster declaration. (See 44 CFR Part 206 Subpart N for guidance and implementation). Please see Appendix C for more information on the HMGP program in Tennessee.

> ***Award Range:*** HMGP funding is allocated on a sliding scale with 15% of the first $2 billion of estimated aggregated amount of disaster assistance in a presidentially declared disaster. This grant has a match ratio of 75% federal share and 25% local share.
>
> ***Agency Contact:*** Doug Worden, State Hazard Mitigation Officer
> dworden@tnema.org

Hazardous Materials Emergency Preparedness Grant (HMEP)

The HMEP grant program provides financial and technical assistance to first responders in state and local governments as well as national direction and guidance toward hazardous materials emergency planning and training. TEMA uses this funding to train state & local government first responders for hazardous material incidents and to provide planning assistance to local emergency planning committees (LEPC). The requirements for the use of funds are contained in the federal guidance that is provided each year for that fiscal year's program. Also additional eligibility is determined by the regional director for TEMA for each participating county.

Award Range: Approximately $550,000 annually.

Contact: Andy Rose, HMEP Program Manager
arose@tnema.org

National Earthquake Hazards Reduction Program (NEHRP)

The NEHRP was established by the U.S. Congress when it passed the Earthquake Hazards Reduction Act of 1977, Public Law (PL) 95–124. At the time of its creation, Congress' stated purpose for NEHRP was "to reduce the risks of life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program." In establishing NEHRP, Congress recognized that earthquake-related losses could be reduced through improved design and construction methods and practices, land use controls and redevelopment, prediction techniques and early-warning systems, coordinated emergency preparedness plans, and public education and involvement programs.

Award Range: For 2012-14, this program allocates $109,725 for the State of Tennessee. The NEHP also requires a 50% state match.

Agency Contact: Cecil Whaley, Director of Natural Hazards
cwhaley@tnema.org

Oak Ridge Contract

This contract is used for offsite monitoring and planning for jurisdictions and personnel around the DOE Oak Ridge Reservation. This contract assists local and state personnel to facilitate training and exercise programs for offsite events.

Award Range: Annual contract approximately $970,000.

Contact: Sean Kice, Radiation Protection Officer
skice@tnema.org

Pre-Disaster Mitigation Grant Program (PDM)

PDM was established through the Disaster Mitigation Act of 2000, Public Law 106-390. It provides technical and financial assistance to states and local governments for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program, and reduce injuries, loss of life, and damage and destruction of property. The program focuses primarily on mitigation planning and projects and will follow many of the guidelines of the Hazard Mitigation Grant Program. Please see Appendix C for more information on the PDM program in Tennessee.

> ***Award Range:*** PDM Grants are awarded on a competitive basis and are allocated year to year by Congress with any 1 project not to exceed $3,000,000 federal share. This grant has a match ratio of 75% federal share and 25% local share. This grant program is available to state and local governments, and Native American tribes.
>
> ***Contact:*** Doug Worden, State Hazard Mitigation Officer
> dworden@tnema.org

Public Assistance Program

FEMA's Public Assistance is a federal grant program designed to fund the repair, restoration, reconstruction or replacement of eligible public facilities and infrastructure damaged or destroyed in a disaster. Assistance is provided to states, communities, and certain private non-profit organizations to help them respond to and recover from disasters as quickly as possible.

> ***Award Range:*** Depending on size of disaster declaration, a 75% federal and 25% Local match for funding.
>
> ***Agency Contact:*** Mary Lynn Gillingham, State Public Assistance Officer
> mgillingham@tnema.org

Repetitive Flood Claims Grant Program (RFC)

RFC was authorized in Section 1323 of the National Flood Insurance Act of 1968, as amended by the Flood Insurance Reform Act of 2004 (FIRA 2004). The program provides funding to reduce or eliminate long-term risk of flood damage to structures that are insured under the National Flood Insurance Program and have had 1 or more claim payment(s) for flood damages. RFC funds may only be used to mitigate structures located within a state or community that is participating in the NFIP and cannot meet the requirements of the Flood Mitigation Assistance program due to lack of cost share or lack of capacity to manage the activities. The long-term goal of the RFC Program is to reduce or eliminate multiple claims for a single property insured under the NFIP through mitigation measures deemed in the best interest of the National Flood Insurance Fund.

> ***Agency Contact:*** Doug Worden, State Hazard Mitigation Officer
> dworden@tnema.org

Severe Repetitive Loss Grant Program (RL/SRL)

The RL/SRL program was authorized by the National Flood Insurance Act of 1968 as amended by the Flood Insurance Reform Act of 2004 (FIRA 2004). The program provides funding to reduce or eliminate long-term flood risks to severe repetitive loss properties insured under the National Flood Insurance Program. As defined in Section 1361A of the National Flood Insurance Act, as amended, 42 U.S.C. 4102, a severe repetitive loss property must be a residential property currently insured under the National Flood Insurance Program. It must have incurred flood losses that resulted in either: (1) 4 or more flood insurance claims payments (building and contents) that each exceeded $5000.00 each and the cumulative amount of such claims payments exceeding $20,000.00, or (2) at least 2 separate flood insurance claims payments (building and contents) with the cumulative amount of the building portion of such claims exceeding the market value of the building. In either case, at least 2 of the referenced claims must have occurred within any 10 year period and be greater than 10 days apart.

Agency Contact: Doug Worden, State Hazard Mitigation Officer
dworden@tnema.org

Southern States Energy Board

This contract centers around radiological transportation. Funding pays for staffing and equipment focused around radiological monitoring devices and material escorting. Planning and exercise services are also funded by this contract.

Award Range: Varies depending on selected activities

Agency Contact: Sean Kice, Radiation Protection Officer
skice@tnema.org

State Homeland Security Grant Program

This grant is specifically designed to address the homeland security and response capabilities in Tennessee by providing specific equipment and training to first responders and state agencies based on the needs, vulnerabilities and population of each county, along with other program priorities and authorizations. Eligibility includes all counties participating in the needs assessment. The deadlines are based on each grant timeframe. Counties receiving funding must participate within the strict guidelines of the grant program, including providing mutual aid to surrounding counties, completing a terrorism annex to their Emergency Operations Plan (EOP) and holding an annual terrorism exercise. Equipment purchased through the grant will be tracked by the local jurisdiction and reported to TEMA for 3 years after the close of the grant. The HSGP is a disaster preparedness grant program. The State of Tennessee is divided into 11 state homeland districts.

Award Range: Based upon assessment of needs, vulnerabilities and population of each county, along with other program priorities/ authorizations.

Agency Contact: Gary Baker, Homeland Security Manager
gbaker@tnema.org

Tennessee Valley Authority Contract

The contract is used for offsite monitoring and planning for jurisdictions and personnel around TVA locations. This contract facilitates local and state personnel to facilitate training and exercise programs for stakeholders located around TVA facilities including Watts Bar, Watts Bar and Browns Ferry Nuclear Plants in accordance with federal statutory and regulatory requirements, and Nuclear Regulatory Commission and Federal Emergency Management Agency guidance.

Agency Contact: Gary Lima
glima@tnema.org

5.2.12 – Tennessee Housing & Development Agency

Emergency Repair Program

The Tennessee Housing Development Agency has created a statewide Emergency Repair fund for the elderly. The program provides grants to low income, elderly homeowners who are 60 years or older to correct, repair, or replace an essential system and/or a critical structural problem. The purpose of the program is to stabilize the elderly homeowner's residence by making rapid, essential repairs to make the home livable. The Emergency Repair Program is administered through Tennessee's 9 development districts to help ensure that the program is available state-wide.

Agency Contact: Coralee Holloway, Director of Community Programs
coralee.holloway@tn.gov

Housing Locator Assistance for Displaced Individuals

TNHousingSearch.org is a housing locator service, launched across the State of Tennessee in April 2008. Sponsored by the Tennessee Housing Development Agency, TNHousingSearch.org provides detailed information about rental properties and helps people find housing to best fit their needs. The service can be accessed at no cost online 24 hours a day or through a toll-free, bilingual call center. To help displaced residents find housing quickly, the Tennessee Housing Development Agency urges all property providers to list available rental housing on the free, statewide housing locater service www.TNHousingSearch.org.

Award Range: The amount available is $6.6 million, which consists of $3.15 million in FY 2012 THDA funds, $3.15 million in FY 2013 THDA funds, and $300,000 recaptured from 2007 Competitive Grants.

Agency Contact: N/A
info@socialservce.com

Weatherization Assistance Program

The Weatherization Assistance Program is designed to assist low-income households in reducing their fuel costs while contributing to national energy conservation through increased energy efficiency and consumer education. Households that include young children, elderly, or disabled members are given priority for service. Weatherization measures provided will reduce heat loss and energy costs by improving the thermal efficiency of dwelling units occupied by low-income households. Examples of common weatherization measures that may be provided are weather stripping, caulking, and adding of insulation to attics, walls, and floors. The Weatherization Assistance Program is administered and funded at the federal level by the U.S. Department of Energy.

Agency Contact: Coralee Holloway, Director of Community Programs
coralee.holloway@tn.gov

5.2.13 – Tennessee Regulatory Authority – Gas Pipeline Safety Division (TRA GPSD)

The mission of the Tennessee Regulatory Authority's (TRA) Gas Pipeline Safety Division (GPSD) is to contribute to the safety and reliability of intrastate natural gas distribution and transmission pipeline facilities by conducting pipeline safety inspections across the state. It is the goal of the staff to minimize the risk to public health and safety as a result of the unintended release of natural gas from a pipeline. Public health and safety also depends on maintaining the flow of natural gas as a source of energy necessary to sustain domestic, commercial and industrial activities. In support of this effort, pipeline safety inspections by the TRA's GPSD promote pipeline integrity and reliability. The GPSD inspections promote underground utility damage prevention and public awareness of gas pipeline safety issues.

Agency Contact: Larry Borum, Division Chief
larry.borum@tn.gov

5.2.14 – Tennessee Valley Authority

The Tennessee Valley Authority (TVA) is a federal corporation and the nation's largest public power company. Although not a state agency or program, it has had and continues to have such a vast impact on Tennessee, its water bodies and watersheds that it must be included in this list of Tennessee's available mitigation resources. Created in May 1933, TVA's jurisdiction covers most of Tennessee. It is a geopolitical entity with a territory the size of a major state, and with some state powers (such as eminent domain), but unlike a state it has no citizenry or elected officials. It was the first large regional planning agency of the federal government and remains the largest.

TVA's responsibility to provide flood control and thus reduce flood risk in the Tennessee Valley is outlined in the Tennessee Valley Authority Act. It provides the legal foundation for the policies that guide the operation of TVA's dams and reservoirs today, requiring that the reservoir systems be operated primarily to promote navigation and flood control. TVA works closely with FEMA and local governments responsible for administration of NFIP requirements to guide sound floodplain development below TVA projects, provide assistance with identification to areas within the Tennessee Valley that are prone to flooding, provide information on flood risks, and advise communities on appropriate steps needed to ensure consistency with the NFIP.

Tennessee Valley Authority activities include: emergency preparedness, mitigation, response, and recovery programs; development of agency plans, exercises, and training; support of state and local preparedness and evacuation planning efforts; and interagency planning and coordination. TVA also is involved in the evaluation, design, and construction of specific projects to mitigate flood threats. The TVA: updates hazard models; develops design standards and guides; evaluates risks due to natural hazards; modifies and strengthens existing dam structures and designs and; constructs new facilities to withstand threats from natural hazards. In conjunction with regional power distributors, TVA works to reduce losses from earthquakes, severe weather, and fire. The agency also manages a seismic safety program to implement seismic design standards and federal mandates, and it conducts research to assess seismic hazards at its facilities. TVA supports federal disaster response and recovery efforts with technical engineering and specialized support, as required, and supports major wildland firefighting with trained firefighters.

Agency Contact: N/A
tvainfo@tva.com

5.2.15 – Tennessee Wildlife Resources Agency

Farm Wildlife Habitat Program (FWHP)

TWRA's GIS Habitat Program is a modestly funded cost-share program intended to complement the major conservation programs available through the U.S. Department of Agriculture. The program is used for qualified projects on lands not eligible for USDA funding, practices that complement existing habitat conversions already under a USDA contract, or assist a landowner to begin implementing habitat projects in a timely manner when USDA funds are not available.

Under an approved plan written by a TWRA Private Lands Biologist, the program provides 75% cost share reimbursement at a maximum of $2,000 in any state fiscal year to implement prescribed habitat practices intended to restore and manage native habitats. Upon approval of a FWHP plan that includes at least 5 acres of habitat practices, the landowner signs the contract agreeing to protect the improved habitat for 5 years. After the practices are implemented, the landowner is reimbursed at the specified practice rates based on 75% of established state average practice costs. Applicants are considered on a first-come, first-served basis.

Agency Contact: N/A

Stream Mitigation Program (TSMP)

The TSMP was created to serve as 1 alternative for providing compensatory mitigation to offset unavoidable stream impacts permitted through Sections 404 and 401 of the Clean Water Act. The TSMP uses the principles of natural channel design and process-based methodologies to identify and develop stream restoration projects statewide. The program uses a watershed approach to complete large-scale restoration projects. Working with private landowners, other non-profit organizations, municipalities as well as state and federal agencies, the TSMP funds projects on significantly degraded streams to arrest bank erosion, improve water quality and restore aquatic and riparian habitat. With permission and cooperation from participating landowners, the TSMP designs and implements mitigation projects that benefit both the stream and the landowner. All TSMP projects are constructed at no cost to the landowner. Mitigation projects are monitored for success over a period of 2 to 5 years and must be protected by a perpetual land preservation agreement held by the Tennessee Wildlife Resources Foundation.

Agency Contact: N/A

5.2.16 – State Agencies' & Departments' Technical Capabilities

Table 105 – State Agencies' & Departments' Technical Capabilities, Part 1

State Agency or Department	Agriculture Data Gathering/ Analysis	Demographic Data Gathering/ Analysis	Economic Analyses	Energy Resource Regulation	Environmental Data Gathering/ Analysis	GIS Data Management	Historical/ Cultural Resource Analyses	Natural Resource Management	Risk Analysis	State Property Information and Management
Adjutant General's Department		X	X		X	X			X	X
Tennessee Emergency Management Agency	X	X	X		X	X	X	X	X	
Department of Agriculture: APHIS	X	X	X		X	X		X	X	
Tennessee Corporation Commission			X			X			X	
Department of Education Facilities Management		X	X			X				X
TDEC: Division of Water Resources	X		X	X	X	X		X	X	
Department of Commerce		X	X			X				X
Department of Environment and Conservation	X	X	X	X	X	X		X	X	X
Tennessee Department of Health CEDEP	X	X	X		X	X			X	X
Department of Labor		X	X							X
Department of Transportation		X			X	X			X	
Tennessee Forestry Division	X			X	X	X		X	X	
Tennessee Geological Survey	X	X		X	X	X				X
Tennessee Highway Patrol		X				X			X	X
Tennessee State Fire Marshal 's Office					X				X	X
Tennessee State Historical Society						X	X			
Tennessee Cooperative University Extension Service		X	X		X	X		X	X	
State Conservation Commission			X				X	X		X

**This assessment is based on an interpretation of the each organization's capabilities and does not necessarily reflect an organization's legal responsibility, legal authority, or proven ability.*

Table 106 – State Agencies' & Departments' Technical Capabilities, Part 2

Agency or Department	Audits/Code Enforcement	Information Management	Inspection	Project Engineering/ Design	Project Funding	Project Operations/ Maintenance	Project Permitting/ Licensing	State Water Planning	Grants and Loans	Regulatory Guidance/ Control	Technical Support	Training and Education
Adjutant General's Department	X	X	X	X		X					X	X
Tennessee Emergency Management Agency		X			X	X	X		X		X	X
Department of Agriculture: APHIS		X	X		X	X	X				X	X
Tennessee Corporation Commission	X	X	X			X	X			X		X
Department of Education Facilities Management			X	X	X	X		X		X		X
TDEC: Division of Water Resources	X			X		X	X	X		X	X	
Department of Commerce	X								X		X	X
Department of Environment and Conservation			X	X			X			X	X	X
Tennessee Department of Health CEDEP		X			X				X	X	X	X
Department of Labor	X	X	X							X	X	
Department of Transportation		X										
Tennessee Forestry Division			X								X	
Tennessee Geological Survey		X	X	X	X	X	X				X	X
Tennessee Highway Patrol			X						X		X	X
Tennessee State Fire Marshal 's Office									X		X	X
Tennessee State Historical Society	X		X	X	X				X	X	X	X
Tennessee Cooperative University Extension Service	X		X		X				X		X	X
State Conservation Commission									X			X

**This assessment is based on an interpretation of the each organization's capabilities and does not necessarily reflect an organization's legal responsibility, legal authority, or proven ability.*

5.2.17 – Legal Statutes and Regulations

The State of Tennessee has enacted various laws, acts, and statutes establishing mitigation measures. The table below details the Tennessee's legal efforts to protect its people and property.

Table 107 – Legal Statutes & Regulations, Tennessee

Statute/Regulation	Hazard/s Addressed	Description
Safe Dams Act of 1973, T.C.A. §69-11-101	Dam Failure	The Tennessee Department of Environment and Conservation has been charged for over 40 years with the responsibility for regulating the construction, alteration, and operation of all dams in the state. A certificate of approval of safety issued by TDEC is a requirement of the operation of any dam and the certificates may be revoked if a dam fails an inspection by the TDEC. The act also preempts any local dam regulation.
T.C.A. §13-7-101	All-Hazards	Grants county governments the authority to adopt zoning and building regulations, as well as to establish special districts in areas subject to flooding.
T.C.A. §13-7-201	All-Hazards	Grants municipal governments the same broad authority given to counties to adopt zoning and building regulations, including creating special districts or zones in flood prone areas.
T.C.A. §13-3-101	All-Hazards	The state is authorized to establish regional planning commissions the main purpose of which is to foster communication and cooperation among the various local planning commissions and agencies.
T.C.A. §64-1-101, et seq.	Floods	Tennessee has authorized and created numerous river basin development authorities to regulate development and flood control on various rivers within the state and these authorities are to cooperate with the soil conservations commissions affected by the river basin.
T.C.A. §64-3-101	Floods	Provides for broad flood control authority as a public purpose and specifically creates the Mill Creek watershed flood control authority in Davidson, Williamson, and Rutherford Counties.
T.C.A. §6-58-117	Floods	Requires any county with a special flood hazard area to meet all the requirements of the National Flood Insurance Program.
T.C.A. §68-221-1103	Floods, Flash Floods	Provides municipalities with broad authority to construct, enlarge, or acquire storm water or flood control improvements within its boundaries.
Watershed District Act, T.C. A. §69-6-101	Floods	Passed in 1955, this act establishes watershed districts and outlines how they will be established and operate. One of the main purposes of the watershed districts is to conserve soil and water and to retard floods and develop the water resources of the district.
T.C.A.§69-5-101	Floods, Flash Floods	Provides any county court with the authority to establish a levee or drainage district within its boundaries that has the power and discretion to alter the course, direction, width, or depth of any natural watercourse in the county.
Tennessee Water Resources Information Act, T.C.A. §69-7-301	Droughts	Provides a regulatory system for the use of surface and ground water which requires a permit for withdrawals greater than 10,000 gallons. The Commissioner of the Tennessee Department of Environment and Conservation is assisted in setting water use policies by a Technical Advisory Committee.

Statute/Regulation	Hazard/s Addressed	Description
T.C.A. §68-102-112	Wildfires	Establishes the Office of the State Fire Marshal and outline its duties as well as the role the state will play in fire prevention, safety, and investigation.
T.C.A. §5-6-121 & §6-21-704	Wildfires	Provides the authority for the appointment of a fire marshal by a county and city government, respectively. Subject to the authority of the local fire chief, their main role is fire prevention and investigation.
T.C.A. §43-3-201	Communicable Diseases	The Department of Agriculture and its commissioner are given broad authority to promote agricultural endeavors and to protect the agricultural industry and Tennessee citizens from plant pests and livestock diseases. This includes the appointment of a state veterinarian who is responsible for inspecting and monitoring animal health.
State Apiary Act of 1995, T.C.A. §45-15-101	Communicable Diseases	Specifically provides for the appointment of a state apiarist and the development of regulations to protect the state's honeybee industry from diseases, pests, and other threats.
Tennessee Emergency Management Act, T.C.A. §58-2-101	All-Hazards	Creates Tennessee Emergency Management Agency under the direction of the Adjutant General who shall recommend the appointment of a Director and Deputy Directors. The act outlines the emergency management responsibilities and capabilities of TEMA and gives the governor the power to declare a state of disaster emergency and direct emergency operations. Directs TEMA to formulate a statewide emergency plan and outlines the duties of the agency. Requires counties to establish and maintain a disaster agency responsible for emergency management, prepare a county emergency response plan, and coordinate efforts with TEMA.
Tennessee Emergency Management Act, T.C.A. §58-2-116	All-Hazards	In addition to prevention measures included in the state and local comprehensive emergency management plans, the governor shall consider, on a continuing basis, steps that could be taken to mitigate the harmful consequences of emergencies. At the governor's direction, state agencies, including, but not limited to, those charged with responsibilities in connection with flood plain management, stream encroachment and flow regulation, weather modification, fire prevention and control, air quality, public works, land use and land use planning, and construction standards, shall make studies of emergency mitigation-related matters. The governor, from time to time, shall make such recommendations to the general assembly, local governments, and other appropriate public and private entities as may facilitate measures for mitigation of the harmful consequences of emergencies.
Emergency Planning and Community Right-to Know Act, T.C.A. §58-2-110 & Executive Order 15-98	Hazardous Materials Release	Establishes the state emergency response commission within TEMA and authorizes local emergency planning committees to collect fees. The Executive Order further provides the SERC with the authority to provide assistance in the coordination of state agency activities relating to chemical emergency training, preparedness, and response, as well as chemical release reporting and prevention. The SERC also has the authority to oversee the transportation, manufacture, storage, handling, and use of hazardous materials within Tennessee.
Interstate Earthquake Compact , T.C.A. §58-2-701	Earthquakes	Given its location along the eastern flank of the New Madrid fault, Tennessee has joined other states in pledging mutual aid in the event of an earthquake disaster.
T.C.A. §58-9-101	Earthquakes	Creates the West Tennessee Seismic Safety Commission which is charged with developing a state plan of preparation and response to a major earthquake.
Underground Utility Damage Prevention Act, T.C.A. §65-31-101	All-Hazards	Provides conditions and regulations for the prevention of damage to underground utilities. Includes notice provisions, establishes liability provisions, and, in some cases, provides for criminal penalties.

Statute/Regulation	Hazard/s Addressed	Description
T.C.A. §8-1-108	Wildfires	During periods of extreme drought, the governor may forbid by proclamation the starting of any open air fires in or near woodlands. Violation of such a proclamation is a misdemeanor.
T.C.A. §11-4-401	Wildfires	Creates the Tennessee Division of Forestry to promote public forestry programs that protect and conserve Tennessee's woodland resources.
Wastewater Facilities Act of 1987, T.C.A. §68-221-1001	Droughts	Provides requirements and standards for the construction and operation of wastewater facilities for the protection of surface and ground waters.
T.C.A. §4-3-501 & Title 68	All-Hazards	The Tennessee Department of Environment and Conservation is given broad authority to regulate the entire range of environmental hazards. The discharge of air pollutants, solid waste, hazardous waste, storm water, as well as the storage of fuels and other chemicals are all regulated by the TDEC, which regulations provide a range of mitigation effects for all possible hazards.
T.C.A. §69-1-101	Floods	Provides for the protection of navigable waters including penalties for the diversion or obstruction of their course.
T.C.A. §56-7-130	Land Subsidence/Sinkholes	Requires all insurers in the state that offer homeowners insurance to offer coverage for sinkhole losses, including coverage for the loss of personal property
T.C.A. §58-2-108	All-Hazards	Provides that the head of each executive agency and department shall appoint an emergency service coordinator who shall coordinate and communicate with the Tennessee Emergency Management Agency. The ESC shall also insure that each state facility has a TEMA-approved disaster preparedness plan.
T.C.A. §42-6-101	Infrastructure Incidents	Creates a system of zoning around airports to minimize the hazards faced by both aircraft and the persons living near airport facilities.
Tennessee Modular Building Act, T.C.A. §68-126-301	All-Hazards	Establishes building construction and installation standards for modular structures.
T.C.A. §12-4-109	Floods	Mandates the identification of special flood hazard areas and the establishment of the NFIP in Tennessee.

5.3 – Changes in State Capabilities

Since 2010, the State of Tennessee has seen multiple agency resource reallocations.

5.3.1 – Changes in Agency Capabilities

Tennessee Department of Health
One of the most notable additions to the capabilities of the Tennessee Department of Health's Emergency Response system is the development of designated strike teams with the following functions:

Epidemiology - used for outbreak investigations as well as to measure the impact a disaster has had on a community.

Nursing - provide medical care in shelters and other such venues.

Ambulance - 8 teams each comprised of 5 ambulances and 1 supervisor.

Teams in development are Medico and Legal Death Investigation Response Units for mass casualty events and Environmental Health Units for establishing hygienic food and shelter programs after an event. These CASPER joint teams all now have cross listed capabilities for KY, TN, FL, AL and MS.
TDH is also in the process of revising a request to DHS for the reclassification and typing of medical equipment and assets.

All H1N1 funding provided by CDC is allocated separately from other TDH monies. The external task force is in the process of revising H1N1 response standards and vaccination programs, including consolidation of all data in the CDC's BioSense program.

Tennessee Department of Agriculture
Changes to the TDA's capabilities include the loss of DART funding from DHS in 2008 due to congressional cutbacks: supplementary funding now maintains tagging and ID systems for beef, and health certification and surveillance of poultry and swine. Further, the Department of Agriculture receives state funds to oversee mosquito irradiation programs since the rise in West Nile Virus incidents in 2012. Direct surveillance and monies from USDA and Department of Agriculture are used for safe dairy (7 state alliance initiative) and safe egg supply.

Subsequent to the 2007 drought and 2012 heat waves, emergency funding for 60 – 120 days was approved to provide hay imports for farmers suffering from shortages. These funds will remain available for allocation during environmental emergencies going forward. Tom Womak administers the disaster mitigation efforts and period emergency hay supplies and stock piles for drought response.

TDEC

TDEC has experienced no significant funding changes and regulatory oversight responsibilities and capabilities remain largely unchanged. However, the Safe Dam Program purview has been extended with more frequent inspections and oversight. Additionally, a comprehensive water infrastructure survey was commissioned and completed for seismic risk analysis to water resources in West Tennessee.
TDEC oversees a loan program for drinking water projects under the Drinking Water State Revolving Fund.

Funds for this program come from federal capitalization grants and a state match. The program provides funding for the planning, design, and construction of drinking water facilities, with priority given to projects associated with the greatest health risk, existing water problems, and community need. DWSRF provides funding to the following categories of projects: water quality problems, source or capacity, water storage, leakage problems, pressure problems, replacement or rehabilitation projects, and water line extensions. Projects that are not eligible for DWSRF loan funding include dams, reservoirs, purchase of water rights, laboratory fees for monitoring, operation and maintenance expenses, and projects primarily intended for future growth, economic development, and fire protection. The loan program maintains a priority ranking list to determine funding eligibility and the subsequent allocation of DWSRF loans. DWSRF loans are awarded to those projects that have met the DWSRF technical, financial, and administrative requirements, possess the highest priority rank on the Priority Ranking List, and are ready to proceed. However, there is a relatively small amount of loan funding available in comparison to statewide needs.

The State of Tennessee’s allotment for the 2011 DWSRF loan program is expected to be approximately $12,000,000, including the state match of 20%. Additionally, 15% of the available loan funds are set-aside for communities with populations smaller than 10,000. Only 1 of the 60 projects listed in the 2011 Intended Use Plan and Final Priority Ranking List is located within the 21-county area included in this study. An elevated water storage tank project for Sharon Water Works in Weakley County, with a total project cost of $658,300, is the 2nd highest ranked project on the list. All other projects on the list appear to be located within Middle and East Tennessee.

Safe Dams Program Capabilities

The Division of Water Resources’ Safe Dams Program is responsible for conducting inspections, plans reviews, and permitting of dams and reservoir projects as required in the Safe Dams Act of 1973. The purpose of the program is to protect the public from dam failures. All non-federal dam owners are required to have a certificate of approval from the commissioner to construct, alter, remove, or operate a dam. These responsibilities were extended in response to the Harriman Slurry Dam failure of 2007
A dam is defined as a structure at least 20 feet high or holds 30 acre-feet or more of water at maximum pool. Any dam that meets these size requirements and is used exclusively as a farm pond (not used by the public) is not regulated by the division.

Classifications of Dams

Dams are classified by size and Hazard Potential Category (HPC). The size classification is based on dam height or storage volume, whichever is greater, as shown in the following table.

Table 108 – Dam Hazard Potential Categories

Classification	Storage (Acre-Feet)	Height (Feet)
Small	30 - 999	20 - 49
Significant	1,000 - 49,999	50 - 99
Large	50,000 +	100 +

The HPC is determined by the downstream damage that could result if a dam failed, based on the following definitions.

High hazard (HPC-1) dams would probably cause loss of life in the event of failure.
Significant hazard (HPC-2) dams would cause property damage or temporary loss of roads or utilities with a remote chance of loss of life.
Low hazard (HPC-3) dams would have little or no effect downstream if they failed.

Inspections
Dams are inspected every 1, 2, or 3 years by TDEC engineers and staff depending on whether they are high hazard, significant hazard, or low hazard, respectively. Unregulated dams are reviewed every 5 years for changes in ownership and hazard category. When dams are found to be unsafe, engineering plans that detail repairs are required before alteration permits are issued. Dams regulated by the Safe Dams program maintain a compliance rate of over 95%.

NFIP and Office of Special Projects
There have been extensive changes to NFIP as it is administered in Tennessee. Internal changes include Stanley Harrison as the only official coordinator, with the elimination of 6 regional offices, plus the elimination of internal finance and administration offices. They now coordinate directly with the OIR and Dennis Peterson for GIS services. While they no longer receive direct funds for administrative services, they are required to file annual business cases and meet with all mapping partners in July to discuss the pending year's work.

NFIP offices are entirely funded by a 75/25% share program (with federal cap funds). They have 9 program work activities, of which those with primary importance for mitigation planning are: technical assistance requests, community assistance visits, contact visits, and non-participant outreach. In 2010 legislature passed Public Chapter No.1091 amending T.C.A. 12-4-109, under which all communities with FEMA identified zones must join the program. Of those identified, 393 have joined the program, and 18 have refused to join. Those include:

- Town of Braden (Fayette County)
- Town of Burlison (Tipton County)
- Town of Coalmont (Grundy County)
- Town of Enville (McNairy/Chester County)
- Town of Finger (McNairy County)
- Town of Gibson (Gibson County)
- Town of Guys (McNairy County)
- City of Hollow Rock (Carroll County)
- Houston County Unincor.
- Humphreys County Unincor.
- City of Minor Hill (Giles County)
- City of Niota (McMinn County)
- Town of Normandy (Bedford County)
- Town of Orlinda (Robertson County)
- Town of Orme (Marion County)
- City of St. Joseph (Lawrence County)
- City of Yorkville (Gibson County)

Municipalities have historically participated and have good compliance histories, counties are historically more difficult to integrate. CDBG now also requires compliance under 1091. They receive some TDEC waste water development assistance. Mitigation activities under current development: the Community Rating System needs reevaluation: as 27% of those identified need updating. During the

2009 CRS push FEMA was hesitant regarding the risk map approach. The department is attempting to get more data, and has extended the deadline.

Tennessee Division of Forestry

Tennessee participates as of 2010 in Forest Fire Compacts with 13 states regionally. These regions share DHS typed assets, of which Tennessee owns 120 Type 6 engines with 100 or larger gallon capacities, and has access to 206 aircraft regionally.

The extension of the CWPP to fund more programs for Fire Adaptive communities includes $700 of which 50% is dedicated for mitigation efforts. Those communities also receive dedicated prescribe burn monies beginning in 2013, with 25 classes in prescribed burns offered across the state annually.

Tennessee Department of Economic and Community Development

CBDG funding remains labile through fiscal year 2013. HUD prefers that funds now be directed to direct recovery efforts. However, for declared disasters, TN has received funds at 3 junctures in the past 5 years:

- 92 million 2008-2009 17 counties,
- 30 million for 2010 in 7 counties.
- 20 million in 2011 approved in April: All funds are 100% federal and are based on an ability to pay criteria developed at UT Knoxville in conjunction with BEA and Census data,

None of these funds are allocated for metropolitan use, but exclusively for rural and underserved areas. For regular round funds, 70% of funding must go to LMI recipients; however this threshold is lowered for disasters funds which only requires 50% distribution to LMI. TN however averages a much higher rate than the requirement, with almost 95% LMI. These areas are determined by HUD from US Census data. HUD has instituted a rule that 80% of disaster money must go to those most affected and distressed.

5.3.2 – Changes in Roles & Responsibilities

The mitigation-related roles and responsibilities of state agencies have been more clearly defined by the governor's approval of the TEMP in October 1, 2011. As of July 2013 the Tennessee Emergency Management Plan is in the process of updating the TEMP.

TEMA continues to manage the FEMA mitigation grant programs for HMGP, PDM, and FMA. In conjunction with the state NFIP coordinator, TEMA will continue to inform and educate jurisdictions about the NFIP and mitigation efforts to reduce property impacts within flood hazard areas. Additionally, as the new requirements for local multi-hazard mitigation plans are mandated to include FMA criteria, the state will pursue more FMA grants for interested communities as part of their flood mitigation strategy.

The Fire Prevention Division of the Department of Commerce and Insurance requires all building permits purchased on or after October 1, 2011, to have the plumbing and mechanical systems inspected at rough-in and final inspection. These inspections should reduce the fire hazard at participating jurisdictions.

5.3.3 – Changes in Funding Sources

The HMPC indicated that some grants formerly available through the U.S. Department of Homeland Security designed to improve capabilities in planning, equipment, training, and exercises, had significantly decreased from recent disasters throughout the United States and abroad.

Since the Middle Tennessee floods on June 2010 the State of Tennessee has received approximately $105.4 million in Federal Hazard Mitigation Grant Program funding for mitigation planning and projects. This funding required a 25% match from the state and local stakeholders.

The PDM grant has not been funded by Congress since 2012. This is a big detriment to funding capabilities as PDM funds were not disaster dependent. Currently, it is unclear if Congress will refund this important grant program.

In 2012, the U.S. Congress passed the Biggert Waters Flood Insurance Reform Act of 2012, which calls on FEMA and other agencies to make a number of changes to the way the NFIP is run. Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk, make the program more financially stable, and change how FIRM updates impact policyholders. The changes will mean premium rate increases for some – but not all – policyholders over time.

5.4 – State Capabilities Gap Analysis

This section highlights policies and programs that have been effective in achieving mitigation objectives and actions in Tennessee and discusses opportunities for improving state mitigation capabilities. The HMPC used a small group brainstorming process to identify the strengths and weaknesses in the state's mitigation capabilities, and the opportunities and obstacles to improving mitigation capabilities. Several themes emerged from this process and are summarized below.

Consolidation of the Economic and Community Development NFIP Program:
The elimination of the 6 regional offices for administration of the NFIP and Economic and Community Development has stressed resources and resulted in difficulty with technical assistance, community assistance visits, and non-participant outreach.

OIR-GIS Budget Constriction with Incomplete LiDAR sets for the state as a whole:
The lack of direct set aside funding for LiDar has resulted in incomplete mapping and the inability for the OIR to continue the development of detailed datasets. This directly inhibits the use of accurate elevations for a variety of business and government needs.

Interagency Coordination
The HMPC identified interagency coordination as an obstacle to improving state capabilities, specifically related to planning efforts and sharing information and technical data. The long-term effectiveness of the state's mitigation program is contingent on using existing mitigation-related programs in as coordinated and integrated a manner as possible to achieve the maximum benefits to statewide capabilities.

Based on Tennessee Code Annotated 58-2-108 requires the designation of Emergency Services Coordinators for each state agency. ESC responsibilities include:

- At the direction of the governor, the head of each executive department and independent agency shall select from within such department or agency a person to be designated as the emergency services coordinator for the department or agency together with an alternate ESC.
- The ESC is responsible for coordinating with TEMA and reporting to that agency on emergency preparedness issues, preparing and maintaining emergency preparedness and post disaster response and recovery plans for their agency, maintaining rosters of personnel to assist in disaster operations, and coordinating appropriate training for agency personnel.
- These individuals shall be responsible for ensuring that each state facility, such as a prison, office building, or university, has a disaster preparedness plan that is reviewed by the applicable local emergency management agency and approved by TEMA

Financial and Technical Assistance to Local Governments
Many agencies provide support to local governments through training and education, grants and loans, and technical support:

- TEMA provides technical assistance to counties for the development of local mitigation plans and for funding mitigation projects. TEMA also coordinates programs for local comprehensive emergency management planning and local mitigation planning to ensure that planning efforts are consistent and mutually supportive.

- The Tennessee Department of Commerce and Insurance administers community development programs, such as the NFIP. Other local jurisdictional resources include the administering of Appalachian Regional Commission Grants, Delta Regional Authority Grants, and Community Development Block Grants
- The Tennessee Forestry Commission, serves in an advisory capacity on forestry policy to the Tennessee Department of Agriculture and the governor. In brief, the commission is to formulate and recommend programs of fire protection, reforestation and seedling production, forestry assistance to private landowners, educational and informational

functions which enhance understanding of the value and management of the forest resource, management of state forests, urban tree management, development of markets for Tennessee forest products, protection from insect and disease epidemics, and protection of the soil and water quality.

- The Tennessee Department of Agriculture has several programs that are supportive of local government efforts, particularly in flood control and fire reduction. The Urban Forests Riparian Program and the Volunteer Fire Assistance (VFA) are 2 program examples.
- The Tennessee Department of Health has programs supporting local government efforts to respond to human disease outbreaks.
- The Tennessee Department of Transportation Local Program Development Office (LPDO) administers those federal and state funding programs that are available to local governments to improve their transportation systems. Current programs include Surface Transportation, Enhancement, Safe Routes to School, Congestion Mitigation and Air Quality Improvement, Spot Safety, Local Interstate Connector, State Industrial Access Road, Interchange Lighting and Bridge Replacement.

Opportunities exist for building state and local mitigation capabilities by expanding the state's capabilities for helping local governments meet nonfederal matching costs for mitigation-related projects and by improving the coordination and integration of state training programs for local officials with more emphasis on hazard mitigation. The greatest opportunities for improvement in hazard mitigation in Tennessee exist at the local level. Therefore, helping all communities develop and adopt local hazard mitigation plans is one of the state's top priorities.

Statewide Regulation and Enforcement

One important aspect of the state's mitigation policy framework is the requirement or encouragement of general actions by local governments to reduce vulnerability to disasters. 2 such general actions are adoption and enforcement of building codes and comprehensive land use planning to manage growth in known hazard areas.

The Tennessee state legislature has not implemented a statewide building code nor does it require comprehensive planning by local governments. The state does not have a land use plan or specific plans for critical areas or those of special concern. The HMPC identified the lack of requirements in these areas as a weakness in the state's mitigation capabilities and found that additional statewide guidance and requirements in these areas offer opportunities to enhance mitigation capabilities at the local level. In addition, inadequate enforcement of existing regulations by the state was found to be an obstacle.

New regulations are not popular in Tennessee, which is a Home Rule state. Home Rule is the granting of powers from the central government of a state to governments at regional or local levels. The HMPC identified that distrust of state and federal government is common among residents. The HMPC did not believe that Tennessee legislation in these areas will change in the near future but did identify opportunities to encourage local adoption of building codes and land use plans through promoting model codes and ordinances and providing guidance on integrating land use and mitigation.

GIS Data Integrity for the State

The Office for Information Resources is currently facilitating 2 major GIS data update projects for the State of Tennessee. These projects include the FEMA Flood Map Modernization Program as well as the Statewide LiDAR/Elevation Business Plan.

Flood map modernization is a program that will greatly improve the information used to establish the risk in flood plain development and will allow the insurance industry to make better policy determinations. Moving from paper maps to an integrated digital resource will expand access to flood risk data using both state and federal data access portals. Using the digital base map currently being created and implemented through the Tennessee Base Mapping Program only makes sense. The goal of the Tennessee Base Mapping Program is to create high accuracy base maps that allow a variety of information to be spatially related through geographic information systems technology. Not only will many pieces of information be available for analysis by establishing flood mapping on the state's digital base map, the value of the mapping will be leveraged to request the maximum amount of funds available for Tennessee Flood Map Modernization. The final product will be a flood risk map accessible via the internet that allows private property owners, local regulatory officials, lenders, insurers, and design professionals a more accurate Digital Flood Insurance Rate Map (DFIRM) in each county and municipality of Tennessee.

The OIR is currently working to update State of Tennessee owned and operated facility data. This vital project is pushing toward the goal of adding each building's footprint to a visual database that can then be layered over flood zone maps as well as current LiDar datasets. OIR GIS Services, with the help of AppGeo/AECOM, Tennessee Geographic Information Council (TNGIC), and the Tennessee GIS community, has completed its development of a LiDAR/elevation business plan. The eventual goal is to create a very accurate topographic GIS dataset through the use of LiDAR technology (scanning the earth with lasers from an aircraft) to obtain accurate elevations that will support a wide variety of business needs at all levels of government.

5.5 – Mitigation Actions

TEMA rigorously identified, evaluated, and prioritized cost effective, environmentally sound, and technically feasible mitigation actions for its next hazard mitigation plan cycle. Identification of mitigation gaps was completed in the assessment of state capabilities. This assessment drove the selection of 56 mitigation actions to address the identified gaps and improve existing state and local capabilities. The mitigation actions were then thoroughly discussed and evaluated by Tennessee's Hazard Mitigation Council.

5.5.1 – STAPLE+E

The Hazard Mitigation Council utilized the STAPLE+E method of action prioritization and assessment. The tables below provide the STAPLE+E evaluation criteria and the council's evaluation of the mitigation actions.

Table 109 – STAPLE+E Criteria

Evaluation Category	Sources of Information
Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
Technical	Mitigation actions are technically most effective if they provide long term reduction of losses and have minimal secondary adverse impacts.
Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with federal, state, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Table 110 – STAPLE+E Evaluation

X = N/A - Even Impact   + = Positive Influence   - = Negative Influence

STAPLE+E Criteria	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total Impact
State Hazard Mitigation Plan	+	+	+	+	+	+	+	7
Threat Hazard Identification & Risk Assessment	+	+	+	+	+	+	+	7
Enhanced State Hazard Mitigation Plan	+	+	+	+	-	+	+	6
Grants Program Staff	+	+	-	+	+	+	+	6
State Hazard Mitigation Office	+	+	+	+	+	+	+	7
Grant Process Professional Development	+	+	+	+	+	+	+	7
Mitigation Planning Professional Development	+	+	+	+	+	+	+	7
Mitigation Planning Testing	+	+	+	+	+	+	+	7
Grant Program Outreach	+	+	+	+	+	+	+	7
Mitigation Planning Outreach	+	+	-	+	+	+	+	6
Risk Assessment Distribution	+	+	+	+	+	+	+	7
Coordinate Local Mitigation Strategy	+	+	+	+	+	+	+	7
Local Access to TEMA Databases	+	+	-	+	+	+	+	6
Best Practices Guide	+	+	-	+	+	+	+	6
Individual Mitigation Awareness	+	+	+	+	+	+	+	7
CRS & NFIP Participation	+	+	+	-	-	+	+	5
FireWise & CWPP Participation	+	-	+	-	-	+	+	4
Enforce Building Codes	+	+	-	-	-	+	+	4
Local Development Planning Outreach	+	+	-	+	+	+	+	6
Debris Storage Areas	+	+	+	+	-	+	+	6
Post Disaster Mitigation Guide	+	+	-	+	+	+	+	6
Post Disaster Mitigation Group	+	+	-	+	+	+	+	6
Rebuild & Recover Program	+	+	+	+	-	+	+	6
RL/SRL Properties Prioritization	+	+	+	+	+	+	+	7
RL/SRL Program Acceleration	+	+	+	+	-	+	+	6
Flash Flooding Study	+	+	-	+	+	+	+	6
Flash Flooding Best Practices Guide	+	+	-	+	+	+	+	6
Flash Flooding Mitigation Program	+	+	-	+	-	-	+	4
Severe Storms Study	+	+	-	+	+	+	+	6
Severe Storms Best Practices Guide	+	+	-	+	+	+	+	6
Severe Storms Mitigation Program	+	+	-	+	-	-	+	4
Emergency Water Use Restrictions	+	+	-	+	-	+	+	5
Water Reserves	+	+	-	+	-	-	+	4
Seismic Standards Study	+	+	-	+	+	-	+	5
Seismic Standards	+	+	-	-	-	+	+	4
Seismically Retrofit Transportation Infrastructure	+	+	+	+	-	-	+	5

STAPLE+E Criteria	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total Impact
Seismic Retrofits	+	+	-	-	-	-	+	3
Site Level Soil Tests	+	+	-	-	-	-	+	3
Landslide Prevention Program	+	+	-	+	-	-	+	4
Tornado Safe Rooms	+	+	+	+	+	-	+	6
Anchoring Systems	+	+	-	+	+	-	+	5
Transportation Infrastructure Risks	+	+	-	+	+	+	+	6
Protect Transportation Infrastructure	+	+	-	+	-	-	+	4
Backup Generators	+	+	+	+	+	-	+	6
Critical Systems Backup	+	+	+	+	+	-	+	6
Cyber Attack Prevention	+	+	+	+	+	-	+	6
State Property GIS Database	+	+	-	+	+	+	+	6
Development Regulation Database	+	+	-	+	+	+	+	6
LiDAR Mapping	+	-	+	+	+	-	+	5
Dam Failure Studies	+	+	-	+	+	-	+	5
Flood Map Refinement	+	+	-	+	+	+	+	6
Chemical Spill & Plume Models	+	-	-	+	+	+	+	5
ESC Program	+	+	+	+	+	+	+	7
Historic & Culturally Significant Locations	+	+	-	+	-	+	+	5
Rebuild & Recover Program Promotion	+	+	+	+	+	+	+	7
Non-Profit Mitigation Planning	+	+	-	+	+	+	+	6

**This evaluation is rudimentary by design. Its intention is to give a basic level of prioritization for state agencies. The full effects and impacts of any mitigation action cannot be accurately determined without a comprehensive study.*

5.5.2 – Mitigation Actions

Table 111 – Mitigation Actions List			
Strategy	Action #	Action Name	Status
1.1	1	State Hazard Mitigation Plan	Implemented & Ongoing
1.2	2	Threat Hazard Identification & Risk Assessment	Implemented & Ongoing
1.3	3	Enhanced State Hazard Mitigation Plan	Proposed
2.1	4	Grants Program Staff	Implemented & Ongoing
2.2	5	State Hazard Mitigation Office	Implemented & Ongoing
2.3	6	Grant Process Professional Development	Implemented & Ongoing
3.1	7	Mitigation Planning Professional Development	Implemented & Ongoing
3.2	8	Mitigation Planning Testing	Implemented & Ongoing
4.1	9	Grant Program Outreach	Implemented & Ongoing
5.1	10	Mitigation Planning Outreach	Implemented & Ongoing
6.1	11	Risk Assessment Distribution	Proposed
6.2	12	Coordinate Local Mitigation Strategy	Proposed
6.3	13	Local Access to TEMA Databases	Proposed
7.1	14	Best Practices Guide	Proposed
7.2	15	Individual Mitigation Awareness	Proposed
8.1	16	CRS & NFIP Participation	Implemented & Ongoing
8.2	17	FireWise & CWPP Participation	Implemented & Ongoing
9.1	18	Enforce Building Codes	Proposed
9.2	19	Local Development Planning Outreach	Proposed
9.3	20	Debris Storage Areas	Proposed
10.1	21	Post Disaster Mitigation Guide	Proposed
10.2	22	Post Disaster Mitigation Group	Proposed
10.3	23	Rebuild & Recover Program	Proposed
11.1	24	RL/SRL Properties Prioritization	Proposed
11.2	25	RL/SRL Program Acceleration	Implemented & Ongoing
12.1	26	Flash Flooding Study	Proposed
12.2	27	Flash Flooding Best Practices Guide	Proposed
12.3	28	Flash Flooding Mitigation Program	Proposed
13.1	29	Severe Storms Study	Proposed
13.2	30	Severe Storms Best Practices Guide	Proposed
13.3	31	Severe Storms Mitigation Program	Proposed
14.1	32	Emergency Water Use Restrictions	Implemented & Ongoing
14.2	33	Water Reserves	Proposed
15.1	34	Seismic Standards Study	Proposed
15.2	35	Seismic Standards	Proposed
15.3	36	Seismically Retrofit Transportation Infrastructure	Implemented & Ongoing
15.4	37	Seismic Retrofits	Implemented & Ongoing
16.1	38	Site Level Soil Tests	Proposed
16.2	39	Landslide Prevention Program	Proposed
17.1	40	Tornado Safe Rooms	Implemented & Ongoing
17.2	41	Anchoring Systems	Proposed
18.1	42	Transportation Infrastructure Risks	Proposed
18.2	43	Protect Transportation Infrastructure	Proposed

Strategy	Action #	Action Name	Status
18.3	44	Backup Generators	Proposed
18.4	45	Critical Systems Backup	Proposed
19.1	46	Cyber Attack Prevention	Proposed
20.1	47	State Property GIS Database	Implemented & Ongoing
20.2	48	Development Regulation Database	Proposed
20.3	49	LiDAR Mapping	Proposed
21.1	50	Dam Failure Studies	Proposed
21.2	51	Flood Map Refinement	Proposed
21.3	52	Chemical Spill & Plume Models	Proposed
22.1	53	ESC Program	Implemented & Ongoing
23.1	54	Historic & Culturally Significant Locations	Implemented & Ongoing
23.2	55	Rebuild & Recover Program Promotion	Proposed
23.3	56	Non-Profit Mitigation Planning	Implemented & Ongoing

Mitigation Action 1 – State Hazard Mitigation Plan	
Hazard/s Addressed	All Hazards
Strategy 1.1	Continue to develop a FEMA approved state hazard mitigation plan to ensure state local eligibility for federal grants.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 2 – Threat Hazard Identification & Risk Assessment	
Hazard/s Addressed	All Hazards
Strategy 1.2	Continue to maintain and improve a FEMA approved THIRA.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 3 – Enhanced State Hazard Mitigation Plan	
Hazard/s Addressed	All Hazards
Strategy 1.3	Develop a FEMA approved enhanced state hazard mitigation plan to increase total grant funding.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 4 – Grants Program Staff	
Hazard/s Addressed	All Hazards
Strategy 2.1	Continue to maintain a professional, trained, and effective, grant program staff at TEMA to ensure a continual grant cycle.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA

Mitigation Action 5 – State Hazard Mitigation Office	
Hazard/s Addressed	All Hazards
Strategy 2.2	Continue to maintain a professional, trained, and effective, State Hazard Mitigation Office to ensure a continual grant cycle.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 6 – Grants Process Professional Development	
Hazard/s Addressed	All Hazards
Strategy 2.3	Expand TEMA's professional development program by training its grants staff in FEMA's Cost Benefit Analysis Methodology, the State of Tennessee Historic Site Review process, and the State of Tennessee's Environmental Review process to decrease the grant application process timeframe while improving its effectiveness.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 7 – Mitigation Planning Professional Development	
Hazard/s Addressed	All Hazards
Strategy 3.1	Support and encourage TEMA's professional development program among mitigation staff.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 8 – Mitigation Planning Testing	
Hazard/s Addressed	All Hazards
Strategy 3.2	Encourage participation in the training and testing in mitigation related courses such as the Certified Floodplain Managers program and FEMA's HAZUS loss estimation program.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 9 – Grant Program Outreach	
Hazard/s Addressed	All Hazards
Strategy 4.1	Continue to develop a grant information outreach program for local jurisdictions.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 10 – Mitigation Planning Outreach	
Hazard/s Addressed	All Hazards
Strategy 5.1	Ensure TMI's sustainability by expanding the size of TEMA's mitigation planning outreach program.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA

Mitigation Action 11 – Risk Assessment Distribution	
Hazard/s Addressed	All Hazards
Strategy 6.1	Distribute the HMP's state risk assessment to local jurisdictions.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 12 – Coordinate Local Mitigation Strategy	
Hazard/s Addressed	All Hazards
Strategy 6.2	Work with local jurisdictions to develop better prioritized mitigation goals, objectives, and strategies.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 13 – Local Access to TEMA Databases	
Hazard/s Addressed	All Hazards
Strategy 6.3	Grant local jurisdictions access to TEMA maintained databases to improve mitigation plans and mitigation project planning.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 14 – Best Practices Guide	
Hazard/s Addressed	All Hazards
Strategy 7.1	Develop a best practices guide by collecting mitigation success stories from local jurisdictions.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 15 – Individual Mitigation Awareness	
Hazard/s Addressed	All Hazards
Strategy 7.2	Develop a public awareness campaign designed to encourage the public's practice of individual mitigation activities through local emergency management agencies.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 16 – CRS & NFIP Participation	
Hazard/s Addressed	Floods
Strategy 8.1	Develop a cost benefit analysis for local communities encouraging their participation in the CRS and NFIP programs to increase the number of CRS and NFIP participating communities.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	Medium
Lead Organization/s	TN ECD & TEMA

Mitigation Action 17 – FireWise & CWPP Participation	
Hazard/s Addressed	Wildfires
Strategy 8.2	Develop a cost benefit analysis for local communities encouraging their participation in the FireWise program and the Community Wildfire Protection Plan to increase the number participating communities.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	Medium
Lead Organization/s	TN Forestry & TEMA

Mitigation Action 18 – Enforce Building Codes	
Hazard/s Addressed	All Hazards
Strategy 9.1	Develop a cost benefit analysis for local communities encouraging enforcement of current state established building codes and outline the benefits of enacting enhanced local codes.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 19 – Local Development Planning Outreach	
Hazard/s Addressed	All Hazards
Strategy 9.2	Engage in outreach to local planning commissioners and zoning officials to spread awareness of assistance options, available grant programs, current and future development in hazard prone areas, and mitigation approaches.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 20 – Debris Storage Areas	
Hazard/s Addressed	All Hazards
Strategy 9.3	Encourage the establishment of pre-approved debris storage areas.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TDEC & TEMA

Mitigation Action 21 – Post Disaster Mitigation Guide	
Hazard/s Addressed	All Hazards
Strategy 10.1	Develop a quick assessment tool to be used by the planning and recovery branches to assess mitigation opportunities post disaster.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 22 – Post Disaster Mitigation Group	
Hazard/s Addressed	All Hazards
Strategy 10.2	Develop a coordinated group to make decisions on mitigation opportunities post disaster.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 23 – Rebuild & Recover Program	
Hazard/s Addressed	All Hazards
Strategy 10.3	Assist in the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program to ensure capitalization of post disaster long term recovery operations.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	THDA & TEMA

Mitigation Action 24 – RL/SRL Properties Prioritization	
Hazard/s Addressed	Floods
Strategy 11.1	Identify high property count jurisdictions and prioritize RL/SRL properties by cost.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Very High
Lead Organization/s	TN ECD & TEMA

Mitigation Action 25 – RL/SRL Program Acceleration	
Hazard/s Addressed	Floods
Strategy 11.2	Accelerate the RL/SRL buyout program by targeting the prioritized jurisdictions and properties.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TN ECD & TEMA

Mitigation Action 26 – Flash Flooding Study	
Hazard/s Addressed	Flash Floods
Strategy 12.1	Conduct a study of flash flooding damages, their causes, and assess measures that could have mitigated their impacts.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 27 – Flash Flooding Best Practices Guide	
Hazard/s Addressed	Flash Floods
Strategy 12.2	Distribute flash flooding information and mitigation best practices to the identified hazard prone communities.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 28 – Flash Flooding Mitigation Program	
Hazard/s Addressed	Flash Floods
Strategy 12.3	Based on the flash flooding study, develop flash flooding mitigation projects for local jurisdictions.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 29 – Severe Storms Study	
Hazard/s Addressed	Severe Storms
Strategy 13.1	Conduct a study of severe storm damages, their causes, and assess measures that could have mitigated their impacts.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 30 – Severe Storms Best Practices Guide	
Hazard/s Addressed	Severe Storms
Strategy 13.2	Distribute severe storm information and mitigation best practices to the identified hazard-prone communities.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 31 – Severe Storms Mitigation Program	
Hazard/s Addressed	Severe Storms
Strategy 13.3	Based on the severe storm study, develop severe storm mitigation projects for local jurisdictions.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 32 – Emergency Water Use Restrictions	
Hazard/s Addressed	Drought
Strategy 14.1	Promote local and state legislation mitigating the impacts of droughts through water use restrictions and burning prohibitions during declared events.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TN Drought Taskforce

Mitigation Action 33 – Water Reserves	
Hazard/s Addressed	Drought
Strategy 14.2	Directly and/or indirectly establish secondary and reserve water supplies to mitigate the effects of a drought on identified hazard prone communities.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TN Drought Taskforce

Mitigation Action 34 – Seismic Standards Study	
Hazard/s Addressed	Earthquakes
Strategy 15.1	Develop cost benefit analysis on increasing the use of seismic building codes and distribute it to local governments and private construction companies doing business in Tennessee.
Area of Focus	Local Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 35 – Seismic Standards	
Hazard/s Addressed	Earthquakes
Strategy 15.2	Support, assist, and encourage local governments to provide incentives for private construction companies to voluntarily build higher than the minimum seismic standards.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	State Fire Marshall Office

Mitigation Action 36 – Seismically Retrofit Transportation Infrastructure	
Hazard/s Addressed	Earthquakes
Strategy 15.3	Continue to seismically retrofit bridges and transportation infrastructure in West Tennessee.
Area of Focus	Critical Infrastructure
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA & TDOT

Mitigation Action 37 – Seismic Retrofits	
Hazard/s Addressed	Earthquakes
Strategy 15.4	Continue to support, assist, and encourage local governments to perform seismic retrofit studies and seismic retrofit projects.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	Low
Lead Organization/s	TEMA

Mitigation Action 38 – Site Level Soil Tests	
Hazard/s Addressed	Geologic
Strategy 16.1	Encourage state and local governments to perform increased site level soil testing in identified hazard-prone areas.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Low
Lead Organization/s	TDEC & TEMA

Mitigation Action 39 – Landslide Prevention Program	
Hazard/s Addressed	Geologic
Strategy 16.2	Implement slope stabilizing mitigation measures protecting infrastructure in identified landslide-prone areas.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TDOT & TEMA

Mitigation Action 40 – Tornado Safe Rooms	
Hazard/s Addressed	Severe Storms, Tornadoes
Strategy 17.1	Assist, support, and encourage the construction of FEMA 361 tornado safe rooms throughout Tennessee.
Area of Focus	Local Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA

Mitigation Action 41 – Anchoring Systems	
Hazard/s Addressed	Severe Storms, Tornadoes
Strategy 17.2	Assist, support, and encourage communities to require or implement the installation of anchoring systems at mobile home parks.
Area of Focus	Local Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 42 – Transportation Infrastructure Risks	
Hazard/s Addressed	All Hazards
Strategy 18.1	Coordinate with the Tennessee Department of Transportation to identify transportation infrastructure in hazard prone areas.
Area of Focus	Critical Infrastructure
Status	Proposed
Priority	High
Lead Organization/s	TEMA, TDOT

Mitigation Action 43 – Protect Transportation Infrastructure	
Hazard/s Addressed	All Hazards
Strategy 18.2	Coordinate with the Tennessee Department of Transportation to implement mitigation projects for transportation infrastructure in the identified hazard prone areas.
Area of Focus	Critical Infrastructure
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA, TDOT

Mitigation Action 44 – Backup Generators	
Hazard/s Addressed	All Hazards
Strategy 18.3	Coordinate with state agencies and local governments to install backup generators for critical facilities in identified hazard prone areas.
Area of Focus	Critical Infrastructure
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 45 – Critical Systems Backup	
Hazard/s Addressed	All Hazards
Strategy 18.4	Coordinate with state agencies and local governments to backup software and database systems.
Area of Focus	Critical Infrastructure
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 46 – Cyber Attack Prevention	
Hazard/s Addressed	Terrorism
Strategy 19.1	Install firewall and other hardware system protective measures in critical network systems to prevent cyber-attacks.
Area of Focus	Critical Infrastructure
Status	Proposed
Priority	High
Lead Organization/s	TEMA, TN DHS

Mitigation Action 47 – State Property GIS Database	
Hazard/s Addressed	All Hazards
Strategy 20.1	Develop and maintain a comprehensive statewide GIS database of state property, in collaboration with the State of Tennessee Office of Information Resources, to identify, GPS locate, geocode, and build polygon files of all state property.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA, TN OIR

Mitigation Action 48 – Development Regulation Database	
Hazard/s Addressed	All Hazards
Strategy 20.2	Collect and maintain a database of local jurisdictions' building codes, zoning, and subdivision regulations by adopting the maintenance of the State of Tennessee's "Status of Planning and Land Use Control Report for Tennessee" from the now disbanded Local Planning Assistance Office under the Department of Economic & Community Development.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA

Mitigation Action 49 – LiDAR Mapping	
Hazard/s Addressed	All Hazards
Strategy 20.3	Pursue and promote LiDAR mapping opportunities in at-risk areas throughout Tennessee.
Area of Focus	State Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TN OIR & TEMA

Mitigation Action 50 – Dam Failure Studies	
Hazard/s Addressed	Dam Failure
Strategy 21.1	Identify and assess community risk from potential dam failures by studying the impact potential of non-profiled dams.
Area of Focus	State Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA, USACE

Mitigation Action 51 – Flood Map Refinement	
Hazard/s Addressed	Dam Failure, Floods
Strategy 21.2	In coordination with the USACE, improve and refine flood inundation mapping throughout the state based on river depth measurements.
Area of Focus	State Capabilities
Status	Proposed
Priority	High
Lead Organization/s	TEMA, USACE

Mitigation Action 52 – Chemical Spill & Plume Models	
Hazard/s Addressed	Hazardous Materials Release
Strategy 21.3	Conduct a statewide, multiple scenario assessment of chemical spills and plume models for chemical and radiological facilities.
Area of Focus	State Capabilities
Status	Proposed
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 53 – ESC Program	
Hazard/s Addressed	All Hazards
Strategy 22.1	Maintain TEMA's ESC program and keep the ESCs informed on mitigation efforts, progress, and successes throughout the state.
Area of Focus	State Capabilities
Status	Implemented & Ongoing
Priority	Very High
Lead Organization/s	TEMA

Mitigation Action 54 – Historic & Culturally Significant Locations	
Hazard/s Addressed	All Hazards
Strategy 23.1	Work with state agencies, federal agencies, and non-profits to promote mitigation practices at historic and culturally significant locations and properties.
Area of Focus	Critical Infrastructure
Status	Implemented & Ongoing
Priority	Medium
Lead Organization/s	TEMA

Mitigation Action 55 – Rebuild & Recover Program Promotion	
Hazard/s Addressed	All Hazards
Strategy 23.2	Promote the development of the State of Tennessee's Development and Housing Authority "Rebuild & Recover" program.
Area of Focus	State Capabilities
Status	Proposed
Priority	Very High
Lead Organization/s	THDA & TEMA

Mitigation Action 56 – Non-Profit Mitigation Planning	
Hazard/s Addressed	All Hazards
Strategy 23.3	Continue to support mitigation planning efforts with non-profits such as the Red Cross, Salvation Army, and Volunteer Organization Active in Disasters.
Area of Focus	Non-Governmental Organizations
Status	Implemented & Ongoing
Priority	High
Lead Organization/s	TEMA

5.5.3 – Implemented State Mitigation Activities

The State of Tennessee's mitigation program at the completion of its 2010 plan was lacking in foundation and implementation. However, since 2010, TEMA has gone through great lengths to implement mitigation strategies, goals, objectives, and activities to create a robust mitigation program.

Exemplary strides have been made over the past 3 years, most notably is TEMA's Tennessee Mitigation Initiative (TMI). Developed out of the 2010 HMP's mitigation strategy, TMI has fostered the development of local hazard mitigation plans throughout the state. It has been the primary driving force in increasing Tennessee's approved local mitigation plan rate from 45% in 2010 to 70% in 2013. Additionally, 85% of the existing approved plans in 2010 were successfully updated and FEMA approved during the past 3 years. Detailed information on the TMI program can be found in Section 6.2.

In addition to the astounding success of TMI and drawing on the 2010 HMP's mitigation strategy, TEMA has completed multiple risk assessments (seismic study on water utility systems throughout Tennessee, and a seismic retrofit study for hospitals in Shelby County), increased its grants section staff from 2 to 5, and is now participating in the Silver Jackets program.

The 2010 HMP was ambitious in its mitigation strategy. A significant number of activities were completed, and a number of on-going projects were maintained. A number of previously listed activities were removed from this plan, as the activity is outside the scope of TEMA's mitigation planning authority.

The following table lists the 2010 HMP's mitigation actions, their current status, whether or not they have been included in this plan, and if excluded, the reasoning behind their exclusion.

Table 112 – 2010 State Mitigation Activities

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
1.1	Maintain a full-time hazard mitigation officer/staff to coordinate and monitor hazard mitigation statewide.	Deferred to (2013 - 2016)	2.2/5
1.1a	Maintain a full-time Grants Program Manager/staff to coordinate, develop, and monitor HLS, EMPG,etc. grants statewide.	Deferred to (2013 - 2016)	2.1/4
1.2a	Compile and maintain a master listing of federal, state, and local agencies involved in mitigation; outline their associated programs, responsibilities, and capabilities; and distribute this listing along with available literature to local communities and other state agencies.	Completed	Excluded (Incorporated into TEMA SOP)
1.2b	Provide training to local governments on available Federal Emergency Management Agency Mitigation Grant Programs, as well as technical assistance in developing eligible applications.	Deferred to (2013 - 2016)	5.1/10
1.3	Encourage, promote, and assist jurisdictions across the state in developing an omnibus hazard (Natural, Technological, and Human-caused) mitigation plan.	Deferred to (2013 - 2016)	5.1/10
1.4	Establish and maintain a State Hazard Mitigation Council with oversight provided by the Governor's Authorized Representative (GAR) to review/evaluate the viability of proposed/adopted mitigation actions.	Completed	Excluded (Incorporated into TEMA SOP)

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
1.5	Encourage/promote local and state governments to re-evaluate existing essential services in terms of survivability. Those facilities found to be lacking in protective measure should be highlighted and prioritized for renovation/relocation.	Completed	Excluded (Incorporated into TEMA SOP)
1.6	Encourage utilities to develop proper tree pruning specifications and incorporate them into maintenance plans and right-of-way contracts.	Deleted	Excluded (Not Cost Effective)
1.7X	Encourage development and local adoption of a comprehensive landscape code identifying storm tolerant plants for right-of-ways.	Deleted	Excluded (Not Cost Effective)
1.7	Ensure updated contracts and required documentation are made available to applicants to obtain proper environmental clearances for construction projects.	Deferred to (2013 - 2016)	2.3/6
1.8	Encourage local governments to explore the types of mitigation activities/opportunities that could be implemented or made available.	Deferred to (2013 - 2016)	4.9/9
1.9	Provide technical assistance to applicants on application development that encompasses benefit cost analysis, engineering review, scope of work development, eligible costs, etc.	Deferred to (2013 - 2016)	2.3/6
1.10	Ensure mitigation staff are provided training opportunities on application development that encompass all areas of application development, i.e., benefit cost analysis, engineering review, scope of work development, eligible costs, etc..	Deferred to (2013 - 2016)	3.1/7
1.11	Encourage/assist local governments to adopt/enforce building codes based on nationally recognized codes.	Deferred to (2013 - 2016)	9.1/18
2.1	Orchestrate/conduct training classes for local governments as well as the private sector.	Completed	Excluded (Incorporated into TEMA SOP)
2.2.X	Evaluate the effectiveness of existing public information materials and programs regarding natural hazards. Where there is an identified need, develop new materials for increasing public awareness about the need for individual and family preparedness measures.	Deferred to (2013 - 2016)	7.2/15
2.2	Utilize the media/private sector for the distribution and publication of hazard information.	Deferred to (2013 - 2016)	7.2/15
2.3	Encourage local jurisdictions to implement extensive multi-hazard awareness programs for the general public (particularly targeting schools, hospitals, housing complexes, etc.) in preparing for, responding to and recovering from emergency/disaster situations.	Deferred to (2013 - 2016)	7.1/14
2.4	Establish an annual conference, hosted by the Governor/Authorized Representative (GAR) for all local and state officials.	Completed	Excluded (Incorporated into TEMA SOP)
2.5	Develop and implement a comprehensive training program that presents emergency management information to all elected and appointed officials, volunteers, and local/state government employees.	Completed	Excluded (Incorporated into TEMA SOP)
2.6	Ensure availability and quantity of training to local emergency organizations and personnel.	Completed	Excluded (Incorporated into TEMA SOP)
2.7	Advocate and promote Community Emergency Response Team (CERT) classes of instruction and team formation.	Completed	Excluded (Incorporated into TEMA SOP)
2.8	Increase the number of training community emergency responders.	Deleted	Excluded (Not in planning's scope)

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
2.9	Provide timely information; i.e., syllabi and schedules of local, regional, state, and federal training opportunities to local governments/emergency responders.	Completed	Excluded (Incorporated into TEMA SOP)
3.1	Require and encourage local jurisdictions to develop and maintain basic emergency operation plans, ensuring a comprehensive approach to emergency operations via terms of preparedness, response, recovery, and mitigation.	Completed	Excluded (Incorporated into TEMA SOP)
3.2	Promote and encourage utility companies to develop emergency and/or disaster response/recovery plans, establishing priorities for the restoration of services to critical locations and facilities; i.e., Emergency Operations Centers, shelters, hospitals, nursing homes, etc..	Deferred to (2013 - 2016)	23.3/56
3.3	Develop specific training elements for responsible entities addressing specific Catastrophic Event (CAT) Plan functions.	Completed	Excluded (Not in planning's scope)
3.4	Provide a full-time Emergency Services Coordinator to be co-located at the Tennessee Emergency Management Agency.	Deferred to (2013 - 2016)	22.1/53
4.1	Procure and maintain an automated emergency response system.	Completed	Excluded (Not in planning's scope)
4.2	Encourage/promote utility companies to develop public information programs for keeping the public informed of service restoration progress during disaster response/recovery operations.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
4.3	Ensure Internet availability to all Emergency Services Coordinators at State Emergency Operations Center.	Completed	Excluded (Not in planning's scope)
4.4	Inter-departmentally, promote acquisition and assignment of response vehicles to State Emergency Operations Center Emergency Services Coordinators.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
4.5	Ensure agency emergency response including that motor pool vehicles are properly and adequately equipped with up-to-date communication (radio) equipment.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
4.6	Ensure emergency field personnel are properly and adequately equipped with up-to-date cellular telephones/communication devices.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
4.7	Generators should be purchased for all state radio communication sites presently without generators or with undependable units. A generator maintenance and operator training program for emergency power generator recipients should be implemented.	Deferred to (2013 - 2016)	18.3/44
4.8	In cooperation with the Tennessee Department of Finance and Administration, promote a mechanism to provide salary stipends to appointed primary ESCs.	Completed	Excluded (Incorporated into TEMA SOP)
4.9	Pre-position selected assets and equipment; i.e., self-sustainability, fuel tanks, food, water, laundry, showers, etc., for employees reporting to work.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
4.10	Establish an inter/intra governmental communication interoperability advisory board consisting of representatives from both the state and local government.	Completed	Excluded (Not in planning's scope)
4.11	Develop a fully equipped Joint Information Center/Media Center in the Nashville area in close proximity to the State Emergency Operation Center and the Capitol. This facility should serve as a focus point for media and provide the governor/TEMA with a location that can fully support the SEOC by providing a robust public information response.	Completed	Excluded (Not in planning's scope)

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
5.1	Promote enactment of local legislation dealing with drought (e.g., voluntary and mandatory restrictions in use, reduced water pressure, open burning prohibition, sanctions, fines, etc.).	Deferred to (2013 - 2016)	14.1/32
5.2	Encourage farmers to establish secondary water sources (e.g., good-sized storage ponds, deep wells, etc.) for use in times of drought via press releases, farming organizations, and general public education.	Deferred to (2013 - 2016)	14.2/33
6.1	Encourage local jurisdictions to adopt the International Building Code (IBC) or nationally recognized code with similar provisions.	Completed	Excluded (TN Adopted in 2010)
6.2	The training, licensing, testing, and certification requirements for insurance agents should be revised to address earthquake hazards/insurance.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
6.3	Encourage vulnerable local governments to retrofit emergency service facilities to withstand the maximum credible earthquake for the region. Such retrofitting should be accomplished according to the degree of vulnerability and strategic importance of the facility.	Deferred to (2013 - 2016)	15.4/37
6.4	Promote and encourage local governments to review and utilize existing structure vulnerability studies to develop a prioritized list of potential retrofit candidates.	Deferred to (2013 - 2016)	15.1/34
6.5	Encourage local jurisdictions to provide tax incentives to individuals, corporations, etc., for incorporating earthquake resistance measures into new structures or in the retrofitting of older structures.	Deferred to (2013 - 2016)	15.2/35
6.6	Encourage and support community-based outreach and awareness programs designed to prepare families and community groups for coping with the problems associated with seismic disasters.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
6.7	Develop an outreach program using multi-media i.e., video, radio, internet, etc., targeting public awareness toward ensuring self-sufficiency in disaster response and recovery.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
6.8	Accomplish seismic retrofit of bridges in West Tennessee.	Deferred to (2013 - 2016)	15.3/36
7.1	Encourage temporary community shelter planning for the protection of the homeless, poor, chronically ill, elderly, and physically challenged during periods of prolonged temperature extremes.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
8.1	Eliminate/lessen loss of life as well as minimize the economic losses from fire. Reduce/eliminate fire ignition sources and augment response capability in less populated areas.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
8.2	Assist in equipping, training, and organizing rural volunteer fire departments.	Deferred to (2013 - 2016)	Excluded (Not in planning's scope)
9.1	Promote installation of staff gauges, which include visual indicators of water surface elevations in reservoirs and along waterways where flood forecast information is routinely provided.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
9.2X	Support the Tennessee Valley Authority's position in the denial of 26a approval for developments inconsistent with the flood damage prevention requirements of the NFIP, Executive Order 11988 and TVA Land Rights.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
9.2	Support/encourage adoption of state legislation requiring the following for all real estate transactions: 1) mandatory hazard disclosure (to include flood and earthquake zones), for real estate listings; and 2) mandatory disclosure documents signed by both parties involved in property transactions at the final close or lease settlement.	Deleted (Not feasible)	Excluded (Not feasible)

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
9.3	Promote local jurisdictional adoption, at a minimum, of the statewide accepted building code based on the International Building Code (IBC).	Completed	Excluded (TN Adopted in 2010)
9.4	The licensing, certification, and testing requirements for insurance agents should be revised to address floodplain management through flood insurance criteria presented in the National Flood Insurance Program (NFIP) regulation.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
9.5	Ensure local floodplain management ordinances are evaluated for compliance with the National Flood Insurance Program (NFIP) standards. Work with local jurisdictions to ensure updated floodplain management ordinances.	Completed	8.1/16
9.6	Encourage/facilitate local government reviews of Basic Emergency Operation Plans to ensure compliance with the local/regional solid waste plan and address the collection and disposal of large volumes of non-hazardous debris. Local jurisdictions should work with the Department of Environment and Conservation in developing pre-determined locations for staging and possible burning of severe storm/flood event debris.	Deferred to (2013 - 2016)	9.3/20
9.7	Promote and encourage the adoption and enforcement of federal floodplain management standards by local governments throughout the state to control floodplain development for the purpose of minimizing the risk to property and life.	Deferred to (2013 - 2016)	8.1/16
9.8	Encourage inclusion of the local fire plain administrator official in the review process for local development proposals.	Deferred to (2013 - 2016)	9.2/19
9.9	Encourage and assist local governments to adopt land use controls that would prohibit the placement or replacement of manufactured homes (modular and mobile homes) within the floodway and other vulnerable sections of the floodplain.	Deferred to (2013 - 2016)	9.2/19
9.10	Provide training to local jurisdictions on NFIP requirements and the necessity for ensuring/maintaining continued compliance. Encourage sanctioned local jurisdictions to participate in the National Flood Insurance Program (NFIP) and develop a local floodplain management program in accordance with the NFIP requirements.	Deferred to (2013 - 2016)	8.1/16
9.11	The Tennessee Drivers Instruction Manual and written examination should address the dangers of driving through floodwater, fog, smog, and smoke. Thus, by the inclusion of such information, new drivers will gain a better understanding of the hazards and heed warnings more responsibly.	Completed	Excluded (Not in planning's scope)
9.12	Promote the installation of flood height markers on utility poles or buildings in high visibility locations to indicate the 100-year flood level and flood of record.	Deleted (Not cost effective)	Excluded (Not cost effective)
9.13	Maintain a proactive Hazard Mitigation Grant Program, promoting mitigation activities that significantly reduce or permanently eliminate the risks of flooding through activities such as, but not limited to: acquisition, drainage improvement, flood-proofing, etc. Identified Repetitive Loss/Severe Repetitive Loss (SRL) properties will be given increased emphasis in the prioritization methodology for proposals/projects.	Deferred to (2013 - 2016)	11.2/25
9.14	Ensure timely annual notification is made to affected local officials and property owners of Repetitive Flood Claims and Severe Repetitive Loss properties and the available assistance for reducing such losses.	Deferred to (2013 - 2016)	11.1/24
9.15	Educate the citizenry about the availability of flood insurance through the National Flood Insurance Program (NFIP).	Deferred to (2013 - 2016)	7.2/15

Strategy in 2010 HMP	Project Description	Status	Strategy/Action in 2013 HMP
10.1	Encourage geo-technical testing and better engineering for construction in known karst areas to reduce the occurrence of collapse, flooding, and groundwater contamination.	Deferred to (2013 - 2016)	16.1/38
10.2	Restrict construction of man-made structures (other than public roads and highways) at the top, face and base of steep slopes where possible areas of instability (landslide, slumping, etc.) could occur due to heavy rainfall, toe removal of a hill, or an earthquake.	Deferred to (2013 - 2016)	16.2/39
11.1	Ensure severe storm weather watches and warnings are transmitted through to the local (individual citizen) level by developing a comprehensive alerting and warning system at the state/county/community level. Also, encourage/promote the development of a comprehensive program to identify and prioritize sites for warning systems with the state acting as the liaison between local and federal governments in advising about the availability of technical assistance and potential funding sources.	Deleted (Not in planning's scope)	Excluded (Not in planning's scope)
11.2	In concert with the local emergency management agencies (EMAs), educate residents/local communities on the logic behind and necessity for the construction of communal shelters.	Deleted (Not cost effective)	Excluded (Not cost effective)
11.3	Secure enactment of legislation both at the state and local governments; requiring the construction of communal storm shelters in mobile home parks and apartment complexes.	Deleted (Not feasible)	Excluded (Not feasible)
11.4	Encourage farmers to ensure uninterrupted power through acquisition of backup generator/s either by individual farm or farm cooperatives.	Deleted (Not cost effective)	Excluded (Not cost effective)
11.5	Promote regular maintenance of tree trimming, as well as construction mitigation actions, such as burying power lines or reinforcing water treatment facilities.	Deferred to (2013 - 2016)	7.1/14
11.6	Promote the construction/use of safe rooms/areas.	Deferred to (2013 - 2016)	17.1/40

5.6 – Local Capabilities

Local capabilities are the existing programs and policies through which local governments implement mitigation actions to reduce potential disaster losses. The local capability assessment provides a general description of local mitigation capabilities in Tennessee and their effectiveness for mitigation. The HMPC assessed the challenges and opportunities to implementing and strengthening local mitigation capabilities in Tennessee through a small group brainstorming process. The key issues identified from this process and from reviewing capabilities identified in local plans are summarized below.

There is a wide range of policies that can serve as a foundation for implementing local mitigation plans, including building codes, floodplain ordinances, zoning codes, and comprehensive land use plans. The state continues to encourage and authorize through state statute local adoption of these types of capabilities, but they are not required. Other types of capabilities that may be used to implement local mitigation actions include economic development plans, capital improvement plans, stormwater management plans, erosion management plans, environmental regulations, growth management plans, and hazard specific ordinances.

In 2011, the *Status of Planning and Land Use Controls in Tennessee* manual was published to facilitate a more comprehensive understanding of the role land use controls and zoning play in mitigation efforts and local and state integration. This manual provides includes regional analysis of population to zoning ordinance relationships and the role that Local Planning Assistance Office potentially played in developing mitigation strategies. It also provides guidance for counties and regional planning authorities in regards to the integration of land use controls and the NFIP.

The following table illustrates counties with zoning ordinances and their proportional population.

Table 113 – Zoning & Subdivision Regulations, Tennessee (2011)

	County Population Range						
Counties	**Under 25,000**	**25,000 - 50,000**	**50,000 - 75,000**	**75,000 - 100,000**	**100,000 - 200,000**	**200,000 and more**	**Total**
Total	38	32	11	3	7	4	95
% of Total	40.00%	33.68%	11.58%	3.16%	7.37%	4.21%	100.00%
Total with Zoning	10	15	9	3	7	4	48
% with Zoning	26.32%	46.88%	81.82%	100.00%	100.00%	100.00%	50.53%
Total with Subdivision Regulations	20	25	11	3	7	4	70
% with Subdivision Regulations	52.63%	78.13%	100.00%	100.00%	100.00%	100.00%	73.68%

Local Emergency Management Departments

The county emergency management agency is the first line of defense in responding to emergencies in their jurisdiction. TCA 58-2-110 requires counties to develop a county emergency management plan that is consistent with the TEMP and emergency management program to ensure an effective response and recovery. This plan, called a basic emergency operations plan, must be periodically reviewed and approved by TEMA. Conceptually, local emergency management responders deal with an emergency in their jurisdiction with their assets and with as much additional support that may be provided by intrastate mutual aid or assistance under TCA 58-8-101. When the emergency exceeds the local jurisdiction's capability, the county may request additional assistance from higher levels of government. The mayor or his authorized representative, typically the emergency management director, may request formal assistance from other jurisdictions, including state and federal help.

- Counties have responsibility for emergency preparedness and response within their jurisdictions. These officials may appoint an Emergency Management Coordinator/Director (EMC) to manage day-to-day program activities. Local emergency management programs include all hazard threat identification and prevention activities, emergency planning, providing or arranging training for local officials and emergency responders, planning and conducting drills and exercises, carrying out public education relating to known hazards, designing and implementing hazard mitigation programs, coordinating emergency response operations during incidents and disasters, and carrying out recovery activities in the aftermath of a disaster.
- Local emergency management organizations may be organized at the city level, at the county level or as an inter-jurisdictional program that includes 1 or more counties and multiple cities. Local emergency management organizations may be organized as part of the county's staff, as a separate office or agency, as part of the local fire department or law enforcement agency, or in other ways. Local emergency management agencies may also have some homeland security responsibilities.
- Many local jurisdictions have an Emergency Operations Center staffed by members of its various departments which is activated to manage the response to major threats and incidents and coordinate internal and external resource support. Some local governments have an alternate or mobile EOC as well. Most local governments use the Incident Command System (ICS) as their incident management scheme. Under ICS, an Incident Commander typically directs the on-scene response by local responders from a field command post set up at or near the incident site. Responders from other jurisdictions and state and federal responders that have been called on to assist when local resources are inadequate to deal with a major emergency are integrated into the local incident command system.

While counties are required to develop an emergency management plan, many smaller jurisdictions also adopt plans and even create agencies or departments to deal with the specific needs of their citizens. In Tennessee, these smaller jurisdictions include cities, local school districts and university campuses.

Local Hazard Mitigation Plans

Federal regulations require local jurisdictions to prepare and adopt a local hazard mitigation plan approved by FEMA to be eligible for FEMA's Hazard Mitigation Grant Program and Pre-Disaster Mitigation program. The mitigation section of TEMA supports local hazard mitigation planning, administers funding programs, and reviews plans before submission to FEMA. There are 67 FEMA approved local hazard mitigation plans in Tennessee. Therefore, out of 95 counties in Tennessee, about 70% have approved/approval pending adoption local hazard mitigation plans. Several other plans are at various stages of review and adoption. The majority of these local plans are multi-jurisdictional and also cover incorporated communities and special districts.

Building, Fire, and Life Safety Codes

The State Residential Building Code Enforcement Program applies to one- and two-family dwellings and townhouses in areas of the state that have not: 1) received an exemption from the State Fire Marshal's Office by having local building codes enforced by the local government, or 2) opted out of state residential building codes and enforcement by a 2/3 vote of the city or county's legislative body. The state has adopted the 2009 International Residential Code (IRC) and the 2006 International Energy Conservation Code (IECC). Fire sprinkler systems are not required in one- and two-family dwellings or 3 unit townhouses that are less than 5,000 square feet, 3 stories or less, and separated by 2 hour fire walls. Effective October 1, 2011, additions over 30 square feet to existing homes will require a permit. The existing home will not be required to be brought up to code; however, the addition must meet code.

State statutes do assign the fire marshal the responsibility of establishing reasonable and uniform regulations to ensure a minimum level of life safety. To meet the intent of the Tennessee Fire Prevention Code and other statutory requirements, new construction and changes in building use are required to be under the direct supervision of a licensed design professional. It is also required to be designed and constructed to a criteria established by 1 of the 3 model building codes adopted by Tennessee regulations, and either have plans reviewed for compliance to code intent or receive a building permit from a local building official with fire authority with building inspections during construction as well as receive a certificate of occupancy prior to formal use.

Land Use and Comprehensive Plans

The preparation of a comprehensive land use plan is optional for local governments in Tennessee. The state planning statutes are permissive, that is, local governments have the authority to engage in a variety of planning activities. There is no mandate from the state that they are required to have a plan for the future development of the area.

The power to engage in comprehensive planning and to adopt land use controls is authorized by the planning and zoning enabling statutes contained in TCA Title 13. Municipalities and counties are given the authority to establish planning commissions, prepare and adopt a general plan for future development, and adopt and enforce subdivision regulations and a zoning ordinance.

A general or comprehensive plan is not required for local governments to adopt and enforce subdivision regulations and zoning ordinances. Furthermore, there is no requirement for consistency between the zoning ordinance and a comprehensive plan, if it exists. The legislative body is also not required to adhere to the plan in the consideration of zoning amendments in the original statute. An amendment to Title 13 gave local governments the authority for a municipal or county planning commission to recommend the adoption of the plan by the legislative body. If that procedure is followed and the plan is adopted by the legislative body, the plan becomes a legal document of the legislative body, and the law then requires that all land use decisions must be consistent with the adopted plan.

Floodplain Management

The potential for future flood damage may be reduced significantly by preventing inappropriate development from occurring in flood-prone areas. Local governments may accomplish floodplain management through their land use planning and zoning authority to protect the public health, safety, and welfare. Multi-objective management of flood-prone areas can provide significant benefits for recreation, water quality, and wildlife habitat while reducing the risk of future flood damage.

State statute allows cities and municipalities to designate flood zones and restrict the use of land within these zones. It requires that any local ordinances relating to flood zones be in compliance with the Flood Insurance Act of 1968. Currently, out of 442 communities (including municipalities and counties), 394 participate (89%) in the National Flood Insurance Program. Of these NFIP participants, 17 (4%) are current in the associated Community Rating System. Of the top 50 Tennessee communities, in terms of total flood insurance policies held by residents, 6 participate in the CRS.

Currently, in Tennessee there are 18 local jurisdictions that are known to be vulnerable to flood hazards that are not yet participants in the NFIP. According to the Tennessee Water Plan, flood insurance is available to nearly 95% of Tennesseans living within identified flood hazard areas, but fewer than 15 % of flood hazard area residents are actually covered by flood insurance.

One concern of the state mitigation program is repetitive loss properties. There are 902 identified repetitive loss properties in Tennessee. Flood losses to these properties have resulted in total payments of over $59 million over the last 30 years. To date, Tennessee has used mitigation funding from various sources to mitigate 186 repetitive loss properties. Currently, there are 44 validated severe repetitive loss properties in Tennessee. Total payments to these 44 properties and their contents have equaled over $5 million.

Table 114 – Floodplain Management Summary, Tennessee	
NFIP Communities	394
Non NFIP Communities in Identified Hazard Areas	18
CRS Communities	17
Non Mitigated RL/SRL Properties	902

**The data are from FEMA.*

Regional and Local Water Resource Management Organizations

Tennessee state agencies are assisted in their efforts to effectively control water resources through regional and local water resource management organizations. From the state level, the Tennessee Department of Environment and Conservation, the Department of Agriculture and the Water Resources Technical Advisory Committee works with these regional and local organizations on a regular basis.

National Weather Service StormReady Program

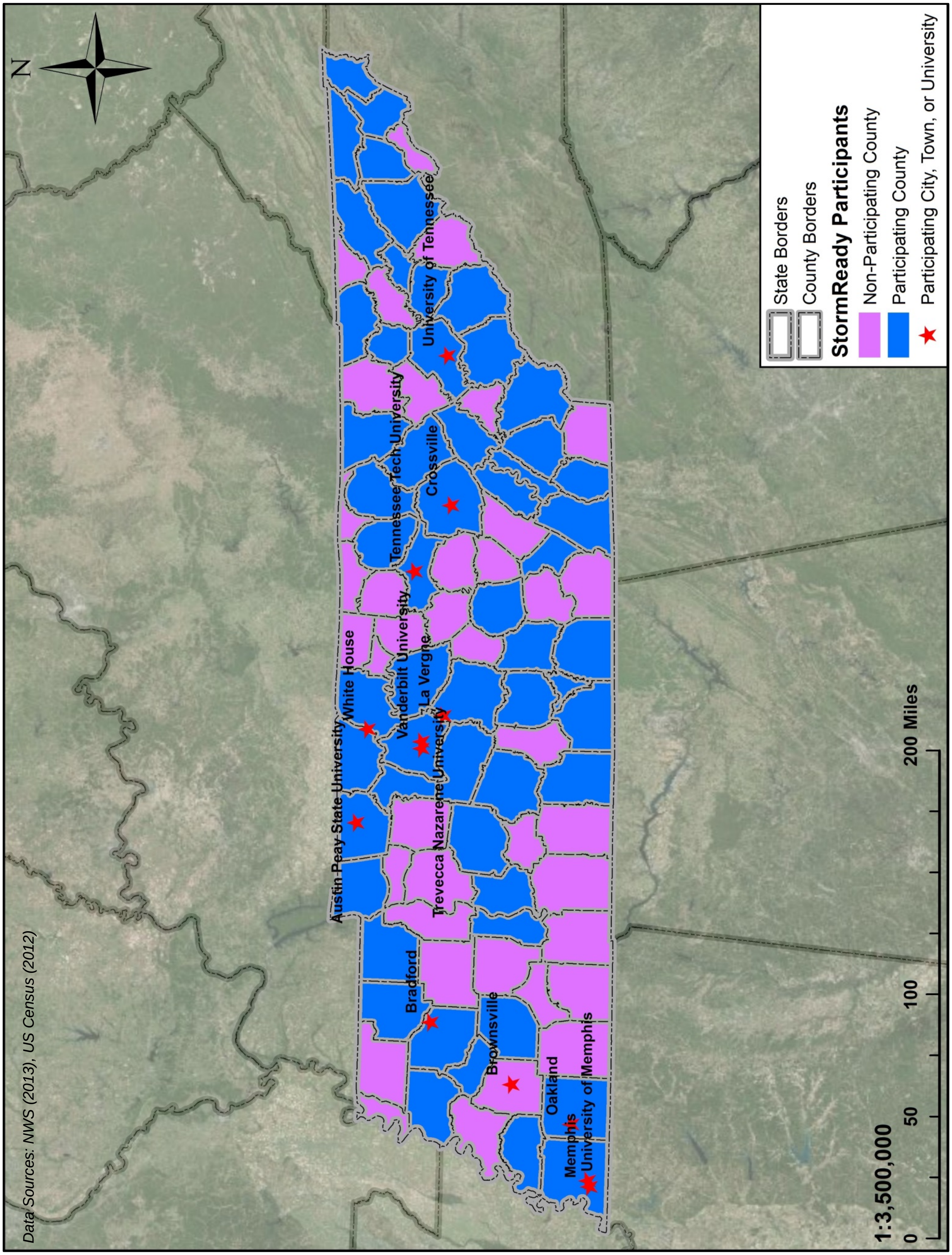
StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to flooding. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. StormReady is designed to help community leaders and emergency managers strengthen local safety programs.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center,
- Have more than 1 way to receive severe weather warnings and forecasts and to alert the public,
- Create a system that monitors weather conditions locally,
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

In Tennessee, there are 56 counties, 6 communities, 6 universities, 1 military site, and 16 supporters with StormReady designations. Please see Map 147 on the following page.

Map 147 – StormReady Communities, Tennessee



5.6.1 – Implemented Local Mitigation Projects

Another measure of a local government's capabilities is its ability to complete mitigation actions and activities as proposed in their local hazard mitigation plans. TEMA's tracking of local mitigation activities is being refined in this HMP and is discussed further in the plan maintenance section. In its current state, TEMA's database is not complete. However, the following table lists the recorded and tracked completed mitigation actions from local government's most recently updated local hazard mitigation plans. Additionally, Map 148 displays all completed local mitigation projects within the State of Tennessee since 2010 and Map 149 displays all completed local mitigation project within the State of Tennessee since 2000.

Table 115 – Completed Local Mitigation Projects

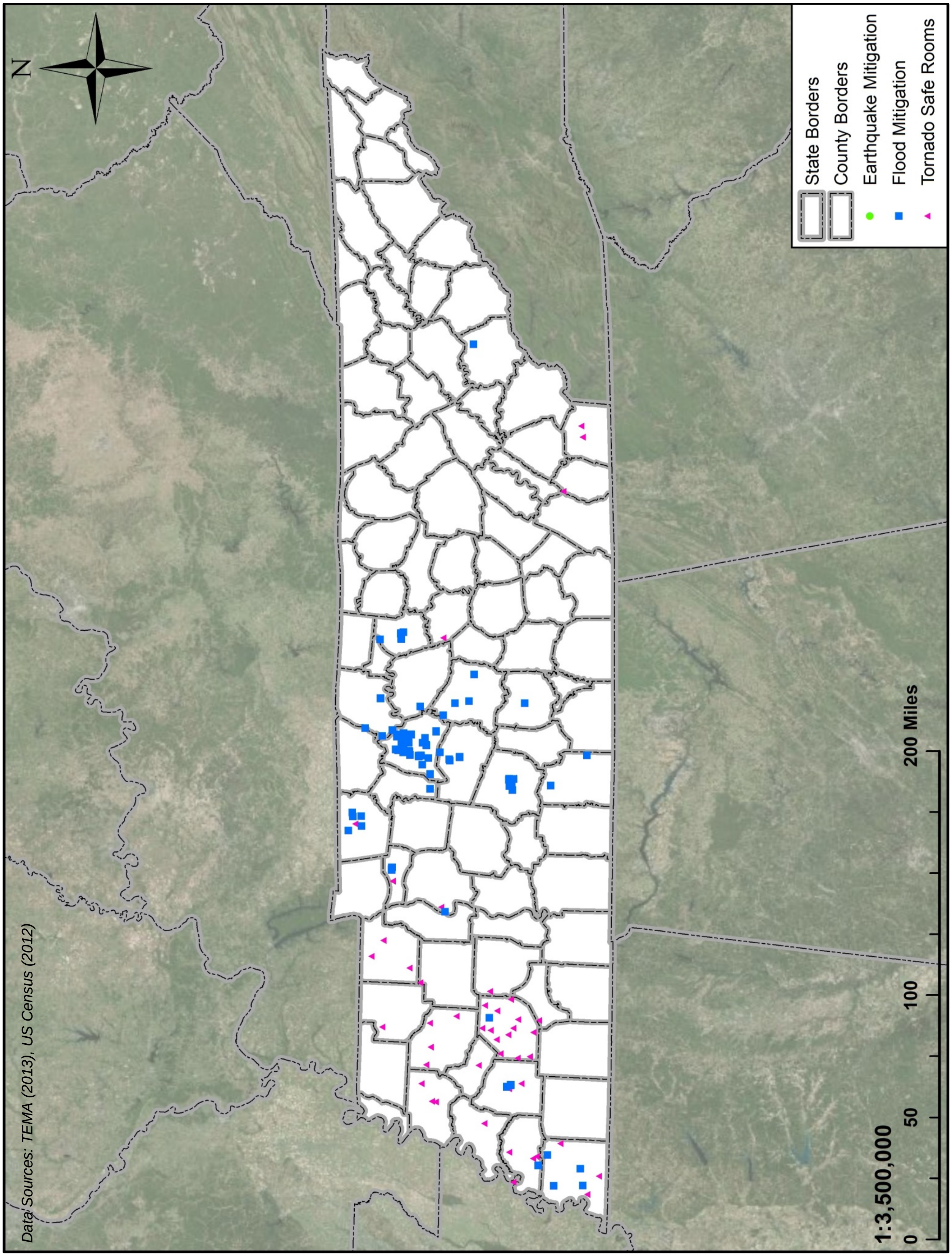
Jurisdiction	Project	Description
Anderson County	Channel Widening	In 1959, the U.S. Army Corps of Engineers made channel improvements through the town of Lake City and excavated an overflow gap through a ridge downstream of town. That work provided protection from a 100-year flood incident for most structures that existed in Lake City at that time.
Anderson County	Channel Improvements	A major flood occurred in the communities of Briceville, Fratersville, and Beech Grove on December 1969, resulting in a fatality on Beech Grove Fork, a tributary of Coal Creek, and prompting TVA to perform channel improvements along Coal Creek from a point approximately 2000 feet upstream of Briceville Elementary School to a point approximately 400 feet downstream of where Beech Grove Fork discharges into Coal Creek, providing protection from a 50-year flood incident for most structures existing at that time.
Anderson County	Acquisition of Private Property	In 1999, Oak Ridge received a FEMA grant to acquire and raze 25 homes affected by land subsidence. Total cost was $3,193,680.
Anderson County	Improved GIS Functionality	The purchase of GIS software and equipment and hiring of a full-time GIS director.
Anderson County	Parental Notification System	All 3 school systems have implemented direct parent contact phone systems.
Anderson County	Preparedness Exercises	Anderson County has expanded preparedness exercises to include severe winter weather and earthquake incidents.
Anderson County	Road Widening	Necessary due to out of bank flooding of the East Fork or Poplar Creek. The creek previously covered the road.
Anderson County	River Channel Clearing	In August 2010, Lake City received a PDM grant totaling $557, 335 for bank stabilization and selective removal of earth-rock sediment from the Coal Creek stream bottom to reduce out-of-bank flooding and erosion.
Carroll County	NOAA Repeater	Work with Henry County to put in a NOAA weather radio repeater to better reach Bruceton, Hollow Rock, and McKenzie.
Carroll County	Dam Construction	County built a dam/lake which will help reduce the amount of flooding of agriculture landing in the western part of the county.
Crockett County	NFIP Membership	Completed - since the first review both Bells and Gadsden have been added to the NFIP by FEMA
Davidson County	EOC Software/Hardware Upgrade	OEM has purchased and is actively utilizing WebEOC within the local Emergency Operations Center
Davidson County	Flood Warning Gauges	Installed hardware for the alarm system at the Dry Creek flood control structure. The alarm will alert MWS and OEM. This was conducted using 100% local funding. Manual staff gauges were installed in 2009 at Mill Creek and are in the process of being installed at Seven Mile Creek.

Jurisdiction	Project	Description
Davidson County	Flood Plain Mgt. - Property Acquisition	Since 2002, MWS has acquired and removed 52 homes from the 100 year floodplain.
Davidson County	Flood Plain Mgt. - Monitoring	The GIS database was completed in 2003 based upon the available data through 2002. A maintenance schedule using the GIS database was initiated in June of 2004. The MWS Stormwater Division Maintenance Staff estimate that they inspect 100 stormwater structures each month. The inspection program is performed in conjunction with system maintenance for documentation purposes.
Davidson County	Flood Plain Mgt. - Public Works Staffing	The MWS Stormwater Division currently employs 8 maintenance crews. The crews are assigned to large ditch maintenance, stormwater inlet construction, stormwater inlet cleanout, and masonry.
Davidson County	Flood Plain Mgt. - Deed Restrictions	Deed restrictions have been revised and/or placed on all flood prone lands purchased with public funds as a part of the CRS annual review and update.
Davidson County	Flood Plain Mgt. - Specific Citizen Info Plan	Developed for the repetitive loss homeowner mail outs, a database of parcels and structures located in the floodplain has been linked to existing elevation certificate information. This information is provided to all homeowners located in the floodplain on an annual basis. Approximately 10,000 homeowners currently receive a residence-specific mail out.
Decatur County	Communications Resources	Have available a list of ham radio operators to assist with communications.
Decatur County	Resource Mgt. - Generators	Have a list and location of available generators and provide these to emergency response people.
Decatur County	Incident Command	A secure room to be prepared at the water filter plant and waste water treatment system for use in the event of a major incident.
Decatur County	Incident Command	EMA, Rescue Squad, and Fire Department personnel to develop an evacuation and detour plan for use in disaster events.
Decatur County	Water Mgt.	Scotts Hill to complete the construction of a 400,000 gallon water storage tank and 2 new wells to enhance the water supply and pressure to their customers.
Dickson County	Flood Mgt.	Updated flood maps.
Dyer County	Flood Mgt.	As a result of the 1997 tornado and flood Dyer County applied for and was awarded a hazard mitigation grant. These funds were used to purchase 14 homes in the Bogota and Miston communities and relocated their occupants.
Dyer County	Severe Weather Notices	The cities of Dyersburg, Newbern, and Trimble and the communities of Finley, Fowlkes, and Tigrett installed outdoor tornado warning sirens. Dyer County purchased a NOAA weather radio transmitter to serve all the citizens of the county and Northwest Tennessee.
Fayette County	Acquire Emergency Generators	Acquire emergency generators
Fayette County	Weather Spotters	Develop weather spotter's program across the county and especially smaller jurisdictions such as Williston, Lagrange, Braden, and Gallaway.
Gibson County	Flooding Avoidance	Local codes enforcement has razed houses in Humboldt.
Gibson County	Building Codes - Earthquake	Building Codes - Trenton, Dyer, Milan, Humboldt, and Gibson County have adopted by resolution the international code in accordance with the State of Tennessee.
Gibson County	Participated in TNCat07	Participated in TNCat07
Hamilton County	Installation of early warning system (Reverse 911)	Completed: A reverse notification system to contact all landlines in the county was completed in 2005. County Emergency Services expanded the capabilities of the notification system in 2009 to contact cell phones, e-mail, and VOIP.

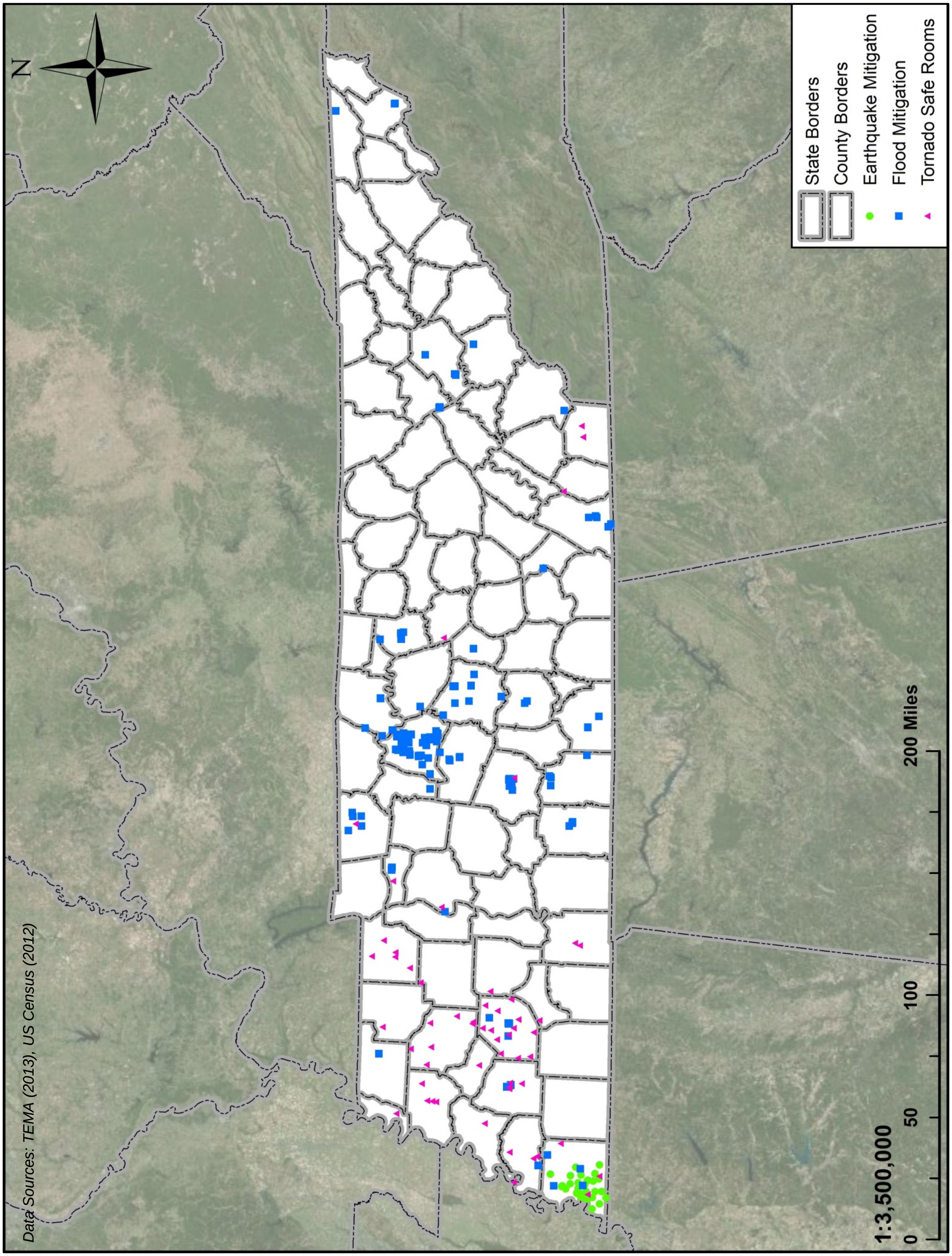
Jurisdiction	Project	Description
Hamilton County	Creek Bank Stabilization	The city received a grant from FEMA in the amount of $1,300,000 to stabilize the creek banks and re-channel over 2,000 feet of the creek. Gabion baskets were installed on the north west side of the creek (adjacent to the Willow Creek Subdivision) for 700 feet and on the northeast side of Dayton Pike bridge adjacent to the industrial park for 325 feet. Total cost of project to include in-kind services is estimated to be $1,600,000.
Henderson County	First Aid Presentations	Prepare and use a disaster and first aid kit to present programs on preparedness for senior citizens, volunteer fire fighters, rescue squad members, and other community groups.
Henderson County	Compile List of HAM Radio Operators	Have available a list of ham radio operators to assist with communications.
Henderson County	Right of Way Mgt.	Henderson County Highway Department to use heavy-duty, side mounted mowers with tractors of sufficient size to operate the mower for cutting down trees and brush that fall on roads and interfere with traffic flow. County funds were used to purchase 2 of these machines in 2005.
Henderson County	Asset Location	Have a list and location of available generators and provide to emergency response people.
Henderson County	NFIP Compliance	Sardis and Parkers Crossroads to complete the certification process for participation in the NFIP and for Henderson County, Lexington, and Scotts Hill to keep their certification current. ALL ARE CERTIFIED.
Henry County	Bridge Removal	City of Paris removed a bridge on Post Oak Drive that was causing flooding in the Valley Wood and Franklin Drive areas.
Henry County	Hardened School Hallways	Paris Special School District completed a new addition at Rhea Elementary School for use as classrooms for kindergarten students. This new addition included hardened hallways to be used as safe areas during severe weather events and earthquakes.
Henry County	Water Source	Henry County Medical Center installed on site water well and water storage tank for back-up potable water supply during disruption of main water supply.
Henry County	Safe Building Built	Tornado Safe Building at Inman School was dedicated and keys turned over to Paris City Manager, Carl Holder and Henry County Mayor, Brent Greer. The building will hold up to 800 persons. PSSD plans to add multi-media equipment and encourages local government to use facility for meetings and events.
Henry County	Bridge Replacement	City of Paris Public Works replaced bridge on Lane Oak Rd with larger box culvert.
Madison County	Anderson Creek flood Mitigation Project	HMGP grant. With 25% local matching funds
Tipton County	Relocation of Atoka wastewater pumping station	Relocate Atoka's wastewater pumping station on Meade Lake Road to a site above flood level to avoid recurring flood damage. Completed in 2008. Funded with an HMPG/CDBG grant
Tipton County	Cobb Parr Park Detention basin	To reduce flooding along Hazen Branch, which runs from the Cobb Parr Park Basin down along the west side of Highway 51, under Highway 59, continuing along the west side of Highway 51 until its confluence with Town Creek north of Peeler Street in Covington, a detention basin was constructed at the lower end of Cobb Parr Park to release the rainfall runoff at a more controlled rate thereby reducing the flood frequency. Completed in 2008 with an HMPG/CDBG/TDOT grant. City of Covington was responsible for the project

Jurisdiction	Project	Description
Tipton County	Increase the size of Munford Culverts	Eliminate flooding along an area between East Drive and West Drive in Munford, by replacing existing culverts with larger ones and installing either headwalls or riff-raff. Completed in 2009 with HMGP funding. Larger culverts also installed between Beaver Road and Bass Street in 2010.
Williamson County	Retention Ponds	22 new retention ponds completed as of 2005 to mitigate flooding in the City of Fairview
Williamson County	Hill Estates drainage improvements	General locally funded improvements to drainage in the City of Franklin.

Map 148 – Completed Local Mitigation Projects, Tennessee (2010 – 2013)



Map 149 – Completed Mitigation Projects, Tennessee (2000 – 2013)



Section 6 – Local Planning

6.1 – Local Planning Integration

Upon approval and adoption of this state hazard mitigation plan, a new 3 year cycle will begin. It is the intention of TEMA's State Hazard Mitigation Planner to update the plan bi-annually. It will not be appropriate to update every section of the plan. Updates will be made to the plan's mitigation goals and objectives, mitigation actions, local plan statuses, grant information, state and local capabilities, and any procedure changes applicable to the processes detailed in this plan. Special attention will be given to these updates to reflect changes in development, priorities, and completed mitigation efforts. On a yearly basis these changes will be presented to Tennessee's ESC program as well as the Hazard Mitigation Council.

TEMA's State Hazard Mitigation Planner's highest priority is local plan development. This includes the state's review process for local mitigation plans. The State Hazard Mitigation Planner requires local jurisdictions not covered by an approved FEMA hazard mitigation plan to submit quarterly reports. These reports detail the local jurisdiction's progress in their hazard mitigation plan development. Once completed, the jurisdiction submits the plan to TEMA for preliminary review. The State Hazard Mitigation Planner reviews plans within a 30 to 45 day timeframe. The state's planner reviews the plans with the utmost scrutiny closely following FEMA's Local Mitigation Planning Handbook and FEMA's Local Mitigation Plan Review Guide. The plan is then returned to the local jurisdiction for revisions, or it is forwarded on to FEMA for their review.

6.2 – Local Planning Assistance

The State of Tennessee is committed to promoting and supporting ongoing successful planning and programming efforts at the local level. To date, this commitment has included financial, technical and personnel assistance in both planning and implementation areas.

There are 95 counties in Tennessee. Currently, 67, or 70%, of those counties have a FEMA-approved/approval pending adoption local mitigation plan.

Table 116 – Local Plan Statuses, Tennessee

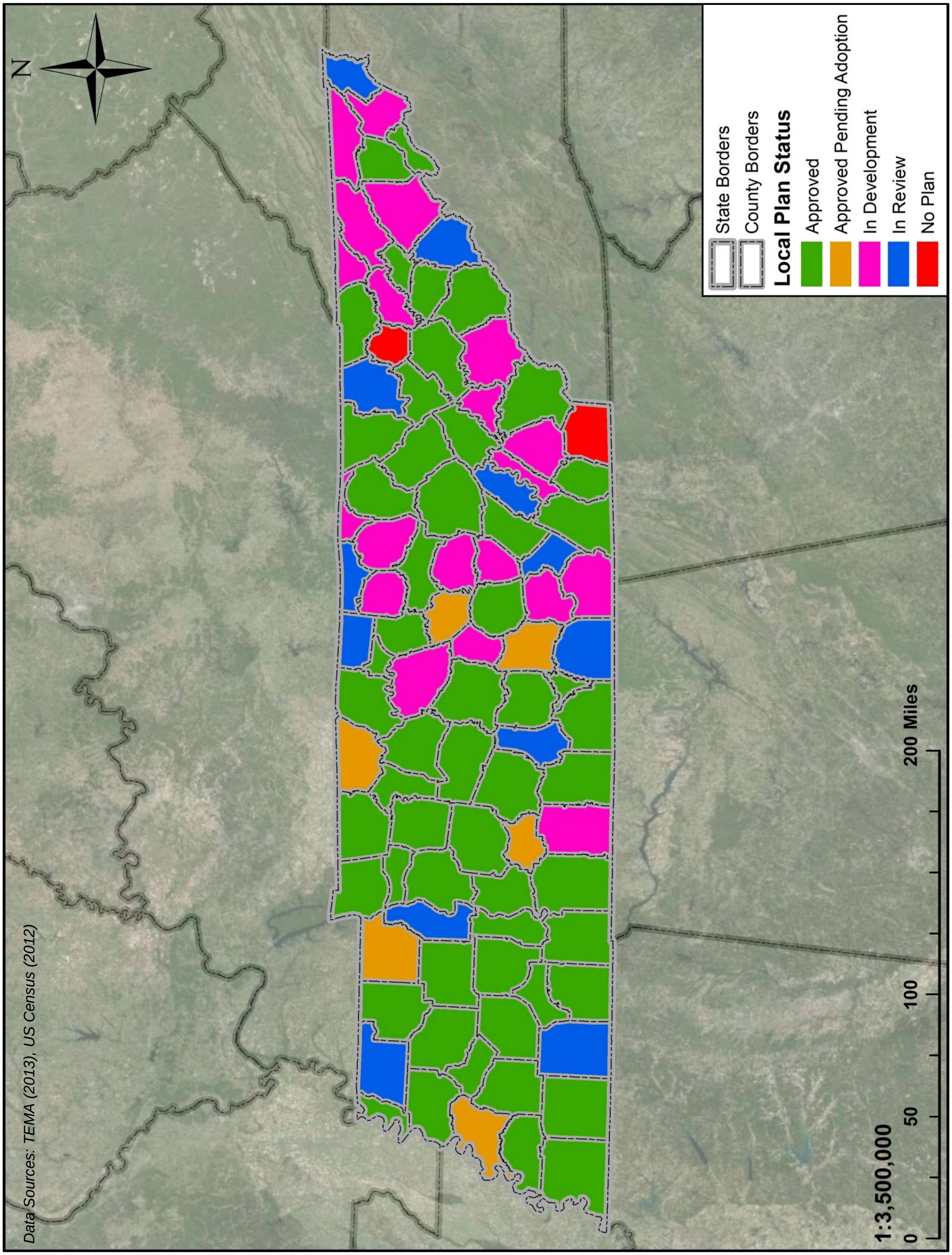
County Status	Count	Ratio	Non-County Status	Count
Approved	62	65.26%	Approved	6
APA	5	5.26%	APA	0
In FEMA Review	3	3.16%	In FEMA Review	0
In TEMA Review	5	5.26%	In TEMA Review	0
In Development	18	18.95%	In Development	2
No Development	2	2.11%	No Development	N/A

Local governments are free to focus their hazard mitigation efforts in a direction of their choosing; however, TEMA encourages local governments to focus on the identified hazards of prime concern. The following table illustrates the alignment of state and local goals and objectives.

Table 117 – Local-State Goal & Objective Alignment

Goal & Objective Categories	% of Local Plans Matching
Increase Grant Eligibility	1.05%
Improve Databases & GIS Data	49.47%
Improve Local Mitigation Capabilities	64.21%
Reduce Vulnerability to Natural Hazards	71.58%
Hazard Specific Goals & Objectives	
Reduce RL/SRL Cost	10.53%
Reduce Vulnerability to Flash Floods	10.53%
Reduce Vulnerability to Severe Storms	3.16%
Reduce Vulnerability to Droughts	2.11%
Reduce Vulnerability to Earthquakes	1.05%
Reduce Vulnerability to Geologic Hazards	1.05%
Reduce Vulnerability to Tornadoes	6.32%
Reduce Vulnerability to Man-Made Hazards	2.11%

Map 150 – Local Plan Statuses, Tennessee



The TEMA is the coordinating body for local hazard mitigation planning. Its responsibilities include:

- Providing funding, as available, to develop local mitigation plans;
- Developing a schedule for completion of local mitigation plans;
- Establishing local mitigation planning criteria;
- Establishing standard methodologies for the identification of hazards, definition of vulnerabilities, and estimation of risk;
- Suggesting categories of critical facilities and systems that are to be addressed in local mitigation plans;
- Providing planning guidance and/or training for local jurisdictions;
- Providing technical support for local mitigation planning efforts;
- Establishing a procedure for receipt and review of completed local plans (including working with FEMA); and Implementing a process to monitor implementation of local mitigation plans.

In light of the number of disasters and the significant amount of Hazard Mitigation Grant Program funding received since 2010, the state has placed a renewed emphasis on the completion and adoption of FEMA-approved plans for all Tennessee counties by the time of the next state plan update in early 2016.

Using protocols provided by FEMA in the *Local Mitigation Planning Handbook (March 2013),* the FEMA 386 "how-to" guides, and the *Local Mitigation Plan Review Guide (October 2011),* TEMA will help Tennessee jurisdictions better understand the planning process and their hazard landscapes to allow the most beneficial projects to be selected. This will be an ongoing support function consisting of workshops as well as one-on-one meetings with individuals and committees to make sure that they receive the information that is required to complete an approvable hazard mitigation plan.

Currently, TEMA offers 3 types of mitigation planning assistance to Tennessee jurisdictions wanting to develop or update a hazard mitigation plan. These 3 assistance options include standard assistance, financial assistance, and Tennessee Mitigation Initiative (TMI) assistance. The State Hazard Mitigation Planner has used these 3 programs to facilitate over 120 local government planning process meetings. The following documentation gives a quick overview of these 3 assistance options.

Standard Assistance

Standard mitigation planning assistance has been used by approximately 30 counties in Tennessee since July 2010. This assistance option includes various levels of assistance mainly in the form of suggestions or trainings for stakeholders in the jurisdiction.

Financial Assistance

Financial mitigation planning assistance has been used by approximately 14 counties in Tennessee since July 2010. This assistance option includes determining if grant programs are available to hire consultants to work with the jurisdictions to facilitate the mitigation planning process, and ultimately gain FEMA plan approval. Since 2010, mitigation grant opportunities have centered on the HMGP, PDM, and FMA programs. These programs are detailed in Section – 5.2.11 of this plan.

Tennessee Mitigation Initiative (TMI)

The Tennessee Mitigation Initiative (TMI) has been used by approximately 45 counties since July 2010. This assistance is designed to provide a no-cost, no-headache approach to assisting local governments in developing hazard mitigation plans with a focus on rural, small, and medium-sized counties. As part of the Tennessee Mitigation Initiative, TEMA planning staff help facilitate 2 planning process meetings, data collection and analysis, as well as actual mitigation plan development. The TMI program is considered extremely successful, and has played a vital role in the mitigation planning progress across the State of Tennessee.

Other Mitigation Assistance

In addition to the planning guidance, training, and support offered by TEMA, there are several state agencies and programs that can provide local governments with technical assistance in their mitigation planning. Some of this assistance is described below.

- The Data Access and Support Center provides GIS data.
- The Tennessee Department of Agriculture provides information and advice about food supply safety, flood control (floodplain management, dams and levees), and water availability.
- The Tennessee Department of Commerce & Insurance administers community development programs, which can help local governments incorporate mitigation into community development programs.
- The Tennessee Department of Health helps local governments plan for response to major disease outbreaks and to protect the environment.
- The Tennessee Division of Forestry helps with wildfire planning and is working to map the wildland-urban interface.
- The Tennessee Department of Environment & Conservation provides information about geological hazards in Tennessee as well as surface and groundwater issues.
- The Tennessee Water Office has developed guidelines for preparation of municipal water conservation plans. Technical assistance for plan preparation is provided by the Tennessee Rural Water Association. The Tennessee Water Office also has prepared a guide for local officials covering drought actions they should consider and available assistance.
- The State Conservation Commission works with local conservation districts to plan for watershed development and protection (including flood control and rehabilitation projects).

6.3 – Prioritizing Local Assistance

Clearly defined processes and procedures are critical to the fair and reasonable allocation of funds for hazard mitigation. Competing interests at the state and local level must be subordinated to a prioritization paradigm, as outlined in FEMA's Hazard Mitigation Unified Guidance. To this end, the State of Tennessee has established an explicit application procedure for the procurement and prioritization of HMGPs according to a *Mitigation Application Ranking System* (MARS.) This system allows for a finitely scored, but reasonably adaptive assessment of 14 criteria to help facilitate Tennessee's authorities in assessing a request's qualifications for funding. The process has roughly 5 constituent parts.

An application is provided by the state to jurisdictions requesting funding. This application includes a project proposal, which must include project duration, scope of work and anticipated budget requirements. A CBA is a requisite component of the applicant's proposal. If one is not completed, TEMA will conduct one in cooperation with the local body. To this end, clear and demonstrable economic data should be provided in the application and adjuvant materials.

The state then delineates the grants by the specific activity for which the monies will be used. These include: *Acquisition/Elevation, Flood Control, Safe Room/Space, Seismic Retrofit, Planning, and Not Specifically Defined/or/Miscellaneous*. The more specific and targeted the action, the better the Tennessee Hazard Mitigation Council (TNHMC) and the State Hazard Mitigation Officer (SHMO) will be able to establish its eligibility for FEMA funding. The TNHMC is comprised of 10 members from departments with a broad spectrum of experience and interests in mitigation activities and vulnerable sectors. These departments include:

- Department of Agriculture
- Department of Commerce & Insurance
- Department of Economic & Community Development
- Department of Environment & Conservation
- Department of Finance & Administration
- Department of Health
- Department of Safety- Homeland Security
- Department of Safety- Highway Patrol
- Tennessee Wildlife Resources Agency
- Department of Transportation
- TEMA (1 member- State Hazard Mitigation Officer)

Additionally the SHMO will review every application to established NFIP compliance. The components to the MARS system are then scored: These components are broken down as follows:

- The capability of the applicant to complete the activity based on prior project performance and regional assessments of those activities.
- The population of the area in question.
- Median income of that population.
- The community's participation in CRS, adoption of IBC/building codes, history of mitigation efforts, IDS (Intense Developmental Stress) or its involvement in a declared disaster within the past year.
- If involved in a declared disaster, does the proposal directly address said disaster?

- What is the incidence of presidentially declared disasters in the area for the previous 10 years?
- Does the project address high risk hazards for the geographic region at large?
- What is the relative priority of the proposal to only the applicant's area?
- Does the proposal include Repetitive Flood Claim structures (e.g. insured by NFIP and with a history of 1 or more claims for damage or loss)?
- Is the project located in a floodplain or flood way?
- Does the proposal have a demonstrable and direct economic benefit to the local community through either:
    - Private sector?
    - Public sector?
    - Government?
    - The mitigation of disproportionate environmental effects to minorities and low-income individuals per executive order 12898 or partnerships between the government and private sector?
- Does the proposal include CIAO assets, or assets and infrastructure that perform a critical function for the state, region, or area included in the application?
- Will the proposal permanently eliminate or mitigate the hazard being addressed?
- Does the proposal save lives, address more than 1 hazard or consist of multiple objectives that can be accomplished through a single project?

After the completion of scoring the criteria, the proposal is re-evaluated by the HMC and SHMO. This evaluation includes the following criteria, which the members of TNHMC must verify:

- Is there personal knowledge of an activity in progress, completed, or upcoming that could negatively impact the proposal?
- Is there personal knowledge of any existing financial mechanisms?
- Is there potential for the duplication of benefits?
- Is there personal information capable of supporting the applicant, their proposal, or conversely generating concern for either?

Prior to submission to FEMA, applicants include any and all necessary documentation for a FEMA environmental compliance review. This also includes documentation to establish compliance with Executive Order 12898 to ensure that environmental justice is addressed for disproportionally high and adverse human health or environmental effects on minority populations. Additionally, the protection of wetlands and associated long-term environmental costs will be included in the CBA as part of the environmental compliance assurance. This further assists the SHMO in prioritizing applicants and their regions long term as well as short-term needs.

FEMA will conduct an independent and thorough environmental compliance review, though state standards will ensure a transition of application materials and adequate data for this process. Once the SHMO has completed a summary document outlining all proposals, this summary is presented to the MARS TNHMC for prioritization and final review. This disposition is not binding until a majority vote is reached, as well as any non-consenting objections have been discussed in council or individually to resolve particular areas of concern. The council's final recommendations are forwarded to the GAR/Director for a disposition determination.

As part of their targeted and critical mitigation actions, TEMA has identified as a priority in 2.1 and 2.2 the intent to "continue to maintain a professional, trained, and effective, grant programs staff at TEMA to ensure a continual grant cycle." This Mitigation Action allows for the prioritization of community and local grant funding on a rolling basis throughout the planning year, as well as to address it in contacts with community and local planners.

When RL/SRL, FMA, or RFC grants are applicable, the SHMO or TEMA administration may opt to exempt the applicant from the TNHMC requirement as adequate evaluations will substitute for this component of the process. It remains the responsibility of the SHMO however to ensure that all environmental and CBA information satisfies existing guidelines, as well as the MARS scoring system elements.

The SHMO remains responsible for compliance with application procedures during the course of the fiscal year notification cycle. The director and GAR then submits the completed and approved applications to FEMA via the eGrant module. Acting as adjuvants to the application itself are

- Sub-application summaries with rankings, agreement terms and SHMO notes
- Extensions if applicable from Region IV administrators

Additionally, for FEMA HMGP, PDM and FMA grants, the state shall submit all requisite materials via the director and GAR, but will not submit the proposal to the MARS scoring procedures. These materials will still be reviewed by the TNHMC along with all sub-application summaries and CBA and supporting budget documentation.

Final approval authority for all projects described in the preceding outline resides with FEMA, and given project rejection, the SHMO will advise denied applicants of their status, as well as their rights under appeals processes.

Local Plan Assistance Improvements

The new plan includes criteria that specifically address IDS (Intense Developmental Stress), as well as making requisite the adoption of IBC and nationally recognized building codes. According to US Census data and the BEA, Tennessee contains 2 of the 30 most rapidly growing counties in the United States, with both Rutherford and Davidson Counties expected to more than double in population over the next 25 years. This developmental stress meets Tennessee's criteria for intense development as housing adjustments are expected to produce a significant strain on local building codes and enforcement, as well as zoning regulations and comprehensive plans. Further, in high production agricultural regions, the reallocation of existing farm land that may or may not include floodways and flood zones requires dedicated efforts to account for potential loss and environmental consequences.

Additionally, the new plan addresses the executive order that requires planning officials and grant awards to account for the mitigation of environmental impact on minority and low income populations that are disproportionately affected by disasters and emergencies. Recent grants coordinated through TDEC, THDA, and TDOT to improve environmental conditions, access and improve response times during emergencies all point to compliance and awareness of this directive. The MARS scoring requirement incorporates this directive as well as a ranking based on developmental stress. Separate from these 2 categories are the scorings of high risk communities, Severe Repetitive Loss structures, presidential disasters, and assessment of declared disasters in the areas requesting grant funds. Specifically, the criteria differentiate between SRL, RFC, as well as declared disaster areas. The criteria further enumerate and account for properties that are in floodplains and floodways, as well as those with high population densities where disasters have historically occurred. The scoring for those areas with presidentially declared disasters over the preceding 10 year period rises at a proportion to the number of disasters (1-2 equals a score of 1, 3-4 equals a score of 2, until a score of 5 is assigned for 9 or more disasters in the past 10 years). Cumulatively, 54% of the ranking criteria identify and prioritize high risk, hazard-prone areas. Of these 54% high risk criteria, there are 8 separate methods of prioritizing a hazard-prone area as high risk.

A copy of the mitigation application ranking system can be found on the following page.

County:

TID#:

Mitigation Application Ranking System
Hazard Mitigation Grant Application

Applicant: ______ Proposed Activity Title: ______

Total Cost: ______ Federal Share: ______ Non-Federal Share: ______

Description: Ranking Score –__

Category	Scoring		
	Points	Range	
Capability of the applicant to achieve the desired activity, based on previous grants performance, regional recommendation, and/or local mitigation plan capability assessment.		1 to 5	Lowest to highest capability
Population of the applicant area.		1) 50,001 and Up 2) 25,001 – 50,000 3) 15,001 – 25,000	4) 3,001 – 15,000 5) Up to 3,000
Median Income		1) $40,001 and Up 2) $30,001 – $40,000 3) $20,001 – $30,000	4) $10,001 – $20,000 5) Up to $10,000
Does the community have any of the following: • Member of the Community Rating System • Adoption of IBC/Nationally recognized building code • History of mitigation/prevention measures • Intense Developmental Stress[1] • Involved in a declared disaster within the past year? [1]*Intense Developmental Stress (IDS), as defined by the State of Tennessee, is the lack of or inadequate infrastructure to support the rapidly changing socio-economic conditions in the jurisdiction submitting the application.*		0 to 5	1 point for each "yes" answer
If the community was involved in a declared disaster within the past year, does the proposed project mitigate the hazard generating the disaster?		25 points for "yes"	0 points for "no"
Number of Presidentially-declared disasters in their area in the last 10 years.		1) 1 – 2 2) 3 – 4 3) 5 – 6	4) 7 – 8 5) 9 and Above
Does the proposed activity mitigate a high-risk hazard for the project's geographic area?		5 points for "yes"	0 points for "no"
What priority is the project/strategy being mitigated in the applicants plan?		0 points for "Low" 5 points for "Medium" 10 points for "High"	
Number of people benefiting from the proposed activity.		1) Up to 50 2) 50 – 500 3) 501 – 1,000	4) 1,001 – 1,999 5) 2,000 and Up
Does this proposal include a Repetitive Flood Claims structure(s) in proposed activity[2]? [2]*Repetitive Flood Claims (RFC) is defined as a structure insured under the National Flood Insurance Program (NFIP) and has had one or more claim payment(s) for flood damage.*		5 points for "yes"	0 points for "no"
Does this proposal include a Severe Repetitive Loss structure(s) in the activity[3]? [3]*Severe Repetitive Loss (SRL) is defined as a residential property insured under the National Flood Insurance Program (NFIP). The property must have incurred flood losses that resulted in either (1) four or more flood insurance claims payments that each exceeded $5000.00 with at least two of the payments occurring within a ten-year period, or (2) two or more flood insurance claims payments that cumulatively exceeded the value of the property.*		5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodplain?		5 points for "yes"	0 points for "no"
Does this proposal include a property(ies) located in the floodway?		5 points for "yes"	0 points for "no"
Does this proposal consist of a critical facility or function?		10 points for "yes"	0 points for "no"
Provides economic benefit to the local community? • Private sector (residents) • Public sector (business) • Government (local) • Minority (NEPA) • Partnering (between public and government)		0 to 5	1 point for each "yes" answer
Will the proposed activity permanently eliminate the problem?		5 points for "yes"	0 points for "no"
Will the proposed activity: • Save lives? • Mitigate more than one hazard? • Accomplish multiple objectives?		0 to 6	2 points for each "yes" answer

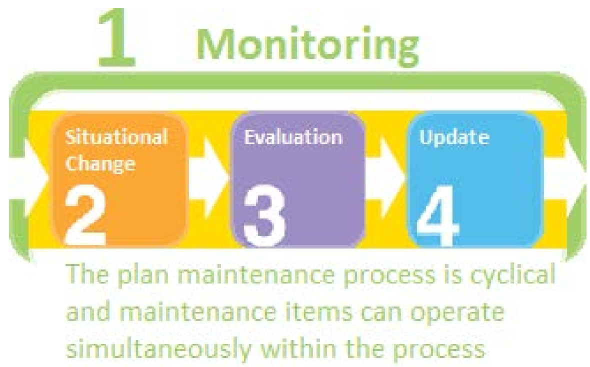
☐ Concur ☐ Non-Concur*

Signature ______ Agency ______ Date ______

Council Questions	Yes*	No
	If Yes, provide explanation	
Do you have personal knowledge of any activity in progress, complete, or upcoming that could negatively impact or conflict with the objective of the proposal (i.e., future highway construction, neighborhood expansion, etc.)?		
Do you have personal knowledge of any other financial mechanism(s) capable of providing assistance for the proposal?		
Do you have any reservation to the possibility of a Duplication of Benefits?		
Do you have personal knowledge of additional information capable of lending support to, or creating concern for, backing the proposal/applicant?		

* Any "Non-Concur" or "Yes" answer requires explanation.

Section 7 – Plan Maintenance Process

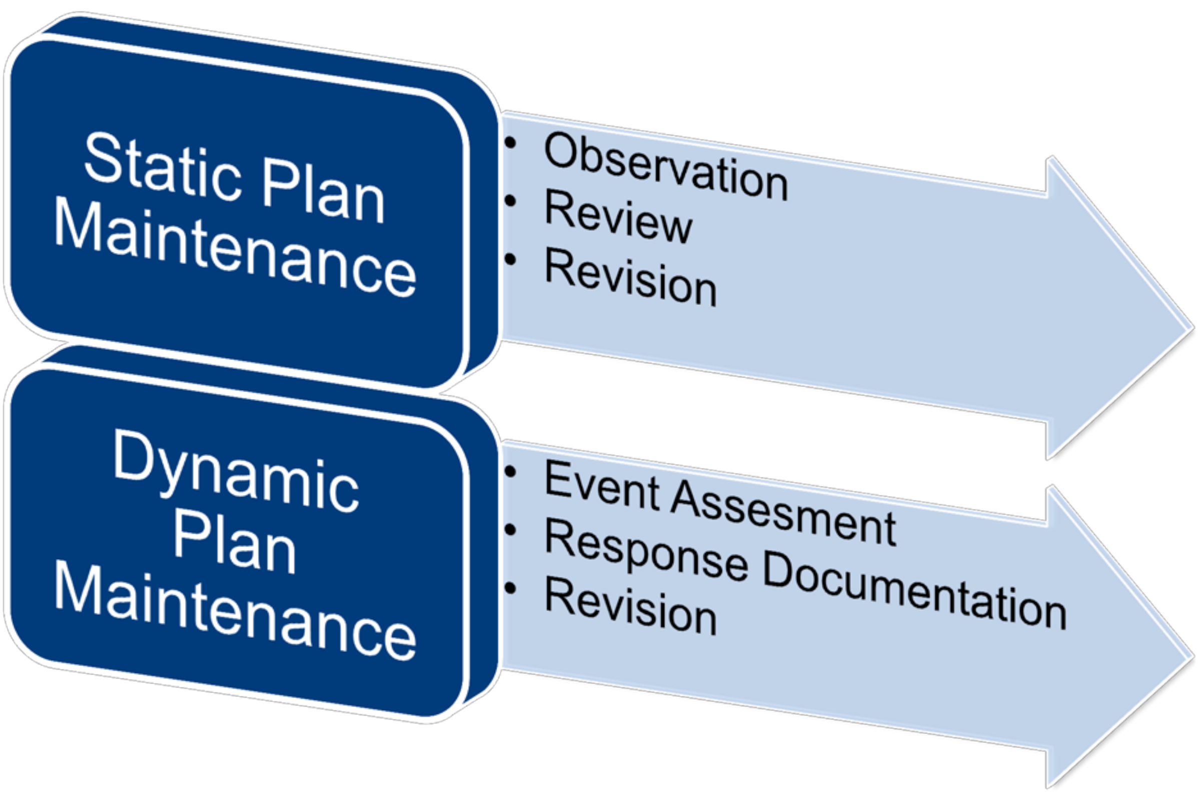


The rebuilding of TEMA's mitigation program, as discussed later in this section, demanded a complete re-write of the HMP's maintenance process. Although plan maintenance was conducted over the past 3 years, it was due to a surge in interest and participation in mitigation and lacked a formal, established process.

While plans are relatively static, the conditions, governments and populations that inform them are not. The maintenance process for the plan in a dynamic setting, as well as with a static timeline is critical to ensure current and up to date information, contact points and accurate legislative guidance. These 2 workflows (an established and fixed one, as well as the dynamic allowances) can operate simultaneously, concurrently or symbiotically under the guidance of the State Hazard Mitigation Planner. Examples of static evaluation for plan maintenance include scheduled annual meetings, LiDAR and GIS plus attendant dataset updates. Both approaches, static and dynamic, work simultaneously throughout the plan maintenance process.

The static workflow maintenance has 3 primary facets: observation, review and revision. These 3 are inherently dependent on integrated scheduling and all invested parties prioritizing the HMP's goals and objectives in their own reports. These reports should reflect the agency or department's specific efforts to achieve goals and objectives outlined in the HMP.

The dynamic aspects of plan maintenance include similar techniques but progress in a different order and usually on an accelerated timeline. They include, but are not limited to: event evaluation, response documentation and revision.



7.1 – Plan Monitoring

1 Monitoring

Regularly report on mitigation action's/project's progress from start to finish.

Plan monitoring can be defined as the ongoing process by which stakeholders obtain regular feedback on the progress being made toward achieving their goals and objectives. In the more limited approach, monitoring may focus on tracking projects and the use of the agency's resources. In the broader approach, monitoring also involves tracking strategies and actions being taken by partners and non-partners, and figuring out what new strategies and actions need to be taken to ensure progress toward the most important results.

The HMPC will set and adhere to an annual meeting schedule. These meetings will include state employees of HMPC, the State Hazard Mitigation Planner, members of TEMA's planning branch, and ESC's from relevant agencies. The meeting content must address but is not limited to the following:

- Changes in state and/or federal legislation
- Changes in funding sources
- Changes in staffing and TEMA organizational structure
- Recent hazard events
- Changes in demographics and development
- Improvements in and availability of hazard data

These meetings and their agendas will be scheduled in a secure portal, and run exclusively by the State Hazard Mitigation Planner. This will include secure electronic reminders and confirmation of attendance. A log of attendees and documentation including minutes and any and all changes to the plan will be kept and disseminated to the HMPC and TNHMC.

It will be the responsibility of the State Hazard Mitigation Planner to disseminate significant changes in federal fiduciary resources and instruments such as HMPG, PDM or other federal sources of importance to mitigation activities. It falls within the purview of the staff members who manage these grant programs to review, respond or incorporate common changes or regular appropriations information. Significant changes or updated information should be sent to the HMPC within 30 days of receipt. Those projects that are funded solely with state funds for state mitigation efforts will be handled by the agency that provides the state funded grant or loan including those with matching rates to federal funding.

Quarterly	Annual	Three Year
• Conduct site visits or obtain reports of completed or initiated mitigation actions to incorporate in the plan revision as needed. • Coordinate, compile, and disseminate hazard mitigation funding information and applications. • Collect and review NFIP HMG/PDM and grant receipient reports	• Collect annual reports from the agencies involved in implementing mitigation projects • Research and document new natural disaster information and incorporate into the Risk Assessment section as needed. • Organize annual meetings with the Hazard Mitigation Committee • Coordinate, compile and disseminate OIR updates and GIS data.	• Document and collate all major disasters and events during the previous three calendar years. • Revise and Ammend the HMP in accordance with collected data, cost benefit analyses and relevant legislation. • Consolidate close out statistics and cost benefit analyses of mitigation actions and grants given during the previous three years.

7.1.1 – Monitoring Plan Implementation

An organized, effective, efficient, monitoring system is integral to the successful deployment of the HMP's mitigation strategy. Since the approval of the 2010 plan, TEMA has significantly improved its tracking and monitoring systems.

The implementation of the 2010 plan and previous plans used outdated technology. Grant applications, grant closeouts, local and state mitigation activities, local and state mitigation projects, mitigation plans, and the completion of goals and objectives were tracked on a network accessible database file. Although and improvement from written documentation, the network accessible file posed significant drawbacks. Users were required to manually input information creating a risk of non-congruent entries. Manual entry also creates the possibility of user error overwriting needed data with new, but incorrect, data. Additionally, this type of system's success is reliant on users specifically being tasked with updating the database. There is also a chance the database could have succumbed to document divergence caused by more than 1 copy being distributed on the network. Once multiple copies are being used by different users, the data is no longer centralized and it becomes difficult to maintain a common operating picture.

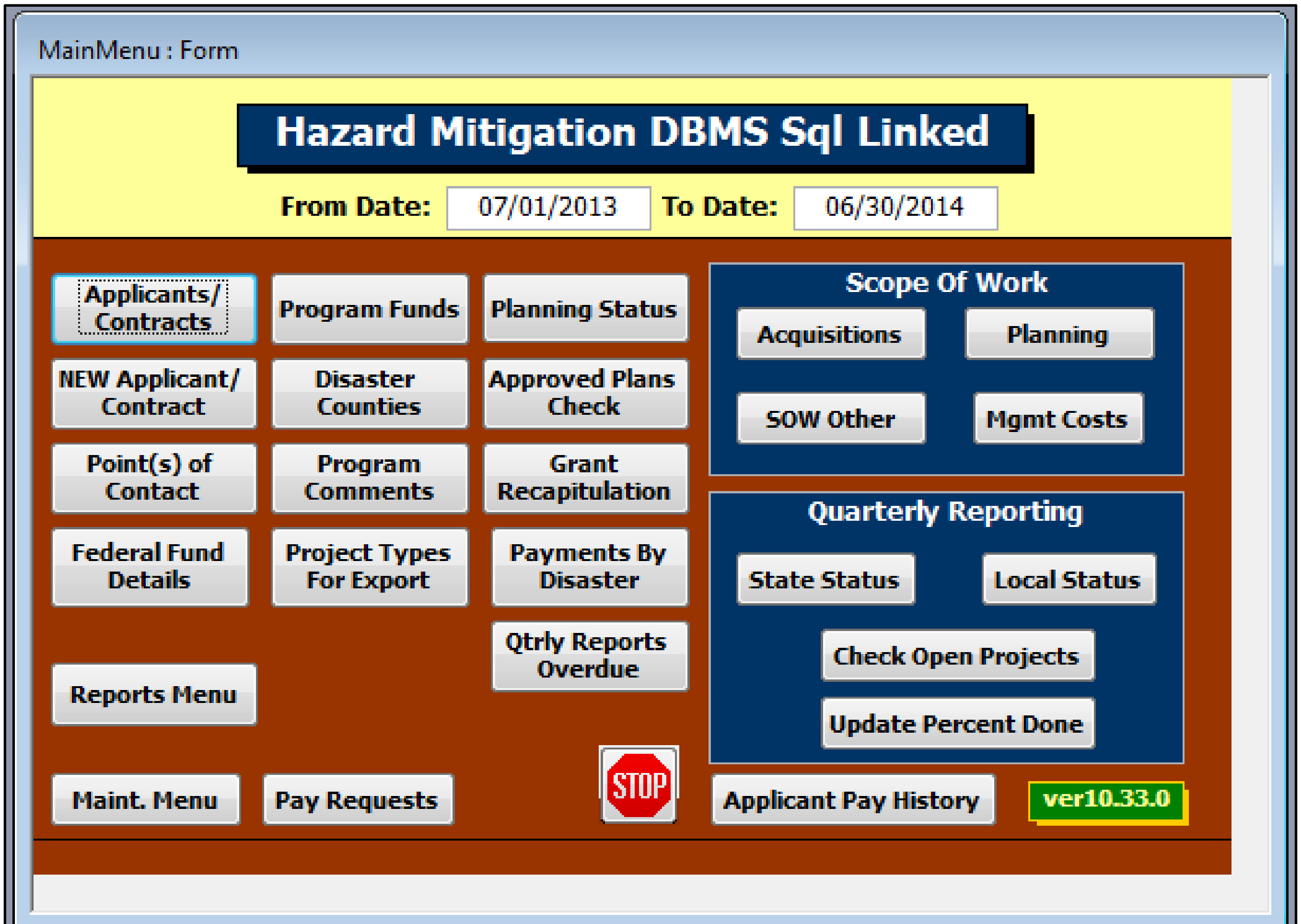
In 2006, TEMA brought online its state of the art Hazard Mitigation Database Management System. The Hazard Mitigation Database Management System runs off of a TEMA hosted Microsoft SQL 2005 database server. In prior years the system was designed and used solely for tracking and monitoring grants, however, over the past year TEMA has begun to integrate the monitoring and tracking of all state mitigation programs, including this HMP. The system integrates all mitigation tracking and monitoring necessary to maintain a common operating picture throughout Tennessee. A centralized SQL system offers significant advantages over the previous system.

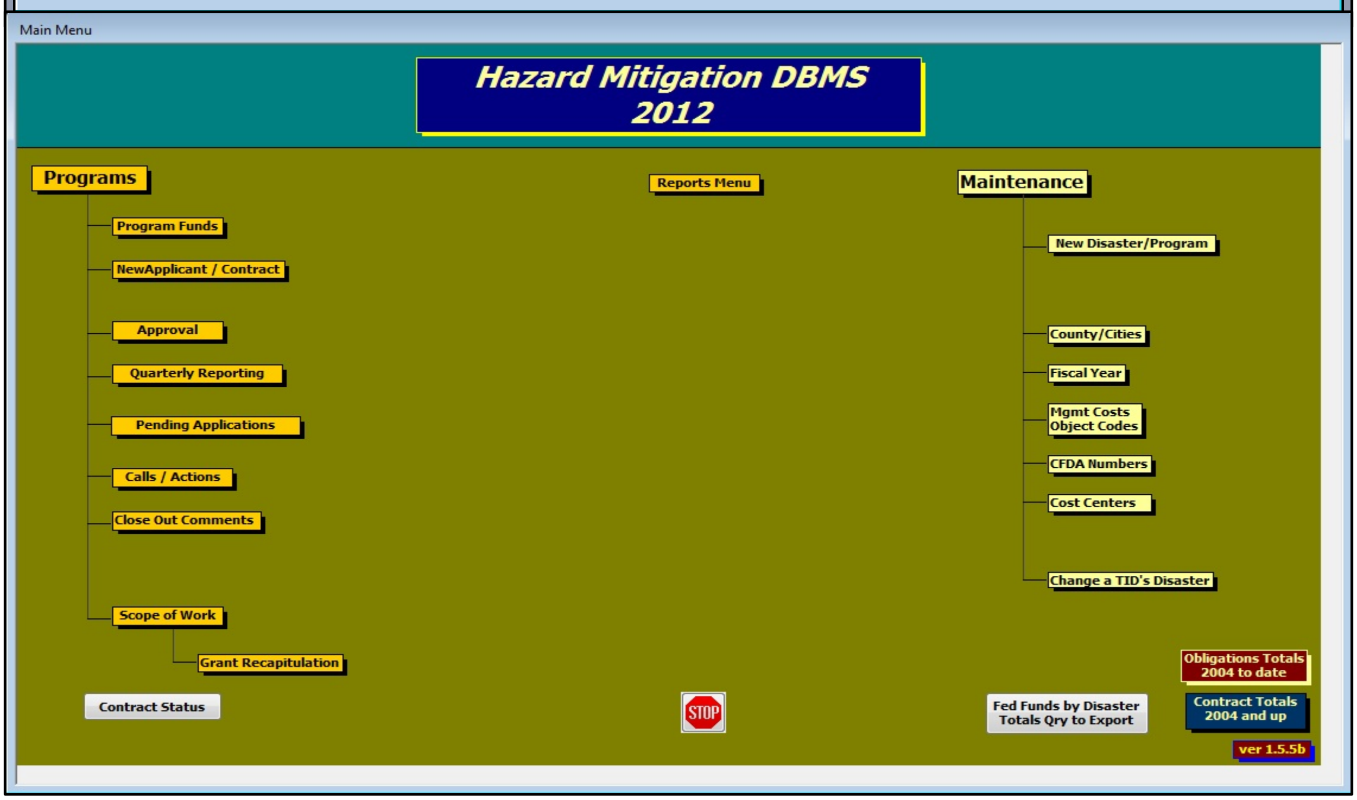
Instead of users updating tracking and monitoring data as a separate task, the new SQL system was designed as a work-user interface. This means users perform their essential job tasks from within the program itself therefore eliminating the need for additional and sometimes unreliable manual user entry. The system's interface is designed with selectable options as the primary interface, not manual entries, decreasing the chance of user entered errors. Additionally, since the system is hosted on a centralized server, a user cannot create divergent systems.

In addition to mitigating many of the old systems deficiencies, the Hazard Mitigation Database Management System offers significant advantages, including:

- Full mitigation program integration
- Tracks grants from NOI to closeout
- Tracks local plan status from NOI to adoption
- Tracks the progress of local mitigation projects
- Exportable mitigation project designs
- Tracks grant funding availability
- Tracks the progress of state mitigation projects and activities
- Tracks the progress of state mitigation goals, objectives, and strategies
- Tracks and displays statewide statuses for grants, plans, project, activities, and disasters
- Tracks overdue activities and notifies of overdue reports
- All tracking and monitoring data can be outputted to printable reports

The screenshot on the following page is of the Hazard Mitigation Database Management System's home screens.

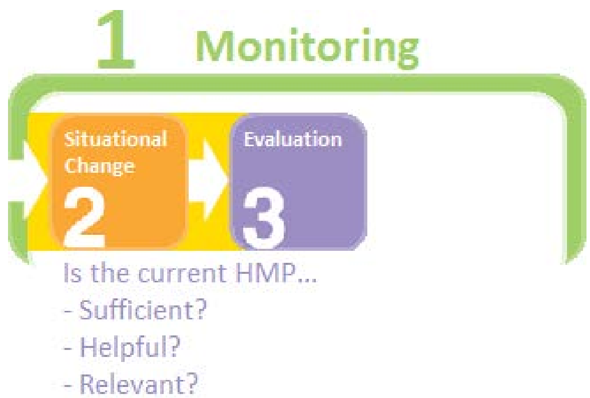

MainMenu : Form
Hazard Mitigation DBMS Sql Linked
From Date: 07/01/2013
To Date: 06/30/2014
Applicants/ Contracts
Program Funds
Planning Status
NEW Applicant/ Contract
Disaster Counties
Approved Plans Check
Point(s) of Contact
Program Comments
Grant Recapitulation
Federal Fund Details
Project Types For Export
Payments By Disaster
Qtrly Reports Overdue
Reports Menu
Scope Of Work
Acquisitions
Planning
SOW Other
Mgmt Costs
Quarterly Reporting
State Status
Local Status
Check Open Projects
Update Percent Done
Maint. Menu
Pay Requests
STOP
Applicant Pay History
ver10.33.0


Main Menu
Hazard Mitigation DBMS 2012
Programs
Program Funds
NewApplicant / Contract
Approval
Quarterly Reporting
Pending Applications
Calls / Actions
Close Out Comments
Scope of Work
Grant Recapitulation
Contract Status
Reports Menu
STOP
Maintenance
New Disaster/Program
County/Cities
Fiscal Year
Mgmt Costs Object Codes
CFDA Numbers
Cost Centers
Change a TID's Disaster
Obligations Totals 2004 to date
Fed Funds by Disaster Totals Qry to Export
Contract Totals 2004 and up
ver 1.5.5b

7.2 – Plan Evaluating

An evaluation report will be written and submitted to the HMPC when the situation dictates. The following situations are typical examples of when an evaluation will be necessary.

- Post hazard event
- Post training exercise
- Post tabletop or drill exercise
- Significant change or completion of a mitigation project
- Significant change or completion of a mitigation action



A plan evaluation is a rigorous assessment of the plan to determine the extent to which stated objectives are being achieved and whether they are contributing to decision making. Evaluating the HMP is the process by which those invested in or responsible for the plan (TEMA, local and state agencies) review existing data or projections and contribute meaningful data driven feedback from real world scenarios, along with economic and demographic projections provided by the OIR or other state agencies.

Quarterly or bi-annual reviews should occur after winter and spring flooding and severe storm months to properly assess major events and, storm damage and to review reports from the Department of Economic and Community Development, TDEC and other regulatory bodies. These reports will include site and assistance visit assessments and follow up documentation from these agencies and departments; they should specifically include assessments of whether the goals and objectives in the plan were adequately met after major natural cycles and/or events.

After a response to a declared disaster has been documented, a comprehensive economic, social and environmental analysis will be completed by the State Hazard Mitigation Planner and incorporated into the HMP.

An evaluation report will ask the following questions in response to the previously listed events.

- Do the mitigation objectives and goals continue to address the current hazards?
- Are there new or previously unforeseen hazards?
- Are current resources appropriate for implementing a mitigation project?
- Was the outcome of a mitigation action/project expected?
- Are there implementation problems?
- Are there coordination problems?

7.3 – Plan Updating

If an evaluation assessment determined any deficiencies in the HMP, then an update is necessary.

The HMP update is initiated upon the completion of a plan evaluation and even then, only when the evaluation determines an update is appropriate. Additionally, when new hazard data becomes available it will be added to the HMP. New data will be confirmed or denied at the annual TNHMC meeting.

The plan will be revised and updated at a comprehensive level every 3 years or sooner if significant changes to state resources, community structures, or incidents have occurred. When the plan review meeting falls within a 3 or 5 year US Census American Community Survey estimate revision, the plan will be updated to include new and accurate community demographics data and components directly affected by this data will be assessed for their continued applicability.

Updates determined to be necessary from recent hazard events will require adjustments to the plan's hazard profiles and risk assessments. Examples of this may include, but are not limited to: dam failure and new inundation studies, serious geologic or seismic events, completion of 3rd party hazard studies, or significant land use and development changes. Additionally, completion of local hazard mitigation plans and their new risk assessments must be incorporated into the HMP's current risk assessment by local integration.

Once significant revisions are instituted, the FEMA regional office will be notified of any changes to the HMP and will be sent a copy of the updated plan, along with documentation of the rationale for said changes. If no changes are deemed necessary, written documentation and an explanatory report will be generated as to why no changes are to be made. As deemed appropriate by the HMPC, public notices will be provided in multiple mediums, including TEMA's website, and other sources as deemed appropriate, during the 3 year review and revision process.

Appendix A – Planning Process Documentation

Sign-In Sheet
TN State Hazard Mitigation Plan Update Meeting
2/15/2013

Name	Department/Title	Email Address	Phone Number
Dave Nock	TEMA Planning	dnock@tnema.org	741-2940
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Doug Worden	TEMA SHMO	dworden@tnema.org	615-741-1345
Peter Hodes	Bold Planning	Peter@boldplanning.com	615-469-5558
Jim Bassham	TEMA		
Josh Wickham	TEMA Planning	jwickham@tnema.org	615-815-8055

State Hazard Mitigation Plan Update Presentation @ Tennessee ESC Meeting

Attendance Sheet: March 1, 2013

State Partners in Attendance

TN Department of Agriculture	TN Division of Forestry
TN Department of Children's Services	TN Department of Commerce & Insurance
TN Division of Fire Prevention	TN Bomb & Arson Investigation Section
TN Emergency Communications Board	TN Department of Correction
TN Dept. of Economic & Community Development	TN Dept. of Environment & Conservation
TN Division of Air Pollution Control	TN Division of Radiological Health
TN Division of Solid & Hazardous Waste Mgmt.	TN Division of State Parks
TN Division of Water Pollution Control	TN Division of Water Supply
TN Department of Financial Institutions	TN Department of Finance & Administration
TN Office of Information Resources	TN Division of Real Estate Administration
TN Department of General Services	TN Department of Health
TN Division of Communicable Diseases	TN Division of Emergency Medical Services
TN Department of Human Services	TN Dept. of Labor & Workforce Development
TN Department of Mental Health	TN Department of Military
TN Emergency Management Agency	TN Department of Revenue
TN Department of Safety	TN Office of Homeland Security
TN Highway Patrol	TN Department of Transportation
TN Division of Multimodal Trans. Resources	TN Department of Veteran's Affairs
TN Regulatory Authority	TN Division of Gas Pipeline Safety
TN Wildlife Resources Agency	TN Housing Development Agency
TN Commission on Aging & Disability	TN Bureau of Investigation
TN Office of Attorney General	

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United States Department of Agriculture	

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AECOM	ATT

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Volunteer Partners in Attendance

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Salvation Army	Voluntary Organizations Active in Disasters

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Volunteer	Ratcliff	Misty	Salvation Army	615-242-0411	misty_ratcliff@uss.salvationarmy.org	Misty Ratcliff
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t.	Last Name	First Name	Last 4	Employer	WorkPhone	Email	Signature
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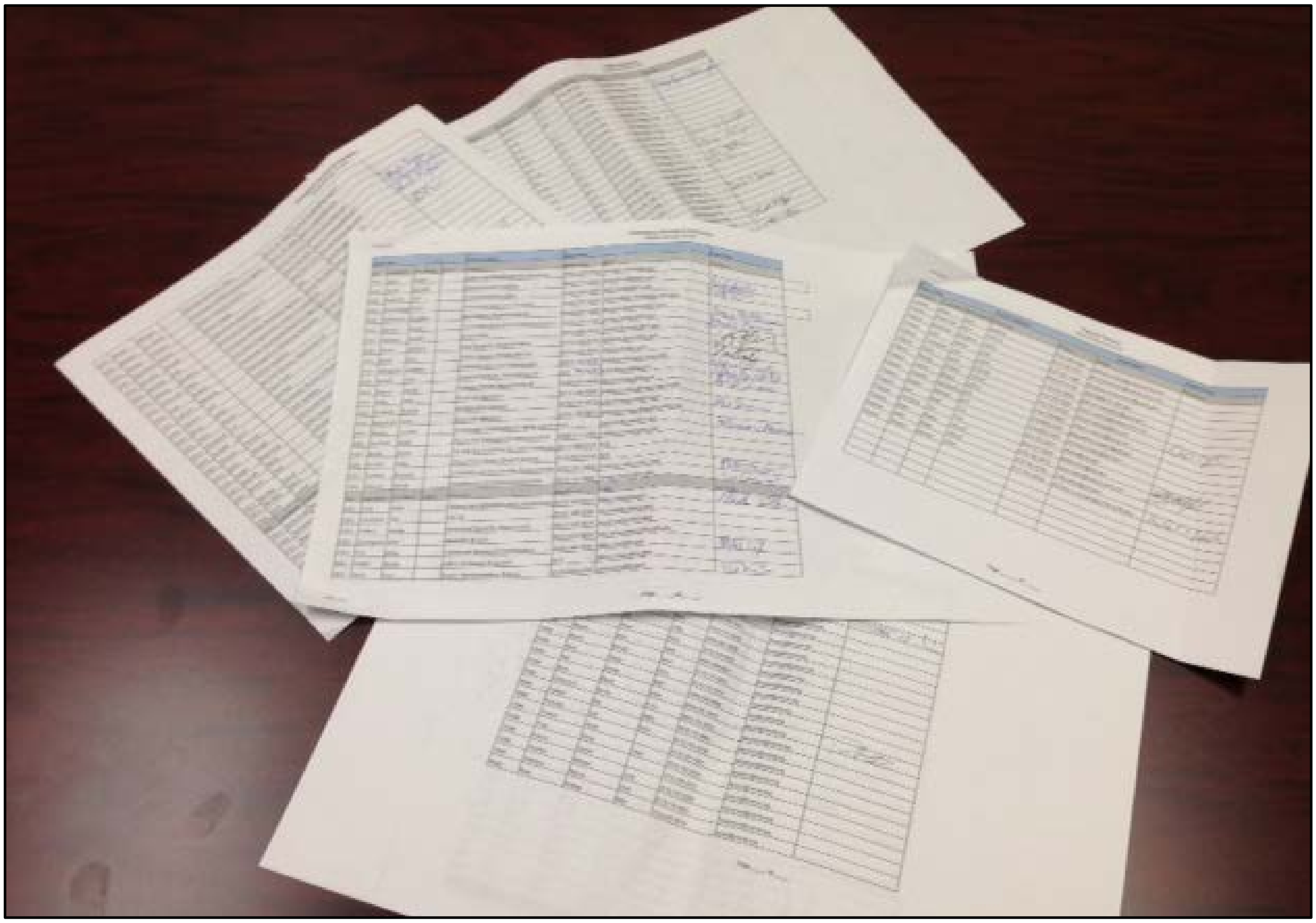

Sign-In Sheet
State of Tennessee Hazard Mitigation Plan Meeting
3/14/2013

Name	Department/Title	Email Address	Phone Number
Joshua Wickham	TEMA / Planner	jwickham@tnema.org	615-815-8055
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David Nock	TEMA	dnock@tnema.org	615-741-2540
Brenna Robinson	TEMA / Planner	brobinson@tnema	
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Sign-In Sheet
OIR GIS: Hazard Mitigation Meeting
5/10/2013

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State Hazard Mitigation Plan Update Presentation # 2 @ Tennessee ESC Meeting

Attendance Sheet: June 7, 2013

State Partners in Attendance

TN Department of Agriculture	TN Department of Children's Services
TN Department of Commerce & Insurance	TN Division of Fire Prevention
TN Division of Insurance	TN Emergency Communications Board
TN Department of Correction	TN Dept. of Economic & Community Development
TN Dept. of Environment & Conservation	TN Division of Air Pollution Control
TN Division of Geology	TN Division of Radiological Health
TN Division of Solid & Hazardous Waste Mgmt.	TN Division of State Parks
TN Division of Water Supply	TN Department of Financial Institutions
TN Department of Finance & Administration	TN Office of Information Resources
TN Division of Real Estate Administration	TN Department of General Services
TN Department of Health	TN Division of Communicable Diseases
TN Division of Emergency Medical Services	TN Department of Human Services
TN Department of Human Resources	TN Dept. of Labor & Workforce Development
TN Department of Mental Health	TN Department of Military
TN Emergency Management Agency	TN Department of Revenue
TN Department of Safety	TN Office of Homeland Security
TN Highway Patrol	TN Department of Transportation
TN Division of Multimodal Trans. Resources	TN Department of Tourist Development
TN Department of Veteran's Affairs	TN Regulatory Authority
TN Division of Gas Pipeline Safety	TN Wildlife Resources Agency
TN Housing Development Agency	TN Alcoholic Beverage Commission
TN Commission on Aging & Disability	TN Bureau of Investigation
TN Office of Attorney General	

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ESC	Nifong	Stephen	Tennessee Wildlife Resources Agency	(615) 781-6580	stephen.nifong@tn.gov	[illegible]
ESC	Pack	Robert	Tennessee Housing Development Agency	(615) 815-2267	rpack@thda.org	[illegible]
ESC	Remke	David	Revenue, Department of	(615) 365-6212	David.Remke@tn.gov	[illegible]
ESC	~~Rich~~ Ross	~~Janice~~ Michae	Tourist Development, Department	(931) 468-2654	Janice.Rich@TN.gov	[illegible]
ESC	Roop	Daniel	Solid Waste Management	(615) 687-7104	daniel.roop@tn.gov	Daniel Roop

ESC	Shults	Debra	Radiological Health	(615) 532-0426	debra.shults@tn.gov	
ESC	Sledge	David	Finance and Administration	(615) 532-4595	david.sledge@tn.gov	
ESC	Smith	Kirk	Correction, Department of	(615) 253-3620	Kirk.Smith@tn.gov	K Smith
ESC	Spencer	Lisa	Human Resources, Department of	(615) 532-3224	Lisa.Spencer@tn.gov	
ESC	Spivey	Joseph	Tennessee Department of the Army and	(615) 741-0445	joseph.spivey@us.army.mil	
ESC	Stockton	Gary	Human Services, Department of	(615) 253-5847	gstockton@tnema.org	
ESC	Strickland	Dan	Correction, Department of	(615) 741-7144	dan.c.strickland@tn.gov	
	[illegible]ple	Dennis	State of Tennessee Mental Health and De	(615) 253-5558	Dennis.Temple@tn.gov	Dennis Tem
ESC	Tidwell	Donna	Emergency Medical Services	(615) 741-4521	donna.g.tidwell@mail.stat.tn.us	Donna G. Tidwell
ESC	Ward	Steve	State Parks	(615) 373-3467	Steve.Ward@tn.gov	
ESC	Waugh	Carolyn	Veteran's Affairs	(615) 741-1959	Carolyn.Waugh@tn.gov	Carolyn Waugh
ESC	Whitehous	Benjamin	Attorney General's Office	(615) 741-6249	Ben.Whitehouse@ag.tn.gov	
ESC	Williams	Carol	Air Pollution Control	(931) 840-4161	Carol.M.Williams@tn.gov	Carol M. Willi
ESC	Zurawski	Ron	Geology	(615) 532-1502	ron.zurawski@tn.gov	Ronald J. Zurawski
	Hooper	Arnold	Safety	365-1611	Arnold.Hooper@tn.gov	

TEMA	Bassham	James	(615) 741-4332	jbassham@tnema.org	
TEMA	~~Duclos~~ Bennett	Dawn	(615) 741-0001	~~dduclos@tnema.org~~ dbennett@tnema.org	DnBennett
TEMA	Flener	Dean	(615) 532-5131	dflener@tnema.org	B. Dean Flener
TEMA	Dunnivant	Dani	6157413734	ddunnivant@tnema.org	
TEMA	Gillingham	Mary Lynn	(615) 741-0001	mgillingham@tnema.org	Mary Lynn Gilling
TEMA	Grant	Kenya	(615) 741-3732	kgrant@tnema.org	Kenya Grant
TEMA	Heidt	Jeremy	(615) 741-0482	jheidt@tnema.org	Jeremy Heidt
TEMA	Holden	Tim	(615) 741-2128	tholden@tnema.org	
TEMA	Kellogg	Todd	(615) 532-1207	tkellogg@tnema.org	
TEMA	Lima	Gary	(615) 741-4503	glima@tnema.org	
TEMA	Raborn	Lauren	(615) 741-3781	lraborn@tnema.org	Lauren Vato Raborn
TEMA	Rose	Andrew	(731) 421-2624	arose@tnema.org	
TEMA	Smith	Donnie	(615) 741-1453	dsmith@tnema.org	Donnie Smith
TEMA	Wickham	Joshua	(615) 815-8055	jwickham@tnema.org	Joshua Wickham
TEMA	Ledford	Alan			

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Goradia, Manish Dept. of Children's Services - 615-257-6671 - manish.goradia@tn.gov

ESC Ritchie Worrell Dept. of Human Resources 615-741-5561 ritchie.worrell@tn.gov Ritchie Worrell

Danny Talley TTHP 615-251-5125 Danny.Talley@tn.gov

Federal Partners in Attendance

Bureau of Alcohol, Tobacco, & Firearms	Tennessee Valley Authority
United States Department of Agriculture	United States Department of Transportation

Federal	Knight	Michael	ATF	615-565-1265	michael.knight@atf.gov	M Knight
Federal	Pitchford	Tim	TVA	423-751-2087	tepitchford@tva.gov	
Federal	Wooten	Michael	USDA	615-781-5310	michael.d.wooten@aphis.usda.gov	Michael D Wooten
Federal	Varney	Gerald	USDOT	615-781-5765	gerald.varney@dot.gov	

Private Partners in Attendance

AT&T	DET Distributing Co.

Private Org.	Judd	Hugh	AT&T	615-401-4066	hugh.judd@att.com	
ESCS	Dettwiller	G. Fred	Aeronautics	(615) 313-4602	gfd@detdist.com	

Volunteer Partners in Attendance

US Air Force Auxiliary- Civil Air Patrol	American Red Cross
Voluntary Organizations Active in Disasters	

Volunteer	Mynhier	Rob	ARC	865-4147312	rob.mynheir@~~tn.gov~~ RedCross.org	
Volunteer	Rader	Raymond	CAP	615-364-3928	rrade10108@aol.com	
Volunteer	Ward	Gary	VOAD	615-218-6114	gary.t.ward@comcast.net	

Appendix B – Previous Plan Meetings

Table 118 – Previous Hazard Mitigation Plan Development Meeting		
Date	**Action Entity**	**Summary**
1-Dec-01	FEMA: Jacky Bel, Sam Washington; TEMA: SHMO, Chief-Plans/Programs, Chief-Natural Hazards	Overview of FEMA Region IV concept of the new state and local requirements.
Week of (8-Apr-02)	FEMA Region IV	Training conducted at Region IV on 44 CFR 201 requirements. (Tennessee Department of Environment and Conservation (NFIP), SHMO, TEMP Planner)
23-May-02	East Tennessee Region	One-day workshop to disseminate the local planning requirements to all local entities. Letters were mailed to all County Executives, City Mayors, and Local Emergency Management Agencies informing them of the new regulations. Workshop included information relative to planning grant availability.
28-May-02	West Tennessee Region	One-day workshop to disseminate the local planning requirements to all local entities. Letters were mailed to all County Executives, City Mayors, and Local Emergency Management Agencies informing them of the new regulations. Workshop included information relative to planning grant availability.
29-May-02	Middle Tennessee Region	One-day workshop to disseminate the local planning requirements to all local entities. Letters were mailed to all County Executives, City Mayors, and Local Emergency Management Agencies informing them of the new regulations. Workshop included information relative to planning grant availability.
(18-Jun-02) and (25-Jun-02)	Hazard Mitigation Planning Council	A Planning Council was organized to review and prioritize planning applications. All 2002 planning applications were reviewed and prioritized on June 18 and 25, 2002. The applications were submitted to FEMA June 30, 2002.
Sep-02	State Hazard Mitigation Officer/Staff	A brief overview of the new planning requirements was provided and the Emergency Services Coordinators were advised that they would be called upon to aide in the development of the state's mitigation plan.
1-Oct-02	State Hazard Mitigation Officer	The Federal Register published a change in the date the planning requirement was to become effective for HMGP and the state. A one-year extension was given for November 1, 2004. Notification was sent to all communities/counties holding planning grants for developing their plan.
(28-Jan-03) and (29-Jan-03)	West Tennessee Region - Local jurisdictions, Hazard Mitigation Planning members	Workshop - Inform local governments of significant change in future mitigation assistance through the Robert T. Stafford Act and planning requirements.
(11-Feb-03) and (12-Feb-03)	East Tennessee Region - Local jurisdictions, Hazard Mitigation Planning members	Workshop - Inform local governments of significant change in future mitigation assistance through the Robert T. Stafford Act and planning requirements.
(19-Feb-03) and (20-Feb-03)	Middle Tennessee Region - Local jurisdictions, Hazard Mitigation Planning members	Workshop - Inform local governments of significant change in future mitigation assistance through the Robert T. Stafford Act and planning requirements.
7-Mar-03	State Hazard Mitigation Officer	Overview provided to ESCs on the state planning requirements.
27-Mar-03	Chief, Planning, Deputy Director (TEMA), Director-Plans and Programs, and SHMO	Working session for developing the risk assessment.

Date	Action Entity	Summary
7-Nov-03	State Hazard Mitigation Planning Committee (Core & Supporting Cadre)	Initial meeting of the combined committee to orient the Supporting Cadre to the new plan and ensure all members were of the same understanding toward the upcoming planning task.
(9-Feb-04) and (10-Feb-04)	State Hazard Mitigation Officer/Staff	Workshop on the development of the Local Hazard Mitigation Plan. (West Tennessee Local Government Hazard Mitigation Planning member)s
(12-Feb-04) and (13-Feb-04)	State Hazard Mitigation Officer/Staff	Workshop on the development of the Local Hazard Mitigation Plan. (Middle Tennessee Local Government Hazard Mitigation Planning members)
(18-Feb-04) and (19-Feb-04)	State Hazard Mitigation Officer/Staff	Workshop on the development of the Local Hazard Mitigation Plan. (East Tennessee Local Government Hazard Mitigation Planning members)
22-Mar-04	State Hazard Mitigation Council	Established formal council Standard Operation Procedure signed and authorized by Director of TEMA. Distributed copies to Planning Team.
2-Apr-04	State Hazard Mitigation Planning Committee (Core	Reviewed goals, objectives, and proposed actions from previous 409 plan submittal for relevancy in the new undertaking.
4-Jun-04	State Hazard Mitigation Officer/Staff	Presented update on Hazard Mitigation Plan development (State Hazard Mitigation Planning Committee. (Supporting Cadre)
8-Jun-04	State Hazard Mitigation Officer	Formal request for FEMA assistance in HAZUS Flood analysis. (statewide)
(29-Jun-04) - (1-Jul-04)	State Hazard Mitigation Officer/Staff	HAZUS-MH software utilization workshop. (East Tennessee - Local Government Hazard Mitigation Planning members)
(13-Jul-04) and (15-Jul-04)	State Hazard Mitigation Officer/Staff	HAZUS-MH software utilization workshop. (West Tennessee - Local Government Hazard Mitigation Planning members)
27-Jul-04	State Hazard Mitigation Officer	Provided FEMA with rough draft of Hazard Mitigation Plan (excerpts) - Introduction through Risk Assessment. (Less Vulnerability Analysis)
1-Aug-04	State Hazard Mitigation Officer	Presented update on Hazard mitigation Plan development (State Hazard Mitigation Planning Committee. (Supporting Cadre)
(17-Aug-04) - (19-Aug-04)	State Hazard Mitigation Officer/Staff	HAZUS-MH software utilization workshop. (Middle Tennessee - Local Government Hazard mitigation Planning members)
1-Sep-04	FEMA	Received HAZUS Flood analysis. (statewide)
2-Sep-04	State Hazard Mitigation Planning Council	Working session - Review Draft state plan for acquiescence to 44 CFR 201.4 requirements.
10-Sep-04	State Hazard Mitigation Officer	Forwarded State Hazard Mitigation Plan to FEMA for interim review.
1-Oct-04	State Hazard Mitigation Officer/Staff	Presented overview of draft State Mitigation Plan. (State Hazard Mitigation Planning Committee (Supporting Cadre)
15-Oct-04	State Hazard Mitigation Officer	Submitted State Hazard Mitigation Plan to FEMA Region IV.
18-Oct-04	FEMA Region IV	Formal Plan approval.
(Oct-04) - (Nov-04)	State Hazard Mitigation Officer	Distribute copies of approved State Hazard Mitigation Plan to State Department Commissioners.
Jan-04	State Hazard Mitigation Officer/Department of Commerce and Insurance	Review/evaluate selected strategies with respect to Lead Agency responsibilities.
Jan-05	State Hazard Mitigation Officer/Department of Economic and Community Development	Review/evaluate selected strategies with respect to Lead Agency responsibilities.

Date	Action Entity	Summary
10-Jan-05	State Hazard Mitigation Officer	Established formal council Standard Operation Procedure signed and authorized by Director of TEMA Distributed copies to Council.
11-Jan-05	State Hazard Mitigation Planning Committee (Core & Supporting Cadre)	In concert with Council review/comment on state plan 2004. (Focus on Risk Assessment/Mitigation Omnibus Goal/Strategies)
(7-Mar-05) - (9-Mar-05)	State Hazard Mitigation Council	Prioritized planning/project applications. All PDM '05 grant applications were reviewed/evaluated against the state plan and prioritized. The applications were submitted to FEMA March 9, 2005.
5-Aug-05	State Hazard Mitigation Officer	Initiate annual state hazard mitigation plan review process.
2-Sep-05	State Hazard Mitigation Planning Committee (Supporting Cadre)	Assess/reaffirm validity of state mitigation goal/strategies document in 2004 plan for continued relevance/status and comment.
19-Sep-05	State Hazard Mitigation Council	Review mitigation strategy comments for relative pertinence plus plan viability in addressing issues emanating from Hurricane Katrina evacuation/mass sheltering. (strategies)
1-Dec-05	State Hazard Mitigation Council	Review Supporting Cadre comments for relevance and plan incorporation.
6-Jan-06	State Hazard Mitigation Council	Review Supporting Cadre Risk Assessment comments for relevance/plan incorporation.
12-Jan-06	State Hazard Mitigation Officer/ University of Memphis	Working session on state plan enhancement with additional risk analyses.
12-Apr-06	State Hazard Mitigation Officer/Staff/Hazard Mitigation Council/ Hazard Mitigation Planning Committee	Post Disaster #1634 - State Hazard Mitigation Plan reviewed for continued relevance and effectiveness for severe weather.
1-May-06	State Hazard Mitigation Planning Committee (Supporting Cadre)/TEMA Regions	Review/comment on Section IV, Risk Assessment.
(31-Jul-06) - (2-Aug-06)	Combined State/FEMA Meeting and Working Session	Review/discuss/modify proposed FEMA Local/State Grants Management and Hazard Mitigation Planning Guidance.
Jan-06	State Hazard Mitigation Planning Committee (Supporting Cadre)	Review/reassess validity of state prime (single) mitigation goal and continued relevance of existing supporting mitigation objectives/strategies.
Jan-06	State Hazard Mitigation Planning Committee (Core) and Council	Review/evaluate the relevance of Supporting Cadre new mitigation strategies, incorporating into revised plan/addendum where appropriate.
Jan-06	State Hazard Mitigation Planning Committee (Core/Supporting Cadre)	Review/comment on state plan 2007 Draft. (Focus on Risk Assessment/Mitigation Omnibus Goal/Strategies)
Jan-06	State Hazard Mitigation Officer, Mitigation Planning Officer	Attended Region IV Conference where state plan update guidance was presented, discussed, and provided to attendees.
1-Sep-06	State Hazard mitigation Planning Committee (Supporting Cadre) working session.	Each emergency Services Coordinator submit new Departmental (Discipline) strategies for the state's Natural, Technological, and Human-caused hazard concerns.
11-Oct-06	State Hazard Mitigation Officer/University of Memphis	Review/progress made by school toward enhancement of state plan to include Technological/ Human-caused hazards.
(16-Oct-06) - (20-Oct-06)	State Hazard Mitigation Officer/State Hazard Mitigation Council	Working session on mitigation proposals for Technological/Human-caused hazards.
30-Oct-06	State Hazard Mitigation Officer	Department of Agriculture ESC tasked to review overall draft plan/mitigation strategies (Addendum) and comment.

Date	Action Entity	Summary
31-Oct-06	State Hazard Mitigation Officer/Select TEMA Branch Chiefs	Branches tasked to review excerpts of draft plan/mitigation strategies (Basic Plan/Addendum/Supplement) and comment.
Jan-07	State Hazard Mitigation Council	Review PDM 2007 applications and comment.
Jan-07	State Hazard Mitigation Council	Review HMGP Disaster #1634 applications and comment.
Jan-07	State Hazard Mitigation Officer/Staff/Hazard Mitigation Council/Hazard Mitigation Planning Committee (Core)	Review comments/suggestions from state departments/agencies for pertinence and inclusion into 2007 Hazard Mitigation Plan.
(Jan-07) and (Feb-07)	Ad hoc meetings with Council ESCs & TEMA Mgrs. & Senior Staff	Ensure understanding of and gain commitment for strategy review/strategies. Discussed review status of existing strategies (Natural hazards) and development of new strategies. (Tech/Human-caused hazards)
9-Mar-07	Hazard Mitigation Planning Committee/TEMA Senior Staff (Director/Dep. Director/Ops./Planning/Logistics Branch Chiefs, etc.	Review status of State Hazard Mitigation Plan with respect to EMAP accreditation schedule plus mitigation strategy review/comment.
28-Mar-07	State Hazard Mitigation Officer	Letter developed/mailed to Commissioners letters advising of scheduled Hazard Mitigation Council meeting/agenda. Requested support for plan reviews and comments.
11-Apr-07	TEMA, FEMA, TN Department of Environment and Conservation, TN Assoc. of Utility Districts	Discuss seismic risk study for West Tennessee water supply systems/funding sources.
17-Apr-07	State Hazard Mitigation Council	Review 2007 Draft Hazard Mitigation Plan (Basic/Addendum/Supplement) including strategies comments requested.
6-Jun-07	State Hazard Mitigation Officer/Staff and Public Assistance Officer	Discuss/solidify Mitigation's role in long-term Recovery.
9-Jun-07	State Hazard Mitigation Officer and Senior Staff	Discuss status of State Hazard Mitigation Plan with respect to EMAP accreditation and FEMA submission.
11-Jun-07	State Hazard Mitigation Officer and Tennessee Hazard Mitigation Council	Submitted Draft Excerpts of TEMP Hazard Identifications, Evaluations, and Considerations for disciplinary litmus test.
12-Jun-07	State Hazard Mitigation Officer/Staff and Senior management	Discuss and finalize hazards identified in the Tennessee Emergency Management Plan and utilized for state's hazard mitigation plan development.
20-Jul-07	State Hazard Mitigation Officer and Governor, State of Tennessee	Submit 2007 state hazard mitigation plan to governor for review/approval and signed Letter of Promulgations.
1-Aug-07	State Hazard Mitigation Officer/FEMA Mitigation Staff	Submit Draft Plan to FEMA, Region IV for review.
28-Aug-07	State Hazard Mitigation Officer/Staff, Grants Program Manager, FEMA Mitigation Staff	Joint FEMA/TEMA discussion of Federal Crosswalk review comments/concerns on 2007 updated plan
24-Sep-07	State Hazard Mitigation Officer	Submit 2007 Hazard Mitigation Plan to FEMA Region IV for reviews/approval.
18-Oct-07	FEMA, Region IV, HIRA	Formal federal approval of state plan.
Jan-08	State Hazard Mitigation Officer	Solicit status of strategies from lead agencies via Mitigation Strategy Reports. (MSRs)
Jan-08	TEMA-Crisis Action Team (CAT)	Discussed sheltering issues with Louisiana as well as future mitigation recommendations.
Jan-08	State Hazard Mitigation Officer/Staff	Discussed mutual update planning concerns with bordering states. (Open forum)
Jan-08	State Hazard Mitigation Officer	Solicited annual review/comment on state plan 2007. (Focus on Sections III, IV, IVA, and V. (TEMA Staff, Hazard Mitigation Planning Committee, Local Gov'ts, Academia, etc.)

Date	Action Entity	Summary
Jan-08	State Hazard Mitigation Officer/Hazard Mitigation Council	Review status of state strategies via Mitigation Strategy Reports. (MSR)
12-Feb-08	State Hazard Mitigation Planning Committee, SHMO/Mitigation Staff	DR 1745 TN, reviewed Risk Assessment, and Strategy sections of state hazard mitigation plan, Severe Weather/Tornado, for continued viability and possible revision.
14-Feb-08	State Hazard Mitigation Officer/Staff	Develop state hazard mitigation plan revision incorporating Repetitive Flood Claims/ Severe Repetitive Loss. (SRL)
26-Mar-08	State Hazard Mitigation Officer	Following Hazard Mitigation Council/ Director concurrence, submitted revised (RFC/SRL) state hazard mitigation plan to FEMA, Region IV for review/evaluation.
8-Apr-08	FEMA, Region IV, HIRA	Revised state hazard mitigation plan approved for RFC/SRL.
18-Apr-08	FEMA, Region IV, HIRA	Revised state hazard mitigation plan approved for RFC/SRL.
6-Sep-08	TEMA Senior Staff	Discuss ramifications of interruption to state petroleum supplies and measures to lesson impact to both the public/private sectors.
15-Sep-08	TEMA-Crisis Action Team (CAT)	Discussed lessons learned from Hurricane Gustav evacuee reception/sheltering to include strategies for improving the effectiveness of future operations.
27-Oct-08	State Hazard Mitigation Officer and key TEMA staff	Review and discuss emergency sheltering issues/shortfalls and proposed solutions for possible inclusion in agency-wide planning efforts.
Jan-09	State Hazard Mitigation Officer	Solicit statues of strategies from lead agencies via Mitigation Strategy Reports. (MSRs)
Jan-09	State Hazard Mitigation Officer	Solicited additional review/comment on updated state plan 2010 (Focus on Sections IV and V. (HM PC, Local Gov'ts, Academia, etc.)
Jan-09	State Hazard Mitigation Officer/ HMPC (Core)	Review plan review comments for incorporation into 2010 FINAL version of plan.
Jan-09	State Hazard Mitigation Officer	Solicited Mitigation Strategy Reports (MSRs) from all Lead Agencies.
10-Feb-09	State Hazard Mitigation Officer/ Hazard Mitigation Planning Committee	DR 1821 TN, reviewed for continued viability and possible revision Risk Assessment and Strategy sections (Severe Storm) of the state hazard mitigation plan.
(21-Apr-09) and (22-Apr-09)	State Hazard Mitigation Officer/Staff, FEMA HQ, FEMA Region IV	Orchestrated/hosted/conducted Benefit Cost Analysis (BCA) Training for local jurisdictions, public utilities, and other interested parties.
Aug-09	State Hazard Mitigation Officer/Staff, FEMA	Discuss Local/State planning guidance/issues to include development of state enhanced plan.
Oct-09	State Hazard Mitigation Officer/HMPC (Core)	Review plan review comments and, if pertinent, incorporate into updated plan.
Oct-09	TEMA Planning Supervisor/South Carolina Planning Supervisor	Discussed mutual concerns/challenges to state plan update requirements also benefits of Regional (multi-county) plans versus single jurisdictional efforts.
(13-Oct-09) and (14-Oct-09)	TEMA Mitigations Staff/FEMA Region IV Mitigation Staff	Coordinated/conducted Planning Training Workshop - West Tennessee region. FEMA conducted.
(20-Oct-09) and (21-Oct-09)	TEMA Mitigations Staff/FEMA Region IV Mitigation Staff	Coordinated/conducted Planning Training Workshop - West Tennessee region. FEMA conducted.
(17-Nov-09) and (18-Nov-09)	TEMA Mitigation Staff/FEMA Region IV Mitigation Staff	Coordinated/conducted Planning Training Workshop - East Tennessee Region. FEMA conducted.

Date	Action Entity	Summary
Jan-10	State Hazard Mitigation Officer, HMPC	Review contested MSR strategy dispositions.
Jan-10	State Hazard Mitigation Officer	Submit 2010 Hazard Mitigation Plan to Director, Tennessee Emergency Management Agency for review and final approval.
Jan-10	State Hazard Mitigation Officer	Submit 2010 Hazard Mitigation Plan to FEMA Region IV for review, evaluation, and subsequent approval.
8-Jan-10	State Hazard Mitigation Officer, Strategy Leads	Update/document status of strategies via MSRs.
(Feb-10) and (Mar-10)	State Hazard Mitigation Officer/ HMPC (Core) and Hazard Mitigation Council	Review/quality check FINAL plan.

Appendix C – Federal Grant Records

Table 119 – HMGP Awards, Tennessee (1990 – 2012)				
Disaster #	Federal Share	State Share	Local Share	Total Cost
858	$61,425.00	$30,712.50	$30,712.50	$122,850.00
889	$357,617.00	$178,808.50	$178,808.50	$715,234.00
910	$290,293.00	$149,534.00	$172,782.00	$612,609.00
1010	$7,695,859.00	$1,389,422.20	$1,225,514.20	$10,310,795.40
1022	$744,597.00	$125,986.00	$122,213.00	$992,796.00
1057	$266,464.00	$59,727.00	$29,094.00	$355,285.00
1167	$1,295,891.00	$263,647.00	$218,969.00	$1,778,507.00
1171	$317,680.00	$56,811.00	$49,083.00	$423,574.00
1197	$2,956,964.00	$511,277.50	$474,375.50	$3,942,617.00
1215	$2,713,548.00	$467,868.50	$436,647.50	$3,618,064.00
1235	$566,592.00	$94,432.00	$94,432.00	$755,456.00
1260	$1,802,405.00	$159,477.06	$813,382.16	$2,775,264.22
1262	$1,430,282.00	$242,643.85	$234,116.85	$1,907,042.70
1275	$814,058.00	$139,046.16	$132,305.77	$1,085,409.93
1331	$427,610.00	$8,337.00	$134,201.31	$570,148.31
1387	$629,051.00	$21,628.87	$190,420.00	$841,099.87
1408	$1,198,466.00	$16,296.23	$383,195.00	$1,597,957.23
1441	$571,265.00	$25,480.43	$164,943.00	$761,688.43
1456	$158,053.00	$10,295.00	$42,389.00	$210,737.00
1464	$5,051,903.00	$32,651.00	$1,560,065.24	$6,644,619.24
1482	$4,195,433.00	$12,751.00	$1,195,997.00	$5,404,181.00
1568	$215,442.00	$4,833.02	$66,981.00	$287,256.02
1634	$721,253.00	$170,366.00	$552,247.00	$1,443,866.00
1745	$3,147,356.00	$549,004.50	$500,114.50	$4,196,475.00
1821	$1,034,693.00	$164,409.00	$164,409.00	$1,363,511.00
1839	$735,110.00	$116,806.50	$116,806.50	$968,723.00
1851	$1,447,061.00	$229,933.00	$229,933.00	$1,906,927.00
1856	$386,169.00	$61,361.00	$61,361.00	$508,891.00
1909	$85,546,517.00	$13,593,052.50	$13,593,052.50	$112,732,622.00
1937	$666,616.00	$105,923.00	$105,923.00	$878,462.00
1965	$1,214,209.00	$192,933.50	$192,933.50	$1,600,076.00
1974	$9,684,522.00	$1,538,838.00	$1,538,838.00	$12,762,198.00
1978	$1,352,803.00	$214,956.00	$214,956.00	$1,782,715.00
1979	$5,726,845.00	$909,976.50	$909,976.50	$7,546,798.00
4005	$1,003,172.00	$159,400.50	$159,400.50	$1,321,973.00
4060	$154,505.00	$19,313.13	$19,313.13	$193,131.26
Total =	**$146,581,729.00**	**$22,027,938.95**	**$26,309,891.66**	**$194,919,559.61**

**The data are from TEMA and FEMA*

Table 120 – PDM Grant Program Awards, Tennessee (2002 – 2012)

Year	Federal Share	State Share	Local Share	Total Cost
2002	$223,974.64	$16,667.00	$58,835.88	$299,477.52
2003	$162,489.66	$12,325.00	$40,691.37	$215,506.03
2003C	$484,526.00	$156,008.00	$55,007.00	$695,541.00
2003 DRU	$103,356.00	$3,333.00	$30,785.33	$137,474.33
2005C	$3,876,604.34	$25,000.00	$1,266,202.00	$5,167,806.34
2006C	$2,053,200.00	$0.00	$684,400.00	$2,737,600.00
2007C	$82,500.00	$27,500.00	$0.00	$110,000.00
2008C	$4,143,392.58	$121,190.50	$1,067,806.76	$5,332,389.84
2009C	$71,541.00	$2,167.75	$21,679.25	$95,388.00
2009L	$501,601.50	$0.00	$55,733.50	$557,335.00
2010C	$1,485,000.00	$45,000.00	$450,000.00	$1,980,000.00
2011C	$11,128,915.00	$337,239.85	$3,372,398.49	$14,838,553.34
2012C	$0.00	$0.00	$0.00	$0.00
Total =	**$24,317,100.72**	**$746,431.10**	**$7,103,539.58**	**$32,167,071.40**

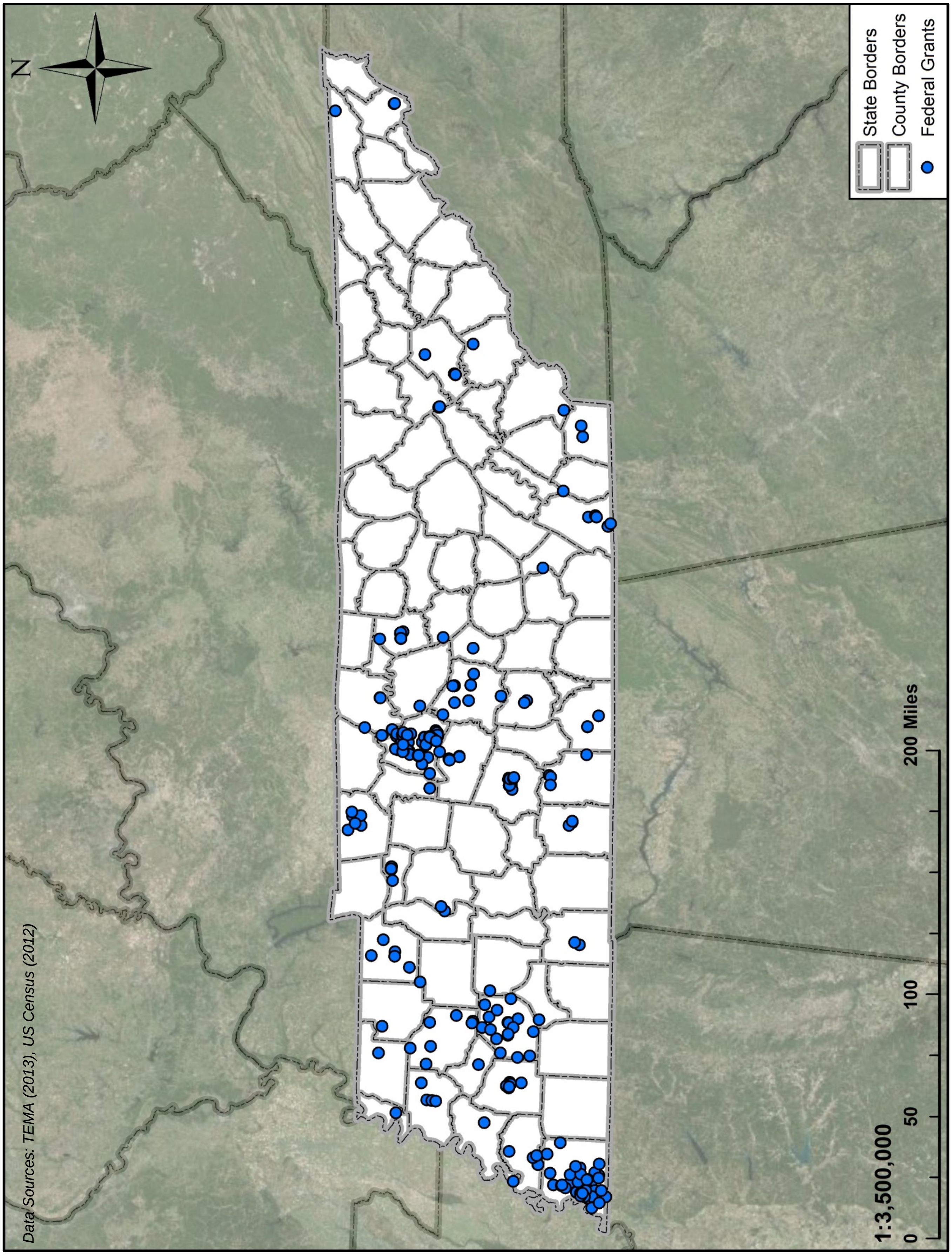
**The data are from TEMA & FEMA*
**C = competitive grant; DRU = Disaster Resistant University, L = legislative*

Table 121 – FMA Grant Program Awards, Tennessee (1997 – 2012)

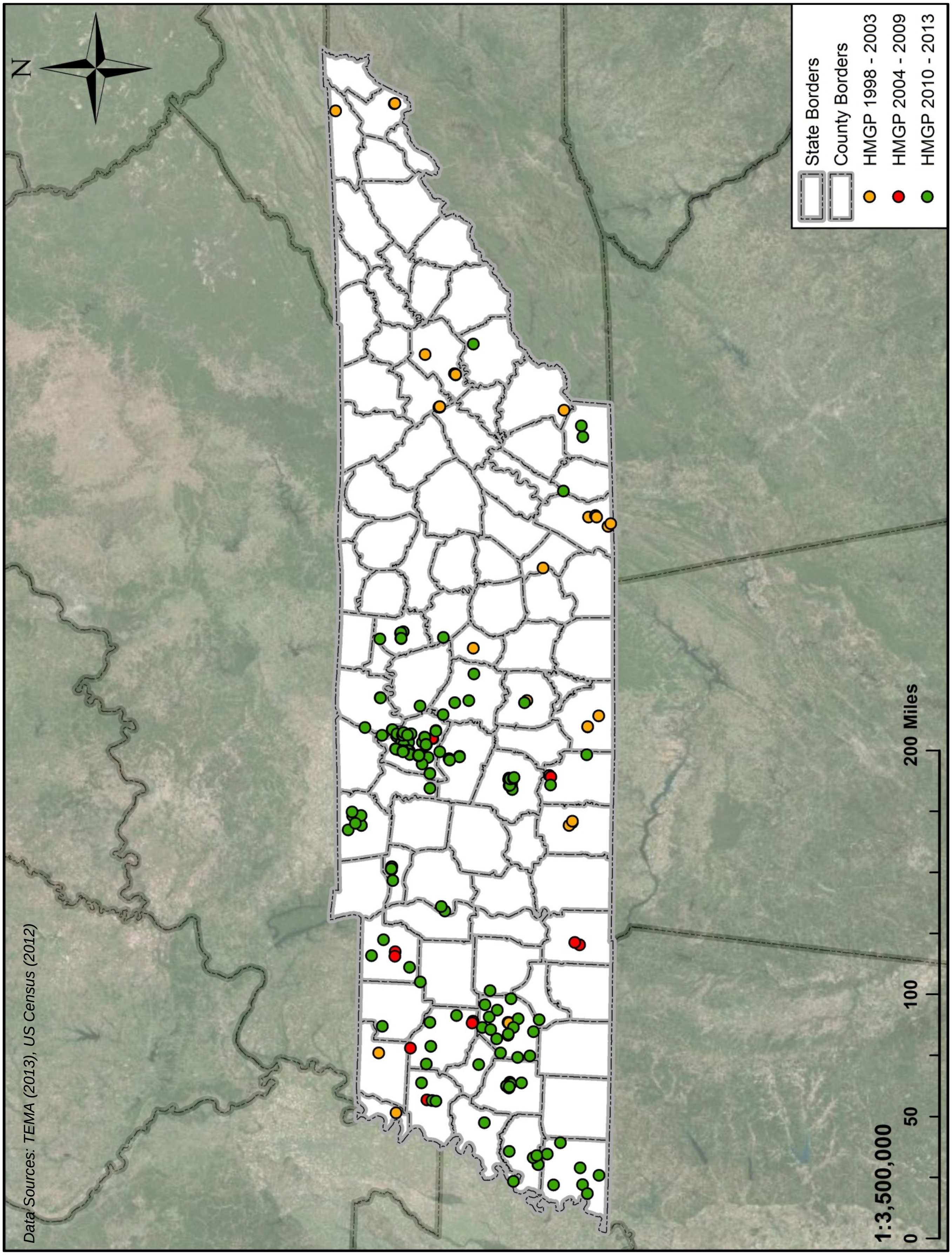
Year	Federal Share	State Share	Local Share	Total Cost
1997	$137,300.00	$22,883.00	$22,883.00	$183,066.00
1998	$152,326.15	$25,388.03	$25,388.03	$203,102.21
1999	$27,185.00	$2,530.50	$2,530.50	$32,246.00
2000	$157,508.71	$26,666.50	$25,836.07	$210,011.28
2001	$136,076.57	$0.00	$45,358.19	$181,434.76
2002	$88,366.40	$0.00	$29,454.80	$117,821.20
2003	$107,893.94	$0.00	$35,964.98	$143,858.92
2004	$167,130.00	$0.00	$55,710.00	$222,840.00
2005	$132,412.50	$0.00	$44,137.50	$176,550.00
2006	$0.00	$0.00	$0.00	$0.00
2007	$146,940.00	$0.00	$48,890.00	$195,830.00
2008	$0.00	$0.00	$0.00	$0.00
2008	$0.00	$0.00	$0.00	$0.00
2009	$0.00	$0.00	$0.00	$0.00
2010	$0.00	$0.00	$0.00	$0.00
2011	$0.00	$0.00	$0.00	$0.00
2012	$0.00	$0.00	$0.00	$0.00
Total =	**$1,253,139.27**	**$77,468.03**	**$33,153.07**	**$1,666,760.37**

**The data are from TEMA & FEMA*

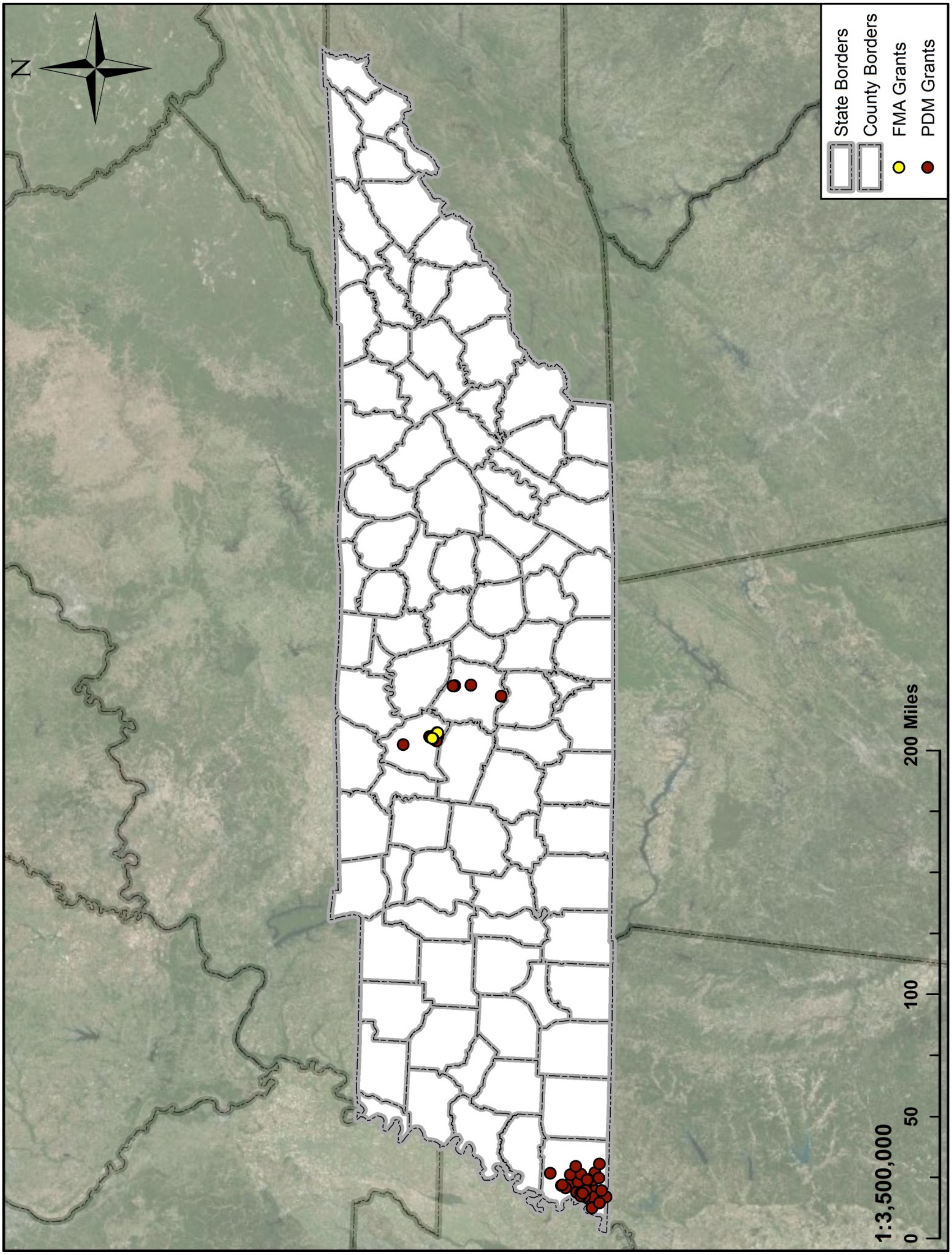
Map 151 – Federal Mitigation Grants, Tennessee



Map 152 – HMGP Grants, Tennessee



Map 153 – PDM & FMA Grants, Tennessee



Appendix D – Reference Sources

Geographic Data Sources

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ESRI
Federal Emergency Management Agency – *HAZUS – MH v2.1*
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Global Terrorism Database
National Oceanic and Atmospheric Administration, National Climatic Data Center
National Oceanic and Atmospheric Administration, National Weather Service – *Storm Prediction Center*
Tennessee Bureau of Economic Analysis
Tennessee Department of Health
Tennessee Department of Safety
Tennessee Department of Transportation
Tennessee Department of Treasury
Tennessee Division of Geology
Tennessee Emergency Management Agency
Tennessee Valley Authority
Texas Department of Health
United States Army Corps. of Engineers
United States Census Bureau
United States Department of Agriculture
United States Department of Agriculture, Natural Resources Conservation Service – *Soil Survey Geographic Database v2.2*
United States Geological Survey
University of Tennessee, Knoxville
University of South Carolina, Department of Geography, Hazards & Vulnerability Research Institute – *Social Vulnerability Index©*
University of Wisconsin, Madison, Department of Forest Ecology and Management

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United States Center for Disease Control and Prevention, *Unknown*

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- **FEMA 386 – 1**, Getting Started building – support for mitigation planning, *September, 2002*
- **FEMA 386 – 2**, Understanding Your Risks – identifying hazards and estimating losses, *August, 2001*
- **FEMA 386 – 3**, Developing the Mitigation Plan – identifying mitigation actions and implementation strategies, *April, 2003*
- **FEMA 386 – 4**, Bringing the Plan to Life – implementing the hazard mitigation plan, *August, 2003*
- **FEMA 386 – 5**, Using Benefit-Cost Review in Mitigation Planning*, May, 2007*
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- **FEMA 386 – 7**, Integrating Human-Caused Hazards Into Mitigation Planning v2.0*, September, 2003*
- **FEMA 386 – 8**, Multi-Jurisdictional Mitigation Planning – State and Local Planning How-To Guide Number Eight*, August, 2006*
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Federal Emergency Management Agency
Federal Emergency Management Agency – *HAZUS – MH v2.1*
National Highway Transportation Safety Administration
National Oceanic and Atmospheric Administration, National Climatic Data Center
Tennessee Department of Health
Tennessee Department of Safety
Tennessee Department of Treasury
Tennessee Emergency Management Agency
United States Census Bureau
United States Army Corps. of Engineers
United States Center for Disease Control & Prevention
United States Geological Survey
University of South Carolina, Department of Geography, Hazards & Vulnerability Research Institute – *Social Vulnerability Index©*
University of Vermont

Appendix E – FEMA Approval Letter

U.S. Department of Homeland Security
FEMA Region IV
3003 Chamblee Tucker Road
Atlanta, GA 30341

FEMA

October 17, 2013

Mr. James H. Bassham, Director
Tennessee Emergency Management Agency
3041 Sidco Drive
Nashville, Tennessee 37204

Reference: Approval of the 2013 Updated Tennessee Standard State Mitigation Plan

Dear Mr. Bassham:

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region IV has approved the updated 2013 Tennessee Standard State Mitigation Plan. This approval modifies the previous 2010 Standard Plan, which was approved on October 18, 2010. The Standard Plan designation becomes valid effective October 18, 2013 through October 17, 2016 at which time an updated plan must be approved to maintain program eligibility, per §201.4 Code of Federal Regulations (44CFR).

We commend the State of Tennessee for developing a solid, workable plan that demonstrates commitment to reduce risks from natural hazards and that will guide mitigation activities over the coming years. We acknowledge and support the State's intention to review and update the plan annually and after each presidential disaster declaration as needed.

We look forward to receiving the 2016 Standard Plan update for review, which will capture the experiences gained over the subsequent three years. A formal plan update is required at least once every three (3) years. If the Plan is amended or revised, it must be resubmitted to FEMA Region IV for formal review and approval.

In summary, the 2013 Standard Plan update continues to show that the State has a comprehensive mitigation program and is meeting expectations with not only FEMA programs but also state programs. Additional comments were provided by Region IV Program specialists for your information and continued use for plan documentation. The Mitigation office will continue to provide technical support through our Grants and Planning programs to the State. A draft of the next Standard State Plan update must be submitted to Region IV by April 2016, or no later than three months prior to the end of the three-year approval period of the existing plan.

We look forward to continuing a productive relationship between FEMA Region IV and the Tennessee Emergency Management Agency. If this office can be of further assistance, please do not hesitate to contact me or Mr. Brad Loar, Mitigation Division Director, at 770-220-5416.

Sincerely,

Major P. May
Regional Administrator