Alabama State Hazard Mitigation Plan

State of Alabama

July 18th, 2018

HAGERTY

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Executive Summary

Background

On October 20, 2000, the United States Congress passed the Disaster Mitigation Act of 2000, also known as DMA2K. Among its other features, DMA2K established a requirement that to remain eligible for federal disaster assistance and grant funds, States and localities must develop and adopt hazard mitigation plans. On February 26, 2002, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule that provided the guidance and regulations under which such plans must be developed. The Final Rule was released in October of 2007 and technical corrections were made in September of 2009. The Final Rule on standard state mitigation plans and enhanced state mitigation plans are found in the Code of Federal Regulations (CFR) at 44 CFR Parts 201.4 and 201.5 (October 1, 2010). The CFR provides detailed descriptions of both the planning process that States and localities are required to observe, as well as the contents of the plan that emerges.

Additionally, the Flood Insurance Reform Act of 2004 (P.L. 108-264) created two new grant programs: the Severe Repetitive Loss (SRL) and Repetitive Flood Claim (RFC) programs. The Act also modified the existing Flood Mitigation Assistance (FMA) program. One of the provisions of this Act is that if a State includes certain elements as required by the Act, the State be eligible for an increased federal cost share (90/10) for projects funded under the Flood Mitigation Assistance and Severe Repetitive Loss programs that address mitigation of severe repetitive loss properties.[1] Alabama has addressed the repetitive loss provisions required by the Act in the **Mitigation Strategy** of this plan. The Biggert-Waters Flood Insurance Reform Act of 2012 extends the National Flood Insurance Program (NFIP) through 2017 and included several reforms included eliminating subsidized insurance rate of repetitive loss properties.

On October 17, 2004, the State of Alabama officially adopted the initial Alabama Statewide Hazard Mitigation Plan in response to the requirements of DMA2K and the IFR Section 201.4(a). In addition, Section 201.4(d) mandates that a state update its plan every three years "to reflect changes in development, progress in statewide mitigation efforts, and changes in priorities." The first update of this plan was approved on October 19, 2007. The 2018 version of this plan is the fourth update in response to the DMA2K requirements.

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[1] The Flood Mitigation Assistance, Repetitive Flood Claims, and Severe Repetitive Loss grant programs now fall under the Hazard Mitigation Assistance (HMA) grants program which was established on June 1, 2010.

The State Alabama will continue to comply with all applicable Federal statutes and regulations related to hazard mitigation planning during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). Further, the State of Alabama and will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d).

Organization of the Plan

The Alabama Hazard Mitigation Plan is organized into the following 10 sections.

Table 1: Plan Contents

Section Number	Section
None	Executive Summary
None	Plan Approval, Adoption, and Assurances
Section 1	The Planning Process
Section 2	Alabama Current and Future Conditions
Section 3	Risk Assessment
Section 4	Capability Assessment
Section 5	Mitigation Strategy
Section 6	Plan Maintenance
Appendices	A. Approval and Implementation B. Glossary of Acronyms and Terms C. Coordination with Local Planning D. Comments Received from SHMT and FEMA E. Planning Process Documents F. Record of Changes G. Hazard Mitigation Grant Program Implementation Process H. Updates to the 2013 Mitigation Action Plan I. State of Alabama Office of Water Resources Risk MAP Program Business Plan

There are references to the CFR throughout the plan; where possible these provide specific section and subsection notations for the convenience of reviewers.

The 2018 plan update revises the structure from the 2013 version of the plan. Section 5, Current and Future Conditions, and Section 7, Capability Assessment, were added into the plan, while the Coordination of Local Planning and the Enhanced Mitigation Plan Elements sections were removed, with the content being reworked to fit into the remaining sections. An in-depth review of changes made from the 2013 to the 2018 version of this plan is available in **Section 1.4**. The

complete descriptions of previous plan development efforts can be found in the 2004, 2007, 2010 and 2013 versions.

Highlights of the Plan

The purpose of the Plan is to rationalize the process of identifying and implementing appropriate hazard mitigation actions across the State. The document includes a detailed characterization of natural hazards Statewide; a risk assessment that describes potential losses to physical assets, people and operations; a set of goals, objectives, strategies and actions that will guide the State's mitigation activities; and a detailed plan for implementing and monitoring the required aspects of the Plan. The following provides a brief summary of each section of the Plan.

Approval and Adoption

This section describes the Plan approval and adoption process and provides assurances as required by the CFR. It also includes documents related to Plan adoption, including an approval letter from the Director of the Alabama Emergency Management Agency (AEMA), and a letter of endorsement and support from the Governor.

The Alabama State Hazard Mitigation Plan was adopted by the Governor through the authority delegated to AEMA. As noted elsewhere in the plan (Section 1), each State Hazard Mitigation Team (SHMT) member was provided a full draft copy of the plan for review, comment and endorsement prior to adoption by the Governor. AEMA retains the comments and changes. The Plan was approved by the Director of the Alabama Emergency Management Agency, through authority delegated by the Governor.

Upon completion, this Plan Update will be approved and adopted through the same mechanism used for previous versions of this plan.

The Planning Process

This section includes a detailed description of the planning process and the individuals and agencies who were involved.

As the process of developing the 2004 Plan began, Alabama Governor Bob Riley signed Executive Order No. 19 (EO 19). EO 19 established the State Hazard Mitigation Council (also referred to as the State Hazard Mitigation Team throughout this document), directed the members of the SHMT to participate in the process and reiterated the importance of the plan for the State. The Governor delegated responsibility for overseeing development of the plan to the AEMA. The SHMT has been the core group responsible for all decisions about planning process and content for plan updates since the Executive Order was signed. During the 2018 plan update process, the SHMT met four times during development of the plan and, during the meetings, considered and

approved/amended aspects of it. A list of the SHMT members and other agencies involved in the planning process is provided in Section 1.

Executive Order 19 has remained valid for the plan updates, leaving the SHMT intact with AEMA as the lead agency for the plan updates. AEMA developed a strategy for updating each section of the plan for the 2018 Plan. This strategy was reviewed and approved by the SHMT at its first meeting and AEMA led the update of all sections of the plan. Subject matter experts on the SHMT were solicited for specific information regarding hazards, risks, capabilities, and strategies. SHMT members were also asked to review mitigation strategies from the 2013 Plan for which they were responsible and asked to provide new mitigation actions that they may pursue in the future.

After all sections were completed and comments incorporated, the Plan was submitted to the SHMT in June 2018 for review prior to submission to FEMA.

The Planning Process provides more detailed summaries of the meetings held for the development of the 2018 update, including the four SHMT meetings. Detailed meeting minutes of each meeting can be found in **Appendix E**.

Current and Future Conditions

This section includes a detailed description of the demographic, economic, infrastructural, and geographic conditions of Alabama as well as outlines trends for population and land-use changes. This section is designed to inform the remainder of the Plan about the impact that hazards can have on specific people, industries, or infrastructure currently or in the future. Recognizing the importance of outlining these factors for the purpose of comprehending implications of the Plan and creating effective mitigation strategies, this section was added to the 2018 update.

Risk Assessment

This section includes a detailed description of the process that was used to identify, assess, and prioritize Alabama's natural hazard risks. **Section 3.1** provides an overview of the identified hazards and the risk ranking methodology. **Section 3.2** provides hazard profiles for 14 natural hazards. **Section 3.3** provides the more detailed vulnerability assessment and loss estimation for the highest ranked hazards. **Section 3.4** provides a summary of the impacts development trends have on the vulnerabilities outlined in **Section 3.3**.

As part of the plan update process, the team reevaluated its hazards based on new and current information and modified its risk assessments based on newly available data. These hazards were then evaluated based on newly acquired data and risk assessment were performed on the most threatening hazards to incorporate current data. Jurisdictions were then ranked based on their vulnerability and risk.

Capability Assessment

This section includes a detailed description of the capabilities the State can provide to carry out the Plan. This includes summaries of the various programs, policies, and legislation that outlines a structure for carrying out mitigation in the State as well as the agencies and funding sources that work to implement specific actions outlined in the plan. Through the Plan update process, information from other sections was gathered and integrated into one section to develop a better implementation resource. Additionally, information related to programs and funding was updated based on current capabilities.

Mitigation Strategy

This section is a description of the State's mitigation strategy, goals, and actions. The strategy and goals were reviewed and revised, as required, as part of the 2018 update. This process is detailed in **Section 1**, and the changes are reflected throughout **Section 5.** The State hazard mitigation strategy is to "Reduce vulnerability through collaborative actions and policies that limit the effects of natural hazards on the citizens of Alabama and physical assets."

The State Hazard Mitigation Team and AEMA originally developed six goals for hazard mitigation in 2004, in support of this general strategy. These goals have been revised since this original plan and were revisited again for the 2018 update by the SHMT. Revisions were made to refine the five goals in the 2013 plan to the following four goals. Further details can be found in **Section 5.**

Table 2: Mitigation Goals

Goal Number	Goal
Goal 1	Enhance the comprehensive statewide hazard mitigation system.
Goal 2	Reduce the State of Alabama's vulnerability and increase resilience to hazards to protect people, property, and natural resources.
Goal 3	Foster public awareness and understanding of their hazard risk and of mitigation opportunities.
Goal 4	Expand and promote coordination and communication with other government agencies, local governments, other relevant organizations.

The SHMT members updated the mitigation actions relating to their agency from the 2013 Mitigation Action Plan. Each agency provided an implementation status, funding source, and priority for their actions. In addition, new actions were provided where appropriate, and this information was consolidated to create the 2018 Mitigation Action Plan.

Plan Maintenance

This section describes how the plan will be periodically evaluated and updated. The Final Rule requires that the State Hazard Mitigation Plan be updated and re-submitted to FEMA for re-approval every five years. In addition to meeting this requirement, AEMA will review the plan annually, based on criteria that are described in **Section 6.1.3**. The criteria to be evaluated are:

Changes in the level of risk to the State and its citizens.

1. Changes in laws, policies, or regulations at the State or local levels.
2. Changes in State agencies or their procedures that will affect how mitigation programs or funds are administered.
3. Significant changes in funding sources or capabilities.
4. Changes in the composition of the State Hazard Mitigation Team.
5. Progress on mitigation actions (including project closeouts) and new mitigation actions that the State is considering.
6. Major changes to the local or multi-jurisdictional hazard mitigation plans.

In addition, as outlined in **Section 6.1.4** AEMA may initiate the review process under the following conditions:

1. At the request of the Governor;
2. When significant new risks or vulnerabilities are identified; or
3. If the findings of the annual/post-disaster review and evaluation warrant.

Section 6.1 describes the process that AEMA will use to initiate and complete the periodic reviews and updates. The interim reviews may be relatively simple, but the five-year update is expected to comprise a comprehensive update and multi-stage process similar to the initial development of the plan.

Other parts of **Section 6** describe how the State will monitor mitigation activities and measure progress toward achieving the goals that are described in **Section 5**.

Plan Approval, Adoption, and Assurances

Plan Approval and Adoption Process

Background

Executive Order No. 19 delegates plan development and approval authority to the Director of the Alabama Emergency Management Agency (AEMA). As discussed in earlier sections, the Order also designates specific agencies and organizations Statewide to participate as members of a State Hazard Mitigation Council (also called the Team, or SHMT throughout this document).

The SHMT last approved this plan in October 2013 and has been involved with the 2018 Plan Update process. Meeting minutes document the presentation materials and discussions. Minutes are provided in Appendix E. This version of the 2018 Plan was reviewed and approved by the SHMT prior to submission to FEMA.

AEMA Review and Approval

After the all comments are compiled and incorporated, the Director of AEMA will review the document for approval and formal adoption on behalf of the Governor as was the case in previous versions.

Formal Adoption Documents

By agreement between FEMA Region IV and AEMA, the official adoption documents will be provided after FEMA's final review and conditional approval of the Plan.

Assurances

The assurances required by 44 CFR Part 201.4 (c) (7) will be included in Appendix A of this plan, the AEMA letter of approval.

1. The Planning Process

The *2018 Alabama State Hazard Mitigation Plan* (HMP) *Update* (Plan Update) is the result of many different agencies and groups working together to coordinate between state and local planning efforts in a manner that is consistent with federal regulations. This section comprehensively introduces the planning process used to develop this Plan Update and demonstrates compliance with the federal regulations pertinent to this process.

1.1 Requirements for the Planning Process

The Federal Emergency Management Agency's (FEMA's) *State Mitigation Plan Review Guide* (2015) synthesizes the requirements outlined in 44 Code of Federal Regulations (CFR) 201.4 to provide guidance for states conducting updates to their hazard mitigation plans. Accordingly, this Plan Update is required to describe the planning process used to build this document, including an explanation of how the state coordinated with "other State agencies, appropriate Federal agencies, and interested groups."[1] Further, the planning process should be "integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives."[2] The CFR also requires that the description of the planning process include "how it was prepared, who was involved in the planning process, and how other agencies participated."[3]

The remainder of this section follows the guidance of the *State Mitigation Plan Review Guide* by first describing in detail the planning process used by Alabama Emergency Management Agency (AEMA) to build this document, and then describing coordinating efforts with local planning at the county level (this Plan Update also gives specific attention to integration with other state and federal planning initiatives in Section 5, the Mitigation Strategy). This section concludes with an analysis of differences between this Plan Update and its predecessor, the *2013 Alabama State Hazard Mitigation Plan Update*.

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[1] 44 CFR 201.4 (b). Retrieved at: https://www.law.cornell.edu/cfr/text/44/201.4
[2] Ibid.
[3] 44 CFR 201.4 (c) (1). Retrieved at: https://www.law.cornell.edu/cfr/text/44/201.4

1.2 Description of the Planning Process

1.2.1 How the Plan was Prepared and Updated

1.2.1.1 General Requirements

The 2018 Alabama State Hazard Mitigation Plan is the fifth version of this plan. The initial plan (2004) was prepared in general accordance with the processes established in the How-To Guides produced by FEMA, and the requirements of 44 CFR 201.4.

The initial planning process established many of the vital functions that continue through the update process. Early in the development of the initial plan, Governor Riley signed Executive Order 19 (EO 19) on February 24, 2004, which outlined the infrastructure around which the initial planning process, as well as the planning process for subsequent updates, should occur.[4] To do this, EO 19 accomplished the following:

- Established the State Hazard Mitigation Council (also known as the State Hazard Mitigation Team, or SHMT), which is described further in Section 1.2.2.3;
- Encouraged representatives from all State agencies to attend SHMT meetings;
- Directed all State agencies to participate in the development of the plan by providing services as directed by the SHMT;
- Encouraged agencies and other interested parties to participate in the planning process by providing comments and information via meetings, surveys, questionnaires and other means;
- Directed the SHMT to assist in prioritizing and selecting of hazard and pre-disaster mitigation grant program project applications;
- Directed the SHMT to meet when called by the Chair and remain in place until the five-year update to the plan has been approved by FEMA; and
- Directed the SHMT to prepare the State Hazard Mitigation plan.

Each version of this plan was approved by the SHMT, adopted by the AEMA Director on behalf of the Governor, and approved by FEMA. Specific information on the initial plan and the subsequent update planning processes can be found in each version of the plan.

Previous versions of this plan called for the SHMT to reassemble before the next update on an annual basis to review and evaluate the plan in the following areas:

- Changes in risk;
- Changes in laws, policies, or regulations at the state or local level;

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[4] EO 19 by Governor Bob Riley. Alabama Department of Archives & History. Retrieved at: http://digital.archives.alabama.gov/cdm/singleitem/collection/executive/id/540/rec/2

- Changes in State agencies or their procedures that may affect mitigation programs or administration of funds;
- Changes in funding sources or capabilities;
- Changes in composition of the SHMT;
- Progress on mitigation actions and new mitigation actions being considered; and
- Major changes to local hazard mitigation plans.

The results of this review impacted the implementation of mitigation actions in between plan updates and influenced the content and planning process of the 2018 Alabama State HMP Update.

FEMA requires that State Hazard Mitigation Plans be updated every five years. AEMA began working on the 2018 plan update in October 2017 and hired a consultant team from Hagerty Consulting (Hagerty) to facilitate the plan update process. FEMA requirements state that plan updates must have provisions for updates to be made to all sections of the plan. As a result, the consultant reviewed and analyzed each section of the plan and determined that each section would be updated to some degree to meet the FEMA requirements. The planning process exercised to update the plan is described below.

1.2.1.2 Project Management

AEMA and Hagerty held regular bi-weekly project management conference calls throughout the project, including the Project Planning Conference Call to initiate the project. The Project Planning Conference Call was held on October 19, 2017 to introduce the planners from AEMA and Hagerty, determine an initial strategy for updating the plan, and review the project schedule. Through the bi-weekly calls, Alabama monitored the update process and provided direction on the review of the 2013 State Hazard Mitigation Plan and creation of the 2018 State Hazard Mitigation Plan.

1.2.1.3 SHMT Planning Process Meetings

AEMA hosted five planning meetings with the SHMT during the planning process. The second of these, the Risk Assessment Methodology and Outreach Strategy Meeting, was held virtually, with the remaining four meetings all held at AEMA Headquarters in Clanton, Alabama (with an option for virtual attendance). These meetings were:

- Kickoff Meeting on November 6, 2017;
- Risk Assessment Methodology and Outreach Strategy Meeting on December 1, 2017;
- Risk Assessment Meeting on March 13, 2018;
- Mitigation Strategy Meeting on May 17, 2018; and
- Plan Review Meeting on June 12, 2018.

These meetings are summarized in the sections below. Agendas, slide decks, notes, and lists of attendees for each of these meetings are provided in Appendix E.

1.2.1.3.1 Kickoff Meeting

The purpose of the Kickoff Meeting, held on November 6, 2017, was to meet with all SHMT members to present the following information at the outset of the project:

- Project goals and objectives;
- Purpose and benefits of hazard mitigation planning;
- Review the project schedule and tasks, including updating the Risk Assessment, Capability Assessment, and Mitigation Strategy;
- Review the roles of Hagerty, AEMA, and the SHMT throughout the planning process; and
- Introduce the Hazard Analysis and Risk Assessment methodology.

Throughout the meeting, AEMA and the facilitators emphasized the importance of stakeholder participation at the planning meetings. Participants were asked to identify any additional stakeholders that should be incorporated into the planning process as well.

All federal and state representatives were invited were invited to the Kickoff Meeting. Representatives from one federal agency, eight state agencies or groups, and one dual-mission department, the Alabama National Guard (ALNG), were present.

1.2.1.3.2 Risk Assessment Methodology and Outreach Strategy Meeting

The SHMT convened virtually on December 1, 2017 for the Risk Assessment Methodology and Outreach Strategy Meeting. SHMT members received a briefing on the outreach strategy (see Section 1.2.3.2) and reviewed the proposed list of hazards. Participants discussed FEMA's State Mitigation Plan Review Guide which requires the effects of climate change to be addressed as part of the identified hazards, and participants discussed the role that the Sea Level Rise profile would play in meeting this requirement.[5] Participants also concurred that Sea Level Rise should be treated as the product of both global sea level rise as a result of climatological factors and local sea level rise as a result of land subsidence. Several other potential hazards were discussed at this meeting, such as Space Weather and Pandemic, but the SHMT ultimately declined to include these hazards in favor of using the list of hazards from the previous plan update in 2013, with the addition of Sea Level Rise.

All federal and state representatives were invited to the Risk Assessment Methodology and Outreach Strategy Meeting. No federal agencies were represented at this meeting, but seven state agencies or groups were present.

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[5] The Hazard Profiles (Section 3.2) describe the role of climate change in relation to other hazards as well. This section only represents the discussion that took place during the Risk Assessment Methodology and Outreach Strategy Meeting

1.2.1.3.3 Risk Assessment Meeting

The SHMT and county stakeholders met for the Risk Assessment Meeting on March 13, 2018 to review the Hazard Profiles and Vulnerability Assessment, including the locations, extents, and past occurrences of each hazard; the future probability of each hazard; an overview of the initial hazard rankings; and the detailed vulnerability analysis for four selected highly-ranked hazards. During the meeting, participants discussed the importance of the Risk Assessment as the foundation for identifying mitigation strategies.

The SHMT discussed the ranking methodology used in this analysis. The 2013 State Hazard Mitigation Plan used a qualitative ranking system for hazards based on probability of occurrence and ease of mitigation. The participants indicated that a quantitative methodology for ranking hazards, considering multiple metrics that inform risk, would provide a more consistent metric across hazards and to help prioritize mitigation strategies. This Risk Factor (RF) system was developed based on agreement from the SHMT during this meeting.

In previous versions of the plan, the SHMT and FEMA determined that a subset of the hazards would receive detailed vulnerability analyzes based on the determination of high-level of risk. Based on this methodology, Flooding, High Winds, and Sea Level Rise received vulnerability analyses because they were high-ranked hazards, while earthquakes were selected based on the well-developed Hazus loss estimation methodology (see Section 3.3.1).

Stakeholder discussion also focused on the selection of Sea Level Rise for detailed analysis given that its geographic extent is limited to only two of the 67 counties in Alabama. Some consideration was also given to tying Sea Level Rise to storm surge. Ultimately, the SHMT decided to defer to the results of the RF analysis (see Section 3.1.2).

The subsequent RF analysis yielded three high-risk hazards for detailed vulnerability analysis, which mirrored the original selection: Flooding, High Winds, and Sea Level Rise. The SHMT also selected earthquakes for detailed vulnerability assessment despite its lower ranking because data for earthquake vulnerability assessments are readily available through the free Hazus program (see Section 3.3.1), and because a detailed vulnerability assessment for earthquakes was included in the 2013 plan. The RF analysis was sent for, and received, SHMT concurrence on March 30, 2018.

All identified federal, state, and county stakeholders were invited to the Risk Assessment Meeting. Representatives from one federal agency, nine state agencies or groups, one dual-mission department (ALNG), one regional authority, and at least eight counties were present.

1.2.1.3.4 Mitigation Strategy Meeting

The SHMT and county stakeholders met for a fourth time to hold the Mitigation Strategy Meeting. During the meeting, participants discussed and approved minor recommended revisions to the goals and objectives from the 2013 Plan. The SHMT also reviewed the five different types of

mitigation techniques available to reduce their risk to identified risks and vulnerabilities: plans and regulations, structure and infrastructure projects, natural systems protection, education and awareness programs, and preparedness and response actions.

The SHMT reviewed the 2018 Action Plan. Participants discussed recommended changes from the 2013 Plan to streamline actions for ease of implementation and discussed new actions to address the updated risk and vulnerabilities identified in the Risk Assessment.

All identified federal, state, and county stakeholders were invited to the Mitigation Strategy Meeting. Representatives from one federal agency, nine state agencies or groups, one dual-mission department (ALNG), and four counties were present.

1.2.1.3.5 Plan Review Meeting

The SHMT and county stakeholders attended the fifth and final meeting on June 12, 2018 when the draft document was presented for review during the Plan Review Meeting. Each section of this Plan Update was presented to stakeholders for discussion, approval, and comments.

AEMA provided a copy of the initial draft of this plan to the SHMT and county stakeholders in advance of this meeting, on June 1, 2018. Additionally, the full draft was made publicly available beginning June 5, 2018, on the AEMA Hazard Mitigation Web Page (see Section 1.2.3.2). At the conclusion of the Plan Review Meeting, the SHMT and county stakeholders were invited to submit additional comments to AEMA for inclusion in the Plan Update by July 2, 2018.

All federal, state, and county representatives were invited were invited to the Plan Review Meeting. Representatives from one federal agency, eight state agencies or groups, one regional authority, and six counties were present.

1.2.1.4 Submission to FEMA

Following completion of the plan draft, both FEMA and the SHMT had 45 days to review the draft plan. AEMA received all comments and then incorporated them into the plan, where appropriate. A summary of comments is available in Appendix D. The plan was finalized and submitted to FEMA in July 2018 for final review and approval.

1.2.2 Who was Involved in the Planning Process

The Alabama State Hazard Mitigation Council (referred to as the SHMT throughout the Plan) was the primary mechanism for developing and updating the 2018 State Hazard Mitigation Plan. The SHMT is, however, part of a larger organization and process, including the entities listed below:

- The Governor of Alabama;
- AEMA;
- The SHMT;
- Regional Planning Commissions (RPCs);

- AEMA Geographic Divisions;
- Other Federal and State agencies and interested groups;
- County Stakeholders;
- Citizens; and
- Consultants.

In previous versions of this plan, this list included the SHMT Technical Advisory Committee (TAC). However, the TAC did not participate in the 2010, 2013, or 2018 Updates.

The following sections provide a general description of the respective roles in the planning process of each of the entities listed above.

1.2.2.1 The Governor of Alabama

By issuing EO 19 on February 24, 2004 the Governor initiated development of the SHMT, designated its members, outlined their tasks, and directed the Director of AEMA to lead the planning effort. EO 19 is valid until the updated plan has been approved and adopted, so there was no need for a new Executive Order. The Plan Update will be approved and adopted by the Governor through the AEMA Director as was done in previous versions of the plan.

1.2.2.2 The Alabama Emergency Management Agency (AEMA)

AEMA is the lead agency for development of the plan. Although the SHMT is the group responsible for the actual development and production of the plan, AEMA serves as a coordinating entity throughout its development. The Agency facilitated interactions among various Federal, State, and local governments, and provided important oversight and quality control to ensure that the plan and associated process met Federal requirements. AEMA coordinated the update of all aspects of the plan and facilitated coordination among agencies at all levels of government. Further, AEMA helped to establish meeting times and locations. The AEMA Director is also responsible for final approval and adoption of the Plan on behalf of the Governor.

1.2.2.3 The State Hazard Mitigation Team

The SHMT is the key organization in the development of the plan. The group was designated by the Governor via EO 19 and is mostly comprised of a variety of state organizations that were originally identified to be on a similar team in a previous administration. Some federal and regional agencies or groups also participate as a part of the SHMT. Throughout the plan update, minor changes have been made as new stakeholders are identified. The complete list of participating SHMT members can be found below.

The SHMT, in coordination with AEMA, was responsible for developing and reviewing all substantial plan processes and content. The SHMT formally met five times during development of this plan update (see Section 1.2.1.3).

The SHMT made all final decisions regarding the plan, reviewed drafts, provided comments, and made recommendations to the AEMA Director. Individual representatives of agencies on the

SHMT were also asked to provide feedback for their respective agencies, data for development of the risk assessment, and input for the Mitigation Strategy.

The SHMT was convened on November 6, 2017 for a Kickoff Meeting and as part of the plan update process. The SHMT met virtually on December 1, 2017 for a Risk Assessment Methodology and Outreach Strategy Meeting. The SHMT met again for the Risk Assessment Meeting on March 13, 2018 to review the Hazard Profiles and Vulnerability Assessment. The SHMT met for a fourth time to hold the Mitigation Strategy Meeting on May 17, 2018. A final Plan Review Meeting was held on June 12, 2018 when the draft document was presented for review. These meetings are described in further detail in Section 1.2.1 and detailed meeting materials including agendas, slide decks, notes, and attendance lists can be found in Appendix E.

EO19 directed the following individuals and agencies to serve as members of the SHMT:

- The Governor or his designee who shall serve as chair;
- The Commissioner of the Alabama Department of Agriculture and Industries (AGI);
- The Attorney General;
- The Commissioner of the Alabama Department of Conservation and Natural Resources (DCNR);
- The Director of the Alabama Department of Economic and Community Affairs (ADECA);
- The Director of the Emergency Management Agency;
- The Director of the Alabama Department of Environmental Management (ADEM);
- The State Forester of the Alabama Forestry Commission (AFC);
- The Office of the State Geologist;
- The State Historic Preservation Officer;
- The Commissioner of the Insurance Department;
- The Director of the Governor's Legal Council Office;
- The Director of the Alabama Department of Public Health (ADPH);
- The Director of the Governor's Public Information Office;
- The Director of the Alabama Department of Public Safety;
- The Commissioner of the Alabama Public Service Commission (PSC);
- The Secretary of State;
- The Director of the Alabama Department of Transportation (ALDOT);
- The Director of the Alabama Association of Regional Councils;
- The Director of the Alabama League of Municipalities;
- The Director of the Association of County Commissioners;
- The Director of the Indian Affairs Commission;
- The Chief of the U.S. Army Corps of Engineers; and
- The Director of the Choctoawhatchee, Pea and Yellow Rivers Watershed Management Authority (CPYRWMA).

In addition to those individuals and agencies directly assigned to the SHMT, EO 19 requested that the following federal agencies or groups establish points of contact for the Hazard Mitigation Team:

- The American Red Cross;
- The Military Department;
- The National Weather Service (NWS), Birmingham;
- The NWS, Huntsville;
- The NWS, Mobile;
- The NWS, Tallahassee;
- U.S. Air Force, Maxwell AFB;
- U.S. Army, Fort Rucker Army Post; and
- United States Department of Agriculture (USDA) Forest Service (USFS).

During the 2018 Update process, AEMA tracked participation by the entities listed above. Table 1.1 summarizes participation by agency. Note that although EO 19 calls for the director or commissioner of many agencies or groups, a designee was often invited or participated on their behalf. Lists of attendees (including names of individual attendees and the agencies which they represent) for each SHMT meeting can be found in Appendix E.

Table 1.1 Summary of Agencies or Groups Represented at SHMT Meetings

Agency or Group	Requested by EO 19	Representative Identified for 2018 Update	Attended at least one 2018 SHMT Meeting
Governor's Office	X		
Alabama Department of Agriculture and Industries	X	X	X
Office of the Attorney General, State of Alabama	X		
Alabama Department of Conservation and Natural Resources	X	X	X
Alabama Department of Economic and Community Affairs	X	X	X
Alabama Emergency Management Agency	X	X	X
Alabama Department of Environmental Management	X	X	X

Agency or Group	Requested by EO 19	Representative Identified for 2018 Update	Attended at least one 2018 SHMT Meeting
Alabama Forestry Commission	X	X	X
Office of the State Geologist (Geological Survey of Alabama)	X	X	X
State Historic Preservation Office (Alabama Historical Commission)	X		
Alabama Department of Insurance	X	X	X
Governor's Legal Council Office	X		
Alabama Department of Public Health	X	X	X
Governor's Public Information Office	X		
Department of Public Safety (Alabama Law Enforcement Agency)	X	X	X
Alabama Public Service Commission	X	X	X
Office of the Alabama Secretary of State	X	X	
Alabama Department of Transportation	X	X	X
Alabama Association of Regional Councils	X		
Alabama League of Municipalities	X		
Association of County Commissioners (Association of County Commissions of Alabama)	X		

Agency or Group	Requested by EO 19	Representative Identified for 2018 Update	Attended at least one 2018 SHMT Meeting
Alabama Indian Affairs Commission	X		
U.S. Army Corps of Engineers	X		
Choctoawhatchee, Pea and Yellow Rivers Watershed Management Authority	X	X	X
American Red Cross	X		
Military Department (Alabama National Guard)	X	X	X
National Weather Service, Birmingham	X	X	X
National Weather Service, Huntsville	X		
National Weather Service, Mobile	X		
National Weather Service, Tallahassee	X		
U.S. Air Force, Maxwell AFB	X		
U.S. Army, Fort Rucker Army Post	X		
USDA Forest Service	X		
Alabama Division of Risk Management		X	X
Alabama Department of Senior Services		X	
Alabama Department of Human Resources		X	X
Alabama Department of Finance		X	
Alabama State Department of Education		X	X
Troy University		X	

Agency or Group	Requested by EO 19	Representative Identified for 2018 Update	Attended at least one 2018 SHMT Meeting
Poarch Band of Creek Indians		X	
Federal Emergency Management Agency		X	X

1.2.2.4 Regional Planning Councils

RPCs are a group of 12 organizations that provide a variety of services to the counties in their respective regions. All the counties in Alabama are part of an RPC. Historically, RPCs provided oversight and coordination of the development and update of county-level hazard mitigation plans.

In past updates of this plan, AEMA interacted with the 12 RPCs to promulgate information about the State Plan and to gather input about the local and county plans to inform the state-level process. In the 2010 update, the RPCs were the primary entity updating the local plans. However, RPC involvement in local mitigation planning declined for the 2013 State Plan Update due to limited funding. For the 2018 State Hazard Mitigation Plan Update process, AEMA elected for its own geographic divisions to facilitate this regional coordination process, rather than RPCs.

Therefore, RPCs were not directly involved in this Plan Update. Nonetheless, RPCs are described here and in Appendix C because in the case of a few counties, RPCs still maintain some responsibility for the update of local hazard mitigation plans.

1.2.2.5 AEMA Geographic Divisions

In previous versions of this Plan, AEMA and the SHMT interacted with the twelve RPCs to coordinate information between county plan development and state plan development. For the 2018 Update process, AEMA and the SHMT elected to facilitate this process through AEMA's geographic divisions.

Figure 1.1 AEMA Geographic Divisions

AEMA divides the state into seven geographic regions, or divisions, within the emergency management structure. Each division, labeled A through G, represents the geographically-proximate counties as shown in Figure 1.1. These divisions provide a mechanism for county-level collaboration and coordination during the development and update of the State Hazard Mitigation Plan. Division meetings are held quarterly, with relevant stakeholders from each county in attendance. In accordance with the Outreach Strategy (see Section 1.2.3.2) and the project timeline, AEMA and the SHMT provided materials for distribution to stakeholders at each quarterly meeting

to promulgate information about the State Plan Update and to gather input about the local and county plans to inform the state-level process. Additionally, staff from the AEMA Regional Divisions attended SHMT meetings to provide perspective from their communities and to bring information back to their counties.

1.2.2.6 Other Federal and State Agencies and Interest Groups

Early in the planning process the SHMT and AEMA identified a list of entities that should be involved in the plan development process including federal and state agencies and other interested groups. In the first stages of the process these groups were contacted, and points of contact identified. Throughout development of the plan, these groups and the points of contact were informed of the planning process and its outcomes. Because EO 19 formally established the SHMT, the Team itself was the only body directly authorized to make decisions about what was included in the plan. However, at many points in the process, these other organizations were invited to review materials related to the plan and comment on them. Representatives from these agencies, groups, and organizations were invited to attend the SHMT meetings and participate in the plan update process.

FEMA provided technical assistance on this plan and kept AEMA abreast to the latest requirements needed in the state plan update. AEMA informed FEMA of the planning process and process benchmarks and invited FEMA to participate in all planning meetings.

1.2.2.7 County Stakeholder Involvement

Stakeholders from each county were invited to participate in the Risk Assessment Meeting, Mitigation Strategies Meeting, and the Plan Review Meeting. Table 1.2 summarizes participation by county.

Table 1.2 County Participation in SHMT Meetings

County	Risk Assessment Meeting (March 13, 2018)	Mitigation Strategy Meeting (May 17, 2018)	Plan Review Meeting (June 12, 2018)
Autauga			
Baldwin			
Barbour			
Bibb	X		
Blount			
Bullock	X		
Butler			
Calhoun			
Chambers			
Cherokee			

County	Risk Assessment Meeting (March 13, 2018)	Mitigation Strategy Meeting (May 17, 2018)	Plan Review Meeting (June 12, 2018)
Chilton			
Choctaw			
Clarke			
Clay			
Cleburne			
Coffee			X
Colbert			
Conecuh			
Coosa			
Covington			
Crenshaw			
Cullman			
Dale			
Dallas	X		X
DeKalb			
Elmore			
Escambia			
Etowah			
Fayette			
Franklin			
Geneva			
Greene			
Hale			
Henry			
Houston		X	
Jackson			
Jefferson			
Lamar			
Lauderdale			
Lawrence			
Lee			
Limestone			
Lowndes			

County	Risk Assessment Meeting (March 13, 2018)	Mitigation Strategy Meeting (May 17, 2018)	Plan Review Meeting (June 12, 2018)
Macon			X
Madison			X
Marengo			
Marion			
Marshall			
Mobile		X	X
Monroe			
Montgomery			
Morgan			
Perry	X		
Pickens	X		
Pike		X	
Randolph			
Russell			X
St. Clair	X	X	
Shelby			
Sumter	X		
Talladega			
Tallapoosa			
Tuscaloosa			
Walker			
Washington			
Wilcox	X		
Winston			

Additionally, the Outreach Strategy identified other avenues for county stakeholder engagement (see Section 1.2.3.2). For example, county stakeholders were engaged through participation in AEMA's quarterly geographic division meetings (see Section 1.2.2.5) and through distribution of targeted mitigation informational materials, such as the monthly newsletter.

1.2.2.8 Public Involvement

For the 2018 Plan Update, the citizens of Alabama were invited to participate in this planning process according to the Outreach Strategy (see Section 1.2.3.2). To accomplish this, the AEMA Hazard Mitigation Web Page was updated to include a plan update description, plan update

contact information (including the SHMT), a link to the 2013 Plan Update, and links to the Draft 2018 Plan Update and the Final 2018 Plan Update.

1.2.2.9 Consultant Assistance in Developing the Plan

In addition to the groups discussed above, AEMA secured the services of a professional consultant to facilitate the planning process and develop some technical materials for the 2018 update. The Hagerty Consulting team assisted AEMA and the SHMT in a variety of ways:

- Provided technical assistance including planning guidance and federal compliance;
- Collected and analyzed data from the appropriate local, state, and federal sources to describe Alabama Current and Future Conditions;
- Collected and analyzed data for the Risk Assessment from the appropriate local, state, and federal sources;
- Collected and analyzed data from the appropriate state and local agencies for the Capability Assessment;
- Facilitated SHMT meetings;
- Developed materials for meetings;
- Documented the Plan Update process including meeting notes and lists of invitees and attendees;
- Developed and facilitated an Outreach Strategy (see Section 1.2.3.2) to directly and indirectly engage stakeholders and the public in the planning process;
- Worked with the SHMT to revise and update the Mitigation Strategy (including mitigation goals, objectives, and actions);
- Assembled and incorporated information into the Plan Update; and
- Prepared the Plan documents.

1.2.3 How Other Agencies Participated in the Planning Process

1.2.3.1 General Participation

A range of state agencies and groups were designated by EO 19 as participants in the planning process (see Section 1.2.2.3). Members of these State agencies and groups participated in the planning process in several ways. Their primary means of doing so was by attending the SHMT meetings and participating in discussions and decisions about various plan procedures and components. The entire planning process was carefully documented. Documentation includes invitee lists, attendees, materials provided, presentations, and meeting notes. These materials are included in Appendix E.

A range of Federal agencies and departments were also identified in EO 19 as recommended participants (see Section 1.2.2.3). Many of these agencies and departments were invited to each SHMT planning meeting and were encouraged to provide input to all aspects of the plan. AEMA

was established as the main point of contact for this purpose, and telephone numbers and email addresses were provided on communications with the Federal agencies.

During the 2018 Update process, AEMA tracked participation by these state and federal agencies and groups. Refer to Section 1.2.2.3 for a summary of participation by these agencies.

1.2.3.2 Outreach Strategy

44 CFR 201.4 states that "the mitigation planning process should include…interested groups." AEMA and its consultant developed an Outreach Strategy to meet this requirement and facilitate the participation of agencies and groups outside of AEMA. First, AEMA and Hagerty defined a successful outreach strategy as one that possesses the following characteristics:

- Informs and educates about hazards and risks;
- Invites interested parties to contribute their views and ideas for mitigation;
- Identifies conflicts and incorporates different perspectives and priorities early in the process;
- Provides data and information that improves overall quality and accuracy of the plan;
- Ensures transparency and builds trust; and
- Maximizes opportunities for implementation through greater consensus and acceptance.

The Outreach Strategy defines four goals to ensure it encompasses these characteristics:

- **Organization identification:** The Plan update process should identify organizations and stakeholders that AEMA and the SHMT should engage to participate in the Update;
- **Direct engagement:** To ensure comprehensive outreach, stakeholder meetings should be held in-person in various regions statewide;
- **Indirect engagement:** Technological solutions should be leveraged to allow for more comprehensive awareness and involvement in the planning process; and
- **Outreach documentation:** All planning outreach efforts should be documented and captured within the Plan, including any related meeting materials and notes.

These four goals were supported by six specific tactics:

- **Outreach to critical partners:** AEMA coordinated with the SHMT to identify potential partners in the types of organizations that FEMA encourages engagement with during the planning process: emergency management, economic development, land use and development, health and social services, infrastructure, and natural and cultural resources. AEMA and SHMT determined that they did not have appropriate state-level contacts into the housing organizations that FEMA recommends, but will continue to explore partnerships with these types of organizations. concentrated on building out organizational involvement by engaging these identified organizations, re-engaging partners involved in the 2013 Plan Update, and conducting targeted outreach to organizations in each of the FEMA-recommended categories above.

- **Leverage existing cohorts and/or stakeholder/public engagement activities:** AEMA prepared Plan Update information for distribution to stakeholders at the quarterly meetings of each AEMA geographic division (see Section 1.2.2.5) in accordance with the project timeline.
- **Develop a distinctive and cohesive 2018 HMP Update brand:** Hagerty, in coordination with AEMA, developed style guides and templates distinctive to the HMP update planning process for all materials, as well as a 2018 HMP Update logo.
- **Ensure meeting materials and plan elements are available for stakeholder and public review:** To satisfy the requirement that the Plan be a publicly available resource and to satisfy the need for a comprehensive approach to outreach process, the AEMA Hazard Mitigation Web Page was updated to include a plan update description, plan update contact information (including the SHMT), a link to the 2013 Plan Update, and links to the Draft Plan Update (posted initially on June 5, 2018 and maintained through submission to FEMA) and the Final Plan Update. The SHMT also conducted in-person meetings to gather information and validate findings for each of the elements being updated during the planning process, including hazard analysis and risk assessment, mitigation strategy development, and draft plan review (see Section 1.2.1.3).
- **Generate awareness and engagement through email distribution, and newsletters:** AEMA delivered monthly mitigation newsletters to the SHMT and other state and federal partners. These newsletters provided an update on the process, profiled notable mitigation strategies from around the state and country, and outlined upcoming planning expectations. AEMA made these newsletters electronically available to all counties through AEMA's intranet, which is commonly used to post information for distribution to county stakeholders. SHMT and other planning partners also received emails with information about upcoming meetings, as well as requests to review components of the Plan.
- **Document outreach activities:** All meeting materials and planning activities were captured in this Plan Update document. All agendas, slide decks, notes, and lists of attendees for each meeting are provided in Appendix E. An ongoing outreach strategy was also developed for the Plan Maintenance portion of this document (see Section 6).

1.2.4 Agency Coordination During Development of 2018 State Hazard Mitigation Plan

Most agency coordination was achieved by assembling the SHMT. Beyond the activities of the SHMT, the following summarizes efforts to involve other agencies in the planning process.

1.2.4.1 Coordination to Incorporate Local Hazard Mitigation Plans

44 CFR 201.4 requires that state hazard mitigation plans contain a review of FEMA approved local hazard mitigation planning efforts including risk assessments and mitigation goals and actions. Much progress has been made with local level planning. When the initial State Hazard Mitigation Plan was developed in 2004, no local hazard mitigation plans had been approved. The

number of approved plans (and approved updated plans) has increased with each plan update process. By the 2010 State Hazard Mitigation Plan Update, all counties had an approved plan in place. By the 2013 State Plan Update, most counties had an approved update. With the 2018 State Plan Update, all counties now have approved updates in place. Coordination between AEMA, local Emergency Management Agencies (EMAs) and the 12 RPCs helped to make this possible.

Because all 67 counties have approved hazard mitigation plan updates in place at the time of the 2018 State Plan Update, these plans could be reviewed directly, and appropriate information could be extracted and incorporated into the state plan update. Information from the local risk assessment and mitigation strategy sections was extracted and incorporated into this plan. This process helped to ensure that the statewide planning effort was both a "top-down" and "bottom-up" approach as it pertains to the relationship between the local and state plans. The integration of local plans is described further in Section 1.3 and referenced throughout this plan.

1.2.4.2 Coordination to Complete the Risk Assessment

AEMA also consulted with several state and federal agencies represented on the SHMT to obtain information and guidance while updating the Risk Assessment section. For example, National Oceanic and Atmospheric Administration (NOAA) was contacted to obtain SLOSH data and sea level rise trend data for coastal area analysis. FEMA Region IV was contacted to obtain National Flood Insurance Program (NFIP) claim data. Many of the agencies consulted by AEMA lead and incorporate statewide mitigation programs, as discussed in Section 4.6. Table 1.3 summarizes the different agencies and organizations from which data was obtained for the 2018 Risk Assessment.

Table 1.3 Data Sources per Hazard[6]

Agency/Organization	DF	DR	EQ	ET	FL	HA	HW	LS	LT	SL	SU	TS	WF	WS
ADECA-OWR	X	X												
AFC													X	
ASCE	X													
ASCE/SEI							X							
ASDSO	X													
Climate Central													X	
Climate Impact Lab				X										

[6] Hazards are abbreviated as follows: Dam Failure (DF), Drought (DR), Earthquakes (EQ), Extreme Temperatures (ET), Flooding (FL), Hail (HA), High Winds (HW), Landslides (LS), Lightning (LT), Sea Level Rise (SL), Sinkholes and Land Subsidence (SU), Tsunamis (TS), Wildfire (WF), Winter Storms (WS)

Agency/Organization	DF	DR	EQ	ET	FL	HA	HW	LS	LT	SL	SU	TS	WF	WS
FEMA	X	X	X	X	X	X	X		X				X	
GSA			X					X			X			
ICC							X							
NCEI						X			X					
NDMC		X												
NHC					X									
NLDN									X					
NOAA		X		X	X	X	X		X	X		X		X
NWS		X		X	X	X	X		X					
SERCC				X										
SGSF													X	
UCS										X				
US Climate Data				X										
US Dept. of Commerce										X				
US Dept. of Interior													X	
US Drought Monitor		X												
USACE	X													
USDA-RMA		X												
USFS													X	
USGS			X		X			X		X	X	X	X	
Vaisala, Inc.									X					

AEMA continues to coordinate with State agencies to identify state owned and/or operated critical facility information for incorporation into the plan. 44 CFR 201.4 states that “State owned critical or operated facilities…shall also be addressed.” The SHMT determined that these facilities should include state-insured facilities and state-identified Critical Infrastructure and Key Resources (CIKR). The Alabama Division of Risk Management (DORM) provided an inventory of state-insured facilities, and the Alabama Law Enforcement Agency (ALEA) provided an inventory of CIKR. These two databases were merged to facilitate Geographic Information System (GIS) spatial overlay analysis of critical facilities with various hazards. This process is described further in Section 3.3 (Vulnerability Assessment & Loss Estimation).

The Risk Assessment was finalized following comments and verification provided at the Risk Assessment Meeting on March 13, 2018, to which all state, federal, and county stakeholders were invited.

1.2.4.3 Coordination to Complete the Mitigation Strategy

AEMA coordinated with members of the SHMT to complete the Mitigation Strategy. AEMA requested all members of the SHMT, but especially those named as "Responsible Agency" for mitigation actions in the initial plan, to do the following:

- Review and provide an update for their mitigation actions from the 2013 plan;
- Identify any new mitigation actions that they were interested in pursuing; and
- Validate new mitigation actions developed by AEMA.

The Mitigation Strategy was finalized following comments and verification provided at the Mitigation Strategy Meeting on May 17, 2018, to which all state, federal, and county stakeholders were invited.

1.2.4.4 Coordination with FEMA During the Planning Process

AEMA and FEMA continued to coordinate for the 2018 Plan update. FEMA Region IV participated in the Plan update process by providing technical assistance and by providing general guidance on the plan update process. FEMA also provided data for the Risk Assessment (see Table 1.3).

Further, AEMA coordinated with FEMA to submit the Mitigation Strategy (see Section 5) for review prior to formal submission of the entire 2018 Plan Update. This was done to expedite the review and comment process.

1.3 Coordinating Local Planning

1.3.1 Process for Reviewing, Coordinating and Linking the State and Local Plans

This section explains the process used to link local plans to the state plan. The risk assessment and mitigation strategies of local plans were reviewed to ensure consistency with the state plan to meet the local plan integration requirement.

When the initial State Plan was being composed in 2004, no local plans were finalized. As a result, an appropriate methodology was used to incorporate the few plans that were near completion. A detailed description of that methodology can be found in the 2004 or 2007 version of this plan.

For the 2013 update, all 67 counties had reviewable plans. Consequently, the SHMT was able to cross-check the state hazard data with that of the local risk assessments. This review process continues to be used for the 2018 update and is expected to be used for subsequent updates.

The review of local plans focuses on three main areas:

- Hazard identification and profiles;

- Potential loss estimates; and
- Mitigation goals and actions.

This review ensures that the state's mitigation strategy is reflective of the local mitigation strategies. AEMA utilizes this opportunity to identify areas where local plans can be improved during the local plan updates.

During the 2013 Plan Update, only local plans with changes were reviewed. However, as of this writing, all 67 counties have implemented approved updates since the 2013 State HMP Update was approved (with one of the 67 county updates designated as "approvable pending adoption"); therefore, every county plan was reviewed for the 2018 Plan Update. In future versions of this plan, newly updated local plans will be incorporated into the state plan, focusing on the areas of hazard identification, potential loss estimates, and mitigation goals and actions. The following sections describe the methodology used to review the local plans and a summary of the results.

1.3.2 Review and Incorporation of Local Plan Information into the State Plan Update

1.3.2.1 Hazard Identification and Profiles

As part of the plan update process, the hazard profile sections of all local hazard mitigation plans were reviewed to determine which hazards were identified and profiled by local jurisdictions.

The purpose of this review is to ensure that there is consistency between the state and county documents. In 2007, AEMA refined the list of hazards identified in the state plan to reflect those hazards commonly found in local plans and those hazards which affect the state. For example, hazards that do not affect the state, such as volcanoes, were removed from the hazard identification list. This hazard list was used to review local plans for the 2013 update. As described in Section 5.2 and Section 7.3 of the 2013 update, the SHMT made slight modifications to this list. The 2018 update uses the same hazard list as the 2013 update.

Most county plans profiled the hazards identified in this plan, except for coastal counties who profiled hazards that are unique to coastal area (e.g., Sea Level Rise and Tsunamis). Some county plans combine hazards identified separately in this plan, such as Winter Storms and Extreme Temperatures. For a more complete description of this review process including a tabular summary of hazards profiled in county plans, refer to Section 3.1.3 (Hazard Profiled in County Plans) and Table 3.4 (Summary of County Hazard Mitigation Plans).

1.3.2.2 Potential Loss Estimates

In previous versions of this document, AEMA conducted an initial review of the loss estimates contained in each local plan to identify common elements that could be extracted and incorporated into this plan update. However, local plan developers often used a wide range of methodologies to determine these potential loss estimates and were only able to include loss

estimates for hazards for which there was ample historical data. Typically, these hazards were tornadoes, flooding, high winds and windstorms, and hurricanes. In both the 2013 and 2018 Plans, tornadoes, windstorms, and hurricanes were grouped into a single hazard, High Winds.

For the 2018 Plan, the SHMT selected four hazards for a detailed Vulnerability Analysis and Loss Estimation (see Sections 3.1 and 3.3). This analysis included loss estimates at the state level for all four hazards for state-owned or state-insured facilities, as well as potential loss estimates per county for three of the four selected hazards.

Consistent with previous plans, Flooding and High Winds were selected for detailed vulnerability analysis at the county level. Earthquakes were also selected for further analysis at the county level, including loss estimates per county. To determine potential county-level loss estimates for each of these three hazards, the SHMT decided to apply FEMA's Hazus loss estimation software. Hazus (Hazard US) is an integrated GIS-based simulation system that was designed to promote more consistent and standardized assessments of vulnerability, and more transparent and effective approaches to setting local and state priorities. Each Hazus analysis calculated two kinds of economic losses: 1) immediate losses related to the damage to structures and their contents; and 2) business interruption losses related to how long businesses remain inoperable. This methodology is described in detail in Vulnerability Assessment & Loss Estimation (see Section 3.3.1).

Sea Level Rise was selected for detailed vulnerability analysis as well, but analysis for this hazard only includes loss estimates for state-owned or state-insured facilities (see Section 3.3.5). County level loss estimates for Sea Level Rise are not available for this Plan.

1.3.2.3 Mitigation Goals and Actions

The final part of the local plan review involved reviewing the local mitigation strategy including goals and actions. Each of the local plans were reviewed to determine if the actions in the local plan met the goals as defined in the State Plan and, conversely, to determine if the State hazard mitigation goals were reflective of local goals, objectives, and actions. The State's hazard mitigation goals (see Section 5.1.1) are as follows:

- **Goal 1:** Enhance the comprehensive statewide hazard mitigation system;
- **Goal 2:** Reduce the State of Alabama's vulnerability and increase resilience to hazards to protect people, property, and natural resources;
- **Goal 3:** Foster public awareness and understanding of their hazard risk and of mitigation opportunities; and
- **Goal 4:** Expand and promote coordination and communication with other government agencies, local governments, other relevant organizations.

Table 1.4 summarizes this review.

Table 1.4 Review of County Plan Goals Against State Plan Goals

County	State Goal 1	State Goal 2	State Goal 3	State Goal 4
Autauga	X	X	X	
Baldwin	X	X	X	X
Barbour	X	X	X	
Bibb	X	X	X	
Blount	X	X	X	X
Bullock	X	X	X	
Butler	X	X	X	
Calhoun	X	X	X	
Chambers	X	X	X	X
Cherokee	X	X	X	
Chilton	X	X	X	
Choctaw	X	X	X	
Clarke	X	X	X	
Clay	X	X		X
Cleburne	X	X	X	
Coffee	X	X	X	
Colbert	X	X	X	X
Conecuh	X	X	X	
Coosa	X	X	X	
Covington	X	X	X	
Crenshaw	X	X	X	
Cullman	X	X	X	
Dale	X	X	X	X
Dallas	X	X	X	
DeKalb	X	X	X	
Elmore	X	X	X	X
Escambia	X	X	X	
Etowah	X	X	X	
Fayette	X	X	X	X
Franklin	X	X	X	X
Geneva	X	X	X	
Greene	X	X		
Hale	X	X		
Henry	X	X	X	

County	State Goal 1	State Goal 2	State Goal 3	State Goal 4
Houston	X	X	X	
Jackson	X	X	X	
Jefferson	X	X	X	X
Lamar	X	X		
Lauderdale	X	X	X	X
Lawrence	X	X	X	X
Lee	X	X	X	X
Limestone	X	X	X	
Lowndes	X	X	X	
Macon	X	X	X	X
Madison	X	X	X	
Marengo	X	X	X	
Marion	X	X	X	X
Marshall	X	X	X	X
Mobile	X	X	X	X
Monroe	X	X	X	
Montgomery	X	X	X	
Morgan	X	X	X	
Perry	X	X	X	
Pickens	X	X		
Pike	X	X	X	
Randolph	X	X	X	
Russell	X	X	X	X
Shelby	X	X	X	X
St. Clair	X	X	X	
Sumter	X	X	X	
Talladega	X	X	X	
Tallapoosa	X	X	X	
Tuscaloosa	X	X	X	X
Walker	X	X	X	X
Washington	X	X	X	
Wilcox	X	X	X	
Winston	X	X	X	X

This review demonstrated the local mitigation goals, objectives, and actions are consistent with the State mitigation goals; and, conversely, that the State hazard mitigation goals are reflective of the local goal, objectives, and actions.

1.3.3 Future Local Plan Review and Incorporation

The review and incorporation of local plan information has resulted in this plan being reflective of local hazards risks, loss estimates, and goals. However, these elements evolve over time, given that the Disaster Mitigation Act of 2000 and 44 CFR 201.4 require local plans to be updated every five years.

As a result, future state plan updates, which will be performed on a five-year cycle, will continue to incorporate the latest information regarding local risk assessment and mitigation strategy. At this time, it is assumed that the review process will be used for subsequent versions of this plan unless it is deemed insufficient.

1.4 Summary of Review, Analysis, and Update of Each Section

The following provides a summary of the methodology utilized to review, analyze, and update each section of the plan. As described in Section 1.2, each section of the plan was reviewed, and it was determined that revisions would be required to each section to meet FEMA requirements. Detailed language used in previous sections of this plan has been revised, removed, or reorganized where appropriate. These changes are called out in each respective section. This was done to keep the document current and user-friendly, while highlighting mitigation planning capabilities that have improved over time. As future updates are conducted, a similar update process will be used.

For the 2018 update, the Enhanced Plan Elements section has been entirely removed. The 2018 State Hazard Mitigation Plan includes the same information that was developed in the 2013 Plan, updated as appropriate and described in each section. However, the structure of the 2018 Plan was reorganized slightly for ease of reference and use. These changes are summarized below:

Table of Contents: The table of contents was revised to reflect the new structure and contents of the 2018 plan update.

Executive Summary: The executive summary was moved to the front matter of the Plan, instead of a section within the base part of the Plan and was revised to summarize the 2018 plan update.

Plan Approval, Adoption, and Assurances: This section was moved to the front matter of the Plan, instead of a section within the base part of the Plan. Minor changes were made to this section to reflect the dates for the 2018 plan update process.

Section 1 – The Planning Process: This section was revised to reflect the 2018 plan update planning process. This sub-section, Summary of Review, Analysis and Update of Each Section (Section 1.4) was created. Additional edits and restructuring include:

- Information about integration efforts was moved to Section 4 (Capability Assessment);
- Coordinating Local Planning (Section 1.3), which was a stand-alone section in the 2013 Plan, was revised and integrated with other elements in Section 1 – The Planning Process; and
- Criteria for Prioritizing Jurisdictions to Receive Funds Under Existing Programs, a sub-section of Coordinating Local Planning in the 2013 Plan, was renamed Prioritization of Communities to Receive Planning Grants and moved to Section 5 (Mitigation Strategy) as described below.

Section 2 – Alabama Current and Future Conditions: This section is new to the 2018 plan update process and establishes a demographic, economic, and geographic profile of the state.

Section 3 – Risk Assessment: The risk assessment section was updated as appropriate with current risk and vulnerability information.

For the 2018 planning process, each of the hazard profiles was reviewed to determine if more current information was available based on recent studies, actual hazard events, or input from State agencies and local stakeholders. Several SHMT members provided up-to-date information for inclusion in the hazard profiles section.

Some adjustments were made to the content of Section 3 (Risk Assessment). Impacts of Development Trends on Vulnerability was updated per the information identified in Section 2 (Alabama Current and Future Conditions). Additionally, the methodology for prioritizing the list of identified hazards for further analysis was revised in coordination between the SHMT and Hagerty to include a RF analysis, which ranks hazards by the degree of risk they pose based on a set of factors deemed important by the SHMT and other stakeholders. The results of the RF approach called for detailed risk assessments for Earthquakes, High Winds (tornadoes, wind storms, and hurricanes), Flooding, and Local Sea Level Rise. These hazards (less Local Sea Level Rise) are identical to those identified for detailed assessment in the 2013 plan. The RF approach is described further in Section 3.1.2.

The methodologies used to update and maintain the vulnerability assessment and potential loss estimates were reviewed from the previous plan update and used as appropriate in this update. Potential loss estimates were updated for the selected hazards (Floods, High Winds, Earthquakes, and local Sea Level Rise) using the identified methodologies and the most current data available as described in Section 3.3. In addition, dollar values were inflated to 2017 values.

Section 4 – Capability Assessment: The content in this section was extracted from the Planning Process and the Mitigation Strategy sections in previous plans to be a stand-alone section. The content pulled from the 2013 Mitigation Strategy includes:

- Discussion and Evaluation of State Pre- and Post-Disaster Hazard Management Policies, Programs and Capabilities (Section 4.1);
- Evaluation of State Laws Regulations, Policies, and Programs Related to Hazard Mitigation and Development in Hazard Prone Areas (Section 4.2);
- State Funding Capabilities for Hazard Mitigation Projects (Section 4.3; this section includes some information about FEMA grant programs previously included in Appendix I in the 2013 Update, as described below); and
- General Description and Analysis of the Effectiveness of Local Mitigation Policies, Programs, and Capabilities (Section 4.4).

The assessments of state and local capabilities, including state funding capabilities, were reviewed to determine what information was still current and if new capabilities had been added and were revised accordingly.

Integration into Other Ongoing State Planning Efforts (Section 4.5) and Integration into Other FEMA Mitigation Programs and Initiatives (Section 4.6), included in the 2013 Planning Process, were also incorporated into Section 4 (Capability Assessment) for this Plan Update. Information identified in the previous plan as a potential improvement or integration effort, was reviewed and updated by AEMA or the appropriate agency.

Section 5 – Mitigation Strategy: During the plan update process, the SHMT reviewed and made changes to the State Mitigation Strategy (Section 5.1 of this plan) and State Hazard Mitigation Goals (Section 5.1.1) at the Mitigation Strategy Meeting. In addition, each SHMT agency was asked to provide an implementation update on each mitigation action described from their agency identified in the 2013 Mitigation Strategy. Each agency was also encouraged to provide new actions that the agency was interested in pursuing. These were incorporated into the updated Mitigation Action Plan (Section 5.1.2).

Additionally, some Mitigation Strategy content was structurally altered. Some Mitigation Strategy content in the 2013 Plan was migrated into a new stand-alone Capability Assessment in the 2018 Plan, as described above, including:

- Discussion and Evaluation of State Pre- and Post-Disaster Hazard Management Policies, Programs and Capabilities;
- Evaluation of State Laws Regulations, Policies, and Programs Related to Hazard Mitigation and Development in Hazard Prone Areas;
- State Funding Capabilities for Hazard Mitigation Projects; and
- General Description and Analysis of the Effectiveness of Local Mitigation Policies, Programs, and Capabilities.

Criteria for Prioritizing Jurisdictions to Receive Funds Under Existing Programs, a sub-section of Coordinating Local Planning in the 2013 Plan, was also moved to Section 5 (Mitigation Strategy) for the 2018 Plan Update and renamed Prioritization of Funding (Section 5.2).

Information from Jurisdictions Most Threatened and Vulnerable to Damage and Loss, a sub-section of the Risk Assessment in the 2013 plan, was renamed to Jurisdictions with Highest Risk, and moved to Section 5.2.1 for the 2018 Plan Update. Some information featured in this section, such as loss estimates, is taken directly from Section 3.3 (Vulnerability and Loss Estimation) of the Risk Assessment.

Strategy for Repetitive and Severe Repetitive Loss Properties has been included as Section 5.1.3 for the 2018 Plan Update. This information was previously included in "draft" form in Appendix O in the 2013 Plan Update, as described below.

For the 2018 Plan Update, the mitigation actions are presented in two tables. First, the 2013 Mitigation Action Plan was modified to provide updates on all 2013 actions and was renamed accordingly as the 2013 Mitigation Action Plan Review table. In addition to updating the status of the 2013 actions, the 2013 Mitigation Action Plan Review also makes recommendations where necessary to:

- Better position certain ongoing actions from the 2013 Plan Update for implementation with the 2018 cycle; or
- Combine multiple 2013 actions into a single action to be continued for the 2018 Plan Update.

The second table is the 2018 Mitigation Action Plan. The 2018 Mitigation Action Plan contains all actions moving forward, including those described above carried over from the 2013 Mitigation Action Plan, as well as actions that are entirely new as of the 2018 Plan Update. The 2018 Mitigation Action Plan also employs a new method for prioritizing mitigation actions as described in Section 5.1.2.2 (Mitigation Action Prioritization).

Other content changes to Section 5 for the 2018 Plan Update include updating Mitigation Successes (Section 5.3) to include new mitigation project successes and new summaries of Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) projects.

Section 6 – Plan Maintenance: The method for monitoring, evaluating, and updating was revised slightly to reflect the plan maintenance activities that were proven to be effective since the 2013 plan adoption.

Appendices: In the 2013 Plan Update, Section 7 was titled Coordination of Local Planning. Some information from Section 7 in the 2013 Plan Update is placed in Appendix C for the 2018 Update. This information includes:

- CFR Requirements for Coordination of Local Mitigation Planning; and

- Development and Update of Local Mitigation Plans, which has been expanded to include a description of Barriers to Updating, Adopting, and Implementing Local Hazard Mitigation Plans.

Some Appendices from the 2013 Plan Update were simply migrated to the appendices of the 2018 Plan Update, with minor adjustments to update per the 2018 Plan Update. These include:

- Approval & Implementation (Appendix F in the 2013 Plan Update; this is Appendix A for the 2018 Plan Update);
- Glossary of Acronyms and Terms (Appendix G in the 2013 Plan Update; this is Appendix B for the 2018 Plan Update);
- Local Capability Table (Appendix J in the 2013 Plan Update; this is in Appendix C for the 2018 Plan Update);
- Comments Received from SHMT and FEMA (Appendix K in the 2013 Plan Update; this is Appendix D for the 2018 Plan Update);
- Record of Changes (Appendix N in the 2013 Plan Update; this is Appendix F for the 2018 Plan Update); and
- Meeting Minutes and Meeting Sign-In Sheets (Appendices L and M, respectively, in the 2013 Plan Update; for the 2018 Plan Update all meeting materials, including agendas, slide decks, one-pagers, notes, and attendee lists are included as Appendix E; Planning Process Documents).

Other Appendices from the 2013 Plan Update were migrated to other sections of the 2018 Plan Update. These include:

- Overview of FEMA Mitigation Grant Programs (Appendix I in the 2013 Plan Update; for the 2018 Plan Update this information has been retitled as FEMA Funding Opportunities, included as Section 4.3.2); and
- State of Alabama Draft Repetitive and Severe Repetitive Flood Loss Mitigation Strategy (Appendix O in the 2013 Plan Update; for the 2018 Plan Update this information has been retitled as simply Strategy for Repetitive and Severe Repetitive Loss Properties, included as Section 5.1.3).

Some Appendices from the 2013 Plan Update were not duplicated for the 2018 Plan Update because it was determined that the full-length text of the statutes featured in those Appendices would not be necessary if those statutes were accurately summarized and cited properly elsewhere in the document. Specifically, these include:

- The Disaster Mitigation Act of 2000 (Appendix A in the 2013 Plan Update);
- 44 CFR Parts 201 and 206 (Appendix B in the 2013 Plan Update);
- EO 19 (Appendix C in the 2013 Plan Update); and
- Composition of the State Hazard Mitigation Planning Council (Appendix D in the 2013 Plan Update).

Similarly, some Appendices from the 2013 Plan Update were not duplicated for the 2018 Plan Update because they were redundant with other sections of the 2018 Plan Update. These include:

- General Descriptions of Hazards that Affect Alabama (Appendix H in the 2013 Plan Update; this duplicates the Hazard Profiles in Section 3.2 of the 2018 Plan Update).

Some Appendices from the 2013 Plan Update were not duplicated for the 2018 Plan Update because they described groups or activities that are not part of the 2018 planning process. These include:

- Alabama State Hazard Mitigation Council Technical Advisory Committee Membership (Appendix E in the 2013 Plan Update).

Finally, HMGP Implementation Process was added as Appendix G to the 2018 Plan Update.

2 Alabama Current and Future Conditions

2.1 Current Conditions

Understanding the current condition of the population, economy, infrastructure, and natural environment in Alabama supports the determination of areas or communities that are more vulnerable to natural hazards. This section outlines the current conditions across these sectors and highlights areas of potential or inherent vulnerability.

2.1.1 Demographics

2.1.1.1 Population

Alabama has an estimated total population of 4,874,747 people and is the 23rd largest state in the United States in terms of total population.[1] Given the population size and geography, the average population density of the state is 96.2 people per square mile. However, the population density varies throughout the State by county where the maximum population density is 593 people per square mile in Jefferson County and the minimum population density is 12.1 people per square mile in Wilcox County.[2,3,4] A map displaying population density per county can be seen in Figure 2.1 and the major metropolitan areas are seen in Figure 2.2.

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[1] Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2017. U.S. Census Bureau, December 2017. Retrieved at: https://factfinder.census.gov.
[2] Ibid.
[3] 2017 U.S. Gazetteer Files. U.S. Census Bureau, December 2017. Retrieved at: https://www.census.gov/geo/maps-data/data/gazetteer2017.html.
[4] Densities were calculated by dividing the area of dry land per county by population estimates.

Figure 2.1 Alabama Population Density by County

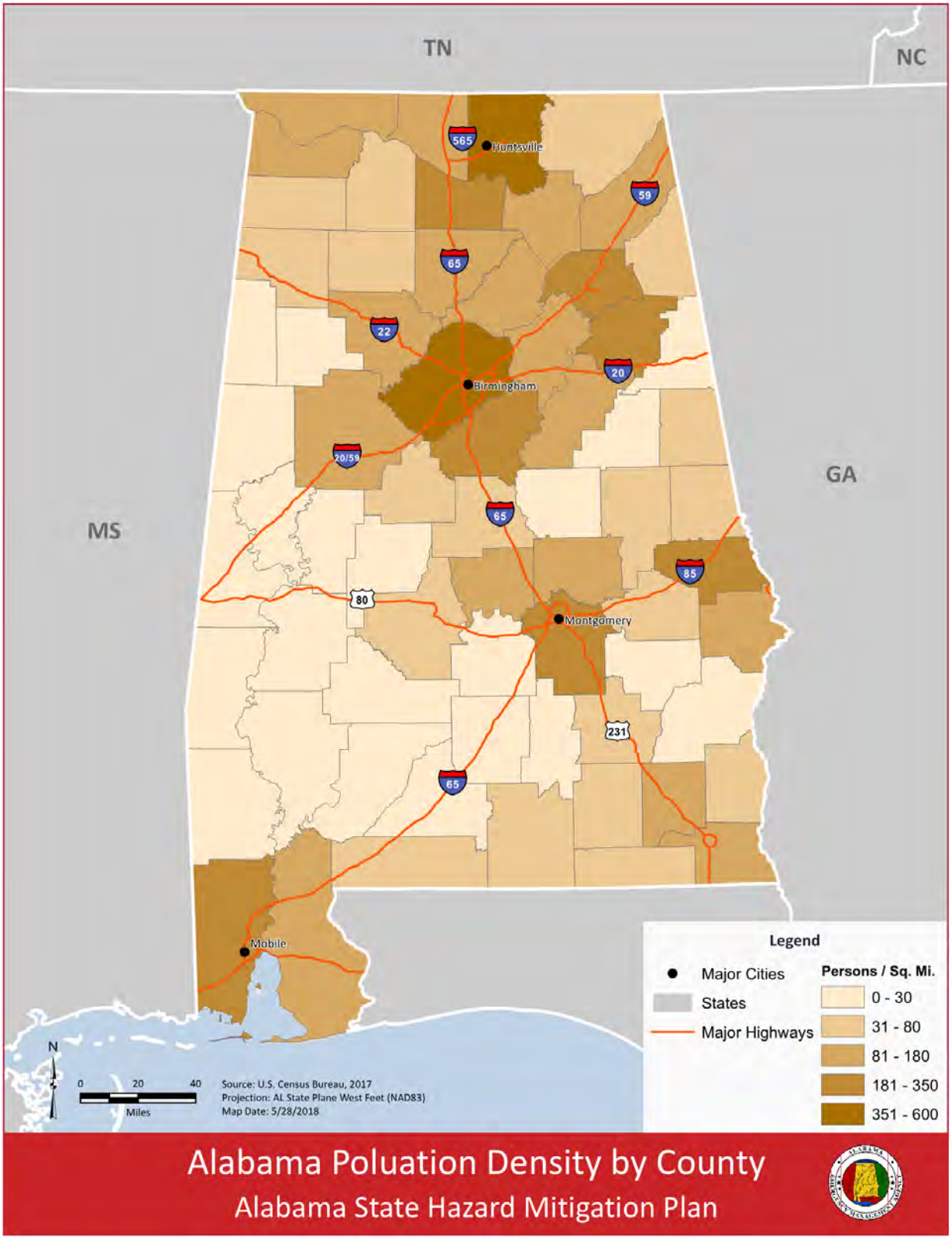
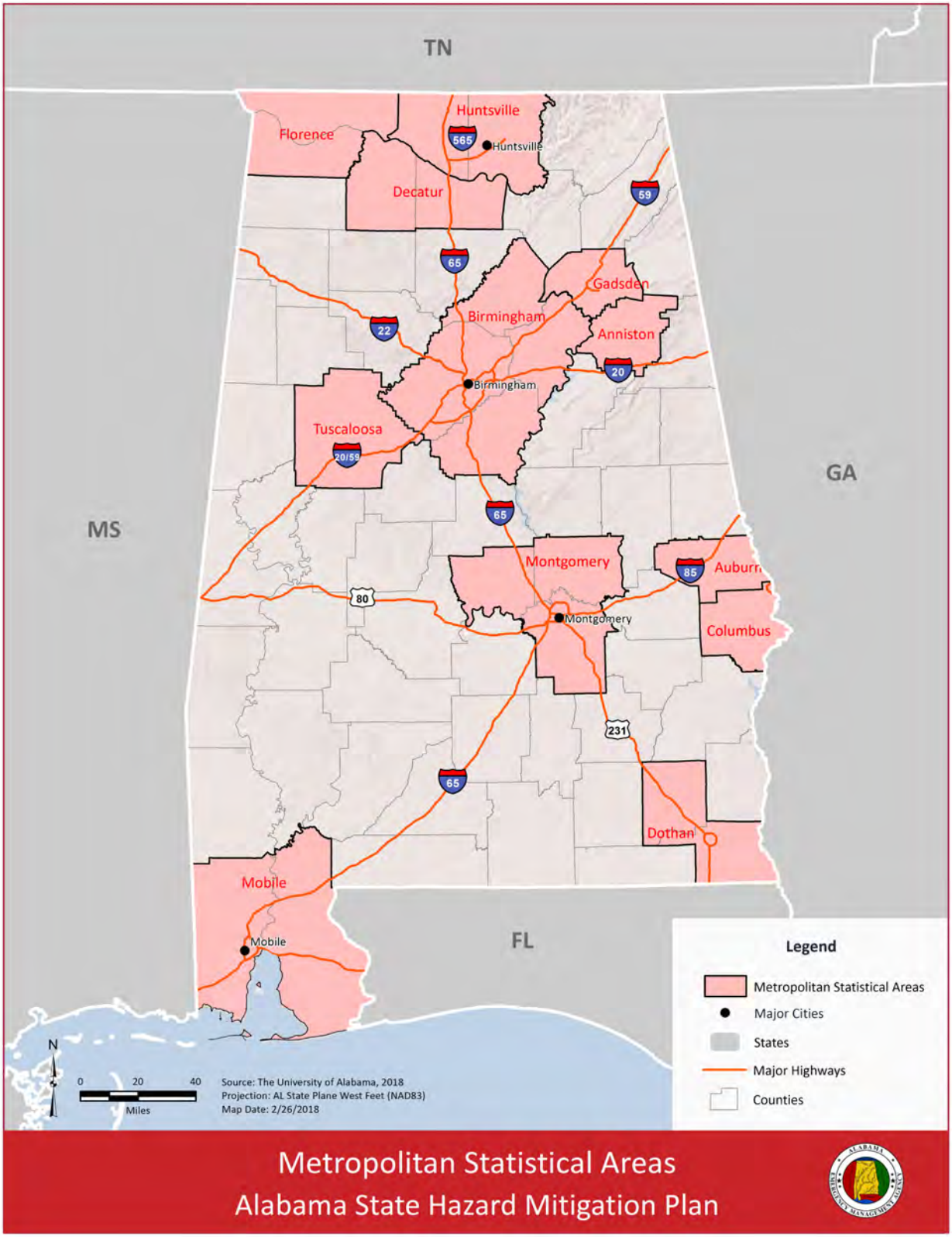


Figure 2.2 Major Metropolitan Areas



2.1.1.2 Population Characteristics

Specific characteristics of the population of the State help describe the situation of the State and can also help to identify vulnerabilities that exist within the population.

Income can be an important factor to consider during the planning process. Alabama has a median household income of $44,758 which is lower than the national median income of $55,322.[5] Alabama has wide variation of median household income per county, ranging from $20,428.00 (Shelby County) to $72,310.00 (Sumter County).[6]

Mobility is an important population characteristic to consider for hazard mitigation planning as it can affect community members' resources and can present a challenge in educating the public on the hazards facing the community. One measure of population mobility is the type of housing, as homeowners are less likely to move as renters. In Alabama, an average of 31.5% of residents are renters, compared to the national average of 36.4%, implying that residents in Alabama are less mobile then the rest of the country.[7]

In Alabama, 59% of the population is urban compared to 81% of the United States.[8] There are considerations for addressing risks in both urban and rural areas. Alabama will need to address these considerations, especially to identify mitigation solutions in the large areas of dispersed, rural communities.

Diversity is an important characteristic in understanding the vulnerabilities introduced by hazards and how to mitigate these vulnerabilities. Understanding the diversity in areas is critical because language barriers and unique community needs can impact the identification of vulnerabilities and implementation of actions to reduce risk. In Alabama, the racial and ethnic composition is 66.19% White (not Hispanic), 26.35% Black (not Hispanic), 1.24% Asian (not Hispanic, 4.00% Hispanic, and 2.22% Other.[9] Compared to the national average, Alabama has a higher percentage Black

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[5] U.S. Census Bureau, 2016. Income in the Past 12 Months (in 2016 Inflation-Adjusted Dollars) 2012-2016 American Community Survey 5-Year Estimates. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1901&prodType=table.

[6] Ibid.

[7] U.S. Census Bureau, 2016. Occupancy Characteristics 2012-2016 American Community Survey 5-Year Estimates. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S2501&prodType=table.

[8] U.S. Census Bureau, 2010. Urban and Rural Universe: Total Population 2010 Census Summary File 1. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_P2&prodType=table.

[9] U.S. Census Bureau, 2016. ACS Demographic and Housing Estimates 2012-2016 American Community Survey 5-Year Estimates. Retrieved at:

population (by approximately 15%) and a lower percentage Hispanic population (by approximately 13%).[10] Another indicator of diversity can be language. In Alabama, there is one federally recognized tribal government, the Poarch Band of Creek Indians, who are located in Atmore and in Alabama about 0.45% of the population is Native American or Alaskan native.[11][12] Overall, 1.2% of Alabama's households are limited English speaking. Language spoken at home can indicate diversity and limited English speaking households which can result in direct language barriers that need to be considered and addressed in planning.

Alabama faces population vulnerabilities in their older adult and young child populations. Older adults often are less mobile and are more likely to have chronic diseases that make them more sensitive to disruptions in their living situations. Young children often cannot care for themselves and may not be able to communicate their needs during a hazard or disaster events, requiring special planning for their needs. Overall, 15.3% of Alabamans are aged 65 or older and 6.0% of Alabamans are aged 5 or younger, which is consistent with the national average.[13] While Alabama has a proportionately sized vulnerable population due to age, over one fifth of Alabamans are in age groups more vulnerable to the effects of hazards and disasters.

Another important population vulnerability for consideration in hazard mitigation planning is persons with disabilities or access and functional needs. Disabled people may require special planning considerations during and following a disaster, especially if they have mobility issues or require regular medical treatment. Disabled people in Alabama make up 16.3% of the total population, which is approximately 4% higher than the national average (12.5%).[14] Being nearly one fifth of the population, the unique planning characteristics for disabled people are important to consider throughout the hazard mitigation process.

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https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_DP05&prodType=table.

[10] Ibid.

[11] U.S. Census Bureau, 2016. ACS Demographic and Housing Estimates 2012-2016 American Community Survey 5-Year Estimates. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_DP05&prodType=table.

[12] National Conference of State Legislatures, 2018. Federal and State Recognized Tribes. Retrieved at: http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx.

[13] U.S. Census Bureau, 2016. Age and Sex 2012-2016 American Community Survey 5-Year Estimates. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S0101&prodType=table.

[14] U.S. Census Bureau, 2016. Disability Characteristics 2012-2016 American Community Survey 5-Year Estimates. Retrieved at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_5YR_S1810&prodType=table.

2.1.2 Economy & Infrastructure

2.1.2.1 Economy

Alabama has the 27th largest economy in the United States with a 2017 GDP of $211.0 billion.[15] Alabama's economy has been growing, 1.2% in 2017 compared with the national change of 2.1%.[16]

The largest industry in Alabama in 2017 was government and government enterprises, which accounted for 16.7% of the Alabama GDP. The second largest industry was finance, insurance, real estate, rental, and leasing which accounted for 16.2% of the GDP accordingly.[17] The fastest growing industries in Alabama are mining, quarrying, and oil and gas extraction and professional and business services which account for 0.44 and 0.35 percentage point of the total growth in GDP respectively.[18]

Alabama's labor market has an estimated 2,032,800 non-farm jobs and 2,081,900 total employed persons.[19] Alabama's largest employing sectors include government (385,800 as of March 2018) and trade, transportation, and utilities (380,500 employees as of March 2018).[20] While the unemployment rate of the State (as of March 2018) was less than the national average, at 3.8%, this still leaves 185,240 people more vulnerable without a steady source of income.[21]

2.1.2.2 Infrastructure

2.1.1.1.1 Roads, Highways, and Bridges

The quality of roads and bridges may impact the effect of a disaster, or the ability to evacuate during a disaster. Over 102,000 miles of public roads exist in the State of Alabama, 75% of which are rural roads maintained by the ALDOT.[22] Approximately 9% of the State's roads are in concerning condition, rated poor or very poor, implying that they have ruts, cracks, and potholes where it is critical to be repaired.[23]

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[15] U.S. Department of Commerce Bureau of Economic Analysis, 2018. Alabama. Retrieved at: https://www.bea.gov/regional/bearfacts/pdf.cfm?fips=01000&areatype=STATE&geotype=3.
[16] Ibid.
[17] Ibid.
[18] Ibid.
[19] Ibid.
[20] Ibid.
[21] Alabama Department of Labor Market Information Division, 2018. Local Area Unemployment Statistics. Retrieved at: http://www2.labor.alabama.gov/LAUS/
[22] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.
[23] Ibid.

Alabama's has 15,986 bridges that span over 485 miles. ALDOT owns approximately one third of the State's bridges, county governments own about one half of the State's bridges, and local governments own the rest. Approximately one fifth of the State's bridges are in concerning condition, with 8.63% of the bridges being classified as structurally deficient and 12% of the bridges being classified as functionally obsolete. Moreover, 16% of the State's bridges are posted as reduced weight or closed to traffic. Approximately $84 million in state and federal funding goes towards improvement of bridges annually, and over the past ten years bridge condition has been improving in the State.

2.1.1.1.2 Other Transportation Infrastructure

Alabama has 80 public use airports, 6 of which are used for commercial flights.[24] The aviation system in the State in managed by the Federal Aviation Administration and ALDOT and receive annual inspections for safety. Overall, Alabama has a very accessible airport network, with 80% of the population living within one hour of a commercial airport.[25]

Alabama has one deep water port in the City of Mobile and several other major ports with access through internal waterways to the Gulf of Mexico. The Port of Mobile has a container capacity of 350,000 TEU per year which makes it the 12th largest port in the USA by volume.[26] Other major ports in Alabama include: Birmingham, Decatur, Tuscaloosa, Florence, Guntersville, and Montgomery. Many of these ports include industry supply shipment.

Alabama's railroad system is primarily freight; however, it also includes one passenger Amtrak line. Alabama is ranked 21st for total rail miles in the United States.[27] The freight network in Alabama is primarily Class 1 (72%), which have annual revenues of at least $452.7 million, followed by Class 3 (20%), which have less than 100 miles of track, and Class 2 (8%), which have annual revenues of at least $36.2 million, and primarily transports coal.[28]

There are fourteen public transportation systems and four major privately-owned transportation systems in Alabama.[29] Alabama does not provide state funding for public transportation systems, so the fourteen public transportation systems are locally funded.[30] The four major public transportation systems in the state include: Birmingham Jefferson County Transit Authority,

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[24] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.
[25] Ibid.
[26] Ibid.
[27] Ibid.
[28] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.
[29] Ibid.
[30] Ibid.

Montgomery Area Transit System, Mobile – The Wave Transit System, and the City of Huntsville – Public Transportation Division.[31] The four major privately-owned transportation systems in the state include: Greyhound Lines, UAB Blazer Express, Auburn's Tiger Transit, and Birmingham Door to Door Shuttle Service.[32]

2.1.1.1.3 Dams

According to the U.S. Army Corps of Engineers (USACE) National Inventory of Dams (NID), Alabama has 2,241 dams and notably does not have a Dam Safety program.[33] The majority of the dams are for recreational or fish and wildlife usage. Approximately 196 of these dams are high hazard potential and 449 of these dams are medium hazard potential. Only 2% of all dams in Alabama have been inspected.

2.1.1.1.4 Energy

Alabama's energy is produced through petroleum, natural gas, goal, and other renewable sources. Alabama produces a modest about of crude oil, 120,000 barrels of crude oil per day from three refineries.[34] For electricity production, natural gas is the primary fuel used (36%), followed by coal (30%), nuclear power (27%), and renewables (7%).[35] Natural gas has recently surpassed the traditional coal for electricity production. Moreover, Alabama ranked 6th in 2016 for the total electricity produced from renewable resources (including hydroelectric) at 143,022 GWh.[36] About 80% of renewable production in Alabama comes from hydroelectric power.[37]

2.1.1.1.5 Drinking Water, Stormwater, and Wastewater

Drinking and wastewater systems in the state of Alabama are regulated by ADEM. Drinking water is provided mainly through small, municipal water system (comparable to the rest of the United States) and is ranked in the top 10% in terms of quality.[38] Much of the drinking water system in the state has well exceeded its lifetime and needs major repairs.

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[31] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.
[32] Ibid.
[33] Ibid.
[34] Ibid.
[35] Ibid.
[36] U.S. Energy Information Administration, 2018. Electric Power Monthly. Retrieved at: http://www.eia.gov/electricity/monthly.
[37] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.
[38] American Society of Civil Engineers, 2015. Report Card for Alabama's Infrastructure. Retrieved at: https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE-AL-Report-Card-2015-Full-Report-FINAL-web.pdf.

There are approximately 250 utility networks operating wastewater treatment plants in the state. Like the drinking water systems, much of the wastewater system has outdated its intended lifetime. Damage to pipes can adversely affect the environment, as sanitary sewer overflows are a common occurrence during storm events.

2.1.3 Natural Environment

2.1.3.1 Geography

Alabama is located in the southeastern part of the United States. It is surrounded by four states: Tennessee to the north, Georgia to the east, Mississippi to the west, and Florida and the Gulf of Mexico to the south. The total area of the State of Alabama is 50,645.33 square miles, making it the 30th largest state in the United States of America[39]. Alabama is comprised of 67 counties and 11 major metropolitan areas.

2.1.1.1.6 Geology

Generally, Alabama's varied topography can be summarized as mountainous in the northeast portion of the state, where the tail end of the Appalachian Mountains is located within the state and moving southwest to slope down to the coastal plains, where the state's coastline is. The highest point in the State is Cheaha Mountain at 2,407 feet above sea level and the lowest point is the coast of the Gulf of Mexico. There are five physiographic sections in the State of Alabama: Piedmont Upland Section, Alabama Valley and Ridge Section, Cumberland Plateau Section, Highland Rim Section, and East Gulf Coastal Plain Section (Figure 2.3).[40] The Piedmont Upland Section, Tennessee Valley and Ridge Section, and Cumberland Plateau Section encompass the Appalachian Highlands Region of the State, the Highland Rim Section encompasses the Interior Plains Region of the State, and the East Gulf Coastal Plain Section encompasses the Atlantic Plain Region of the State.[41]

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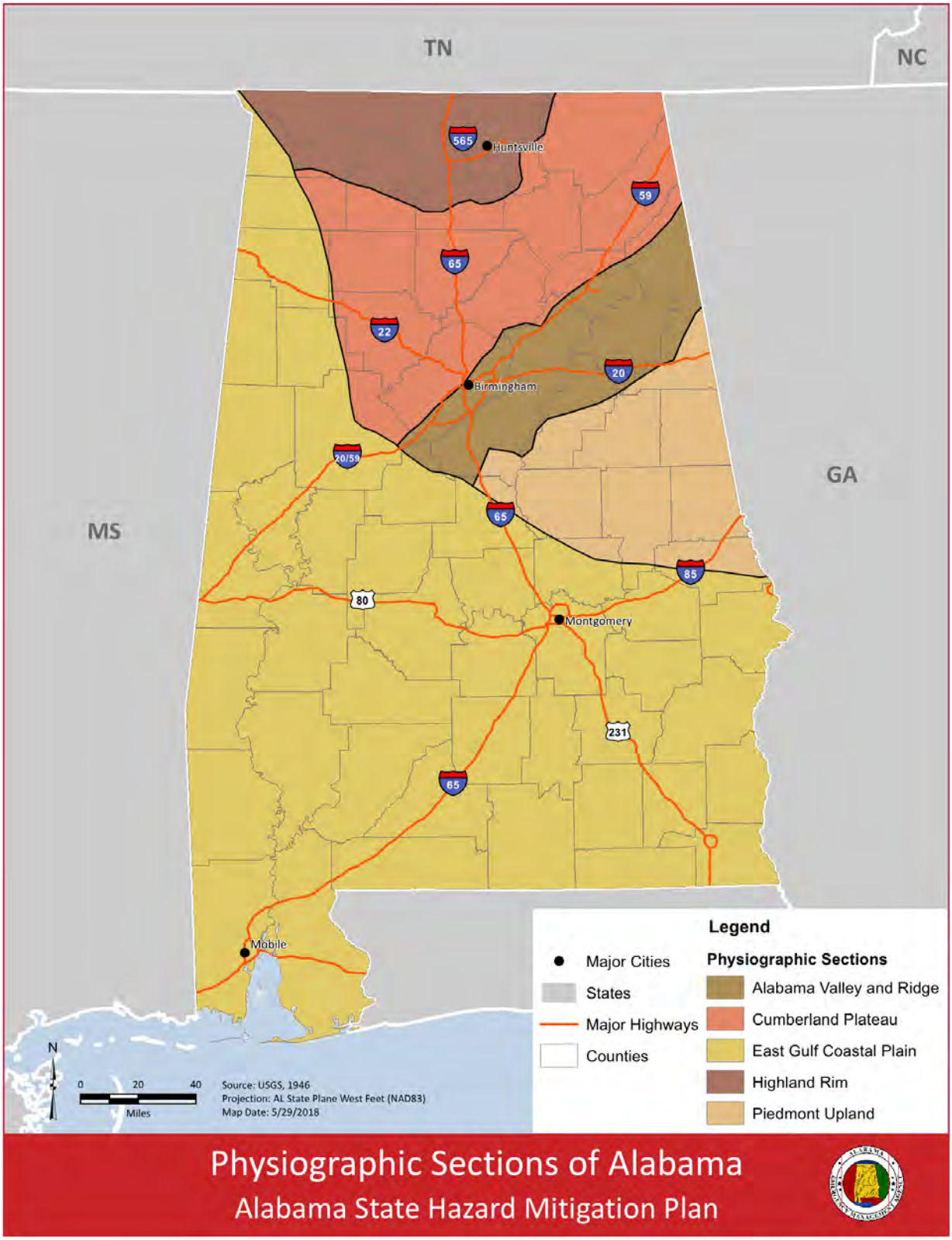
[39] U.S. Census Bureau, 2018. Quick Facts Alabama. Retrieved at: https://www.census.gov/quickfacts/AL.
[40] Encyclopedia of Alabama, 2013. Physiographic Sections of Alabama. Retrieved at: http://www.encyclopediaofalabama.org/article/h-1362.
[41] Ibid.

Figure 2.3 Physiography of Alabama



2.1.1.1.7 Rivers and Watersheds

Water is a critical component to the natural environment of Alabama. The State of Alabama has over 132,000 miles of rivers and streams, including 14 major watersheds (Figure 2.4).[42] One-tenth of the water in the United States originates in or passes through the state.[43] Moreover, Alabama is known for its river biodiversity, containing 22% of North American crayfish species, 27% of North American fish species, 28% of North American freshwater snails, 57% of freshwater turtles, and 61% of North American freshwater mussels. The state ranks number one in the United States for the number of species of each of these animals. The rivers in Alabama are a valuable resource for the state as they supply drinking water for approximately 56% of Alabama's population[44], hold 16 hydroelectric power dams[45], and provide space for the recreation industry that is valued at $1 billion in the state.[46]

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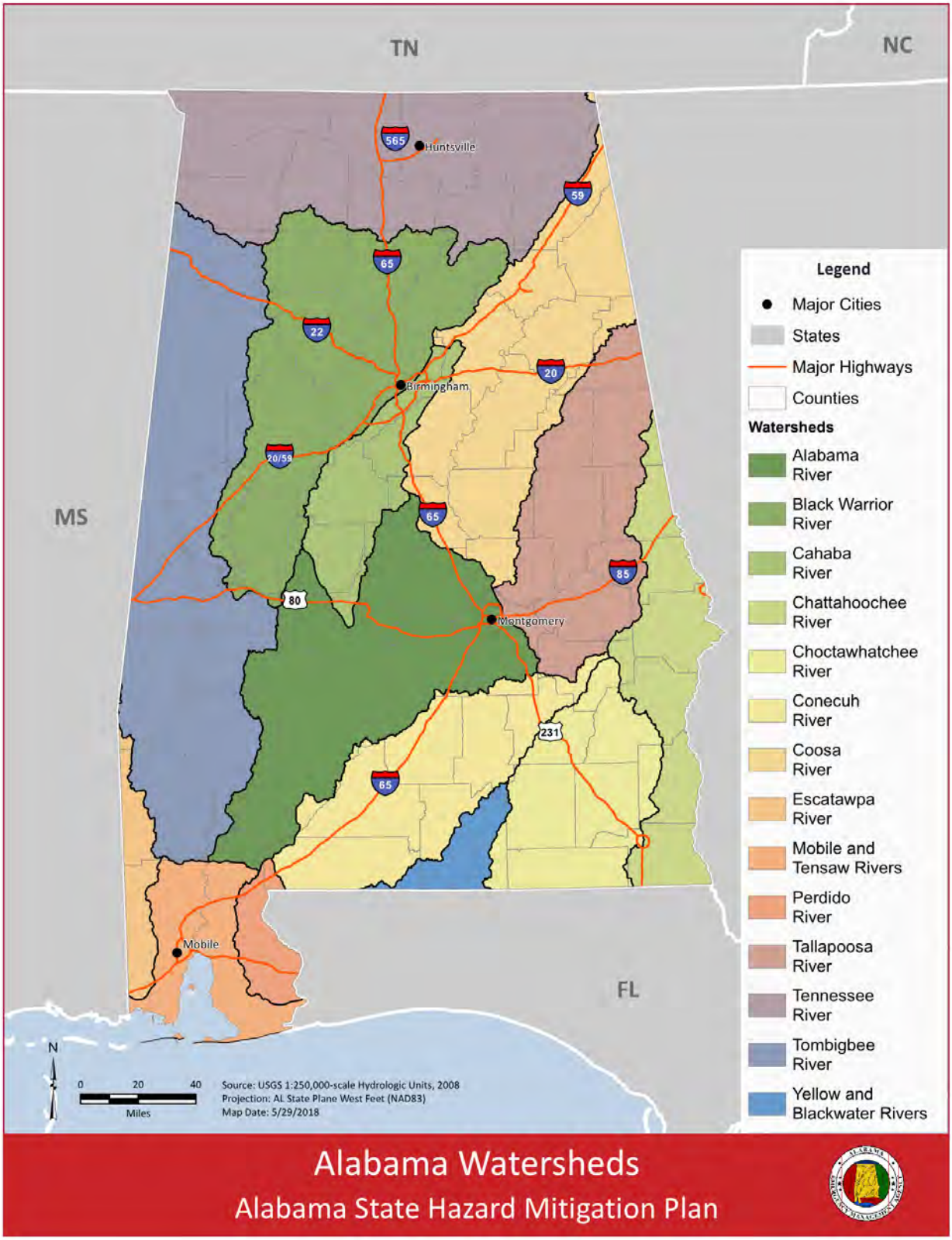
[42] Alabama Rivers Alliance, 2018. About Alabama's Rivers. Retrieved at: https://alabamarivers.org/about-alabamas-rivers/; Auburn University, 2016. Rivers of Alabama. Retrieved at: http://aaes.auburn.edu/wrc/resource/rivers-of-alabama/.
[43] Alabama Rivers Alliance, 2018. About Alabama's Rivers. Retrieved at: https://alabamarivers.org/about-alabamas-rivers/.
[44] Ibid.
[45] Ibid.
[46] Ibid.

Figure 2.4 Alabama Watersheds



2.1.1.1.8 Coastline

Alabama's coastline extends for 60 miles along the southern border of the state and includes an additional 600 miles of bay, coastal river, and bayou tidal shoreline.[47] The geography of this area has been determined by unique coastal geology processes where sea level fluctuations and wind have eroded and built up sand along the coastline. Additionally, human influence has impacted the geography of the coastline through use and development. Wetland infill, coastal construction, and dredging for ship channels have enhanced beach erosion and removed habitat for native species.[48]

2.1.1.1.9 Ecosystems

The ecosystems of Alabama illustrate its terrestrial and aquatic biodiversity. There are 64 terrestrial ecosystems in Alabama, including 25 forest/woodland ecosystems, 11 wetland ecosystems, 7 glades prairies, and dozens of additional aquatic ecosystems.[49]

2.1.1.1.10 Land Use

Much of the state has significant amounts of forest and farm lands. As shown in Figure 2.5, much of the counties, even those with large metropolitan areas are characterized by decentralized development patterns that extend the built environment into rural areas.

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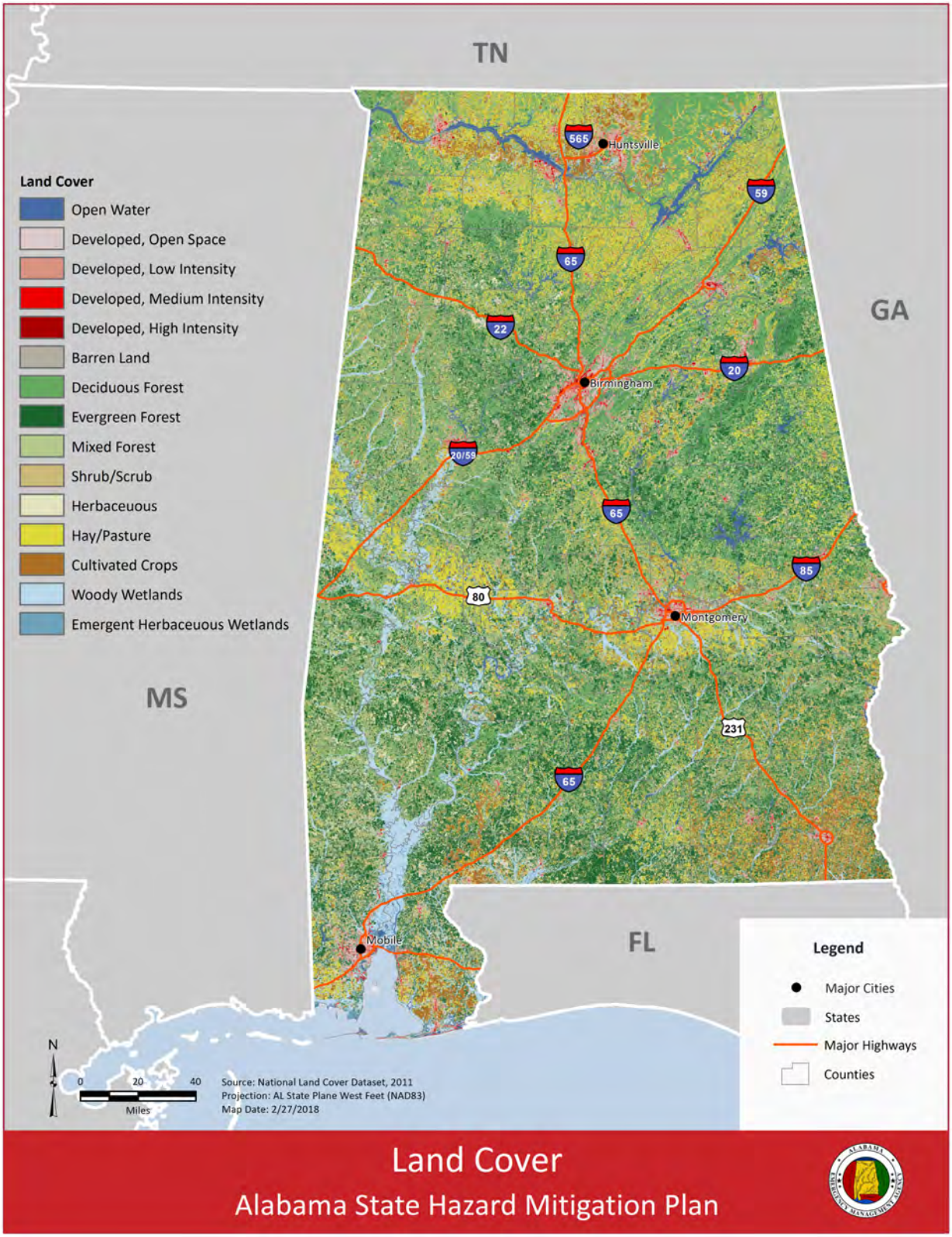
[47] Encyclopedia of Alabama, 2012. Alabama's Coastline. Retrieved at: http://www.encyclopediaofalabama.org/article/h-2049

[48] Ibid.

[49] Encyclopedia of Alabama, 2013. Physiographic Sections of Alabama. Retrieved at: http://www.encyclopediaofalabama.org/article/h-1362.

Figure 2.5 Current Land Use (NLCD, 2011)



2.1.3.2 Climate

The climate of Alabama can be generalized as having mild winters, hot summers, and year round precipitation.[50] Temperatures are generally higher and there tends to be more precipitation in the southern portion of the state.[51] The City of Mobile, located in the southern portion of Alabama, has an average minimum daily temperature of 39.9°F in January, an average maximum daily temperature of 91.2°F, and an average of 65.9 inches of rain per year.[52] In comparison, the City of Huntsville, located in northern Alabama, has an average minimum daily temperature of 29.3°F, an average maximum daily temperature of 86.5°F, and an average of 57.0 inches of rain per year.[53] The warmer, wetter conditions of the south can be attributed to the effects of the Gulf of Mexico.

2.2 Future Conditions

The changing conditions in Alabama have an impact on the future vulnerability of population, property, and the environment from natural hazards. This section identifies the changes in population and land use in Alabama. Each hazard profile, in Section 3.2 of this plan, identifies the impact of the changing land use on the risk from each hazard.

2.2.1 Population Trends

Overall the population of Alabama is increasing, but at a comparatively lower rate than much of the United States. From 2010 – 2017, the population of Alabama increased by approximately 1.86%, 94,612 people, while the population of the United States increased by approximately 5.30% with an average[54] of 318,694 per state. However, within the State of Alabama the rate of population change is variable (Figure 2.6). Only 22 out of the 67 counties in Alabama have increased in population from 2010 – 2017; and of those 22, nine are changes of less than 1,000. The three counties with the highest percentage of population change—Baldwin County, Lee County, and Limestone County—account for over two-thirds of the population increase for the State.[55]

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[50] Encyclopedia of Alabama, 2012. Climate. Retrieved at: http://www.encyclopediaofalabama.org/article/h-1283.
[51] Ibid.
[52] Encyclopedia of Alabama, 2012. Climate. Retrieved at: http://www.encyclopediaofalabama.org/article/h-1283.
[53] Ibid.
[54] Average of All 50 States, Puerto Rico, and the District of Columbia.
[55] Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2017. U.S. Census Bureau, December 2017. Retrieved at: https://factfinder.census.gov.

Alabama's population is only expected to continue to increase. It is predicted that by 2040, there will be a 16.9% population increased compared to the 2010 census.[56] The top five counties in terms of population size are anticipated to be (in order): Jefferson County, Madison County (up from 3rd largest), Mobile County (down from 2nd largest), Baldwin County (up from 7th largest), and Shelby County.[57] The largest population increase is anticipated to be 64.9% in Baldwin County (Figure 2.7).[58]

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[56] Kirby, Brendan, 2015. Alabama in 2040: Check out population forecasts for all 67 counties. Retrieved at: https://www.al.com/news/index.ssf/2015/04/alabama_in_2040_check_out_popu.html.
[57] Kirby, Brendan, 2015. Alabama in 2040: Check out population forecasts for all 67 counties. Retrieved at: https://www.al.com/news/index.ssf/2015/04/alabama_in_2040_check_out_popu.html.
[58] Ibid.

Figure 2.6 Percent Population Change in Alabama by County, April 2010 – July 2017

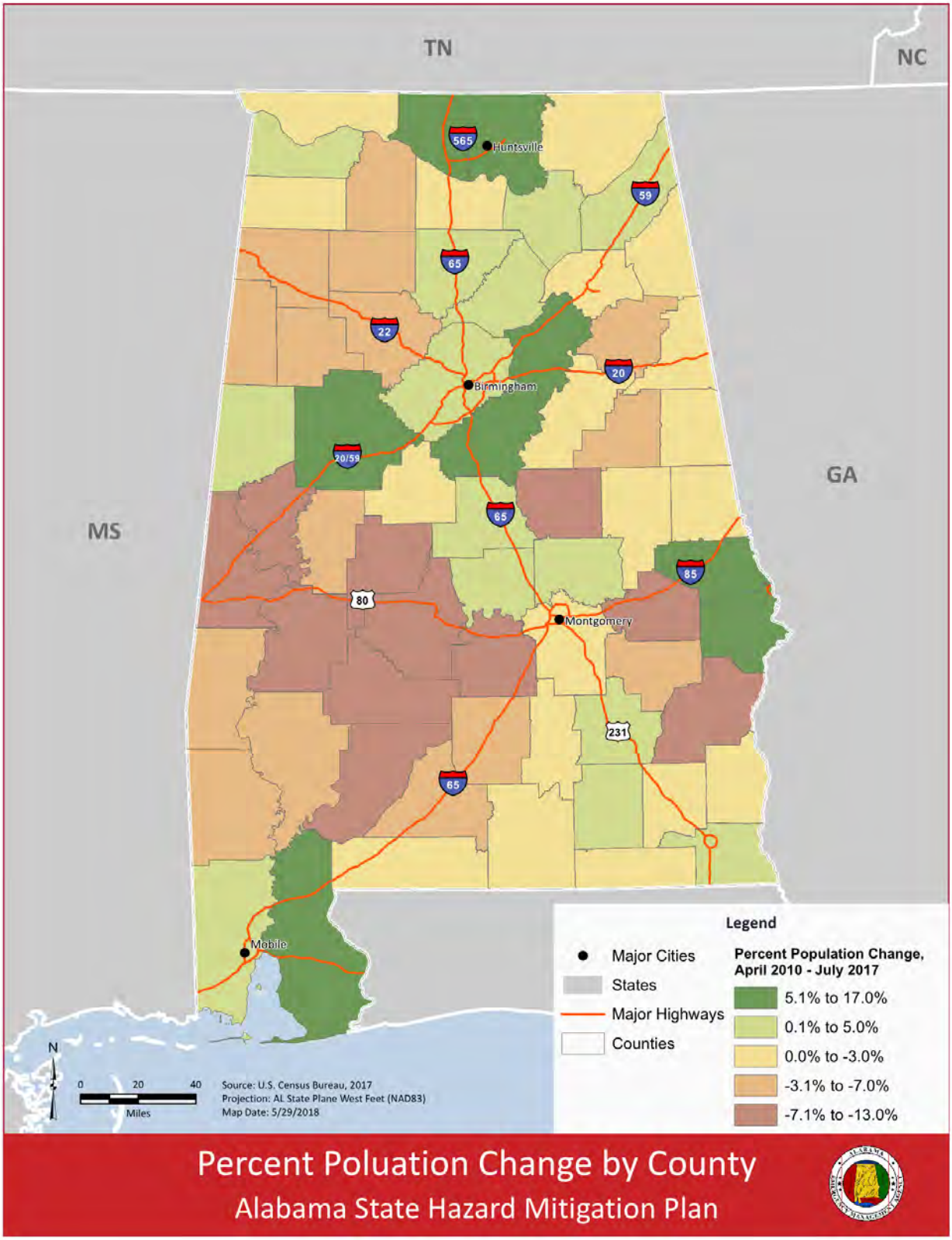
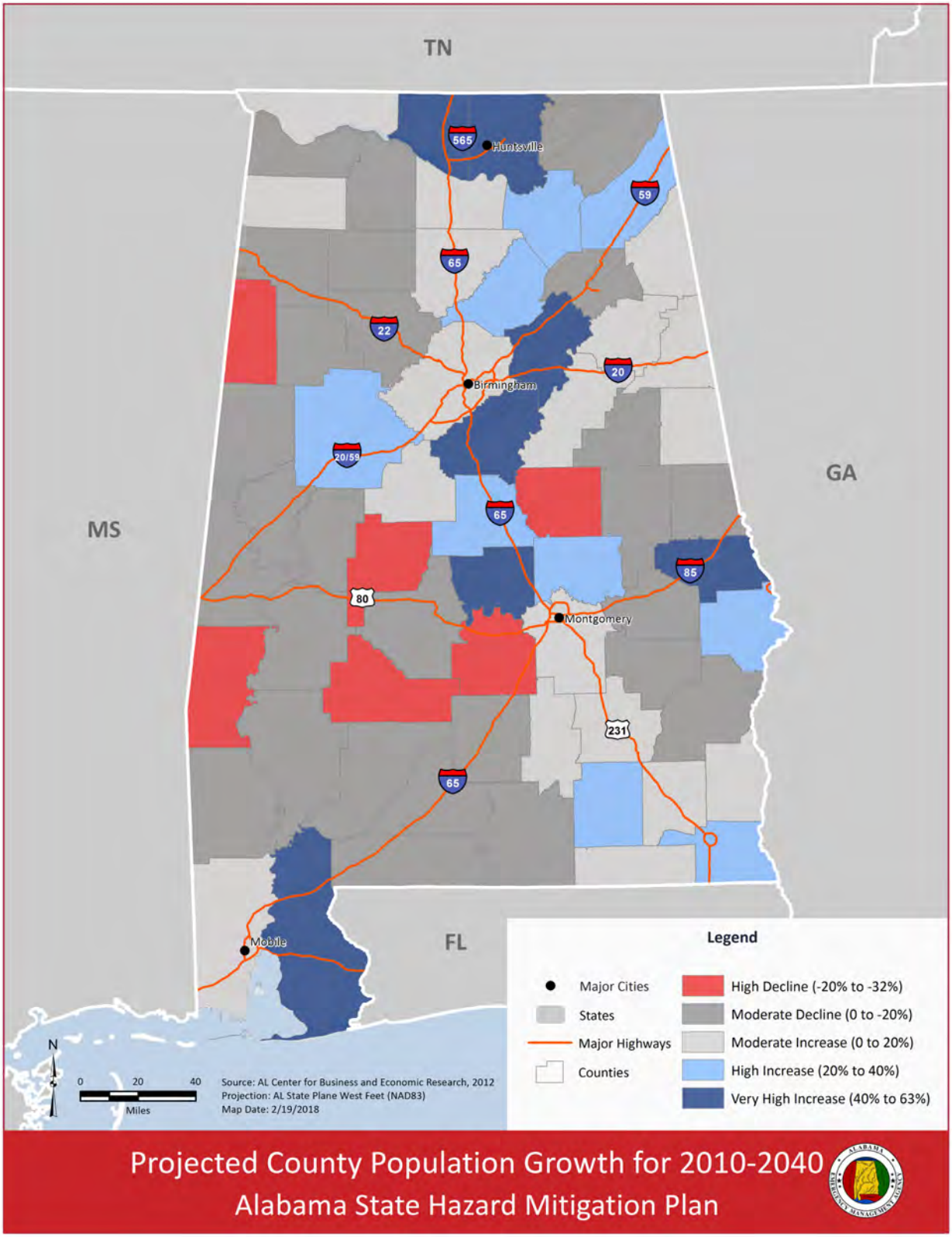


Figure 2.7 Projected Population Growth Rates



As the State's population increases, there will be a greater chance that people will be exposed to different hazards and require State resources for protection and recovery. The larger population increases in coastal counties (Baldwin and Mobile) are particularly concerning due to the significant exposure of this region to coastal hazards, including hurricanes and sea level rise.

2.2.2 Land Use Trends

Alabama's land is becoming more developed. From 1982 to 2012, the percentage of developed non-federal land went from 5.23% to 9.25%.[59] A portion of this land use change is due to the decrease in number of farms and decrease in amount of farmland.[60] Additionally, the increase in land development may be due to an increase in housing in the state. From 2010 to 2016, Alabama saw a 3% increase in housing units within the state.

Compared with the rest of the Gulf Coast, the two Alabama Counties with access to the coast are ranked in the middle range of amount of land developed in the Gulf Coast region, existing in the range of 20-40 square miles from 1996 to 2010. Moreover, it ranked amongst the highest for net loss (-150 to -275 square miles from 1996 – 2010), fairly high for net wetland loss (-10 to -40 square miles from 1996 – 2010), and a mid-range percentage for land use change percent (10% – 20%).[61] It can be noted for all of the coastal counties, in contrast to just the two with access to the coast, percentage land use change is even higher, at 25.3% for the time period of 1996 – 2010.[62] These patterns of development, in conjunction with population trends, are likely to make the coastal regions of the state much more vulnerable to hazards.

Sea level rise threatens to be one of the largest factors to change land use in Alabama in the coming years. The combination of global sea level rise with natural and human induced land subsidence is reducing the amount of useable land next to the Gulf of Mexico (see Sections 3.2.10 and 3.2.11 for more information).

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[59] United States Department of Agriculture National Resources Conservation Service, 2017. National Resources Inventory. Retrieved at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/nri/.
[60] Farmland Information Center, 2018. Alabama Statistics. Retrieved at: https://www.farmlandinfo.org/statistics/alabama.
[61] National Oceanic and Atmospheric Administration, 2010. Gulf of Mexico Regional Land Cover Change Report. Retrieved at: https://coast.noaa.gov/data/digitalcoast/pdf/landcover-report-gulf-coast.pdf.
[62] National Oceanic and Atmospheric Administration Office for Coastal Management, 2017. Alabama. Retrieved at: https://coast.noaa.gov/states/alabama.html.

3 Risk Assessment

Many kinds of natural and technological hazards impact the state of Alabama. To reduce the loss of life and property to the hazards that affect Alabama, state and local officials must have a robust and up-to-date understanding of the risks posed by these hazards. In addition, federal regulations and guidance require that certain components be included in the risk assessment section of state hazard mitigation plans (see 44 CFR Part 201 for federal regulations for mitigation planning and the State Mitigation Plan Review Guide for the FEMA official interpretation of these regulations). The required components are as follows:

- An overview of the type and location of all natural hazards that can affect the state, including information on previous occurrences of hazard events and the probability of future hazard events. According to the State Mitigation Plan Review Guide, the probability of future hazard events "must include considerations of changing future conditions, including the effects of long-term changes in weather patterns and climate;"
- An overview and analysis of the state's vulnerability to these hazards. According to the CFR, the state risk assessment should address the jurisdictions most threatened by the identified hazards, as well as the state assets located in the identified hazard areas;
- An overview and analysis of the potential losses to the identified vulnerable structures. According to the CFR, the state risk assessment should estimate the potential dollar losses to state assets and critical facilities located in the identified hazard areas.

The Alabama State Hazard Mitigation Plan Update approved by FEMA in 2013 assessed statewide risks based on the best available data at the time and complied with existing federal regulations and policy. The 2018 revisions update the previous analyses to reflect the best available data as of December 2017, and to reflect the official FEMA policy on assessing the probability of future hazard events. While the 2013 plan update included limited analysis of climate change, this update includes a thorough review of the anticipated effects of climate change on the future probability of hazard events for each of the profiled hazards.

3.1 Overview

The structure of the risk assessment chapter is intended to support the development of effective mitigation strategies, and to demonstrate compliance with federal regulations and policy. Following the overview provided in Section 3.1, Section 3.2 identifies and profiles the hazards that affect the state of Alabama, Section 3.3 provides detailed vulnerability assessments and loss estimates for a subset of the identified hazards, and Section 3.4 discusses the impacts of development trends on vulnerability.

Section 3.1 is further subdivided into one subsection on the hazards identified as affecting the state (3.1.1), one subsection on the ranking methodology used to determine which hazards would receive detailed vulnerability assessments, (3.1.2), and one section on the hazards profiled in county plans (3.1.3). Section 3.2 presents the greatest volume of information with one subsection for each on the fourteen identified hazards (3.2.1 through 3.2.14). Each of these fourteen subsections provides a general description of the hazard, a discussion of the nature of the hazard in Alabama, a review of the history of the hazard in Alabama, and a summary of the future probability of the hazard in Alabama. The summary of the future probability of each hazard addresses the anticipated effects of climate change, as well as the areas likely to be most vulnerable to the hazard.

3.1.1 Identified Hazards

The list of hazards to be included is reviewed by the SHMT with each plan update. This has led to minor adjustments over the years. For example, in the 2007 plan update, a high winds category was created to include hurricane wind, tornadoes, and windstorms. Storm surge from hurricane was grouped into the flood hazard category which also included riverine flooding and flash flood. In addition, tsunami was added as a hazard and all man-made and human-caused hazards were removed. During the 2010 plan update process, no significant changes were made to the list of hazards addressed. During the 2013 plan update process, it was determined that coastal erosion would be expanded upon based on available data (included in flood), rogue waves would not be addressed, and sea level rise would be added.

During the 2018 plan update process, the SHMT considered hazard additions and adjustments at the Risk Assessment Methodology and Outreach Strategy Meeting on December 1, 2017. It was determined that the plan update should address all the hazards included in the previous plan, with one slight adjustment to the treatment of sea level rise. To support more effective and resilient mitigation strategies, this plan discusses the flooding impacts of sea level rise in Section 3.2.5, and the coastal change impacts of sea level rise in Section 3.2.10. Based on the analysis in Section 3.2.5, mitigation actions to address current flood hazards can be designed to address future flood hazards as well. Based on the analysis in Section 3.2.10, coastal planning and management activities can be adapted to slow the advance of coastal land change and reduce the damage to properties, infrastructure, and the economy.

The hazard list includes hazards that have occurred in the past as well as those that may occur in the future. In addition, hazards with the greatest chance of significantly affecting the state and its residents are included. A variety of sources were consulted to determine hazards that have impacted the state historically or that may occur in the future. These included national, regional, and local sources. Some of the specific sources include:

- AEMA;
- US Geological Survey (USGS);

- Alabama Disaster Center;
- Alabama Forestry Commission;
- NOAA;
- Geological Survey of Alabama (GSA);
- ADECA;
- FEMA.

Input from experts at these agencies was also solicited during the review of the hazards. Additional details on the process can be found in Section 4: Planning Process. The list of 2018 hazards to be included is as follows:

1. Dam Failure;
2. Drought;
3. Earthquakes;
4. Extreme Temperatures;
5. Flooding (riverine flooding, storm surge, flash floods);
6. Hail;
7. High Winds (hurricanes, tornadoes, windstorms);
8. Landslides;
9. Lightning;
10. Sea Level Rise and Coastal Land Change;
11. Sinkholes and Land Subsidence;
12. Tsunamis;
13. Wildfires; and
14. Winter Storms

The SHMT re-affirmed this hazard list at the Risk Assessment Methodology and Outreach Strategy Meeting on December 1, 2017.

Two important sources for characterizing the hazards that affect the state are: 1) the record of significant meteorological events compiled in the NWS Storm Events Database, and 2) the record of federal disaster declarations compiled by FEMA. These data sources are briefly summarized below.

3.1.1.1 NWS Storm Events Database

Since 1950, NWS offices across the US have submitted reports on significant storm events to NWS headquarters. NWS field offices are instructed to document events that:

- Have sufficient intensity to cause loss of life, injuries, significant property damage and/or disruption to commerce;
- Are rare or unusual and generate media attention; or
- Are otherwise significant meteorological events, such as record temperatures or precipitation event.

These reports are then checked by staff at NWS headquarters and compiled into the Storm Events Database, a searchable online platform that can be accessed at www.ncdc.noaa.gov/stormevents.

The Storm Events Database includes a wealth of information that can help characterize hazards within a state and assess historical vulnerability. This information includes the time, date, and location of documented events; a narrative description of the event; the number of injuries and deaths associated with the event; and the estimated amount of property and crop damage caused by the event.

The Storm Events Database is cited frequently throughout this risk assessment and is the source of much of the information on the nature of hazards in Alabama and past occurrences within the state. Three important caveats must be noted, however. First, there are unique periods of record available depending on the event type. While NWS has consistently collected data on some event types from 1950 to the present, data collection for many event types only began in 1996. Second, some uncertainty is introduced into the database by weather phenomena that involve multiple hazards. Tropical cyclones, for example, can cause damage through high winds, storm surge, flooding, and/or tornadoes. NWS field offices are instructed to separate the observed damages into different event types depending on the immediate cause, but this can become a subjective decision. Finally, the damage estimates included in the Storm Events Database come with some limitations. The damage estimates are collected from diverse sources by staff with little or no training in damage estimation and are not compared with actual costs. In addition, the damage estimates only include direct physical damage to property, crops, and public infrastructure. Although damage estimates for individual events may be quite inaccurate, as estimates from many events are added together the errors become progressively smaller.[1]

In this report, all Storm Event Database damage estimates are adjusted to 2017 dollars. This adjustment was made using the Consumer Price Index Inflation Calculator developed by the Bureau of Labor Statistics. The July 2017 value of $1 dollar in July of each year was retrieved to compile a list of inflation coefficients. These coefficients were then multiplied by the reported damage estimates to adjust each estimate to 2017 dollars.

3.1.1.2 FEMA Disaster Declarations Summary

Another important data source for characterizing hazards in Alabama was the FEMA Disaster Declarations Summary, a dataset summarizing all federally declared disasters. This information begins with the first disaster declaration in 1953 and features all three disaster declaration types: major disaster, emergency and fire management assistance. The dataset includes declared recovery programs and geographic areas and is updated daily. The disaster declaration information summarized in this report was obtained from the dataset posted on January 8, 2018.

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[1] Downton, M., Miller, Z., and Pielke, R., 2005. Reanalysis of US NWS Flood Loss Database. Natural Hazards Review, Vol. 6, No. 1.

Since 1960, various parts of Alabama have been declared federal disaster areas. On four occasions (in 1977, 1993, 2004, and 2017), the entire state was included in a declaration, each time for a different hazard. The southern counties tend to experience more disaster declarations related to hurricanes and coastal storms, while the northern counties tend to experience more disaster declarations related to tornadoes and ice storms, the latter of which may also be accompanied by flooding. Since 2013, the two disasters that had the largest number of declared counties were Hurricane Irma in September 2017 (entire state declared) and Hurricane Nate in October 2017 (47 counties declared). Table 3.1 shows the federal disaster declarations in the state from 1960 through the beginning of January 2018.

Table 3.1 Federal Disaster Declarations in Alabama (Through January 8, 2018)

Date	Disaster Number	Type of Incident	# of Counties Declared
February 27, 1961	109	Floods	Info not available
November 7, 1969	280	Hurricane Camille	2
April 9, 1970	285	Heavy Rain, Tornadoes and Flooding	2
March 27, 1973	369	Tornadoes and Flooding	28
May 29, 1973	388	Severe Storms and Flooding	12
April 4, 1974	422	Tornadoes	20
January 18, 1975	3007	Tornadoes	5
March 14, 1975	458	Severe Storms and Flooding	23
April 23, 1975	464	Severe Storms and Flooding	8
October 2, 1975	488	Severe Storms, Tornadoes and Flooding	15
April 24, 1976	3064	Tornadoes	2
April 9, 1977	532	Severe Storms and Flooding	9
July 20, 1977	3045	Drought	67
August 9, 1978	563	Severe Storms and Flooding	1
March 17, 1979	3074	Flooding	9
April 18, 1979	578	Storms, Wind, and Flooding	28
September 13, 1979	598	Hurricane Frederic	11
April 20, 1980	619	Severe Storms, Tornadoes and Flooding	2
April 10, 1981	638	Severe Storms, Tornadoes and Flooding	1
May 14, 1981	639	Severe Storms and Flooding	1

Date	Disaster Number	Type of Incident	# of Counties Declared
December 13, 1983	695	Severe Storms, Tornadoes and Flooding	4
May 11, 1984	3088	Severe Storms and Tornadoes	4
September 7, 1985	742	Hurricane Elena	2
November 17, 1989	848	Severe Storms and Tornadoes	2
February 17, 1990	856	Severe Storms, Tornadoes and Flooding	27
March 21, 1990	861	Severe Storms, Tornadoes and Flooding	33
January 4, 1991	890	Severe Storms and Flooding	12
March 15, 1993	3096	Severe Snowfall and Winter Storm	67
March 3, 1994	1013	Severe Winter Storms, Freezing and Flooding	10
March 30, 1994	1019	Severe Storms, Tornadoes and Flooding	7
July 8, 1994	1034	Severe Storms and Flooding – Tropical Storm Alberto	10
April 21, 1995	1047	Severe Storms, Tornadoes and Flooding	5
October 4, 1995	1070	Hurricane Opal	38
February 23, 1996	1104	Severe Winter Storms, Ice and Flooding	14
March 20, 1996	1108	Severe Storms, Tornadoes and Flooding	3
July 25, 1997	1185	Hurricane Danny	3
March 9, 1998	1208	Flooding, Severe Storm	6
April 9, 1998	1214	Thunderstorms, Tornado	6
September 30, 1998	1250	Hurricane Georges	14
January 15, 1999	1261	Ice Storm, Freezing Rain	11
February 18, 2000	1317	Winter Storm	3
March 17, 2000	1322	Severe Storm, Flooding	2
December 18, 2000	1352	Tornado	11
March 5, 2001	1362	Severe Storm, Flooding	6
December 7, 2001	1399	Severe Storm, Tornado	19
October 9, 2002	1438	Tropical Storm Isidore	2

Date	Disaster Number	Type of Incident	# of Counties Declared
November 14, 2002	1442	Severe Storm, Tornado	29
May 12, 2003	1466	Severe Storm, Thunderstorms, Tornado, Flooding	24
September 15, 2004	1549	Hurricane Ivan	67
July 10, 2005	1593	Hurricane Dennis	45
August 29, 2005	1605	Hurricane Katrina	22
March 1, 2007	3292	Severe Storms and Tornadoes	7
September 10, 2008	1789	Hurricane Gustav	2
September 26, 2008	1797	Severe Storms and Flooding – Hurricane Ike	2
April 28, 2009	1835	Severe Storms, Flooding, Tornado, and Straight-line Winds	21
May 8, 2009	1836	Severe Storms, Flooding, Tornado, and Straight-line Winds	6
June 3, 2009	1842	Severe Storms, Flooding, Tornado, and Straight-line Winds	4
December 22, 2009	1866	Tropical Storm Ida	2
December 31, 2009	1870	Severe Storms and Flooding	14
May 3, 2010	1908	Severe Storms, Tornadoes, Straight-line Winds, Flooding	3
April 28, 2011	1971/3319	Severe Storms, Tornadoes, Straight-line Winds, Flooding	43
February 1, 2012	4052	Severe Storms, Tornadoes, Straight-line Winds, Flooding	3
September 21, 2012	4082	Alabama Hurricane Isaac	8
May 2, 2014	4176	Severe Storms, Tornadoes, Straight-Line Winds, Flooding	21
January 21, 2016	4251	Severe Storms, Tornadoes, Straight-Line Winds, Flooding	39
September 11, 2017	3389	Hurricane Irma	67
October 8, 2017	3394	Hurricane Nate	39
November 16, 2017	4349	Hurricane Nate	8

3.1.2 Ranking Methodology

The identified hazards vary in their probability of affecting the state and in their potential impact on the state. The SHMT and FEMA therefore determined that only a subset of the hazards should receive detailed vulnerability assessments. To identify the hazards for which detailed vulnerability assessments would yield the most benefit, AEMA completed a Risk Factor (RF) analysis. An RF analysis characterizes the degree of risk posed by identified hazards in a planning area based on a set of factors deemed important by the SHMT and other stakeholders. The identified hazards are assigned a numeric value for each risk factor, and a formula is then applied to aggregate the values into an RF value. The higher the RF value, the greater the hazard risk.

The RF approach used by the SHMT to rank hazard risk in Alabama is summarized in Table 3.2. The risk assessment categories shown in the table are based on FEMA's Comprehensive Preparedness Guide (CPG) 101 (see pg. 3-11 of CPG-101). Those categories include: probability, impact, spatial extent, warning time, and duration. Probability indicates how frequently a given hazard event will occur. Impact looks at the systemic loss of life, property, and economic well-being induced in a given hazard event. Spatial extent indicates the geographic area a given hazard event will cover and whether a hazard event is expected to be state-wide, regional, or extremely localized. Warning time evaluates how far in advance a community will know of an impending hazard event, considering hazard-specific warning systems. Finally, duration indicates the length of time the hazard event will last. The numeric value assigned for each category relies mainly on historical data, local knowledge, consensus opinions from the SHMT and information collected through development of the hazard profiles.

To calculate a composite RF ranking, weighting factors were derived from a review of best practice plans and agreed upon by the SHMT. The weighting factors for each risk assessment category are also shown in Table 3.2. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor, and the weighted values were added together.

The RF approach complements more quantitative analyses by reflecting participants' local knowledge and experience and providing a consistent metric across different hazards. Nevertheless, Alabama recognizes limitations to this approach. In some cases, for example, risk levels may not be entirely compatible with multi-hazard events. There may also be differences in how hazards are scored in dense urban areas as compared to rural areas. Despite its limitations, however, the method serves as a useful tool for providing systematic and consistent prioritization of qualitative hazard information. In addition, the method can be used to help prioritize mitigation strategies.

Table 3.2 Summary of Risk Factor approach

Risk Assessment Category	Degree of Risk Level	Criteria	Index	Weight
Probability *What is the likelihood of a hazard event occurring in a given year?*	**Unlikely**	Less than 1% annual probability	**1**	**30%**
	Possible	Between 1% & 49.9% annual probability	**2**	
	Likely	Between 50% & 90% annual probability	**3**	
	Highly Likely	Greater than 90% annual probability	**4**	
Impact *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**Minor**	Very few injuries, if any. Only minor property damage & minimal disruption on quality of life. Temporary shutdown of critical facilities.	**1**	**30%**
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	**2**	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	**3**	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	**4**	
Spatial extent *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**Negligible**	Less than 1% of area affected	**1**	**20%**
	Small	Between 1 & 10.9% of area affected	**2**	
	Moderate	Between 11 & 25% of area affected	**3**	
	Large	Greater than 25% of area affected	**4**	
Warning Time *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**> 24 Hrs**	*Self-Defined (NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	**1**	**10%**
	12 To 24 Hrs		**2**	
	6 To 12 Hrs		**3**	
	< 6 Hrs		**4**	
Duration *How long does the hazard event usually last?*	**< 6 Hrs**	Self-Defined *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	**1**	**10%**
	< 24 Hrs		**2**	
	< 1 Week		**3**	
	> 1 Week		**4**	

The values assigned to each of the identified hazards and the final RF rankings are shown in Table 3.3. The SHMT determined that hazards with RF rankings greater than 2.5 pose a high risk to Alabama and should receive detailed vulnerability assessments. Hazards with RF rankings between 2 and 2.5 were deemed medium risks, and hazards with RF rakings less than 2 were deemed low risk. As data availability and resources permit, the medium and low risk hazards may receive future vulnerability assessments. The three hazards with RF rankings exceeding 2.5 were floods, high winds, and sea level rise. In addition, the SHMT selected one hazard for detailed vulnerability assessment despite its lower ranking. The earthquake hazard had a medium RF ranking of 2.1. Nevertheless, data for earthquake vulnerability assessments are readily available through the free Hazus program, and a detailed vulnerability assessment was included in the 2013 plan. This revision therefore updated the vulnerability assessment for the earthquake hazard.

Table 3.3 Qualitative Ranking for Identified Hazards

Hazard	Risk Assessment Category					Risk Factor
	Probability	Impact	Spatial Extent	Warning Time	Duration	
Flooding	4	4	3	3	3	3.6
High Winds	4	3	3	4	3	3.4
Sea Level Rise	3	3	2	1	4	2.7
Winter Storms	2	3	3	1	2	2.4
Wildfire	3	2	2	2	3	2.4
Extreme Temperatures	4	1	2	1	3	2.3
Drought	2	2	3	1	4	2.3
Landslides	3	2	1	4	1	2.2
Sinkholes and Subsidence	3	2	1	4	1	2.2
Lightning	4	1	1	4	1	2.2
Earthquakes	1	3	2	4	1	2.1
Hail	3	1	1	3	2	1.9
Dam Failures	2	2	1	4	1	1.9
Tsunamis	1	2	2	2	1	1.6

3.1.3 Hazards Profiled in County Plans

As part of the plan update process, the hazard profile sections of all local hazard mitigation plans were reviewed to determine which hazards were identified and profiled by local jurisdictions. This process is also briefly described in Section 1.3.2.1 (Hazard Identification and Profiles).

Some local plans simply provided a table listing what hazards affect the local jurisdictions and what hazards do not. Others provided a ranking system. For consistency, this plan update reviews the hazards that are identified and profiled in the local plans. Table 3.4 summarizes the number of counties that profiled each of the hazards identified as affecting the state.

Table 3.4 Summary of County Hazard Mitigation Plans

Hazard	Number of Counties that Profile Hazard
Dam Failures	55
Drought	62
Earthquakes	62
Extreme Temperatures	42
Flooding	64
Hail	48
High Winds	67
Landslides	60
Lightning	49
Sinkholes and Subsidence	58
Sea Level Rise and Coastal Land Change	6
Tsunamis	10
Wildfire	60
Winter Storms	67

High wind hazard profiles differ between state and county plans and can include severe storms, hurricanes, tropical storms/cyclones, microbursts, and tornadoes. While some counties included an extreme temperature profile, others mentioned characteristics of extreme temperatures within other hazard profiles, such as drought/extreme heat, and winter storms/extreme cold. Human-made hazards were also profiled by several counties and included hazardous materials release, chemical spills, radiation leaks, nuclear accidents, acts of terrorism, criminal activities, transportation system failures. Additional profiled hazards in a few plans include avalanche, communicable disease/pandemic, celestial impact, dense fog, and volcano.

3.2 Hazard Profiles

3.2.1 Dam Failure

3.2.1.1 Description

A dam is a barrier constructed across a watercourse to store, control, or divert water. Dams vary widely in form and function. They can be constructed of earth, rock, concrete, or mine tailings, and they can support irrigation, electrical generation, flood control, navigation, and/or recreation. Although dams represent a vital component of our national infrastructure, most dams are not owned by public entities. Across the US, 56 percent of dams are privately owned, twenty percent are owned by local governments, 4.8 percent are owned by state governments, 4.7 percent are owned by federal government, and 2.4 percent are owned by public utilities. The ownership of the remaining dams is undetermined.[2]

Dam failure is the uncontrolled release of water (and any associated wastes) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. Common causes of dam failure include:[3]

- Flooding caused by prolonged rainfall;
- Overtopping caused by poor design or debris blockage;
- Foundation defects caused by slope instability;
- Cracking caused by the natural settling of a dam; and
- Internal erosion caused by leakage or piping.

According to data collected by the Association of State Dam Safety Officials (ASDSO), most dam failures in the US are caused by extreme weather events or overtopping (60 percent and 20 percent, respectively), and other relatively common causes include piping (10 percent) and deterioration (6 percent).

Deficient condition or design is often an underlying cause of dam failure, and the number of deficient dams in the US is on the rise. The average age of dams in the US is 56 years, and about one-third were built more than 50 years ago (the intended lifespan of most dams).[4] As the nation's

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[2] Federal Emergency Management Association, 2017. Dam Ownership in the US. Website accessed at: https://www.fema.gov/dam-ownership-united-states
[3] Association of State Dam Safety Officials, 2018. What are the Causes of Dam Failures? Website accessed at: https://damsafety.org/what-are-causes-dam-failures
[4] Center for American Progress, 2012. The 10 States Most Threatened by High-Hazard, Deficient Dams. Website accessed at: https://www.americanprogress.org/issues/economy/news/2012/09/20/38679/the-10-states-most-threatened-by-high-hazard-deficient-dams/

dams age, investments in maintenance, upgrades, and repairs are not keeping pace with the need. According to the American Society of Civil Engineers (ASCE), the number of high hazard potential dams that are known to be deficient has risen from 1,367 in 2005 to 2,170 in 2017.[5,6] This is largely the result of the patchwork of state and federal dam safety programs that provides oversight of dams and resources for inspection and maintenance. The federal government oversees about 6.5 percent of the nation's dams, but state governments are responsible for the remaining 93.5 percent.[7] Each state program has different strengths and weaknesses, but many are limited by a lack of statutory authority, limited budgets, and limited staff.

The impact of dam failure in the US is known to be significant but is not well understood. In the absence of a comprehensive nationwide program, the exact number of dam failures that have occurred is unknown. According to the ASDSO, however, dam failures have been documented in every state and are known to have taken thousands of lives.[8] The ASDSO received reports of 173 dam failure and 587 dam incidents between 2005 and 2013 (an incident is a condition that could have resulted in dam failure). The ASDSO has also mapped a subset of dam failures with known locations (a comprehensive database is not available). This map shows that most failures have caused limited loss of life, but a few have caused more than a hundred fatalities[9] (Figure 3.1). Dam failures can also have significant economic and environmental costs. The inundation of neighboring communities can damage property and infrastructure, and the release of agricultural or industrial wastes can pollute downstream waterways.

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[5]The American Society of Civil Engineers, 2017. 2017 Infrastructure Report Card: Dams. Website accessed at: https://www.infrastructurereportcard.org/cat-item/dams/

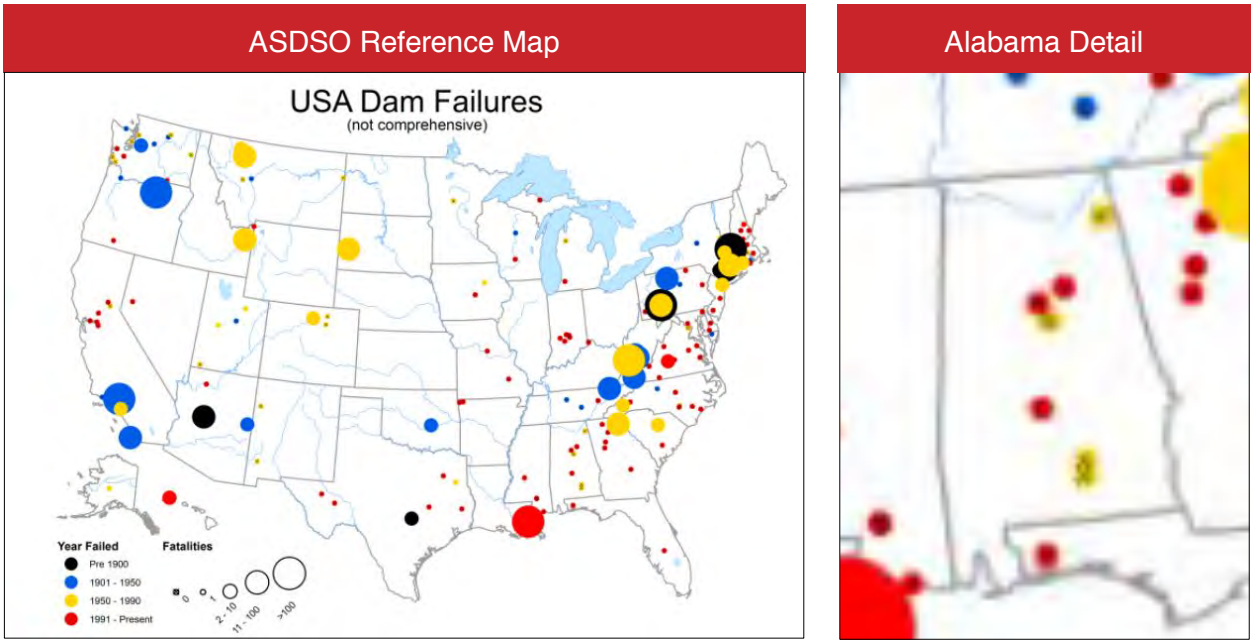
[6] American Society of Civil Engineers, 2009. 2009 Report Card for America's Infrastructure. Website accessed at: https://www.infrastructurereportcard.org/2009/fact-sheet/dams.html

[7] FEMA, 2013. Dam Safety in the US. Retrieved at: https://www.fema.gov/media-library-data/1402876995238-1c041ca9a4489ea27152c515ed72e38f/DamSafetyintheUnitedStates.pdf

[8] Association of State Dam Safety Officials, 2018. Failures and Incidents at Dams. Website accessed at: https://damsafety.org/dam-failures

[9] Ibid.

Figure 3.1 Dam Failures Reported by State Officials (ASDSO, 2015)



The potential impacts of a dam failure depend on the amount of water impounded by the dam and the density, type, and value of downstream development. Many federal and state dam safety programs use a FEMA classification system to divide dams into one of three categories based on the potential impacts of dam failure. The categories are high, significant, and low and are based on the potential for loss of life and damage to property (Table 3.5). It is important to emphasize that this system does not reflect the condition of the dam or its physical integrity. In addition, as more development occurs downstream of a dam, its hazard potential can increase. Across the US, dam safety regulators have limited ability to restrict development in downstream areas, and the number of high hazard potential dams is rising.[10]

Table 3.5 Dam Hazard Classifications (FEMA, 2004)

Class	Health and Safety Impacts	Economic Impacts
High Hazard	Probable loss of life	Widespread damage to homes, industrial and commercial buildings, important utilities, highways, or railroads
Significant Hazard	No loss of life expected	Damage to isolated homes, utilities, highways, or railroads
Low Hazard	No loss of life expected	Slight damage to farm buildings, forest or agricultural land, or minor roads

[10] Association of State Dam Safety Officials, 2018. Dams 101. Website accessed at: https://damsafety.org/dams101

3.2.1.2 Nature of the Hazard in Alabama

The state of Alabama has more than 132,000 miles of river and stream channels and more than 4,800 large dams (defined as dams with a capacity greater than 50 acre-feet or a height greater than 25 feet) that support irrigation, electrical generation, flood control, navigation, and/or recreation.[11,12] Many of the state's largest dams are on the Black Warrior, Coosa, Tallapoosa, and Tennessee Rivers. These include 14 hydroelectric dams operated by Alabama Power that provide more than 6 percent of the company's power generation and 7 dams operated by the Tennessee Valley Authority. The state's thousands of smaller dams are distributed throughout Alabama and serve many purposes, from flood control and sediment reduction to irrigation, livestock watering, and recreation.

Because most of Alabama's dams are not subject to record-keeping or inspection requirements, it is difficult to paint a complete picture of the magnitude of the dam failure hazard in the state. Alabama is the only state in the country without a dam safety program. State officials therefore have negligible authority to oversee dams and limited resources to collect information on their location, hazard potential, and condition. ADECA has compiled an inventory of the state's dams and their estimated hazard potential, but information on dam condition and other characteristics is generally not available. Since Alabama has tens of thousands of small ponds, ADECA only includes dams with a capacity greater than 50,000 acre-feet or a height greater than 25 feet in their inventory.

Based on state records, 195 of Alabama's 4,800 dams (or 4.1% of all large dams) are classified as having a high hazard potential. As noted above, a dam's hazard potential is based on the potential impact if it were to fail, not its condition or chance of failing. Figure 3.2 shows the number of high hazard potential dams by county. The counties with the largest number of high hazard potential dams are generally located in the greater Tuscaloosa area and greater Birmingham area.

The US Army Corps of Engineers (USACE) NID also includes records for dams in Alabama. These records are only up to date, however, for the small percentage of dams subject to federal oversight. For these dams, the records include information on both dam hazard potential and dam condition. Of the 70 dams in Alabama subject to federal oversight, 46 are classified as high hazard potential dams. Of these high hazard potential dams, most are classified as satisfactory or fair condition, and three are classified as poor or unsatisfactory condition. These three dams are:

- The Logan Martin Dam located on the Coosa River in St. Clair County
- The Little Bear Creek Dam located on Little Bear Creek in Franklin County

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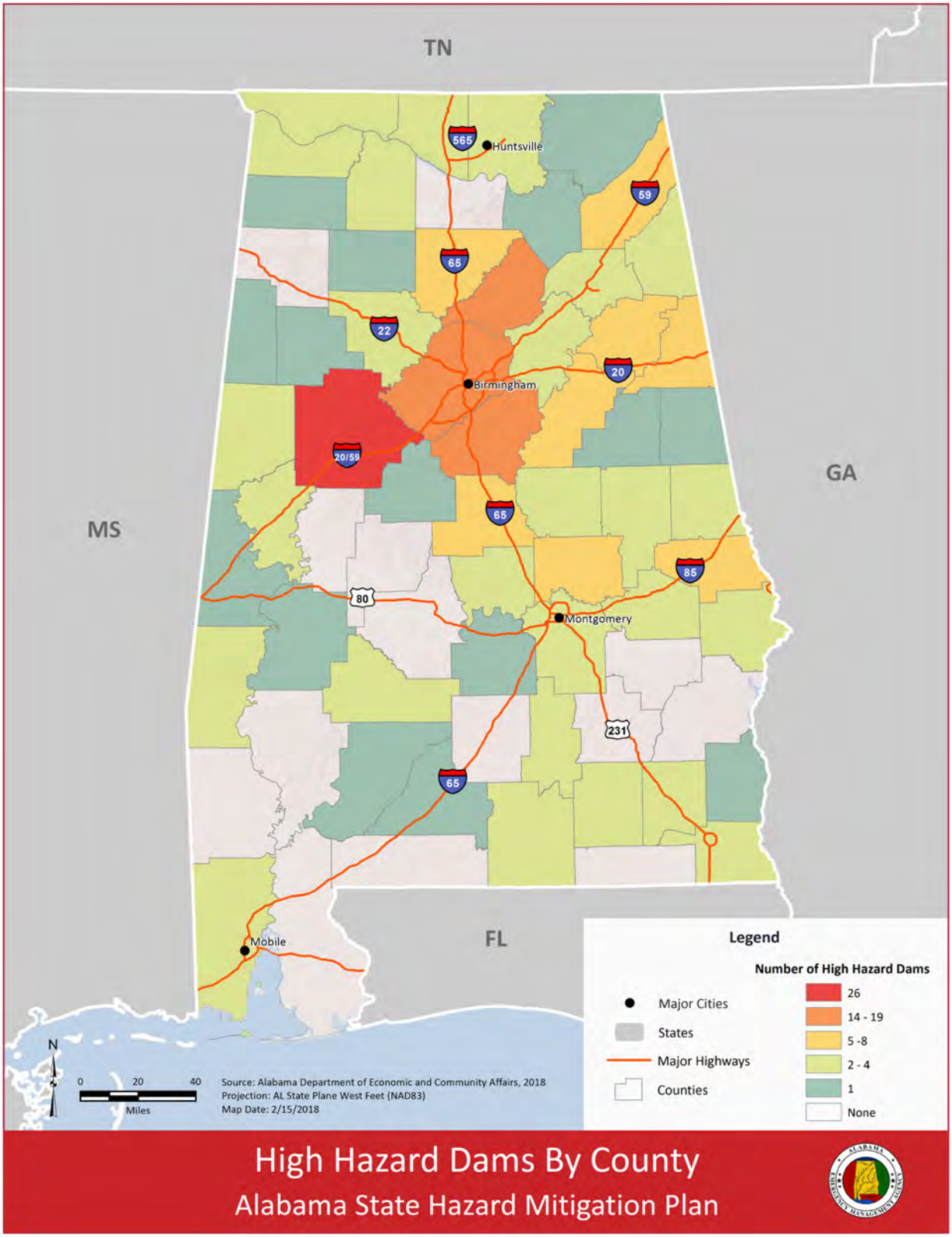
[11] Alabama Rivers Alliance, 2018. About Alabama's Rivers. Website accessed at: https://alabamarivers.org/about-alabamas-rivers/

[12] Alabama Department of Economic and Community Affairs. Personal communication from Wardell Edwards. February 7, 2018.

- The Bear Creek Dam located on Bear Creek in Franklin County

Figure 3.2 High Hazard Potential Dams by County (ADECA, 2018)



3.2.1.3 Dam Failure History in Alabama

There is no official, comprehensive record of dam failures in Alabama that documents all dam failure incidents in the state. At the discretion of local officials, however, some jurisdictions have reported selected dam failures to the ASDSO and to the Alabama section of the ASCE. Table 3.6 catalogues these reported dam failures. It should be emphasized that this list is by no means comprehensive, and that the number of dam failures omitted from this list is unknown.

Table 3.6 Historical Dam Failure Events (ASDSO and ASCE, 2017)

Date	Location	Description
1990	Shelby County	Three earthen dams in Shelby County sustained damage during the flood of February 3 to 17, 1990. Heavy rains and flooding saturated the Holly Brooke Lake Dam, causing the face to slump. Six families were evacuated and the water level of the 55-acre pond impounded by the dam was lowered to prevent failure.
1990	Crenshaw County	A dam at Magnolia Shores Lake in Crenshaw County was overtopped during the heavy rains and flooding of March 23, 1990. The downstream slope was damaged, and the lake was drained to prevent a break in the dam.
1990	Crenshaw County	The C. D. Clark Dam in Dozier, Crenshaw County, failed and washed out 50 yards of northbound US Highway 29. Lake Tholocco, a 600-acre lake on the Fort Rucker reservation near Ozark, was also drained because of excessive flow through its emergency spillway.
1994	Multiple counties	Local officials reported 160 dam breaks during the July 1994 floods. The state does not require local officials to report dam breaks, however, and the actual number of breaks was likely higher.
2004	Jefferson County	East Lake Dam in Birmingham overtopped during heavy rainfall in 2004, resulting in severe slope erosion and near failure. 270 residents were evacuated. If failure had occurred, several homes and roadways could have been destroyed.
2004	St. Clair County	Keith Lake Dam in St. Clair County failed during heavy rainfall in 2004. The dam failure created a path of destruction 3,600 feet long and 1,350 feet wide and led to the evacuation of homes, decreased property values, and environmental damages, as well as significant damage to a downstream dam.
2009	Etowah County	A private dam failed near the Gallant community in Etowah County during the heavy rains and flooding of January 6, 2009. The failure produced twelve feet of flooding, leading to the evacuation of nearby residents and the closure of several roads. Property damage was reported to be $100,000.
2012	St. Clair County	The 55-acre lake at Camp Sumatanga in St Clair County drained to nearly empty in 2012 due to a collapsed pipe. No significant downstream damage was reported.

Date	Location	Description
2013	Shelby County	A Shelby County dam failed due to soil piping along the 60" discharge pipe in 2013. Approximately 200 million gallons of water were released in less than an hour. There was significant damage to roadways and downstream properties.

3.2.1.4 Probability of Dam Failures in Alabama

Dam failures result from multiple natural and human factors that are highly site-specific, and their probability cannot be expressed in quantitative terms. In states with dam safety programs that require dams to be inspected and maintained, the relative probability of dam failures in different jurisdictions can be expressed in qualitative terms. Because there are no inspection and record-keeping requirements in Alabama, the relative hazard in different jurisdictions cannot be determined. Over time, however, the probability of a costly dam failure within the state is growing. This is because many of the state's aging dams are not receiving regular inspection and maintenance, and because the population in the areas downstream of dams is growing.

3.2.1.4.1 Future Probability

The most common cause of dam failure is flooding due to heavy rains. As the frequency of heavy rains increases with climate change (see 3.2.5.4.1 Future Probability on flood hazards), the incidence of dam failure in Alabama may increase. The higher frequency of heavy rains is a particular concern for Alabama's coastal counties, which are more likely to experience hurricanes.

3.2.1.4.2 Risk and Vulnerability

A community's vulnerability to dam failure is a function of the probability of failure, the exposure of people and property to the uncontrolled release of water, and the susceptibility of people and property to the hazard.

An Emergency Action Plan (EAP) is an important safeguard against the loss of life and property that can result from the failure of a high hazard potential dam. EAPs are formal documents that identify potential emergency conditions at a dam and specify actions to be followed to minimize dam failure impacts. One of the most important components of an EAP is the inundation map. The inundation map shows the locations, people, and infrastructure that could be affected by a dam failure by estimating the area that would be flooded by a complete dam breach. While all 46 federally-regulated, high hazard dams in Alabama are required to have an EAP, the state does not require that non-federal high hazard potential dams develop EAPs. As discussed above, 195 of Alabama's 4,800 dams (or 4.1% of all large dams) are classified as having a high hazard potential. Since only 46 of these dams are federally-regulated, the remaining 149 high hazard potential dams are not required to develop EAPs or inundation maps. Should a dam incident occur at one of these dams, local and state emergency managers would therefore have limited information on the possible extent of flooding and evacuation and response needs.

As discussed above, the counties in the greater Tuscaloosa and greater Birmingham areas are home to the largest numbers of dams with high hazard potential. Failure of high hazard potential dam is likely to cause loss of life and significant economic loss.

3.2.2 Drought

3.2.2.1 Description

Drought, which is a normal part of nearly all climates, is a water shortage originating from a deficiency in expected precipitation caused by unusual weather patterns. If these weather patterns persist for several months to several years, the drought is considered to be long-term; a short-term drought may last several weeks to a few months.[13] In addition to its duration, a drought's severity can also depend on such factors as intensity, geographic extent, and regional water supply demands by humans and vegetation. Further, the severity of a drought can be influenced by climatic factors including high temperatures, prolonged high winds, and low relative humidity.[14]

Although the severity and location of drought events in the US have varied, much of the country has suffered from the effects of a drought during the past century. Despite general increases in annual and seasonal precipitation totals in the Unites States since 1900, severe droughts continue to occur.[15] Severe droughts can result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and higher unemployment. Droughts may cause a shortage of water for human and industrial consumption, hydroelectric power, recreation, and navigation. Water quality may also decline and the number and severity of wildfires may increase.[16] Of all the weather-related disasters in the US, drought has historically had the greatest impact on the largest number of people. Since 1980, there have been 25 drought events across the US with losses exceeding $1 billion each and resulting in the deaths of 2,993 people.[17]

Due to its multi-dimensional nature, a drought is difficult to define and conducting a comprehensive risk assessment is challenging. For example, in contrast with other natural hazards, the effects of drought are not immediately apparent and may impact a larger geographic area. Additionally, because the effects of a drought event are slow to accumulate and may linger after an event, the beginning and end of a drought are difficult to determine. Finally, the lack of a

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[13] NOAA, NCEI. Drought Termination and Amelioration.
Retrieved at https://www.ncdc.noaa.gov/temp-and-precip/drought/recovery/
[14] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf
[15] NOAA, NCEI. Drought Termination and Amelioration.
Retrieved at https://www.ncdc.noaa.gov/temp-and-precip/drought/recovery/
[16] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf
[17] NOAA, NCEI. Drought Termination and Amelioration.
Retrieved at https://www.ncdc.noaa.gov/temp-and-precip/drought/recovery/

universally accepted and precise definition of drought adds to the confusion in tracking the existence and severity of droughts.[18]

Although there is no single, concise definition of a drought, droughts can be grouped into four general types. Table 3.7 provides common descriptions and definitions of the four drought types.

Table 3.7 Types of Drought

Drought Type	Description/Definition
Meteorological	Defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrological	Related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural	Defined principally in terms of soil moisture deficiencies relative to water demands of plant life, usually crops.
Socioeconomic	Associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of a weather-related supply shortfall. This type of drought may also be called a water management drought.

There have been many quantitative measure and indices that attempt to define the severity of a drought, which can vary based on the region and application. However, the most commonly used index is the Palmer Drought Severity Index (PDSI). The PDSI was developed in the 1960s and is still frequently used to indicate drought conditions throughout the US. The PDSI may be more widely applied as it accounts for several other factors in addition to total precipitation, including temperature and soil recharge. Table 3.8 provides the PDSI drought classifications; a negative PSDI indicates drought conditions.

[18] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

Table 3.8 Palmer Drought Severity Index (PDSI) Classifications

PDSI Classifications	
4.0 or more	Extremely Wet
3.0 to 3.99	Very Wet
2.0 to 2.99	Moderately Wet
1.0 to 1.99	Slightly Wet
0.5 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-.05 to -0.99	Incipient Dry Spell
-1.0 to -1.99	Mild Drought
-2.0 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 or less	Extreme Drought

Another resource that defines the geographic extent and severity of drought in the US is the US Drought Monitor (US Drought Monitor). The US Drought Monitor is a map that is updated each week to illustrate the current location and intensity of drought. Like the PDSI, the US Drought Monitor is based on many indicators, not just levels of precipitation. The US Drought Monitor categorizes drought on a D0 to D4 scale as shown below in Table 3.9.[19]

[19] University of Nebraska, National Drought Mitigation Center. US Drought Monitor. Retrieved at http://droughtmonitor.unl.edu/

Table 3.9 US Drought Monitor Classifications

Category	Description	Possible Impacts	PDSI
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

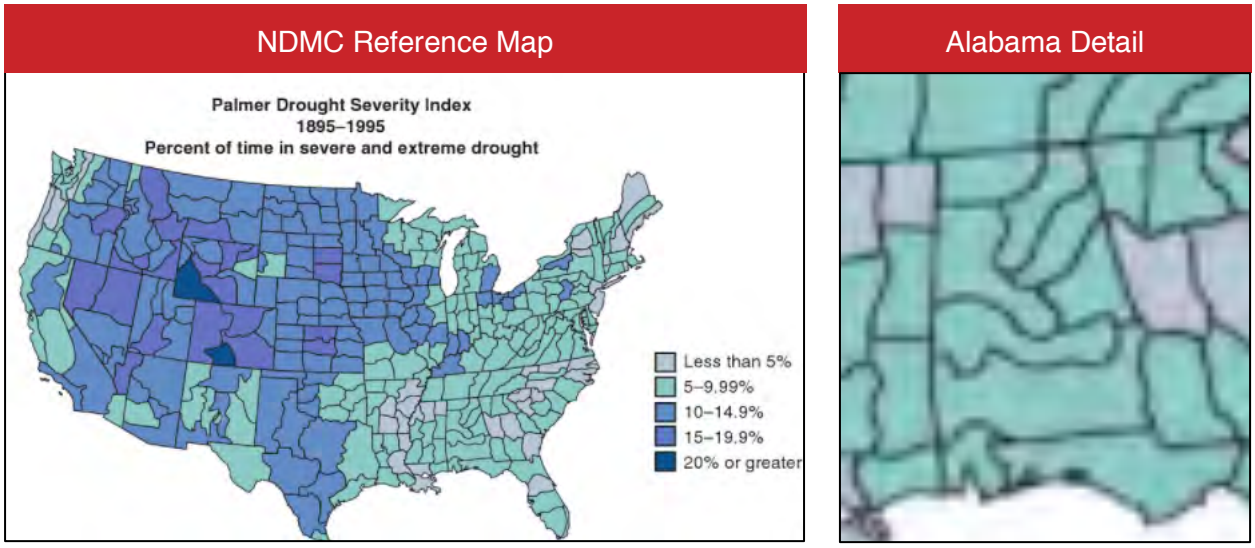
3.2.2.2 Nature of the Hazard in Alabama

As discussed above, drought can occur in virtually all climates in the US, including both areas with high and low average rainfall. Further, the effects of a drought are gradual and often impact large areas in comparison to other natural hazards like tornadoes that are more localized. Lastly, the duration and extent of drought conditions are influenced by a lack of rainfall, which itself is difficult to predict in terms of amount, duration, and location. These factors make it difficult to describe the nature of drought in Alabama with respect to which areas of the state have the highest exposure to the hazard.

The challenge of defining the extent of the drought hazard in Alabama is illustrated in the national map of drought conditions produced by the National Drought Mitigation Center (NDMC) (Figure 3.3). This map shows the frequency of severe and extreme drought conditions between 1895 and 1995, and represents the latest available long-term summary of drought conditions across the US.[20] The NDMC map shows that severe drought conditions in Alabama are relatively uncommon. While severe or extreme drought conditions occurred between 10 and 15 percent of the time in much of the Midwest, West, and Southwest; severe or extreme drought conditions occurred less than 10 percent of the time in Alabama. The NDMC map does not, however, show any geographic variability within the state. This lack of spatial variability shows the limitations of drought indices (such as the Palmer Drought Severity Index) that are based only on physical parameters.

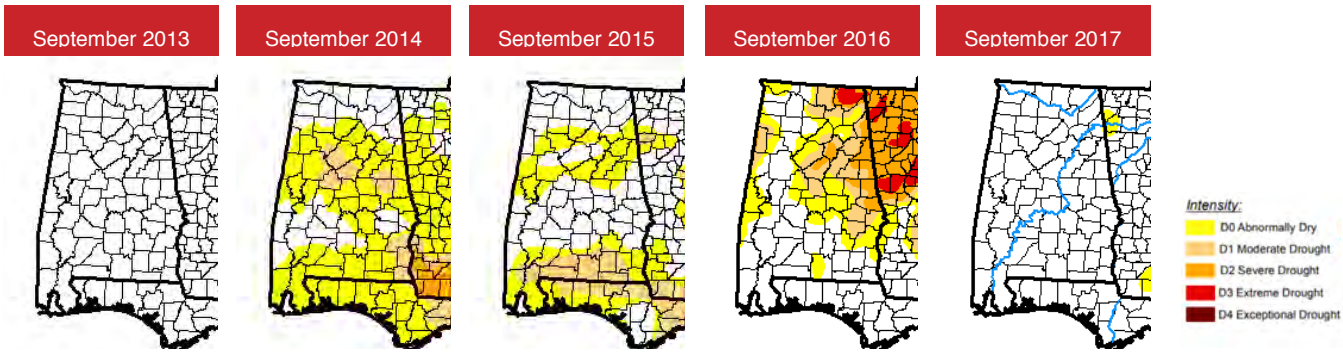
[20] http://drought.unl.edu/Planning/Monitoring/HistoricalPDSIMaps.aspx

Figure 3.3 Percent of Time in Severe and Extreme Drought, 1895-1995 (NDMC, 2018)



Drought indices that integrate physical and socioeconomic parameters tend to show more local variability and provide more meaningful information for decision makers. These indices often show rapidly evolving conditions as both user demands and available supplies shift over time. The US Drought Monitor is an example of a drought index that reflects both physical parameters and socioeconomic impacts. Every week, the US Drought Monitor consults with a network of more than 350 observers across the country to integrate observed local impacts into a map of drought conditions. Figure 3.4 shows the US Drought Monitor map for the five most recent Septembers in Alabama. The rapidly shifting patterns in drought classifications hint at the complex interactions between human and natural systems that produce drought conditions.

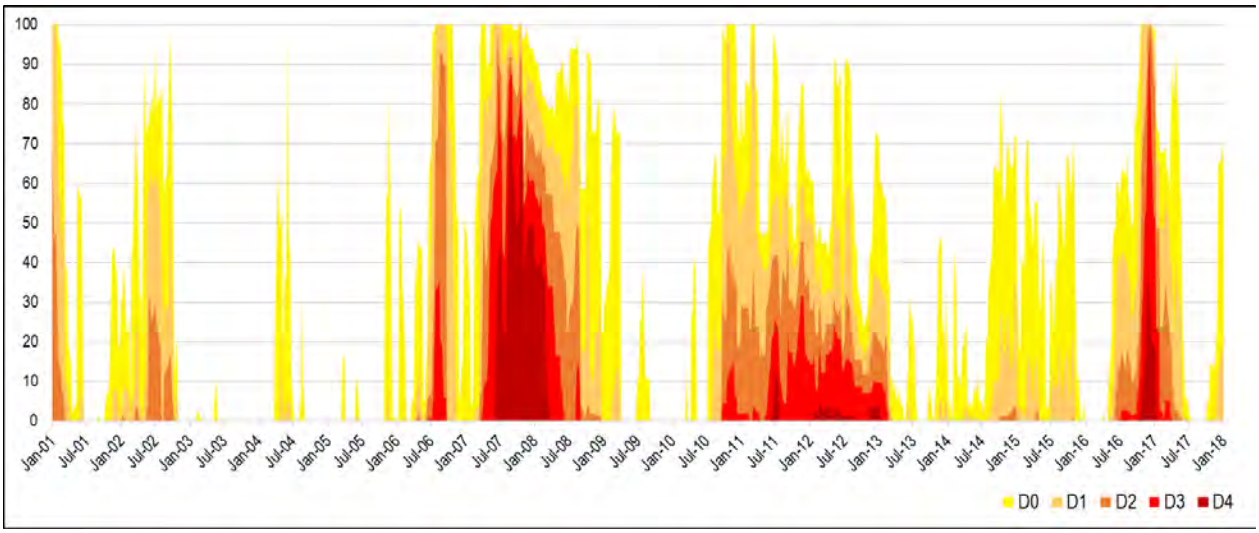
Figure 3.4 Drought Classifications for Five Successive Septembers (US Drought Monitor, 2018)



While widespread, persistent drought conditions are relatively uncommon in Alabama, abnormally dry conditions do affect some part of the state nearly every year. Figure 3.5 illustrates the frequency and severity of droughts recorded in the state since 2001. Specifically, the figure shows

the percentage of land area in Alabama experiencing drought conditions as categorized by the US Drought Monitor. As shown in the figure, abnormally dry events are more frequent than severe to exceptional droughts, but severe droughts have a longer duration. Additionally, severe droughts tend to impact a larger percent of state. A more detailed account of drought history in Alabama is provided below.

Figure 3.5 Percent of Land Area in Alabama Experiencing Drought (US Drought Monitor, 2018)



When a drought does occur in Alabama, the social, economic, and environmental impacts have the potential to be severe and widespread. Examples of the potential effects of drought in the state of Alabama, including effects the state has experienced in past drought events, are as follows:

- Damage to livestock and crops;
- Increased local vulnerabilities to sinkholes and wildfire;
- Water usage conflicts;
- Accelerated coastal erosion;
- Damaged fisheries; and
- Inflated energy prices due to loss of hydro-power.

3.2.2.3 Drought History in Alabama

According to FEMA, Alabama has had one drought that resulted in a federal disaster declaration. The drought, which occurred in 1977, was declared an emergency in all 67 counties of the state.

More recently, according to the NWS Storm Events Database, severe drought events have been reported in Alabama almost every year between 2006 and 2017. The majority of these events

impacted multiple counties and lasted several months to several years. Additionally, the severity of droughts reported as determined by the US Drought Monitor has varied from moderate to exceptional (D1 to D4). Although drought events have occurred frequently, and the severity of several droughts has been exceptional, NOAA's Storm Events Database indicates that no deaths or injuries occurred as a result. However, the most severe drought events in terms of duration, intensity, and extent resulted in widespread agricultural, hydrologic, and sociological impacts.

As shown in Figure 3.5 above, between 2000 and 2017, there were two significant droughts during which D4 drought conditions impacted a substantial portion of the state. These drought events occurred from 2007 to 2008 and from 2016 to 2017. The following provides a more detailed description of these events and a brief summary of their impacts based on information obtained from the Storm Events Database:

- From the March 2007 through December 2008, most of central and northern Alabama experienced moderate and exceptional drought conditions. March, traditionally the wettest month of the year, was instead one of the driest on record in 2007. May 2007 became the month that plunged much of the northern area of the state into a historic drought situation. The D3 status (extreme drought) was retained for the entire month. Area rivers remained at low flow levels, and some reached historically low levels, the lowest recorded for this time of year in more than 50 years. Soil moisture was also at historic lows, at the first percentile or below. Hay cutting ran behind and at a lower production rate. Non-irrigated corn in some areas was believed to be a complete loss. Overall yields were reduced, and the dry conditions caused even further reductions in the expected yields. Local extension agents rated the corn and wheat crops as poor to very poor. Extension agents also reported that cotton and soybeans were stressed due to lack of soil moisture. Pasturelands produced very low yields of hay due to lack of growth, thus farmers were forced to reduce cattle herds. Drought emergencies were issued by the Alabama Forestry Commission, meaning that prolonged drought conditions were creating a situation where the probability of catastrophic fire activity was high.

  By June 2007, drought conditions spread south through central Alabama and central counites reached D4 (exceptional drought) status. Crops continued to be highly stressed due to the lack of rainfall, with losses ranging from 50 to nearly 100 percent. The number of mandatory water restrictions continued to increase, with fines and surcharges being enforced for excessive water usage. Many residential lawns, shrubbery, and gardens became severely stressed by the very dry conditions. Through August 2007, major rivers and reservoirs continued to run much below normal. Navigation on major rivers became significantly impacted, and many boat landings on major lakes became unusable due to extremely low lake levels.

  Drought conditions continued into January 2008 across most of central and northern Alabama, the threat of water shortages for municipal water systems persisted, and most water restriction plans already in place continued. By January, agricultural impacts were

minimized since it was between growing seasons. By March 2008, several storm systems across central Alabama brought limited improvement; the last remaining area of D4 drought was eliminated and the D3 area was reduced as well.

Drought conditions continued to improve through June 2008. August 2008 marked the first substantial rainfall for the Central Tennessee Valley since the beginning of the drought. In October 2008, a storm system brought some rainfall to the east central part of the state, which helped ease D2 drought conditions. Finally, by December 2008, very heavy rainfall put an end to drought conditions in the remaining affected counties. The Drought Monitor issued on December 16, 2008 reported an end to the drought conditions.

- In May 2016, D2 drought conditions were introduced into the northeastern portion of Alabama, and subsequently spread to encompass much of north central Alabama. By the end of July 2016, drought conditions deteriorated in the far western edges of northwest Alabama along the Mississippi state line. Conditions in the area were classified as D2 to D3; D3 conditions also expanded through north central Alabama. Below normal rainfall and above average temperatures continued across central Alabama through September 2016, with drought conditions continuing to worsen.

  By October 2016, the Governor of Alabama issued a Drought Emergency Declaration for all of central Alabama; which prohibited all outdoor burning. No measurable rain was recorded that month in the southwest of the state, leading to D2 drought conditions. Many locations across central Alabama received little or no rainfall during the month of October. Drought conditions continued to worsen with D3 conditions expanding to cover a large portion of central Alabama and with D4 conditions occurring across east central Alabama. This prolonged period of dry weather resulted in worsening drought conditions across central Alabama. By the end of November, 39 counties in central Alabama were experiencing D3 to D4 drought conditions. However, several rounds of beneficial rainfall at the end of November helped alleviate these conditions.

  Below normal rainfall continued for the majority of central Alabama during the month of December. There were a few areas that received near or just above normal monthly rainfall amounts, including the northwest counties and those counties along and south of the I-85 corridor. Drought conditions did not worsen in any county across central Alabama, while six counties were downgraded one drought level category.

  Rainfall continued in January and February 2017, improving drought conditions across central Alabama and lowering the drought intensity to D2 and D1 conditions. Through May 2017, significant rainfall over portions of central Alabama eased the drought conditions. By August 2017, there were no drought conditions present in the state.

As shown in Table 3.10, severe drought events in Alabama have significantly affected agriculture. To provide an estimate of the economic loss, Table 3.10 includes indemnity payments for losses

suffered due to drought in Alabama.[21] The data is from the US Department of Agriculture's Risk Management Agency. On average, a total of $21,239,838 has been paid in the state annually for agricultural loss resulting from drought. The greatest amount of indemnity payments occurred in 2000. Recently, since 2006, indemnity payments are highest in years during which severe drought conditions have been reported. For example, between 2006 and 2008, indemnity payments totaled $107,484,469.

Table 3.10 Indemnity Payments for Losses Suffered from Drought in Alabama

Year	Indemnity Payment
1989	$4,650,131
1990	$61,162,359
1991	$6,467,996
1992	$1,252,901
1993	$24,302,234
1994	$355,637
1995	$21,380,107
1996	$11,011,138
1997	$20,011,224
1998	$25,405,242
1999	$25,907,889
2000	$72,835,802
2001	$13,991,483
2002	$15,242,492
2003	$262,027
2004	$3,191,851
2005	$2,576,453
2006	$41,545,014
2007	$47,119,706
2008	$18,819,749
2009	$4,060,393
2010	$40,012,370

[21] University of Nebraska, National Drought Mitigation Center. Drought Indemnity Payment Data. Retrieved at http://drought.unl.edu/Planning/Impacts/DroughtIndemnityData.aspx

Year	Indemnity Payment
2011	$46,804,629
2012	$19,350,399
2013	$523,961
2014	$23,992,596

In recognition of the potential widespread impacts of drought and to ensure consistent communication of drought conditions and impacts, the ADECA – Office of Water Resources (ADECA-OWR) prepared the Alabama Drought Management Plan (DMP) in May 2013. The DMP establishes state-level operating procedures and a framework for the assessment of drought conditions, assists stakeholders and water managers in mitigating drought conditions and encourages water conservation practices.[22] Shortly thereafter, in April 2014, the state passed the Alabama Drought Planning and Response Act which formally established the state government's role in planning, monitoring, and responding to drought conditions. The law also established the Alabama Drought Assessment and Planning Team (ADAPT), a subcommittee of which is responsible for monitoring all available climate and hydrological data and forecasts to assess current drought conditions and potential impacts. The ADECA-OWR coordinates the monitoring of drought conditions in Alabama.[23]

3.2.2.4 Probability of Drought in Alabama

As discussed above, the state of Alabama has experienced severe drought conditions as defined by the Palmer Drought Severity Index approximately five to ten percent of the time. At the same time, abnormally dry conditions as defined by the US Drought Monitor are observed to affect some part of the state nearly every year. Because the impacts of a drought event are typically widespread, it is likely that when drought conditions occur, a large percent of the state will be affected. Therefore, drought conditions are highly likely events that can be expected throughout the state. However, because the severity and frequency of a drought event is difficult to forecast given the complexity of conditions that determine its extent and impacts, it is difficult to quantify the relative probability of drought hazards across the state.

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[22] Alabama Department of Economic and Community Affairs, Office of Water Resources. Drought Planning and Management in Alabama. Retrieved at http://adeca.alabama.gov/Divisions/owr/Pages/Drought.aspx

[23] Alabama Department of Economic and Community Affairs, Office of Water Resources. Drought Planning and Management in Alabama. Retrieved at http://adeca.alabama.gov/Divisions/owr/Pages/Drought.aspx

3.2.2.4.1 Future Probability

As discussed above, it is difficult to forecast drought events. Although several agencies at the federal, regional, and state levels monitor indicators of drought conditions including precipitation, streamflow, and temperature, these resources only provide information on current conditions or short-term forecasts. However, according to the National Climate Assessment report, "hydrological droughts are expected to increase in frequency and intensity across most of the country through the end of the 21st century."[24] With respect to the Southeast, although some forecast models predict drought to increase specifically across the Gulf Coast, these models are uncertain due to variations in future precipitation projections. However, the National Climate Assessment report does predict that future climate-related issues and increasing development patterns in the Southeast will likely threaten water supplies in the Southeast, which may also increase the risk of drought.

3.2.2.4.2 Risk and Vulnerability

A community's vulnerability to loss from drought is a function of the probability of drought, the exposure of water supplies and economic activities to the hazard, and the susceptibility of water supplies and economic activities to the hazard. As discussed, and as demonstrated in the large percentage of plans that recognize drought as a significant hazard, the risk of drought is prevalent throughout the state and the impacts are potentially widespread.

Agriculture is an important economic activity in Alabama that is highly vulnerable to drought. This vulnerability is amplified by the prevalence of rain-fed agriculture in the state. In Alabama, only 15 percent of the land currently available for farming is irrigated, compared to 61 percent of cropland in Mississippi and 40 percent in Georgia.[25] Figure 3.6 shows the distribution of harvested cropland in Alabama, and Figure 3.7 shows the percent of cropland that was irrigated at the time of the 2012 Census of Agriculture. Across much of the state, less than eight percent of cropland is irrigated. Many farmers are therefore at risk of lower yields and reduced revenues when droughts occur. To incentivize investments in irrigation infrastructure, the Alabama Legislature introduced an income tax credit for agricultural irrigation systems in 2012. Legislation enacted in 2017 has increased this tax credit for the tax years beginning after December 31, 2017 through December 31, 2022

Additionally, as drought can be exacerbated by extreme heat, areas of the state that experience high temperatures may also be more vulnerable to the adverse impacts of drought conditions. See Section 3.2.4 for a more detailed discussion of extreme temperatures in the state. Severe drought can also increase the potential for wildfires, and as such, areas that are more susceptible

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[24] Ingram, K., K. Dow, L. Carter, J. Anderson, eds. 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

[25] Alabama Agricultural Experiment Station, 2017. NRCS funds to demonstrate and promote best irrigation practices in Alabama. Retrieved at: http://aaes.auburn.edu/news/nrcs-funds-to-demonstrate-and-promote-best-irrigation-practices-in-alabama/

to wildfires may be more vulnerable to drought. See Section 3.2.13 for a more detailed discussion of the risk wildfires pose in the state.

Figure 3.6 Harvested Cropland in Alabama (USDA, 2012)

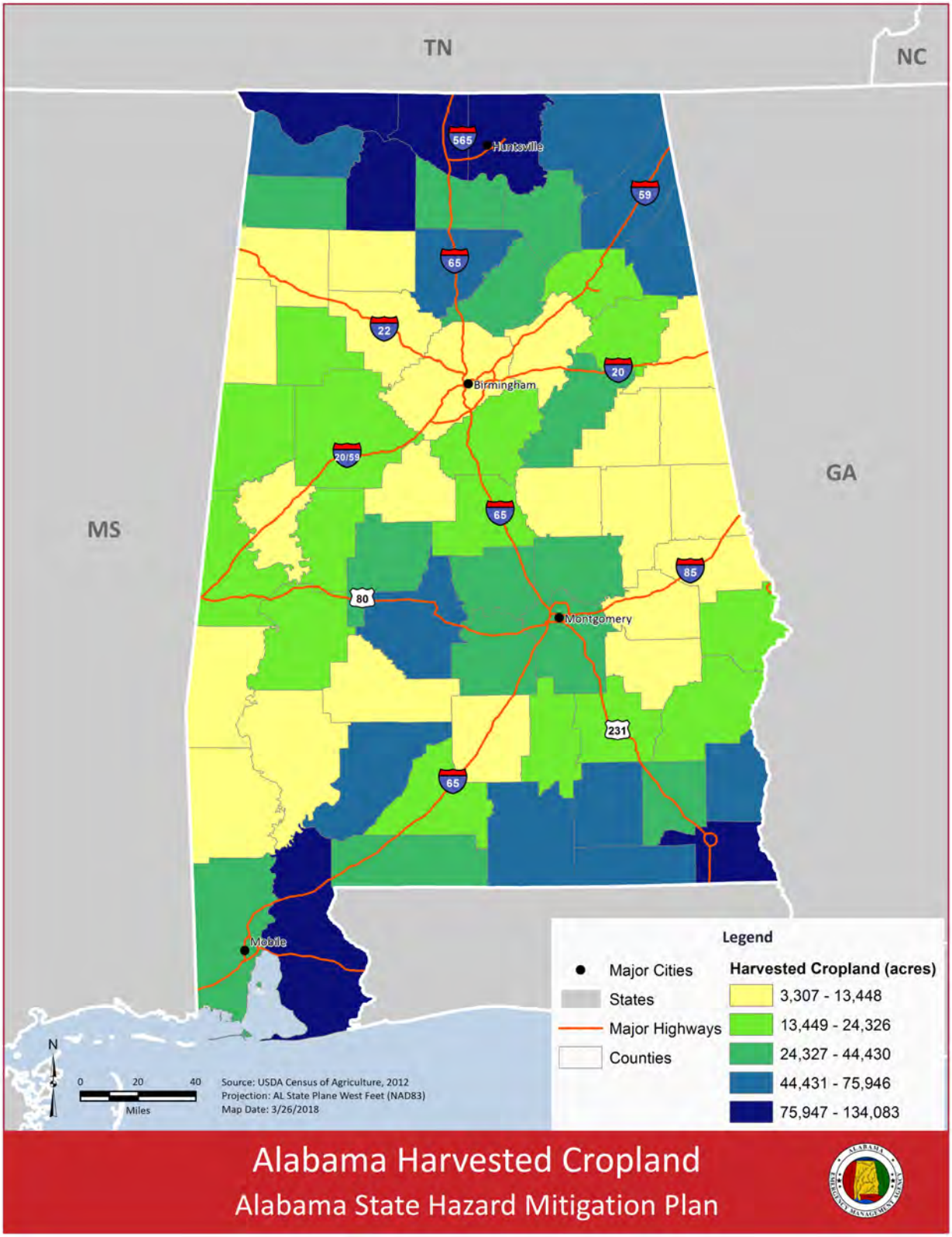
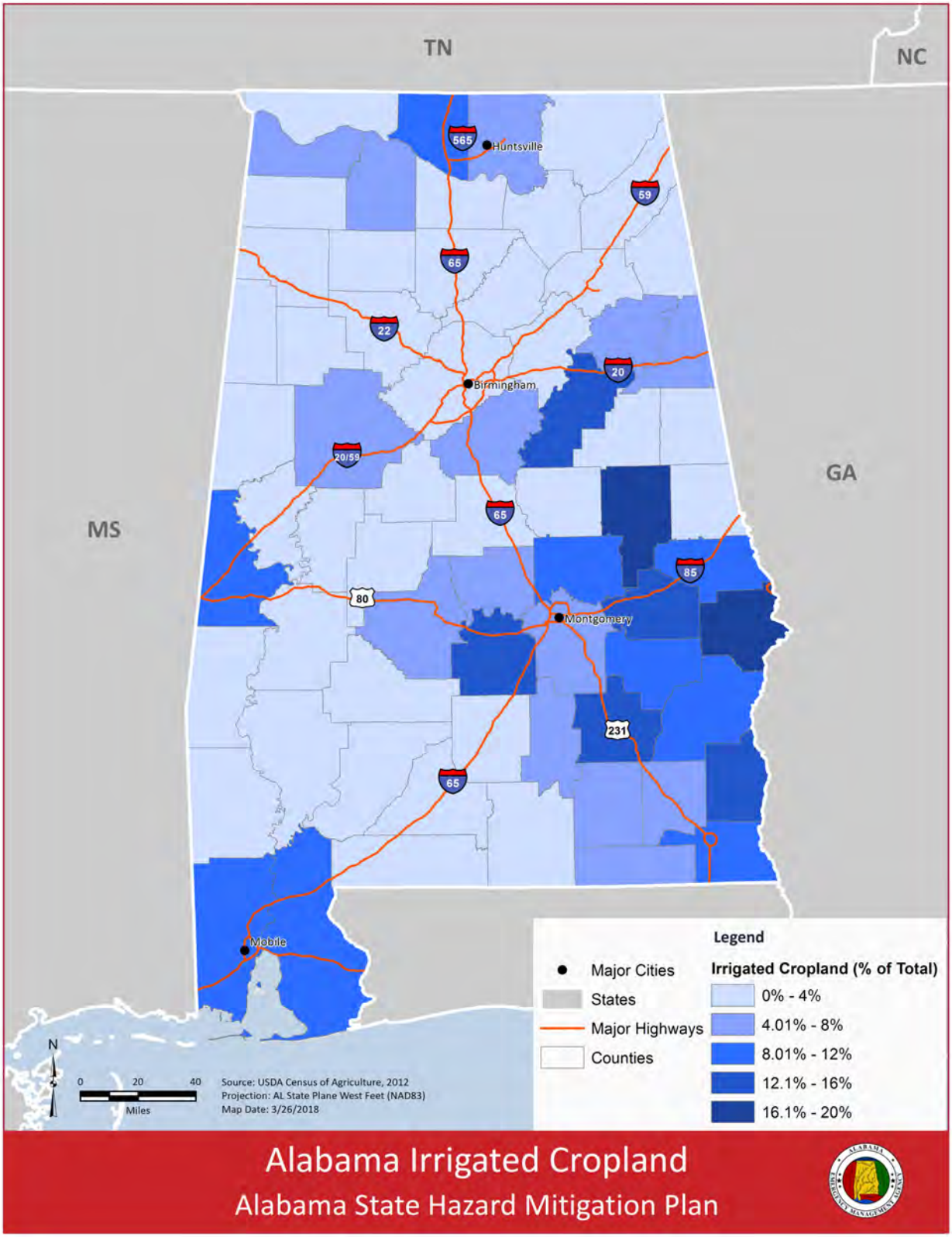


Figure 3.7 Irrigated Cropland in Alabama (USDA, 2012)



3.2.3 Earthquakes

3.2.3.1 Description

An earthquake is "a sudden motion or trembling caused by an abrupt release of accumulated strain on the tectonic plates that comprise the Earth's crust."[26] Most earthquakes originate along faults close to or at plate boundaries. Because the rocks on either side of these faults are locked together by the weight of the overlying rock, the movement of adjacent plates relative to one another causes stress to accumulate at the faults. When the stress exceeds the frictional bond locking the rocks together, the elastic strain energy that was stored over tens or hundreds of years is suddenly released. A small percentage of earthquakes originates within plates. The powerful forces that build mountains along continental margins can buckle the Earth's crust or create faults within a plate's interior. The movement of the continental crust over the Earth's interior can also create small amounts of compression or extension within a plate, causing rock movement along faults that formed long ago.

When rocks suddenly slip along a fault, intense seismic vibrations travel from the site of the rupture (called the focus of the earthquake) and cause the ground to shake. Three types of seismic waves are generated: compressional (P) waves and shear (S) waves that travel through the body of the earth, and surface waves that skirt along the surface. Unreinforced buildings are most vulnerable to S waves, which cause structures to vibrate from side to side. The strength of ground shaking generally increases with the amount of energy released and decreases with distance from the epicenter of the earthquake.

Seismic activity is often measured in terms of the magnitude of an earthquake at its epicenter. The Richter scale is a scale commonly referred to by the general public, and geologists use similar magnitude scales today. This scale is based on the amplitude of seismic waves recorded by seismographs and uses a logarithmic scale. An increase in magnitude of one unit therefore represents a tenfold increase in the amplitude of the earthquake. Near the epicenter, an earthquake with a magnitude of 3 will be felt indoors by some people but will do no damage to buildings; one that reaches 6 will topple chimneys and weak walls; and one that measures 8 will cause nearly total damage to human structures.

Two ways of measuring the intensity of ground shaking at a particular place are the Modified Mercalli Intensity (MMI), and the peak ground acceleration (PGA). The MMI is expressed as Roman numerals between I and XII and is based on observations of earthquake damage and effects. An earthquake with an MMI of III will be felt noticeably indoors; one with an MMI of VII will cause light damage in buildings of poor construction; and one with an MMI of XII can cause

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[26] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

complete structural damage. A more objective measure of the degree of shaking is given by the PGA. Ground motion acceleration is measured using accelerographs and is expressed as a percentage of the force of gravity. The PGA is the maximum value of acceleration for a particular strong motion record and is widely used by engineers to describe the intensity of ground shaking a building must be designed to withstand without collapse.

It is possible to relate measurements of magnitude to measurements of felt intensity using the MMI or instrumental intensity using the PGA (Table 3.11).[27,28] The relationships are approximate, however, and assume that the location of interest is near the earthquake's epicenter, and that the focus of the earthquake is relatively shallow. Ground shaking generally begins to be felt at a magnitude of 3.0, MMI of II, and PGA of 0.17% g. Damage to buildings of poor construction generally begins at a magnitude of 5.0, MMI of VII, and PGA of 10% g. Finally, damage to ordinary buildings generally begins at a magnitude of 5.5, MMI of VIII, and PGA of 34% g.

Table 3.11 Relationship Between Measures of Magnitude, Felt Intensity, and Instrumental Intensity

Magnitude	MMI	PGA (%g)	Perceived Shaking	Potential Damage
Less than 5	I	<0.17	Not felt.	None
Less than 5	II-III	0.17 - 1.4	Felt by some indoors.	None
Less than 5	IV-V	1.4-9.2	Felt by nearly everyone.	None
5	VI-VII	9.2 - 34	Most people are alarmed and run outside.	Damage is negligible in buildings of good construction, considerable in buildings of poor construction.

[27] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

[28] Virginia Department of Emergency Management, 2013. Commonwealth of Virginia Hazard Mitigation Plan. Retrieved at: http://www.vaemergency.gov/emergency-management-community/recovery-and-resilience/commonwealth-of-virginia-hazard-mitigation-plan/

Magnitude	MMI	PGA (%g)	Perceived Shaking	Potential Damage
5.5	VIII	34 – 65	Most people are alarmed and run outside.	Damage is slight in specially designed structures, considerable in ordinary buildings, great in poorly built structures.
~6	IX	65 – 124	Most people are alarmed and run outside.	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse.
Greater than 6.5	X - XII	> 124	Most people are alarmed and run outside.	Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.

Although earthquakes have caused much less economic loss annually in the US than other hazards such as floods, they have the potential to cause sudden and devastating loss.[29] Within 1 to 2 minutes, earthquakes can cause the collapse of buildings and bridges, the destruction of critical infrastructure, injuries, and death. Impacts can result directly from ground-shaking, or from secondary hazards such as surface faulting, ground failure, fire, hazardous material release, flash flooding, avalanches, and dam failure. Surface faulting and ground failure pose a particularly great threat to the integrity of structures. Surface faulting occurs when differential movement on either side of a fault splits the ground at the surface. Ground failure can occur through sinkholes, landslides, or liquefaction (a process in which water-saturated sediment temporarily loses strength and acts as a fluid).

The factors determining the impact of an earthquake include the intensity of ground shaking, the occurrence of secondary hazards, and the design of the structures subject to these hazards. Communities that adopt and enforce up-to-date seismic codes can reduce the loss of life and property when earthquakes occur.

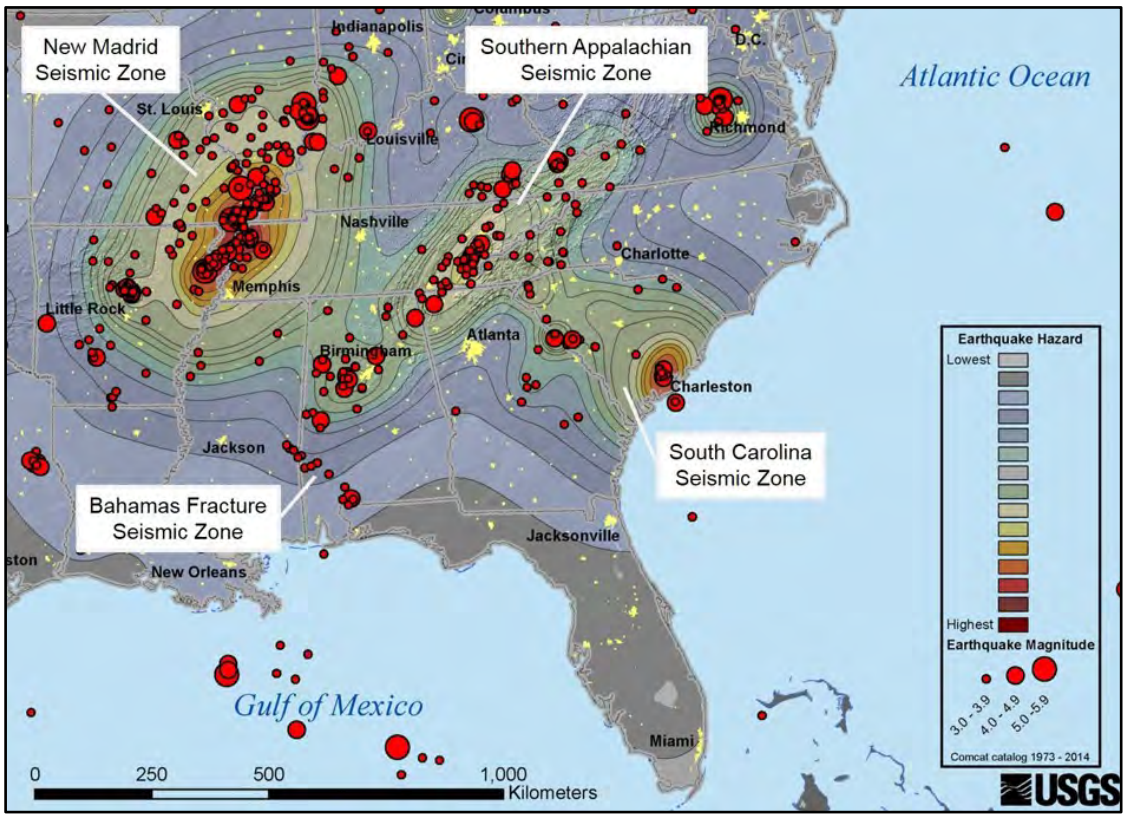
3.2.3.2 Nature of the Hazard in Alabama

In the US, the zone of greatest seismic activity is along the Pacific coast in Alaska and California. The eastern and central US, however, have experienced significant earthquakes. Earthquakes felt in Alabama are associated with four seismic zones: the Southern Appalachian Seismic Zone,

[29] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

the Bahamas Fracture Seismic Zone, the South Carolina Seismic Zone, and the New Madrid Seismic Zone (Figure 3.8).

Figure 3.8 Seismic Zones of the Southeastern US (USGS, 2017)



As discussed above, secondary seismic hazards can significantly increase the impact of an earthquake. One secondary hazard of particular concern in Alabama is ground failure through landslides, sinkholes, or liquefaction. To help the AEMA understand the distribution of areas susceptible to liquefaction, the GSA conducted a modeling study and produced a set of susceptibility maps (Figure 3.9). The coastal plains and major floodplains of Alabama were determined to be highly susceptible to liquefaction and subsequent ground failure. The GSA has recommended additional studies to better understand the distribution of areas susceptible to landslides and sinkholes. Given that these phenomena were triggered during the magnitude 4.9 Fort Payne earthquake in 2003, the GSA finds that it is highly likely that landslides and sinkholes will be triggered by future events, especially in the central and northeastern portions of the state.[30] The small proportion of structures across the state built to withstand intense earthquakes also increases the potential impact of earthquakes in Alabama.

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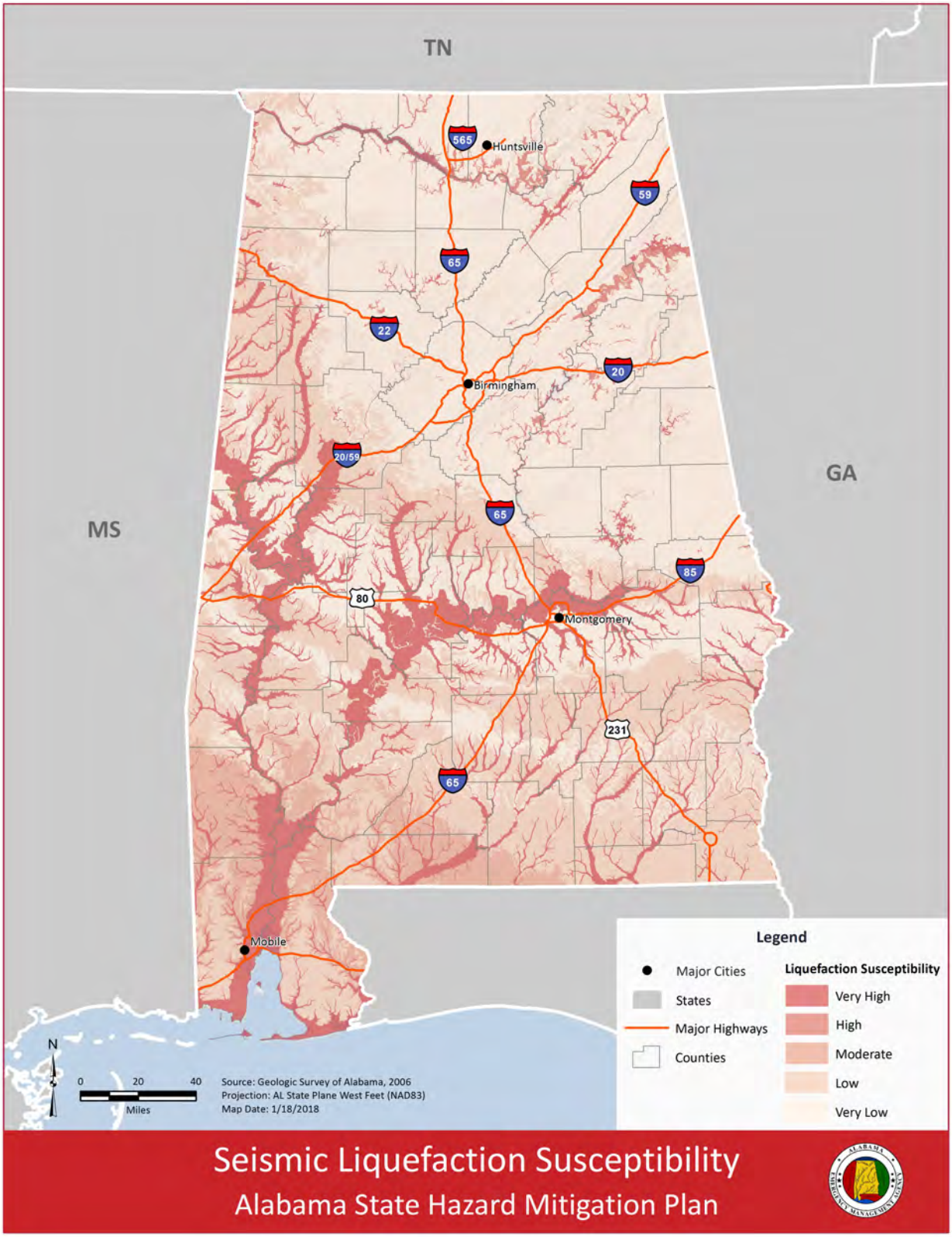
[30] Ebersole, S. M. and Perry, S. L., 2008. Seismic Amplification and Liquefaction Susceptibility Mapping in Alabama. Geologic Investigations Program, Open File Report 0807.

Figure 3.9 Seismic Liquefaction Susceptibility (GSA, 2008)



3.2.3.3 Earthquake History in Alabama

The GSA maintains a catalog of earthquakes centered in Alabama with records dating to 1886. According to this catalog, 83% of seismic activity centered in the state consists of minor earthquakes with magnitudes below 3.0 (Figure 3.10 and Figure 3.11). These earthquakes are not felt by most people, and generally do not cause damage to buildings. Only 57 earthquakes in the GSA catalog (16% of the total) exceeded 3.0, and only one earthquake (0.3% of the total) exceeded a magnitude of 5.0. Damage to poorly constructed buildings generally begins at a magnitude of 5.0. Figure 3.11 shows the epicenters and magnitudes of historical earthquakes in Alabama. Comparing the location of these epicenters to the location of seismic zones in the Southeastern US (Figure 3.8) shows that most of the earthquakes centered in Alabama are associated with the Southern Appalachian Seismic Zone or the Bahamas Fracture Seismic Zone.

Figure 3.10 Alabama Earthquake Magnitude (GSA, 2017)

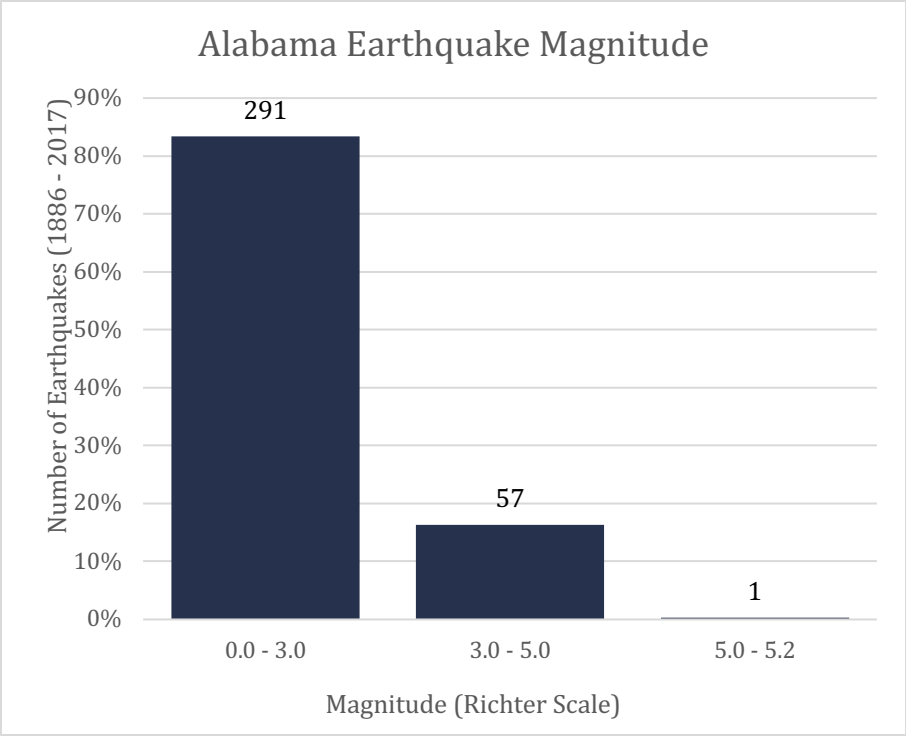
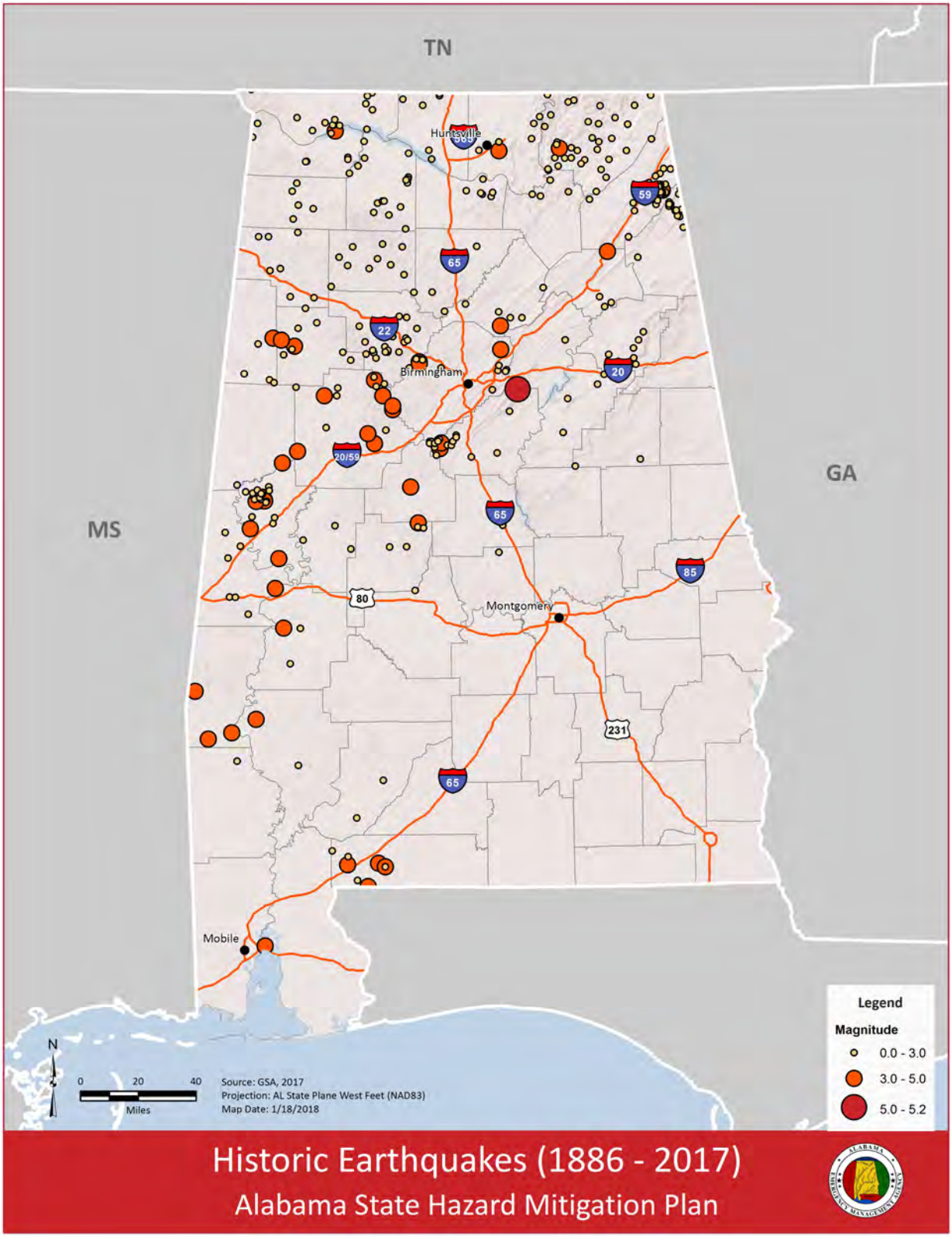


Figure 3.11 Alabama Earthquake History (GSA, 2017)



Earthquakes centered in Alabama are not the only earthquakes with the potential to impact the state. Intraplate earthquakes associated with the New Madrid Seismic Zone to the northwest and the South Carolina Seismic Zone to the east (Figure 3.8) are often felt in Alabama and have the potential to cause considerable damage. In 1811 and 1812, a series of earthquakes estimated to be approximately 7.7 in magnitude occurred in the area of northeast Arkansas and southeast Missouri. Because the earthquakes shook the rigid craton (a large, stable block of the earth's crust forming the nucleus of the continental plate), their shocks waves traveled great distances, cracking pavement and ringing church bells as far away as Washington D.C. According to the GSA, the intensity of ground shaking in Alabama ranged from an MMI of IV in the southeast to an MMI of VII in the northwest. An MMI of VII is high enough to cause considerable damage in buildings of poor construction. In 1886, a magnitude 7.3 earthquake occurred in Charleston, South Carolina, about 400 miles east of Alabama's border. According to the GSA, the earthquake "caused minor damage in the northeastern part of the state." For example, a 1933 photo of the Alexander-Hurt-Whatley house in Tuskegee shows a large crack in one wall reported to have been caused by the Charleston quake. While these earthquakes were centered in other states, they demonstrate how earthquakes in the New Madrid Seismic Zone and South Carolina Seismic Zone have the potential to cause considerable damage in Alabama.

Table 3.12 summarizes the impacts of the seven earthquakes centered in the state that caused structural damage. The information in the table was compiled from the GSA and the USGS.[31,32] For each earthquake, the table lists the approximate location of the epicenter, the magnitude, the maximum felt intensity, and the reported impacts. The GSA has also developed MMI maps of the felt shaking intensity for the three largest earthquakes centered in Alabama. These are reproduced below the table (Figure 3.12). It is important to note the range of magnitudes and the difference between the location of the epicenter and the location of reported impacts. These features show how the impact of an earthquake depends not only of the level of ground shaking, but on the amount and quality of nearby development as well. Note that since the 2013 plan update, no earthquakes have caused structural damage in Alabama.

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[31] Geological Survey of Alabama, 2018. Historical Earthquakes in Alabama. Website accessed at: https://gsa.state.al.us/gsa/geologic/hazards/earthquakes/alquakes

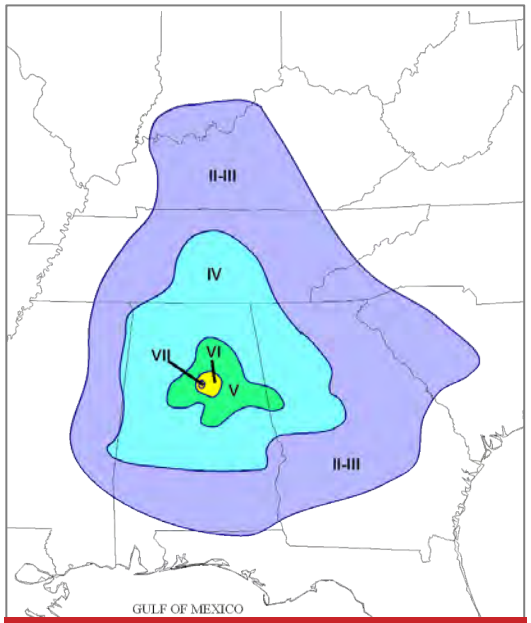
[32] US Geological Survey, 1987. Historical Seismicity in the Southern Appalachian Seismic Zone. Open-File Report 87-433. Retrieved at: https://pubs.usgs.gov/of/1987/0433/report.pdf

Table 3.12 Historical Earthquakes in Alabama that Produced Structural Damage (1916 – 2017)

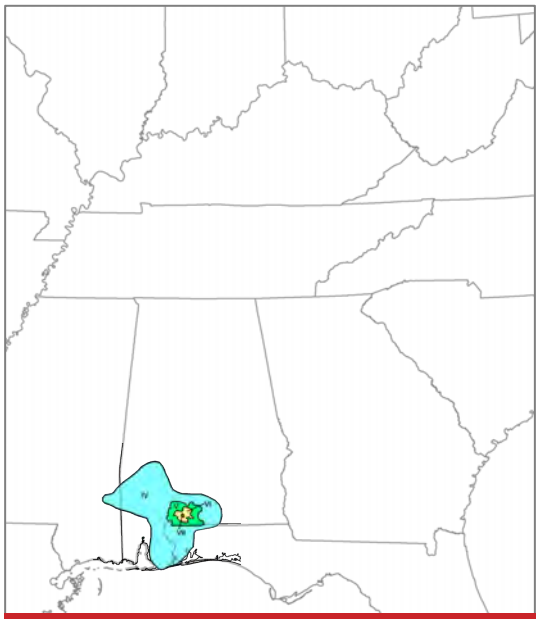
Year	Epicenter	Magnitude	Maximum Intensity (MMI)	Reported Impacts
1916	Town of Irondale, Northern Shelby County	5.2	VII	This is the largest recorded earthquake to originate in Alabama. Near the epicenter, chimneys were knocked down, windows broken, and frame buildings badly shaken. While Irondale was a sparsely populated rural area in 1916, it is now a suburb of the state's most populous city, Birmingham. A similar earthquake today would have a much greater impact.
1957	Town of Guntersville, Marshall County	4.3	VI	This earthquake shook residents in most of northern and central Alabama, southern Tennessee, and western Georgia. The earthquake was felt by, awakened, and alarmed many. Minor damage was reported to several chimneys, walls, and cement steps.
1959	City of Huntsville, Madison County	3.9	VI	This earthquake damaged chimneys in Hazel Green and Meridianville and cracked plaster in Huntsville. According to accounts collected by the USGS, the earthquake also "shook violently the buildings at New Sharon, knocking canned goods from shelves and sending frightened residents fleeing from their homes."
1975	Community of Palmerdale, Jefferson County	4.4	VI	This earthquake cracked a sheetrock ceiling and shifted lamps on tables at Palmerdale, north of Birmingham. It caused slight damage at Watson, where furniture was displaced slightly. The quake was also felt in southern Tennessee.

Year	Epicenter	Magnitude	Maximum Intensity (MMI)	Reported Impacts
1989	Littleville, Colbert County	3.9	VI	A Colbert County official reported that south of Florence, between Littleville and Russellville, a basement wall collapsed beneath a house. Only slight damage was reported north of the epicenter at Florence, where windows were cracked, and hairline cracks formed in plaster. The earthquake was also felt in Lauderdale, Lawrence, and Morgan counties in northwest Alabama.
1997	City of Brewton, Escambia County	4.9	VII	This is the second-largest recorded earthquake to originate in Alabama. Effects from the shaking were seen as far away as Lawrence County where a berm around a pond failed, spilling water and fish across a road. Shaking from the earthquake was felt into Florida and Mississippi. The impact of this earthquake was limited by the rural character of the area near the epicenter.
2003	City of Fort Payne, DeKalb County	4.9	VI	Building damage caused by this earthquake included broken windows, minor cracks in masonry, and chimneys that collapsed or broke. The earthquake also caused the development of minor landslides and sinkholes and muddied the underground water supply for the town of Valley Head, causing the pumps to shut down. The depth of the earthquake limited significant damage in the nearby city of Fort Payne. The quake was felt in several neighboring states.

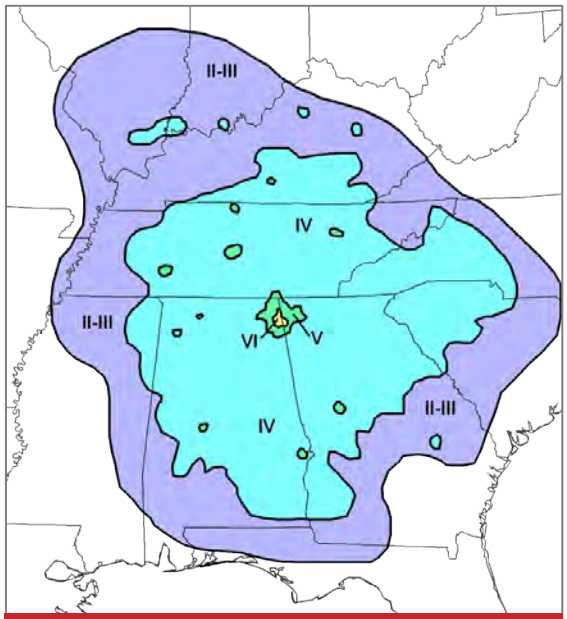
Figure 3.12 Felt Intensity Maps for Three Largest Historical Earthquakes Centered in Alabama (GSA, 2013)



1916 Irondale Earthquake
(5.2)



1997 Escambia County Earthquake
(4.9)



2003 Fort Payne Earthquake
(4.9)

3.2.3.4 Probability of Earthquakes in Alabama

The best available guides to the magnitude and frequency of seismic hazards in Alabama are the probabilistic ground motion maps produced by the USGS. These maps display the intensity of ground motions for various probability levels, and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The latest available maps are the 2014 USGS National Seismic Hazard Maps. These maps include the PGA likely to occur at two probability levels: the 500-year event (10% probability of exceedance in 50 years) and the 2,500-year event (2% probability of exceedance in 50 years). The USGS selected these frequencies to reflect the average design life of a building (50 years) and the different levels of risk tolerance for different applications.

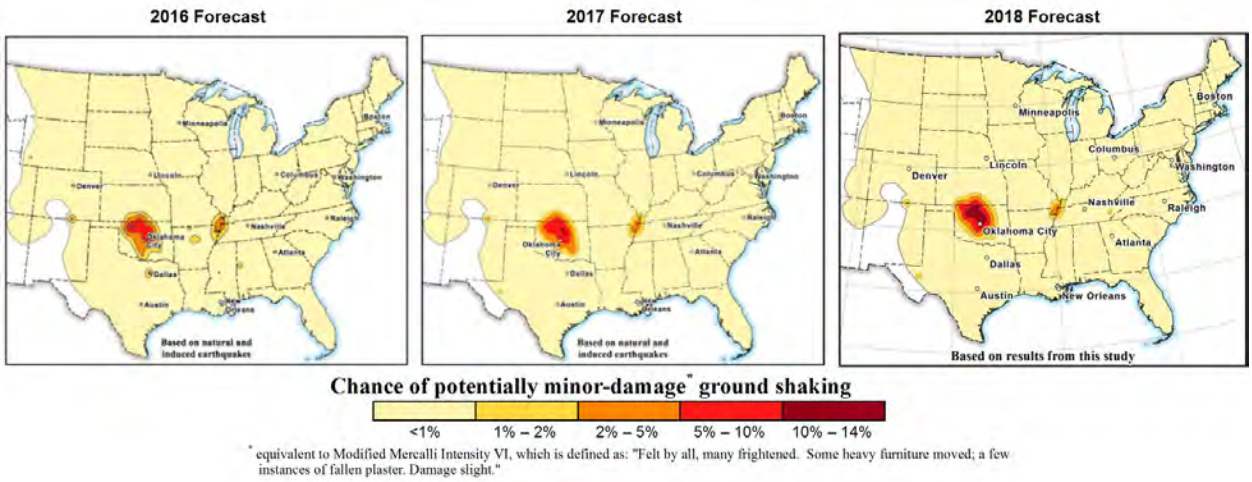
Figure 3.14 shows the PGA in Alabama with a recurrence interval of 2,500 years (2% probability of exceedance in 50 years), as well as the location of historical epicenters (a summary of these historical epicenters by magnitude is provided in Table 3.12). As described above, PGA is expressed as a percentage of the force of gravity, or %g. Damage to buildings of poor construction generally begins at a PGA of 10% g. The areas with the highest probability of significant shaking events include the greater Birmingham region, DeKalb County, and Escambia County.

Alabama could also be impacted by earthquakes in the New Madrid Seismic Zone or South Carolina Seismic Zone. According to a study the USGS and the University of Memphis Center for Earthquake Research and Information (CERI), the probability of a magnitude 6.0 or greater earthquake occurring in the New Madrid region in the next 50 years is 25-40%, and the probability of a magnitude 7.0 or greater earthquake is 7-10%. If a strong New Madrid earthquake with a magnitude equal to the historic 1811-1812 earthquakes (7.0-8.0), were to occur today, the estimated damage to the central US would be in the hundreds of billions of dollars, including more than ten billion dollars in Alabama alone. In Alabama, the shaking would be the most severe in the northwestern part of the state. Non-structural items (such as light fixtures and bookshelves) would be at greatest risk for damage from such an event, but structural damages to weaker buildings and utilities (such as pipelines) could also occur. This damage could be caused by direct ground shaking, or by secondary hazards such as ground failure, fire, hazardous material release, or dam failure.

In recent years, induced earthquakes have emerged as a significant concern in the central and eastern United States. Starting around 2009, the average annual number of earthquakes of magnitude 3 or more began to increase sharply, from 21 per year between 1973 and 2008, to 99 per year between 2009 and 2013. In 2014 alone, the USGS reported 659 earthquakes of magnitude 3 or more in the central and eastern United States. Most induced earthquakes in the central and eastern United States are thought to be caused by deep wastewater disposal related

to industrial activity.[33] As rates of fluid injection rise and fall, earthquake activity rates are observed to rise and fall as well. From 2015 to 2018, for example, fluid injection generally decreased (especially in some areas of Oklahoma and southern Kansas), and rates of earthquakes were observed to steadily decline. To assist with emergency planning and preparedness, the USGS has begun to incorporate the induced earthquake hazard in its one-year seismic hazard forecasts. This is achieved by incorporating an updated earthquake catalog that includes all induced earthquake activity. The 2016, 2017, and 2018 forecasts all show areas of high induced earthquake hazard in Oklahoma-southern Kansas and in the New Madrid Seismic Zone. While the 2016 forecast also showed a small area of high induced earthquake hazard in western Alabama, the 2017 and 2018 forecasts did not (Figure 3.13).

Figure 3.13 One-Year Seismic Hazard Forecasts for 2016 - 2018 (USGS)



It is important to emphasize that earthquakes are low probability, high consequence events. Although a large earthquake exceeding a magnitude of 5.0 may occur only once in the lifetime of a person or asset, the earthquake and its secondary hazards can have devastating impacts.

3.2.3.4.1 Future Probability

The future probability of earthquakes in Alabama is not expected to change with climate change.

3.2.3.4.2 Risk and Vulnerability

A detailed assessment of vulnerability to earthquakes in Alabama is provided in Section 3.3.

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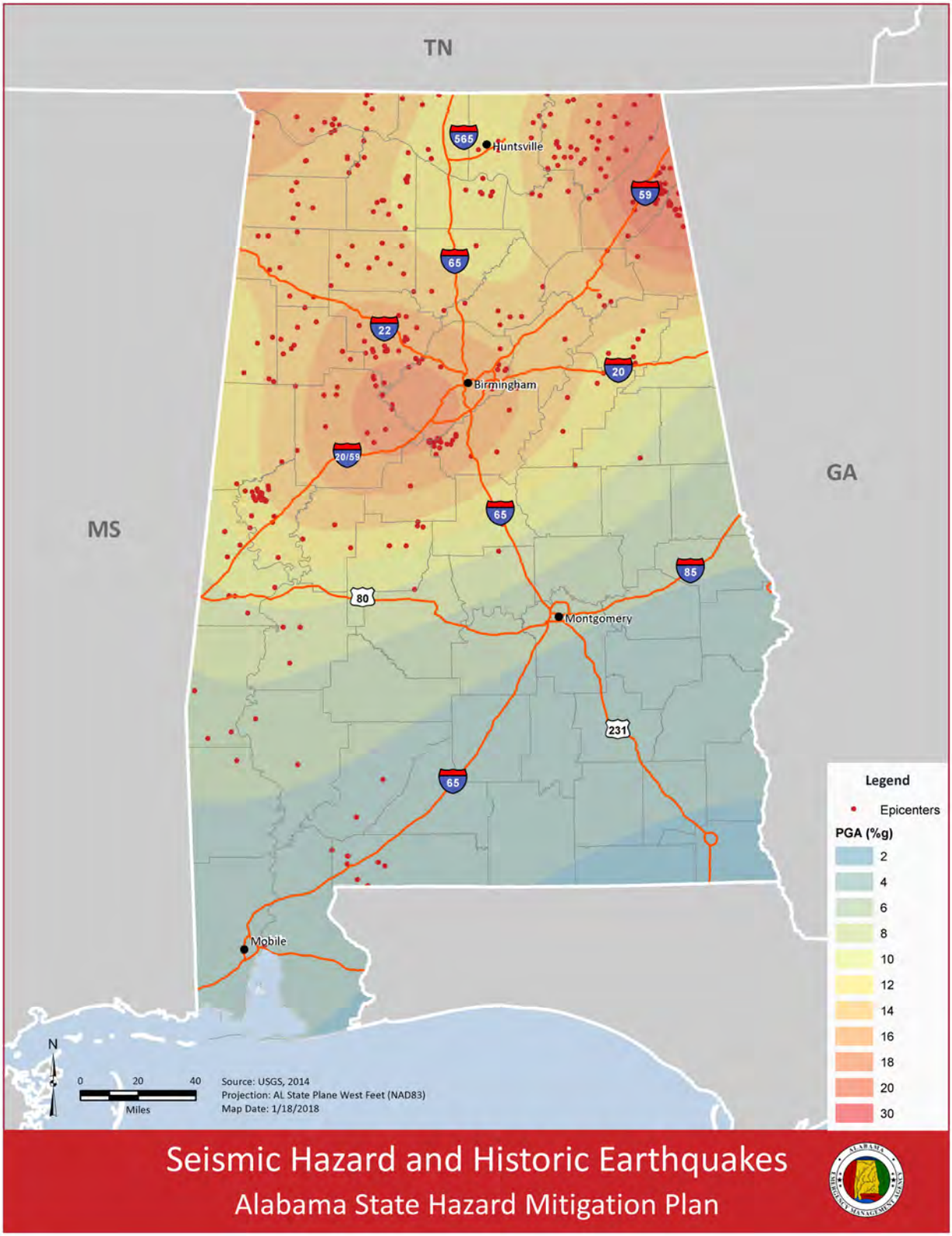
[33] United States Geological Survey, 2018. Induced Earthquakes. Retrieved at: https://earthquake.usgs.gov/research/induced/hazards.php

Figure 3.14 Alabama Hazard and Seismicity Map (USGS, 2014)



3.2.4 Extreme Temperatures

3.2.4.1 Description

The hazard of extreme temperatures encompasses instances of both extreme heat and extreme cold. Both extremes are profiled in this section.

3.2.4.1.1 Extreme Heat

Extreme heat can be defined by a period of excessively hot weather with higher than average temperatures, combined with high humidity. Extreme heat often occurs in the summer months, but can vary regionally.[34] Temperatures above 100°F are generally considered dangerous. Heat stress can be indexed by combining the effects of temperature and humidity, as shown in Table 3.13. The heat index estimates the relationship between dry bulb temperatures (at different humidity) and the skin's resistance to heat and moisture transfer. The higher the temperature or humidity, the higher the apparent temperature. The major human risks associated with extreme heat are:

- Heat/Sun stroke: Considered a medical emergency, heat/sun stroke is often fatal. It occurs when the body's responses to heat stress are insufficient to prevent a substantial rise in the body's core temperature. While no standard diagnosis exists, a medical condition is usually diagnosed when the body's temperature exceeds 105°F due to environmental temperatures. Rapid cooling is necessary to prevent death, with an average fatality rate of 15 percent even with treatment.
- Heat Exhaustion: While much less serious than heatstroke, heat exhaustion can cause victims to complain of dizziness, weakness, or fatigue. Body temperatures may be normal or slightly to moderately elevated. The prognosis is usually good with fluid treatment.
- Heat Syncope: This refers to sudden loss of consciousness and is typically associated with people exercising who are not acclimated to warm temperatures. Causes little or no harm to the individual.
- Heat Cramps: May occur in people unaccustomed to exercising in the heat and generally ceases to be a problem after acclimatization.

[34] FEMA, 2016. Preparing for Extreme Heat. https://www.fema.gov/media-library-data/1463677085878-9910a9fefba8ab4d6fc8e9195b1da115/Preparing_for_Extreme_Heat_EA_JS_edits_final_508.pdf

Table 3.13 Heat Index and Disorders (FEMA, 1997; NWS, 1997)

Danger Category	Heat Disorders	Apparent Temperatures (°F)
I Caution	Fatigue possible with prolonged exposure and physical activity	89-90
II Extreme Caution	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity	90-105
III Danger	Sunstroke, heat cramps, or heat exhaustion likely, heat stroke possible with prolonged exposure and physical activity	105 - 130
IV Extreme Danger	Heatstroke or sunstroke imminent	>130

In addition to affecting people, severe heat places significant stress on plants and livestock. The effects of severe heat on agricultural products may include reduced yields and even loss of crops.[35] Similarly, extreme temperatures can impact livestock. For example, heat stress severely reduces fertility as well as milk production in cows.[36]

3.2.4.1.2 Extreme Cold

Although less likely, extreme cold temperatures can also impact Alabama. Every winter, Arctic air and brisk winds can lead to very cold wind chill values in the US. Prolonged exposure to the cold can cause frostbite or hypothermia and become life threatening. Frostbite occurs when the extremities become excessively cold, and hypothermia is a serious health condition where a person's body temperature falls below 90°F. Both conditions are influenced by wind conditions. Various wind chill indices have been developed to predict cold temperature's effect on humans. For instance, a temperature of 5°F will have a wind chill of -19°F if the wind is blowing 30 mph. Cold weather can also impact crops and livestock. Cold air has the potential to freeze produce, which can damage or kill it.[37]

Older adults are more prone to being impacted by extreme heat and extreme cold events. This is because they do not adjust as well as other demographics to drastic changes in temperature, they are more likely to have a medical condition that changes normal body responses to heat, and cold, and they are more likely to take prescription medications that impact the body's ability to react to changes in temperature. Access to climate control, such as air conditioning and heating

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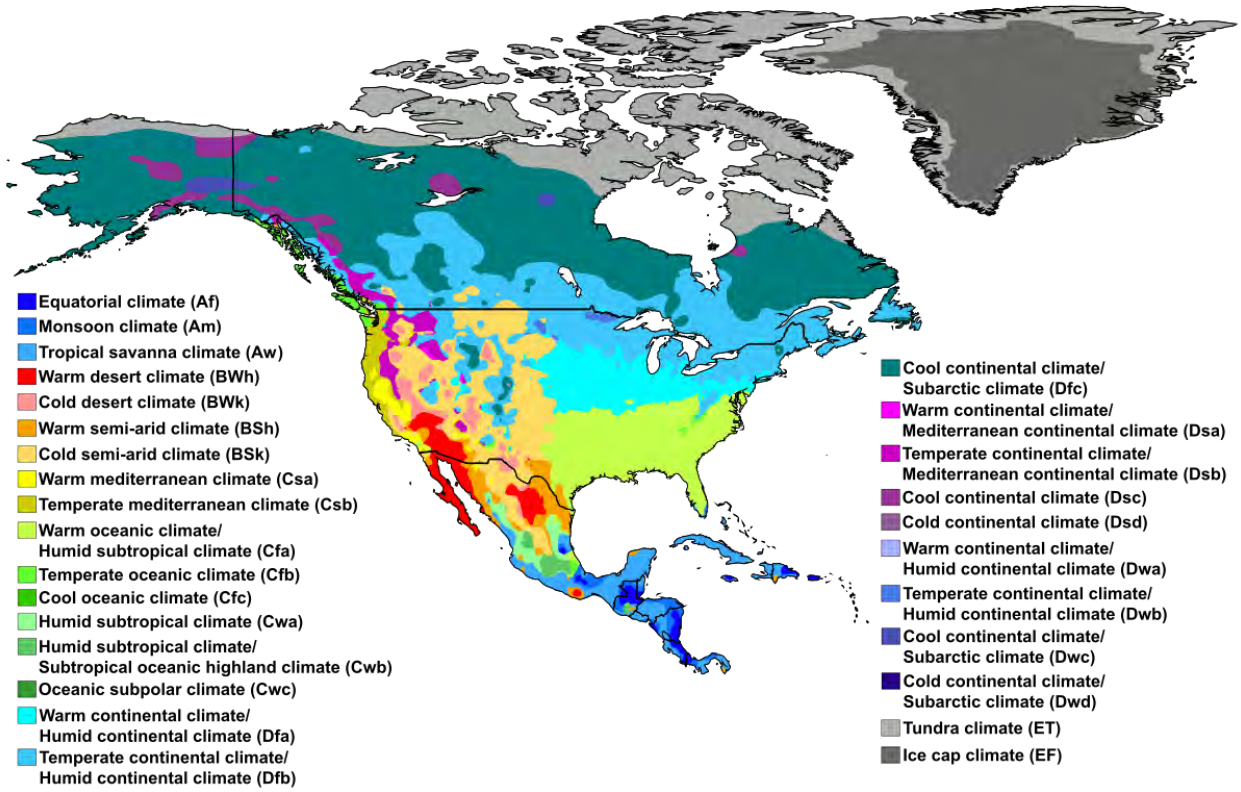
[35] Brown P. W., and C.A. Zeiher, 1997. Cotton heat stress.
[36] Dobson, H et al., 2007. "The High Producing Dairy Cow and Its Reproductive Performance." *Reproduction in domestic animals*. Retrieved at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2748269/
[37] NOAA, 2018. Cold Weather Safety. Retrieved at: http://www.nws.noaa.gov/os/cold/

systems, provides protection from the impacts of extreme heat and cold events and is one way to mitigate against the potential impacts of an extreme temperature event.[38]

3.2.4.2 Nature of the Hazard in Alabama

According to the Köppen-Geiger climate classification system, Alabama has a humid subtropical climate (Figure 3.15).[39] This climate type is characterized by relatively high temperatures and evenly distributed precipitation throughout the year. Summers feature high temperatures with warm, oppressive nights, and are generally wetter than winters. The coldest month is generally mild, with occasional frosts.

Figure 3.15 Köppen-Geiger climate type map for North America (Peel et. al., 2007)



3.2.4.2.1 Extreme Heat

Summers in Alabama are among the hottest in the US, with high temperatures averaging over 90°F throughout the state. Because extreme heat is prevalent across the state, residents are

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[38] Centers for Disease Control and Prevention, 2018. Heat and Older Adults. Retrieved at: https://www.cdc.gov/disasters/extremeheat/older-adults-heat.html

[39] Peel, M.C., Finlayson, B.L., and McMahon, T.A., 2007. Updated world map of the Köppen-Geiger climate classification. Hydrology and Earth System Sciences, 11, 1633-1644.

accustomed to these conditions and are not significantly impacted. However, extreme heat has been known to induce heat stroke among older adults. Some cases have resulted in death. Additionally, some extreme heat events have had significant impacts on crops. Temperature records from Alabama weather stations can help illustrate the nature of the extreme temperature threat in Alabama. Table 3.14 summarizes the number of extreme heat days recorded by weather stations located in Alabama's four largest cities. Extreme heat days were defined as days in which the maximum temperature exceeded 90°F. For each station, the table shows the average annual number of extreme heat days recorded each month as well as across the entire year. The averages were calculated across the period of record for each station, which ranged from 45 years for the Huntsville station to 50 years for the Mobile station. Cities in the south experience more frequent extreme heat days, with Montgomery experiencing an average of 78 extreme heat days per year, and Mobile experiencing an average of 74 extreme heat days per year.

Table 3.14 Average Annual Number of Extreme Heat Days (SERCC, 2018)

Month/Station	Birmingham	Huntsville	Mobile	Montgomery
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	2	1	4	4
June	10	9	16	16
July	18	16	22	22
August	16	15	21	21
September	7	6	11	12
October	7	6	1	1
November	0	0	0	0
December	0	0	0	0
Annual	**53**	**47**	**74**	**78**

3.2.4.2.2 Extreme Cold

Winters are generally mild in Alabama, as they are throughout most of the southeastern US, with an average low temperature of 53°F.[40] The mild winter climate makes extreme cold temperatures fairly uncommon throughout the state. However, because residents are unaccustomed to the severe cold weather, there have been cases where the cold temperatures have caused death. Additionally, most crop species in Alabama do not have a tolerance to cold temperatures, making

[40] US Climate Data, 2018. Climate Alabama. Retrieved at: https://www.usclimatedata.com/climate/alabama/united-states/3170

them more prone to impacts of cold weather. Table 3.15 summarizes the number of extreme cold days recorded by weather stations located in Alabama's four largest cities. Extreme cold days were defined as days in which the minimum temperature was less than 32°F. As in the table for extreme heat days, Table 3.15 shows the average annual number of extreme cold days recorded each month as well as across the entire year. Cities in the north experience more frequent extreme cold days, with Birmingham experiencing an average of 55 extreme cold days per year, and Huntsville experiencing an average of 62 extreme cold days per year.

Table 3.15 Average Annual Number of Extreme Cold Days (SERCC, 2018)

Month/Station	Birmingham	Huntsville	Mobile	Montgomery
January	16	18	8	13
February	12	13	5	8
March	5	6	1	2
April	0	0	1	2
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	6	7	1	4
December	14	16	6	11
Annual	**55**	**62**	**22**	**39**

3.2.4.3 Extreme Temperature History in Alabama

3.2.4.3.1 Extreme Heat

The NWS Storm Events Database began collecting information on extreme heat events in 2008. Since that time, local field offices have reported 13 extreme heat episodes, or 1.4 episodes per year. Most of these episodes were relatively localized, affecting three counties or less. Two of the episodes, however, were widely felt across the state. The extreme heat episode of June 27 to 28, 2009 was reported to affect seven counties, while the extreme heat episode of August 15, 2010 was reported to affect eight counties. None of the events recorded since 2008 were reported to cause direct damage or death, but several were reported to cause injuries. Table 3.16 summarizes the extreme heat events recorded in the Storm Events Database since 2008, as well

as the 1980 heat wave identified by the Birmingham field office as the most noteworthy extreme heat event of the twentieth century.[41]

Table 3.16 Recorded Excessive Heat Events in Alabama (NOAA, 2018)

Date	Counties Impacted	Description
July through September, 1980	80 percent of the state	From mid-July, through mid-September, 1980, a sustained period of extreme heat and high humidity took its toll on the state. The month of July alone saw an estimated 120 heat-related deaths, the loss of more than 200,000 chickens, and the loss of half the state's corn crop. The hottest day of the summer was July 17th, when over 80 percent of the state reached 100°F, and nearly one quarter of the state reached 105°F. The highest reading on that day was 108°F recorded in the cities of Bessemer, Aliceville, and Jasper.
June 7 to 8, 2008	Madison	Heat illnesses prompted the hospitalization of four individuals. Temperatures climbed to between 90 and 95°F and heat index values reached 95 to 100°F.
July 21, 2008	Madison	A strong upper level ridge of high pressure in place across the southeastern US lead to temperatures in the upper 90s to low 100s across Madison County. A record high of 103°F was set at the Huntsville International Airport. This coupled with dewpoints in the mid-60s produced heat index values between 105 and 110°F. This caused some heat related illnesses in Madison county.
June 19, 2009	Lauderdale, Colbert	A large ridge of high pressure built over the region producing hot weather over several days. Daytime high temperatures reached the middle to upper 90s during this period. In combination with humid air, heat index values climbed into the 100 to 105°F range across northwest Alabama, including the Shoals. A newspaper reported that at least 12 people were treated for heat illness at a Florence hospital.
June 27 to 28, 2009	Lauderdale, Colbert, Cullman, Limestone, Lawrence, Madison, Morgan	A ridge of high pressure persisted over the region on the 27th and 28th, producing hot temperatures in the upper 90s to around 100°F. The heat combined with high humidity pushed heat index values into the 105 to 110°F range on both days.

[41] NOAA, NWS Birmingham, AL, 2018. Top 10 Weather Events in the 20th Century for Alabama. Retrieved at: https://www.weather.gov/bmx/climo_top10

Date	Counties Impacted	Description
August 15, 2010	Morgan, Madison, Colbert, Lauderdale, Lawrence, Limestone, Cullman, Franklin	Heat index values reached 110 to 115°F in northwest and north central Alabama.
July 10 to 11, 2011	Lauderdale, Colbert, Madison	Hot and very humid conditions produced dangerous heat during this period, mainly across northwest and north central Alabama. Overnight lows were in the mid to upper 70s at most locations, including a low of 80 at the University of Alabama in Huntsville on the morning of the 12th. High temperatures reached the upper 90s to around 100. Heat index values of 105 to 111 were observed. At least two fatalities have been blamed during this heat wave.
June 29 to July 1, 2012	Madison, Colbert, Montgomery	A strong ridge of high pressure shifted eastward from the Central Plains to the southeastern Continental US, bringing with it recording breaking temperatures. Afternoon highs rose over 100°F. With a moist airmass in place, the heat index value reached 112°F at the Montgomery Regional Airport on June 30.
July 14, 2015	North Alabama	Temperatures warmed into the middle to upper 90s during the afternoon of the 14th. With high dew points in the lower to middle 70s, heat index values reached at or above 105°F over most of north Alabama.
August 5, 2016	Lauderdale	As temperatures reached the middle to upper 90s with dew points in the middle to upper 70s, the heat index reached 110°F in Muscle Shoals and nearby locations during the afternoon hours.

3.2.4.3.2 Extreme Cold

Although extreme cold is less common in Alabama than extreme heat, Alabama residents are less accustomed to and less well-prepared for extreme cold, and therefore more vulnerable to these events. The NWS Storm Events Database began collecting information on extreme heat events in 1996. Since that time, local field offices have reported 109 extreme cold episodes, or 5.2 episodes per year. Most of these episodes were relatively localized, affecting three counties or less. Eleven of the episodes, however, were widely felt across the state. The most widely-felt were two extreme cold events recorded in 1996 that were reported to affect 50 counties, and events recorded in 2003 and 2014 that were reported to affect 39 counties each. None of the events recorded since 2008 were reported to cause direct property damage or injury, but one event was reported to cause direct crop damage, and several were reported to cause direct

deaths. The extreme cold event of March 7, 1996 was reported to cause more than $81 million in direct crop damage (adjusted to 2017 dollars). Six of the recorded events were reported to cause one death each, for a total of six deaths attributed to extreme cold. Table 3.17 summarizes the extreme cold events recorded in the Storm Events Database since 1996.

Table 3.17 Recorded Extreme Cold Events in Alabama (NOAA, 2018)

Date	Counties Impacted	Description
February 6, 2000	Montgomery	A new record low temperature of 20°F was measured at Dannelly Field.
April 9, 2000	Montgomery, Jefferson, Madison	Record low temperatures for April were recorded in each county.
July 24 to 25, 2000	Madison	A new record low temperature of 63°F was measured at the Huntsville International Airport.
August 15, 2000	Montgomery	An early morning temperature of 64°F was measured at Dannelly Field. This temperature tied the previous record low temperature for August.
September 17, 2000	Madison	A morning low temperature of 47°F was measured at the Huntsville International Airport. This temperature tied the previous record low temperature for September.
October 8 to 12, 2000	Madison Jefferson, Montgomery	Record low temperatures for the month of October were recorded in each county.
November 22, 2000	Montgomery	The morning low temperature recorded at Dannelly Field was 21°F. This measurement established a new record low temperature for November.
December 1, 2000	Madison, Montgomery, Jefferson	Record low temperatures were recorded for each county. This was the coldest December since records began in 1910.
December 31, 2000	Jefferson	A Birmingham man died from hypothermia after being found outside of the Norwood boarding house where he lived. The coroner reported that the man's body temperature was 77°F when he was found. The morning low reported at the Birmingham airport was 16°F.
March 26 to 28, 2001	Madison	The early morning low temperature recorded at the Huntsville International Airport was 27°F. This temperature established a new daily record low temperature.
May 23, 2001	Madison	The low temperature of 47°F tied the record low for this date which was first set in 1963.
August 21, 2001	Madison	The morning low temperature measured at the Huntsville International Airport was 57°F which established a new record low temperature for the date.

Date	Counties Impacted	Description
September 26 to 28, 2001	Jefferson, Madison, Montgomery	Record low temperatures for September were recorded in these counties.
October 17 to 18, 2001	Jefferson, Madison, Montgomery	Record low temperatures for October were recorded in these counties.
October 28 to 30, 2001	Madison, Montgomery	New record low temperatures for October were recorded in these counties.
February 28, 2002	Montgomery, Tuscaloosa, Colbert, Madison, Jefferson, Calhoun	Record low temperatures for February were recorded in these counties.
May 20 to 21, 2002	Madison, Montgomery, Jefferson	Record low temperatures for May were recorded in these counties.
January 24, 2003	All Counties	The coldest temperatures in 7 years occurred across much of North and Central Alabama and lasted for about two days. Early morning temperatures ranged from 2 to 10°F. The coldest temperatures were measured in outlying areas. Although no new records were established, these temperatures were very cold for the Deep South. Many area residents reported frozen and broken water pipes as a result of the extended cold. Several lawn sprinkler systems also froze and broke making many areas very icy. One woman in Talladega was found outside dead, apparently succumbing to the harsh, cold conditions. Many area farmers lost a large part of their strawberry crops.
January 7 to 8, 2015	Cullman, Colbert, Lawrence, Madison, Morgan, Limestone, Franklin, Lauderdale, Dekalb, Marshall, Jackson	An Arctic cold front pushed through the region on the afternoon of the 7th bringing gusty northerly winds of 20 to 30 mph. Temperatures fell through the 20s and quickly into the teens and single digits during the evening and overnight of the 7th. Wind chills fell below zero during the mid to late evening hours in northern Alabama. Although winds diminished considerably through the early morning hours of the 8th, wind chills remained below zero with temperatures bottoming out in the single digits.
January 7, 2017	Franklin	Minor winter weather was observed. With a very cold air mass in place, there were light snow fall accumulations. Additionally, cold air convection from the NW produced widespread apparent temperatures around 0F on the morning of Jan 7. Widespread sub-zero temperatures were observed.

3.2.4.4 Probability of Extreme Temperatures in Alabama

The probability of extreme temperatures in Alabama is a function of the state's geography and climate. With its humid subtropical climate type, the state is likely to experience many days with maximum temperatures in excess of 90°F, and somewhat fewer days with minimum temperatures lower than 32°F. As shown in Table 3.14 and Table 3.15, the number of days with extremely high maximum temperatures increases from north to south, while the number of days with extremely low minimum temperatures increases from south to north.

3.2.4.4.1 Future Probability

As Alabama experiences impacts from climate change, the average temperature will become warmer and excessive heat events will be more likely to occur. Climate change will mean that Alabama will experience more extremely hot days, there may be a reduction in crop yield, more livestock may be harmed and there may be an increase in the risk of heat stroke and other heat related diseases.[42]

The Climate Impact Lab provides climate projections for the rest of the 21st century based on Coupled Model Intercomparison Project Phase 5 (CMIP5). In this model, the gridded projections were aggregated to regional estimates. Figure 3.16 illustrates these projections for the number of extreme heat days. As these projections indicate, the number of extreme heat days is projected to increase throughout the state.[43] In addition, the number of heat waves (defined as consecutive days exceeding 95 °F) is expected to increase significantly by the end of the 21st century, with the projected increase ranging from 97% to 207%.[44]

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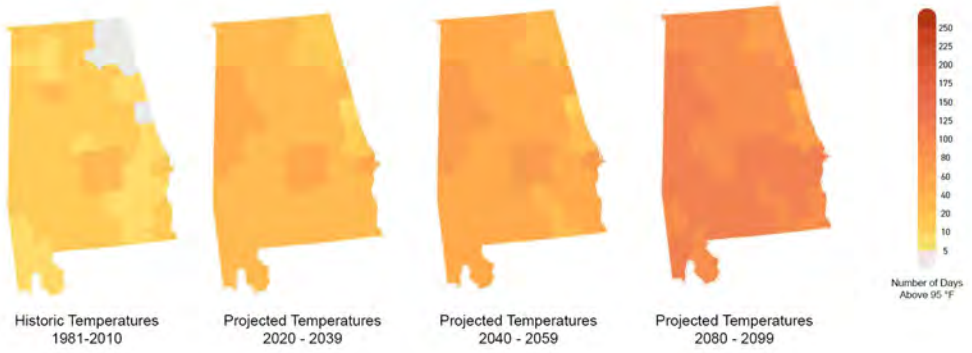
[42] Environmental Protection Agency, 2016. What Climate Change Means for Alabama. Retrieved at: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-al.pdf

[43] Climate Impact Lab, 2018. Climate Impact Map. Retrieved at: http://www.impactlab.org/map/#usmeas=absolute&usyear=2080-2099&gmeas=absolute&gyear=1986-2005

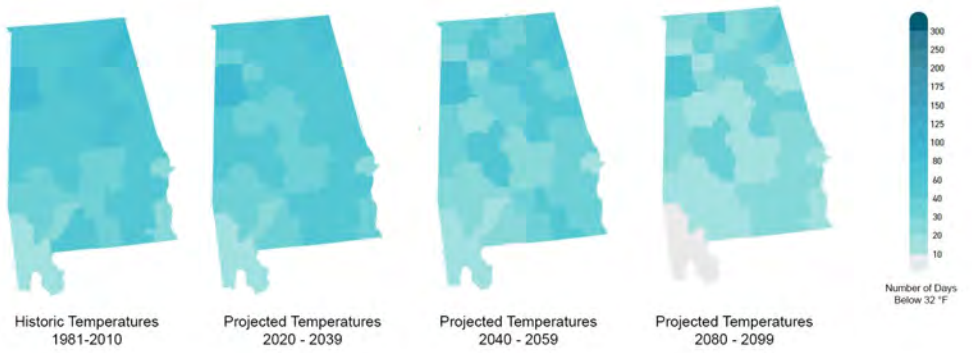
[44] Ingram, K., K. Down, L. Carter, J. Anderson, eds. 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

Figure 3.16 Projected Days Above 95°F (Climate Impact Lab, 2018)



The number of extreme cold days, in contrast, is projected to decrease. Figure 3.17 illustrates the CMIP5 projections for the number of extreme cold days. In addition, overall warming is projected to increase the length of the freeze-free season, or the period between the last spring frost and the first fall frost. In the northern tier of the state, the length of the freeze-free season may increase by as much as 30 days by the middle of the 21st century.[45] This change could have implications for pest management and crop damage, as well as vector-borne diseases and public health.

Figure 3.17 Projected Days Below 32°F (Climate Impact Lab, 2018)



3.2.4.4.2 Risk and Vulnerability

In the US, the projected increase in heat wave deaths is expected to be the single greatest driver of economic impacts from climate change.[46] A community's vulnerability to heat waves will

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[45] Ibid.

[46] New York Times, 2017. As Climate Changes, Southern States Will Suffer More Than Others. By Brad Plumer and Nadja Popovich. Published June 29, 2017. Retrieved at: https://www.nytimes.com/interactive/2017/06/29/climate/southern-states-worse-climate-effects.html

depend not only on the probability of the hazard, but on the characteristics of the built environment, the characteristics of the exposed population, and any adaptation measures taken by the community. In developed areas, the heat-wave risk is related to both regional climate change and local urban heat island effects. Neighborhoods in the city center and neighborhoods with less vegetation are most impacted by the urban heat island effect and will have the greatest exposure to high temperatures (particularly at night).[47] In Alabama, the densest neighborhoods in the state's cities and town may be particularly vulnerable to extreme heat events. As discussed above, certain demographic groups are more susceptible to extreme heat than others. These groups include older adults, infants, young children, and people with chronic health problems.[48] Members of these groups who do not have access to air conditioning will be the most vulnerable to heat-related health impacts. Society and technology could moderate the vulnerability of these groups, however. For example, cities could open cooling centers during heat waves for those who lack access to air conditioning.

3.2.5 Flooding

3.2.5.1 Description

Flooding is the inundation of normally dry land and is the leading cause of natural disaster losses in the US. Flooding can be caused by many different types of weather systems, including slow-moving frontal systems, inland-moving tropical cyclones, and intense summertime thunderstorms. In coastal areas, flooding can also be caused or intensified by high tides. When local weather stations issue flood warnings or report flood damages, they often classify flood events into categories based on the extent and velocity of rising waters.[49] Table 3.18 summarizes flood types based on the definitions used in the NWS Storm Events Database.

Table 3.18 Flood Types (NWS, 2016)

Flood Type	Extent	Description
Flash Flood	Areas near creeks and streams and low-lying areas	A life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam). Ongoing flooding can intensify to the shorter-term flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. Conversely, flash flooding can transition into ongoing flooding as rapidly rising waters abate.

[47] Lemonsu, A., Viguie, V., Daniel, M., and Masson, V., 2015. Vulnerability to heat waves: Impact of urban expansion scenarios on urban heat island and heat stress in Paris (France). Urban Climate, Volume 14, Part 4. Retrieved at: https://www.sciencedirect.com/science/article/pii/S2212095515300316
[48] NOAA, NWS, 2017. Who is Most Vulnerable During a Heat Wave. Retrieved at: https://www.weather.gov/media/lsx/wcm/Heat/MostVulnerableHeatIndex.pdf
[49] NOAA, NWS, 2016. Storm Data Preparation. NWS Instruction 10-1605.

Flood Type	Extent	Description
		Note: This section provides in-depth information on the nature of flash flooding and past occurrences, but limited information on the relative probability of flash flooding across the state. This is because flash-flooding can happen anywhere when the local meteorological, soil, and land cover conditions are right.
Flood	Small to large-scale areas	Any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property. Floods can range from larger scale area floods to the smaller scale urban and small stream flooding that commonly occurs in poorly drained or low-lying areas.
Coastal Flood	Low-lying coastal areas	Flooding of coastal areas due to the vertical rise above normal water level caused by strong, persistent onshore wind, high astronomical tide, and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries.
Nuisance Flooding	Low-lying coastal areas	Shallow coastal flooding caused by the convergence of extreme high tides with other meteorological conditions (e.g., onshore winds). This type of flooding can occur even on sunny days. While nuisance flooding can cause significant public inconvenience, it generally does not cause significant structural damage to buildings.
Storm Surge	Coastal regions	For coastal and select lakeshore areas, the vertical rise above normal water level associated with a storm of tropical origin (e.g., hurricane or tropical storm), caused by any combination of strong, persistent onshore wind, high astronomical tide, and low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries.

The normally dry land that is covered with water during floods is known as the floodplain. For riverine flooding, the factors that determine the extent of the floodplain include rainfall intensity, duration, and extent; soil saturation; topography; and land cover. Higher streamflows are generated when rainfall is heavy, soils are frozen or saturated, slopes are steep, or drainage areas are highly impervious (covered with surfaces that do not absorb water such as roofs, roads, and parking lots). High streamflows tends to translate into larger floodplains where the land adjacent to rivers and streams is characterized by wide flat, areas (as opposed to steep river valleys).

For coastal and storm surge flooding, the factors that determine the extent of the floodplain include the size, strength, intensity, and speed of the storm that is driving storm surge and wave action; the direction the storm is moving relative to the shoreline; how steeply the sea floor is sloping along the shore; topography; and the astronomical tide. In general, storm surge is most damaging when it occurs along a shallow sloped shoreline, during high tide, and in developed areas with limited natural buffers (such as barrier islands, coral reefs and coastal vegetation).[50] Furthermore, the damage from storm surge and waves is greatest in the tropical cyclone's right front quadrant. This is where the storm, its winds and ocean waves are all moving in an onshore direction due to the counter-clockwise rotation of hurricanes in the Northern Hemisphere.[51]

Both localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or when bacteria and disease are spread by floodwaters. Extensive property damage can be caused by the force or volume of floodwaters. Moving water creates hydrodynamic forces that can damage the walls of buildings, scour around their foundations, and damage roads and bridges. The magnitude of these forces is related to both the velocity and depth of flooding. Studies have shown that deep water moving at low velocities can cause as much damage as shallow water moving at high velocities. The debris carried by moving water can also cause damage, acting like battering rams against the walls of buildings. Standing water also exerts force on buildings through the weight of the water. Three feet of standing water can exert enough lateral force to collapse the walls of a typical frame house, and basement walls and floors are particularly susceptible to damage.[52] Soaking is another cause of property damage related to the volume of floodwaters. Soaking can damage plywood, gypsum wallboard, and household goods. In addition, floodwaters usually carry suspended sediments; debris; other contaminants such as oil, farm, and lawn chemicals; and untreated sewage. When floodwaters recede, these contaminants remain on flooded buildings and their contents. It is important to note that even when flooding does not cause property damage or loss of life, flood events can cause economic disruption through traffic diversions and temporary business closures. Shallow coastal flooding caused by extreme high tides often causes these public inconveniences, which is why this type of flooding is sometimes called "nuisance flooding."

The impact of floods is highly dependent on the amount, type, and design of development in the floodplain. The federal government has therefore developed nationwide programs to identify flood-prone areas (Risk Mapping, Assessment, and Planning, or Risk MAP) and to encourage development patterns that place fewer people and assets in harm's way through the NFIP. To

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[50]Wright, James M., 2007. Floodplain Management: Principles and Current Practices. Retrieved at: https://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf

[51] Ibid.

[52] FEMA, 1998. Managing Floodplain Development Through the National Flood Insurance Program: Home Study Course. Retrieved at: https://www.fema.gov/pdf/floodplain/nfip_sg_unit_1.pdf

identify flood-prone areas, the Risk MAP program produces flood hazard maps (also known as Flood Insurance Rate Maps, or FIRMs) that delineate flood zones based on the expected frequency of flooding. Table 3.19 describes the flood zones used in current FIRMs. Note that Zone A and Zone V areas are also known as the Special Flood Hazard Area (SFHA). To encourage effective floodplain management, the NFIP makes more affordable flood insurance available to communities that adopt and enforce floodplain management regulations. Participating communities must meet the NFIP requirements for each flood zone.

Table 3.19 NFIP Flood Zones

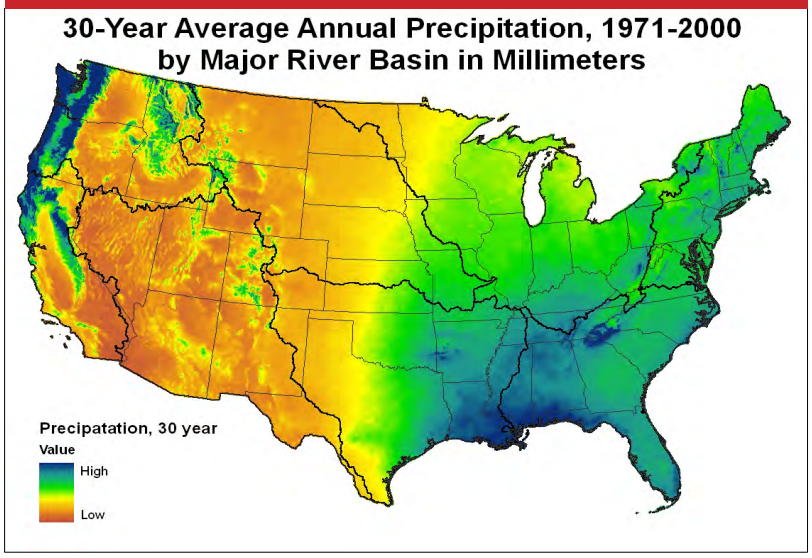
Zone	Frequency	Description
Zone A	1% annual chance or greater	Area of high hazard; also known as the Special Flood Hazard Area
Zone X (shaded)	Between 0.2% and 1% annual chance	Area of moderate flood hazard
Zone X (unshaded)	Less than 0.2% annual chance	Area of minimal flood hazard
Zone V	1% annual chance or greater	Coastal High Hazard Area—part of the Special Flood Hazard Area that is subject to additional hazards associated with storm-induced waves

3.2.5.2 Nature of the Hazard in Alabama

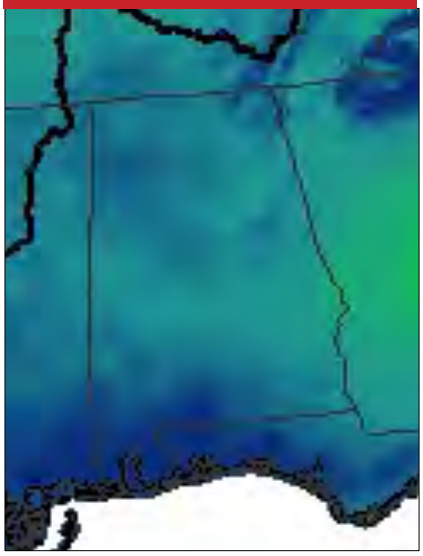
Alabama has a warm and humid climate characterized by often turbulent weather patterns and year-round precipitation. As shown in Figure 3.18, Alabama receives more rainfall than much of the US, particularly along the Gulf Coast of the state. These features of the state's climate, together with its location on the Gulf of Mexico, result in frequent riverine and coastal flooding events.

Figure 3.18 Average Annual Precipitation (USGS, 2000)

USGS Reference Map



Alabama Detail



According to the NWS Storm Events Database, Alabama has experienced more than 1,000 significant or loss-producing flood events since 1996, or about 46 flood events per year. While flood events occur year-round, most take place in the months of April through July. Table 3.20 shows the number of reported flood events by county, with the counties listed from most reported flood events to least. As expected, the coastal counties experience particularly frequent flood events, including coastal flooding and storm surges

Table 3.20 Reported Flood Events by County, 1996-2017 (NWS, 2017)

County	Flash Flood	Flood	Coastal Flood or Storm Surge	All Flood Events
Madison County	148	25	0	173
Mobile County	115	11	19	145
Lauderdale County	112	18	0	130
Jefferson County	105	12	0	117
Baldwin County	82	12	8	102
Morgan County	74	10	0	84
Colbert County	69	4	0	73
Limestone County	59	10	0	69
Cullman County	56	7	0	63
Marshall County	45	18	0	63
Lamar County	57	5	0	62

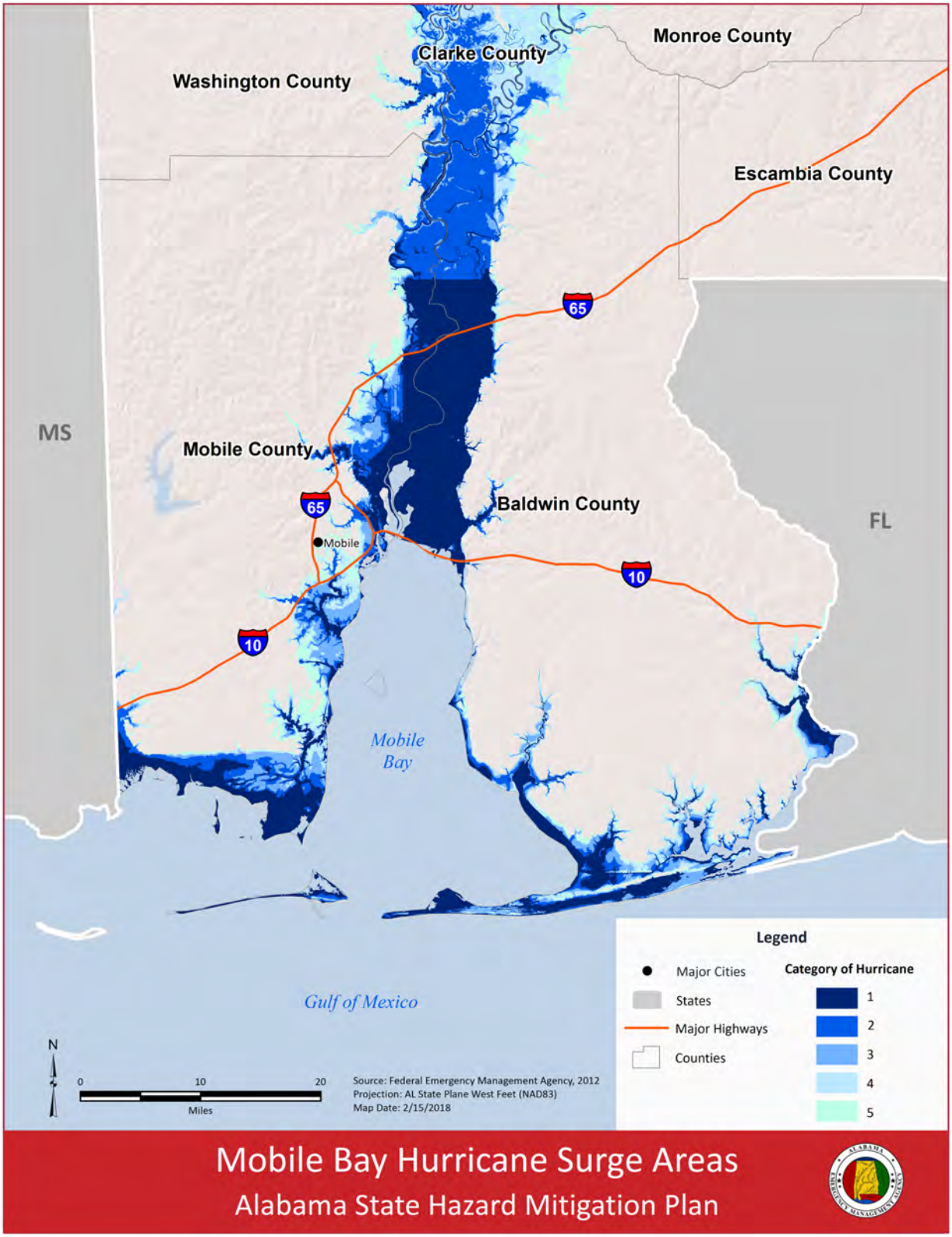
County	Flash Flood	Flood	Coastal Flood or Storm Surge	All Flood Events
Dekalb County	41	16	0	57
Shelby County	46	6	0	52
Tuscaloosa County	43	8	0	51
Lawrence County	43	7	0	50
Houston County	35	10	0	45
Elmore County	36	4	0	40
Montgomery County	33	7	0	40
Geneva County	26	12	0	38
Blount County	33	4	0	37
Escambia County	31	3	0	34
Talladega County	27	7	0	34
Choctaw County	33	0	0	33
Jackson County	31	1	0	32
Dale County	24	7	0	31
Walker County	28	2	0	30
Etowah County	23	6	0	29
Autauga County	24	4	0	28
Clarke County	25	2	0	27
Coffee County	20	7	0	27
Calhoun County	24	2	0	26
Franklin County	24	2	0	26
St. Clair County	24	2	0	26
Marion County	25	0	0	25
Randolph County	20	4	0	24
Sumter County	15	7	0	22
Pickens County	14	6	0	20
Washington County	20	0	0	20
Cherokee County	16	3	0	19
Clay County	18	1	0	19
Monroe County	17	2	0	19
Chambers County	15	3	0	18
Hale County	12	6	0	18
Lee County	16	2	0	18

County	Flash Flood	Flood	Coastal Flood or Storm Surge	All Flood Events
Bibb County	14	3	0	17
Crenshaw County	15	2	0	17
Tallapoosa County	14	3	0	17
Covington County	15	1	0	16
Lowndes County	14	2	0	16
Winston County	16	0	0	16
Russell County	13	1	0	14
Butler County	12	1	0	13
Dallas County	12	1	0	13
Marengo County	7	6	0	13
Pike County	13	0	0	13
Conecuh County	12	0	0	12
Fayette County	11	0	0	11
Greene County	7	4	0	11
Chilton County	10	0	0	10
Macon County	9	1	0	10
Cleburne County	9	0	0	9
Henry County	6	3	0	9
Bullock County	8	0	0	8
Perry County	7	1	0	8
Wilcox County	8	0	0	8
Barbour County	7	0	0	7
Coosa County	3	0	0	3

As discussed above, the extent of storm surge flooding is highly dependent on the size, strength, intensity, and speed of the storm that is driving storm surge and wave action. Figure 3.19 shows the sensitivity of storm surge flooding in Baldwin and Mobile counties to hurricane intensity (as categorized by the Saffir-Simpson hurricane wind scale). Since many factors influence storm surge heights, this figure shows the worst-case outcome at each location based on a series of storm surge scenarios. To emphasizes areas with the highest degree of exposure, the storm surge zones corresponding to the lowest hurricane intensity (Category 1 hurricanes) are displayed in the darkest color.[53] The data shown in Figure 3.19 were derived from storm surge inundation maps created by the National Hurricane Center (NHC) Storm Surge Unit with the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. Emergency managers often use the SLOSH model in hurricane evacuation studies.

[53] FEMA, 2012. Summary of the Coastal Flood Loss Atlas. Retrieved at: https://data.femadata.com/MOTF/CFLA/CFLA_Summary_FINAL.pdf

Figure 3.19 Storm Surge Scenarios for Saffir-Simpson Hurricane Categories 1 through 5 (FEMA)



3.2.5.3 Flood History in Alabama

Alabama experiences flooding and flood impacts almost every year. To demonstrate the potential impacts of flooding in Alabama, Table 3.21 summarizes the six flood events recorded by the Storm Events Database that were reported to generate the highest losses. Each of these flood events generated losses in excess of $8 million (adjusted to 2017 dollars).

Table 3.21 Alabama Flood History, 1996-2017 (NWS, 2017)

Date	Estimated Damage (2017 dollars)	Counties Declared Disaster Areas	Description
March 8, 1998	$519 million	Barbour, Butler, Coffee, Conecuh, Covington, Crenshaw, Dale, Escambia, Geneva, Henry, Houston, Randolph	An intense Gulf storm deposited up to 14 inches of rain across southeast Alabama on March 6-8. Subsequent flooding damaged hundreds of homes, disrupted the water supply for 300 residents, and washed out many county and state roads. A portion of the levee in Elba failed, causing 2,000 people to evacuate. Communities suffering the worst damage were Malvern, Slocomb, Geneva, and Samson.
September 28, 1998	$28.5 million	NA	Torrential rains of 8 to 24 inches produced flash flooding in Geneva County. Numerous roads were damaged or washed out. Significant losses were incurred to peanut and cotton crops.
September 22, 2002	$8.45 million	NA	Very heavy rain fell across central Alabama during the early morning hours. The heaviest rain was measured generally from Tuscaloosa to Birmingham to Wedowee. Radar-estimated rainfall amounts averaged from 3 to 5 inches with many localized areas over 7 inches in only a few hours. The hardest hit area was the Birmingham Metropolitan area where the damage stretched from Bessemer to Pelham to Mountain Brook to Vestavia Hills. The flooding damaged more than 120 homes and 20 businesses and washed out several bridge and culverts. Many roads were temporarily closed and impassable, and over 200 automobiles suffered significant damage in Vestavia Hills.

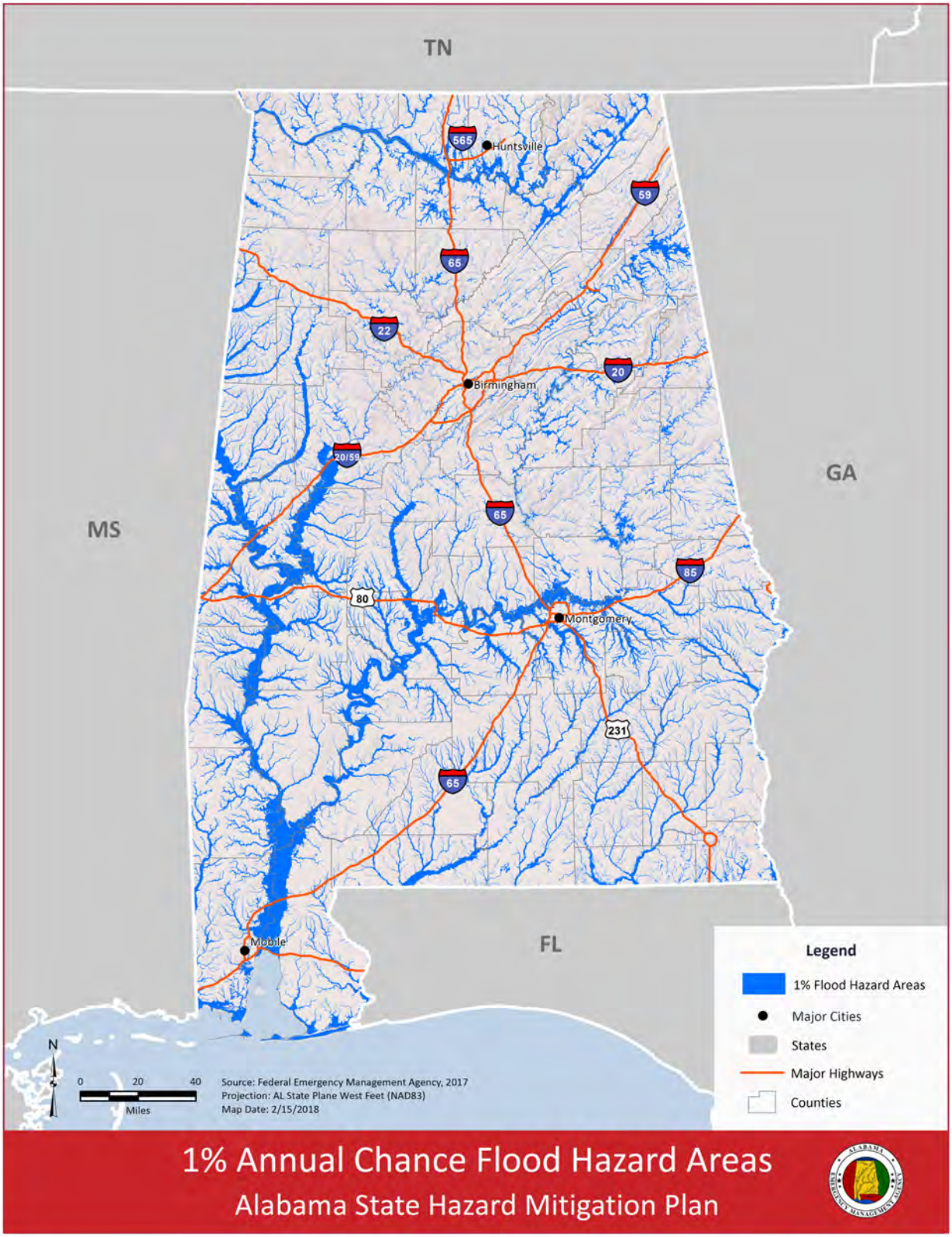
Date	Estimated Damage (2017 dollars)	Counties Declared Disaster Areas	Description
May 7, 2003	$1.33 billion	38 counties across the state	Heavy rains fell across the state. In Jefferson County, up to 12 inches of rain fell in a few hours, with 5 to 8 inches of the total occurring in just one hour. Especially hard hit were Leeds, Brookside, Cardiff, Fultondale, Trussville, and Birmingham. Numerous homes across the county were flooded. At least 120 roadways were impassable. Several sewage treatment plants were flooded, and minor contamination occurred. Several roadways had pavement removed and then washed away. Several bridges were damaged. Seventy-four mobile homes were damaged in the Irondale Trailer Park. Trussville reported that many municipal buildings, police cars, fire trucks, utility trucks, and businesses were damaged. Brookside reported that the city hall and fire department were heavily damaged from the flood waters. In Graysville, 10 people were rescued from their flooded vehicles and 20 homes were evacuated. In Fultondale, almost one million dollars of damage occurred to city services. At least 25 homes and businesses were damaged in Fultondale. In Morris, one manufacturing plant was flooded.
May 7, 2009	$8.47 million	Autauga, Bullock, Elmore, Montgomery	A slow-moving area of thunderstorms brought considerable flash flooding to several counties in central and southeast Alabama. A relatively narrow but rather long swath of rainfall of 3 to more than 7 inches stretched from northeastern Autauga County, across the city of Montgomery, and into southern Russell and northern Barbour Counties. Peak rainfall amounts approached 10 inches. Numerous county roads and city streets became impassable and suffered extensive damage due to flooding caused by torrential rainfall. The cities of Wetumpka, Millbrook, and Deatsville were especially hard hit. At least 43 homes, 10 business, and 2 churches also suffered damage due to the flooding.

Date	Estimated Damage (2017 dollars)	Counties Declared Disaster Areas	Description
April 29, 2014	$34.5 million	NA	A strong storm system brought record flooding along with severe thunderstorms that produced damaging winds and tornadoes to the region. Extremely heavy rain in a short period of time resulted in significant flash flooding issues across West Mobile, Midtown Mobile, and Downtown Mobile. The southern half of Baldwin county experienced historic flooding. 1400 homes and businesses experienced flooding and private property losses are estimated at $17 million with another $10 million estimated for infrastructure damage. Almost every road south of Highway 104 experienced flooding. Numerous roads were flooded between Highway 104 and just north of Interstate 10. Emergency management officials reported having to rescue dozens of people from homes and vehicles due the rapid rise of the water.

3.2.5.4 Probability of Floods in Alabama

The regulatory flood hazard maps developed by FEMA represent the best available guides to the probability of flooding in Alabama. Figure 3.20 shows the extent of the 1-percent-annual-chance floodplain in Alabama. In any given year, the shaded locations have at least a 1-percent chance of experiencing inundation from riverine or coastal flooding. Over time, however, the chance of flooding in a given location increases. For example, a location with a 1-percent chance of flooding over one year has a 26-percent chance of flooding over 30 years, the typical term of a home mortgage.

Figure 3.20 Areas with a 1% or Greater Annual Chance of Flooding (FEMA)



3.2.5.4.1 Future Probability

The future probability of riverine flooding in Alabama is likely to change with changes in weather patterns and land cover. Both historical trends and future projections suggest that the frequency of heavy rains in the southeast will rise through the twenty-first century. According to the Southeast Regional Report for the National Climate Assessment, the entire southeast has seen increases in the frequency of extreme precipitation events since 1900, with particularly pronounced increases in the lower Mississippi River Valley and along the northern Gulf Coast.[54] Model simulations of future precipitation also show significant increases in the frequency of extreme rainfall in the southeast, as well as increases in annual rainfall. The increase in extreme precipitation is expected to be particularly pronounced along the southern Appalachians and in parts of Tennessee and Kentucky. As these changes in weather patterns intersect with changes in land cover related to development, Alabama can expect its risk of riverine flooding to rise.

The future probability of coastal flooding in Alabama will reflect changes in the probability of tropical cyclones and hurricanes, as well as changes in sea level with climate change. According to the National Climate Assessment, hurricane hazards are generally expected to increase through the twenty-first century. The measures of hurricane activity include intensity, frequency, and duration. Since high-quality satellite data first became available in the early 1980s, scientists have observed a substantial increase in all of these measures of hurricane activity for North Atlantic hurricanes, as well as an increase in the frequency of the strongest (Category 4 and 5) hurricanes.[55] Although simulations of future hurricane activity span a range of possible outcomes, on average the models project an increase in the annual number of Category 4 and 5 hurricanes by the late twenty-first century, as well as a slight decrease in the number of tropical cyclones.[56] Changes in the storm tracks of North Atlantic hurricanes are less well understood.[57]

Sea level rise is another factor that will have profound impacts on the future probability of coastal flooding. Coastal areas are seeing higher and higher sea levels as global changes interact with local factors. Across the globe, sea levels have remained relatively stable over the past few thousand years, climbing less than a few tenths of a millimeter per year.[58] Since the mid- to late-nineteenth century, however, sea level rise has accelerated dramatically. Sea levels rose by an

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[54] Ingram, K., K. Down, L. Carter, J. Anderson, eds., 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.
[55] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the US: The Third National Climate Assessment. US Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
[56] *Ibid.*
[57] Woolings, T., Gregory, J. M., Pinto, J. G., Reyers, M., and Brayshaw, D. J. (2012). Response of the North Atlantic storm track to climate change shaped by ocean–atmosphere coupling. Nature Geoscience volume 5, pages 313–317.
[58] National Aeronautics and Space Administration, Goddard Institute for Space Studies, 2007. Science Briefs: Sea Level Rise, After the Ice Melted and Today. Retrieved at: https://www.giss.nasa.gov/research/briefs/gornitz_09/

average of 1.7 to 1.8 mm/year over the twentieth century, but rose by an average of 2.8 mm/year between 1993 and 2017. At the global scale, climate change is driving the rising seas. Warming oceans are causing ocean waters to expand, and the melting of land-based ice (glaciers and ice sheets) is causing ocean volumes to rise. At the local scale, a range of local factors can hasten or slow the rate of sea level rise seen by communities. These factors are described in greater depth in Section 3.2.10, and include land subsidence, changes in regional ocean currents, and tectonic movements. These global and local processes are certain to continue, driving sea level rise throughout the world. While future sea level rise is a certainty, however, the rate at which it will unfold is unknown. The best guide to future planning is therefore the range of local sea level rise scenarios developed by expert working groups. In the US, a federal task force convened by the US Global Change Research Program and the National Ocean Council has produced a comprehensive set of sea level rise scenarios for coastal communities across the country.[59] The scenarios developed for coastal Alabama are discussed further in Section 3.2.10.

Regardless of the timing, sea level rise along the Alabama coast will lead to more frequent floods that cause more damage. As discussed above, coastal flooding comes in many forms - from the shallow coastal flooding associated with extreme tides that mostly causes inconvenience, to the storm surges driven by hurricanes that can wreak havoc on coastal communities. Sea level rise will mean more frequent and damaging events for all forms of coastal flooding, from nuisance high tides to life-threatening storm surges.

Even on sunny days or during small storms, rising sea levels mean that extreme high tides can cause nuisance flooding more frequently and over a greater area. Nuisance flooding can be disruptive and expensive to the local economy, particularly in tourism-dependent areas such as the coastal areas of Mobile and Baldwin counties. Across the US, NOAA estimates that nuisance flooding is now occurring three to nine times more frequently than it did 50 years ago.[60]

Rising sea levels will also mean that deadly and destructive storm surges will push farther inland than they once did. This will place more people, property, and valuable infrastructure at risk, including essential facilities such as wastewater treatment plants. As storm surges push further inland, they can also accelerate the erosion of beaches, dunes, and coastal wetlands. These features serve as natural flood defenses by reducing the height and energy of large waves. The erosion of these natural defenses leaves coastal communities even more vulnerable to the next storm surge event.

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[59] Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekera, J., Horton, R. M., Thieler, E. R., & Zervas, C. (2017). Global and regional sea level rise scenarios for the US. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.
[60] NOAA, National Ocean Service, 2018. What is high tide flooding? Retrieved at: https://oceanservice.noaa.gov/facts/nuisance-flooding.html

3.2.5.4.2 Risk and Vulnerability

A detailed assessment of vulnerability to flooding in Alabama is provided in Section 3.3.

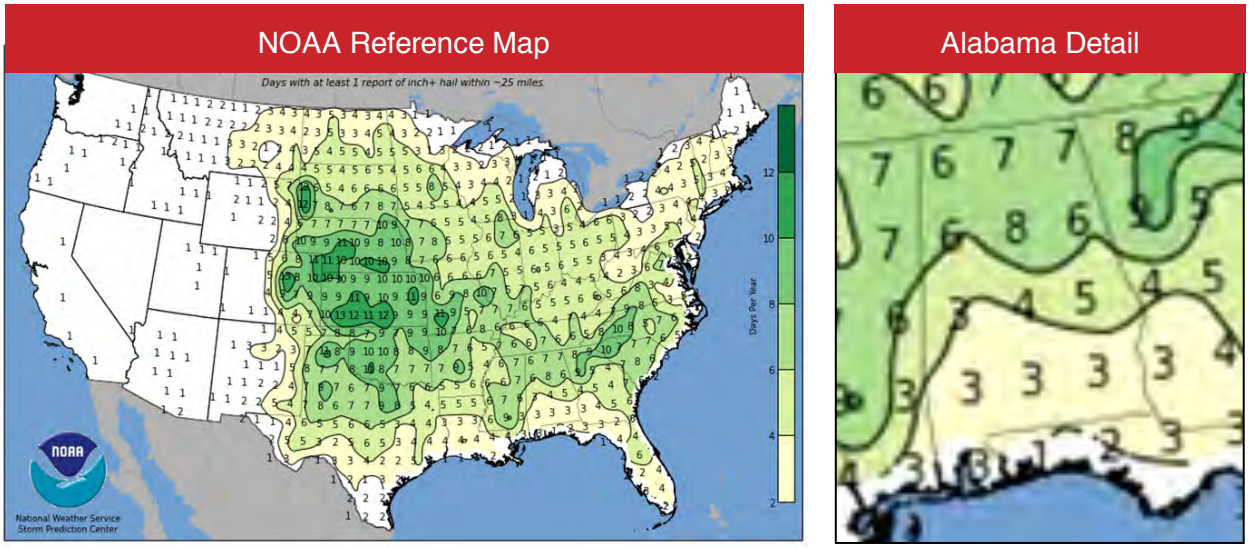
3.2.6 Hail

3.2.6.1 Description

Hail is defined by the NWS as "frozen precipitation in the form of balls or irregular lumps of ice."[61] This type of precipitation is produced by severe thunderstorms characterized by very cold upper level air and strong updrafts. The cold upper level air causes water droplets to freeze, and the strong updrafts keep the frozen droplets suspended while layers of ice are added. When the lumps of ice become too large to be suspended by updrafts, they fall to the ground as hail.

Hailstorms occur most frequently in the late spring and early summer when the jet stream moves northward across the Great Plains. This creates steep temperature gradients from the surface to upper air masses, producing the strong updrafts required for hail formation. While thunderstorms are most common along the Gulf Coast, thunderstorms that produce hail are more common in the Great Plains, where the temperature contrasts associated with the jet stream are greatest. Figure 3.21 shows the average number of severe hailstorms reported across the US each year, where severe hailstorms are defined as those producing hail with diameters of one inch or greater.

Figure 3.21 Severe Hail Days per Year, 2003-2012 (NOAA, 2012)



[61] NOAA, NWS, 2015. Storm Data Preparation. NWS Instruction 10-1605. Retrieved at: http://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf

The size of hailstones is related to the intensity of the thunderstorms that produce them, and to the temperature at the surface. The higher the temperature at the Earth's surface, the greater the strength of the updrafts within a thunderstorm, and the larger the hailstones that form. Most hailstones are less than two inches in diameter, but hailstones as large as softballs (4.5 inches in diameter) are sometimes observed.

In the US, hailstorms cause about $1 billion in economic loss each year.[62] Much of this loss is related to crop damage. Young plants (particularly those with long stems) are highly vulnerable to hail impact and associated winds, and peak hail activity coincides with peak agricultural seasons.[63] Damage to the roofs and windows of cars and buildings is another source of loss. The TORRO Hailstorm Intensity Scale (Table 3.22) relates the size of hailstones to the probable crop and property damage. The damage caused by hail is often compounded by the other hazards that tend to accompany hailstorms, including tornadoes and thunderstorms. Large hail is often observed just north of a tornado track.

Table 3.22 TORRO Hail Intensity Scale

Intensity	Typical Hail Diameter (mm)	Intensity Category	Probable Damage
H0	5	Hard Hail	No damage
H1	5-15	Potentially Damaging	Slight general damage to plants, crops
H2	10-20	Significant	Significant damage to fruit, crops, vegetation
H3	20-30	Severe	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	25-40	Severe	Widespread glass damage, vehicle bodywork damage
H5	30-50	Destructive	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	40-60	Destructive	Bodywork of grounded aircraft dented, brick walls pitted
H7	50-75	Destructive	Severe roof damage, risk of serious injuries
H8	60-90	Destructive	Severe damage to aircraft bodywork

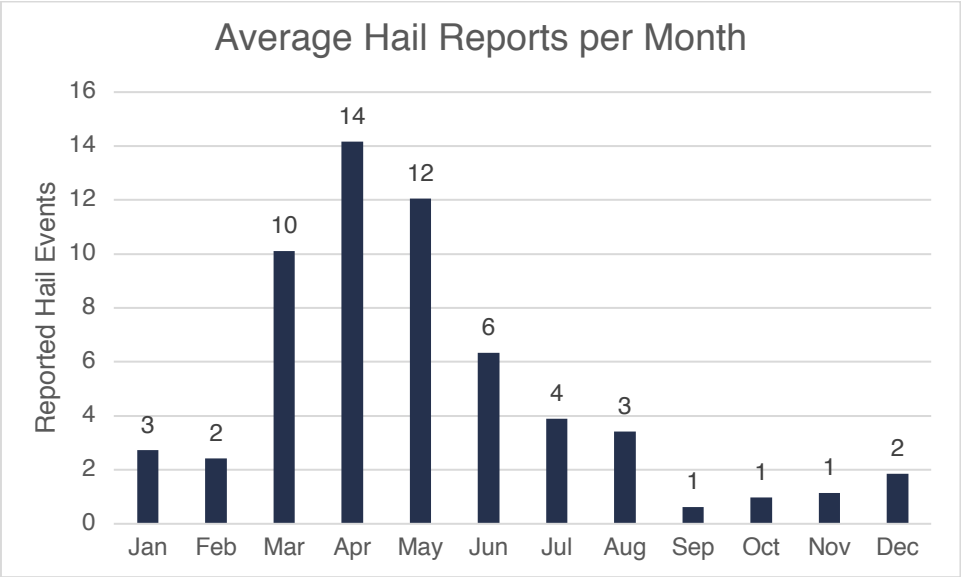
[62] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf
[63] Ibid.

Intensity	Typical Hail Diameter (mm)	Intensity Category	Probable Damage
H9	75-100	Super Hailstorms	Extensive structural damage; risk of severe or even fatal injuries to persons caught in the open
H10	Greater than 100	Super Hailstorms	Extensive structural damage; risk of severe or even fatal injuries to persons caught in the open

3.2.6.2 Nature of the Hazard in Alabama

Hailstorms in Alabama are not as common as hailstorms in the Great Plains, but severe hailstorms are reported every year. More hailstorms are reported in the northern part of the state, where severe thunderstorms are more common (Figure 3.21). The frequency of hailstorms in Alabama is greatest in the spring, with the most episodes of severe hail generally reported in April (Figure 3.22).

Figure 3.22 Severe Hail Reports in Alabama Averaged by Month, 1955-2017 (NOAA, 2017)



3.2.6.3 Hail History in Alabama

Hailstorms in Alabama are moderately loss-producing atmospheric hazards. According to NOAA's Storm Events Database, hailstorms in Alabama caused more than $31.2 million in direct economic losses (adjusted to 2017 dollars) between 1955 and 2017. About $29.5 million of the reported losses were from property damage, and $1.7 million were from crop damage.

Since the Storm Events Database began collecting data on hail storms in 1955, local field offices have reported 3,765 hail episodes, or about 60 episodes per year. Five of the reported hail episodes produced property damage exceeding $1 million (adjusted to 2017 dollars), and two produced crop damages exceeding $75 thousand (adjusted to 2017 dollars). Table 3.23 summarizes these historical storms and their reported impacts.

Table 3.23 Historical Hail Storms in Alabama with Significant Economic Damage (1955 – 2017)

Date	Location	Estimated Property Damage (2017 dollars)	Estimated Crop Damage (2017 dollars)	Description
June 9, 1994	Lauderdale County	$0	$82,500	Hail severely damaged a cotton crop in the Bluewater Creek area about seven miles west of Rogersville. The hail was described as large and stripped cotton plants to the stem.
May 15, 1995	Cullman County	$1,046,500	$0	Hail up to softball-size was reported in the area from southern Cullman to Hanceville. Numerous cars sustained damage in the hail including one Chevrolet dealership where every car sustained hail damage.
May 6, 1998	Bibb County, Perry County	$75,000	$75,000	Four to five trailers in Bibb County had their windows knocked out by Hen Egg sized hail along SR 219. Twenty-three acres of timber was damaged due to the hail. The hail damage continued into Perry County along SR 219 where mostly tree damage occurred.
April 25, 2003	Central Alabama	$5,088,580	$0	Several steady-state, rotating thunderstorms, referred to as supercells, cut swaths of damage through twelve counties Alabama. Large hail caused widespread damage to automobiles and homes and was accompanied by damaging winds. Hail sizes ranged from penny to softball size.
May 2, 2003	Northwestern Alabama	$3,192,000	$0	Several severe thunderstorms moved through the northwestern part of the state and generally affected the counties from Jefferson to Cherokee. Dime to golf ball size hail fell in many locations, causing damage to homes and cars. Two automobile dealerships in Chatom sustained major damage to their automobile inventory.

Date	Location	Estimated Property Damage (2017 dollars)	Estimated Crop Damage (2017 dollars)	Description
March 26, 2011	Walker County, Winston County	$1,728,540	$0	Hailstones up to two inches wide caused extensive damage to vehicles and homes. In the city of Jasper, hundreds of cars in the city were damaged, with many car dealerships sustaining damage to every car on the lot. Hundreds of homes sustained roof damage. Hailstones also caused widespread damage to buildings and vehicles in the city of Hayleyville.
April 15, 2011	Choctaw County	$1,404,000	$0	Numerous supercell thunderstorms crossed southwestern Alabama, producing tornadoes and hail mostly in rural areas. Baseball size hail caused damage to the Georgia Pacific Paper Plant northeast of Pennington. Numerous automobiles around the facility suffered significant damage.
March 19, 2018	Northern Alabama	N/A	$0	A cluster of supercell thunderstorms moved through norther Alabama, producing tornadoes and damaging hail. Hail growth was boosted by strong updrafts with vertical wind speeds of up to 185 mph, and the hail ranged from baseball to grapefruit-sized. The hail caused extensive damage to vehicles and other property and formed small craters in the grassy areas where it landed.

3.2.6.4 Probability of Hail Storms in Alabama

Reported hailstorms have historically affected northern counties more frequently than southern counties (Figure 3.23). It is important to note, however, that the distribution of reported hail events reflects both where hail events occurred, and where people were located to observe and report these events. In other words, there is reporting bias in the Storm Events Database. This reporting bias probably contributes to the high frequency of observed hail events in Jefferson and Madison counties.

3.2.6.4.1 Future Probability

The probability of hail events is directly tied to the probability of severe thunderstorms. According to the Southeast Regional Report prepared for the Third US National Climate Assessment, the effect of climate change on the future probability of severe thunderstorms is unclear.[64] Although scientists have seen a significant increase in the number of severe thunderstorm reports since 1950, this increase appears to be related to better detection and reporting systems. Future projections generated by climate simulations are also unclear. One of the building blocks for severe thunderstorms is the atmospheric instability that results when warm, moist air near the Earth's surface rises and interacts with cooler and drier air higher in the atmosphere. While the frequency of unstable conditions is expected to increase throughout the twenty-first century, global climate models predict significant variability from one year to the next.

3.2.6.4.2 Risk and Vulnerability

A community's vulnerability to loss from hailstorms is a function of the probability of severe hailstorms, the exposure of property and crops to hailstorms, and the susceptibility of property and crops to hail impact. In Alabama, high hail frequency and high property exposure intersect in the northern metropolitan areas of Huntsville and Birmingham. Based on the record of past damages, cars exposed to the elements (such as those on dealership lots) tend to be particularly susceptible to hail damage. Car dealerships tend to be located in areas with higher population densities. Based on these factors, the counties in northern Alabama are most vulnerable to property damage from hail. Many of the state's northern counties are also among the leading agricultural counties in terms of acres of cropland. The counties of Lauderdale, Limestone, Madison, Jackson, DeKalb, Cherokee, Lawrence, Morgan, and Cullman all had more than 65,000 acres of cropland in 2007.[65] These counties are therefore more vulnerable to crop damage from hail.

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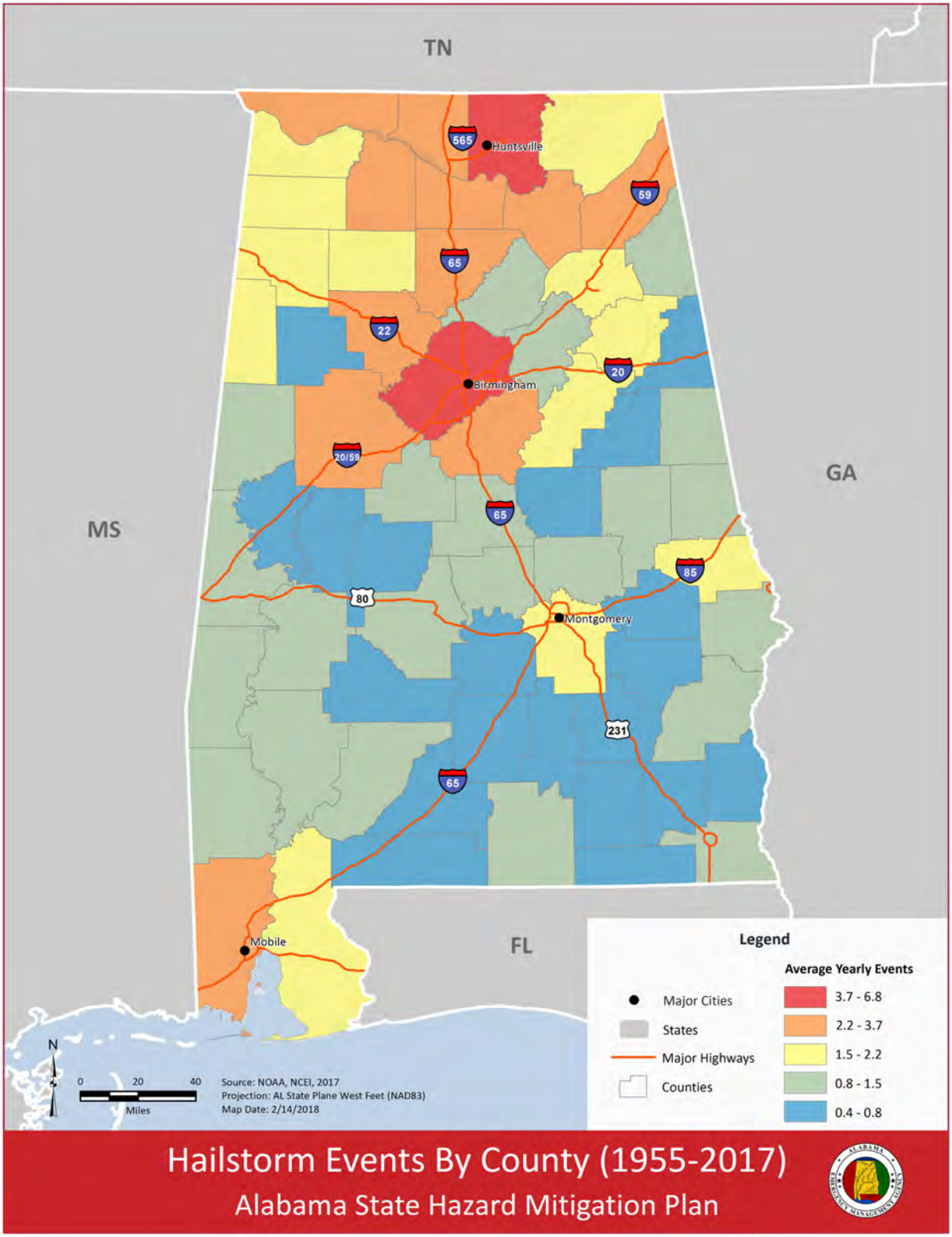
[64] Ingram, K., K. Dow, L. Carter, J. Anderson, eds. 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

[65] The University of Alabama, Department of Geography. Alabama Maps. Retrieved at http://alabamamaps.ua.edu/contemporarymaps/alabama/agriculture/index.html

Figure 3.23 Annual Hail Reports by County, 1955-2017 (NOAA, 2012)



3.2.7 High Winds

3.2.7.1 Description

High winds are one of the most destructive natural hazards that affect the US. Each year, this hazard claims lives, causes injuries, and results in billions of dollars in property damage.[66] High winds are generally associated with three weather phenomena: tornadoes, thunderstorms, and tropical cyclones. Because these three phenomena often overlap (hurricanes, for example, can spawn tornadoes and generate severe thunderstorms), this section addresses the high winds associated with all these phenomena. Flooding and storm surge hazards related to hurricanes and severe storms are discussed in Section 3.2.5.

Tornadoes are nature's most violent storms and can strike with little or no warning. These storms can produce internal winds exceeding 300 mph and can lift and move very large objects (including entire buildings). Tornadoes are localized events, with path widths of less than 0.6 miles, and lengths ranging from less than a mile to tens of miles. Tornado speeds along their path length range from 30 to 125 mph, and their lifespans are generally less than 30 minutes.[67] Since tornadoes are related to large vortex formations, clusters of tornadoes often occur in thunderstorms and in the right forward quadrant of hurricanes.

The magnitude of a tornado is measured in terms of the maximum wind speed as estimated based on observed damage. The two most widely-used scales for tornado magnitude are the Fujita Tornado Scale (or F-scale, developed in 1971 by Theodore Fujita of the University of Chicago), and the Enhanced Fujita Tornado Scale (or EF-scale, implemented by the NWS in 2007).[68] Both scales use observed damage to estimate wind speeds, but the EF-scale takes more variables into account than the F-scale, and generally estimates lower speeds. Figure 3.24 shows the wind speeds (expressed as 3-second gust speeds) and expected damage corresponding to the ratings on the EF-scale. Figure 3.24 shows how the EF-scale in use today compares to the F-scale used before 2007. The historical databases maintained by the NWS continue to report the F-scale ratings for historic events.

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[66] National Windstorm Impact Reduction Program, 2015. Biennial Report to Congress for Fiscal Years 2013 and 2014. Retrieved at: https://www.nist.gov/sites/default/files/documents/el/nwirp/NWIRP-FY2013-2014-Biennial-Report-to-Congress-2.pdf

[67] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library/assets/documents/7251

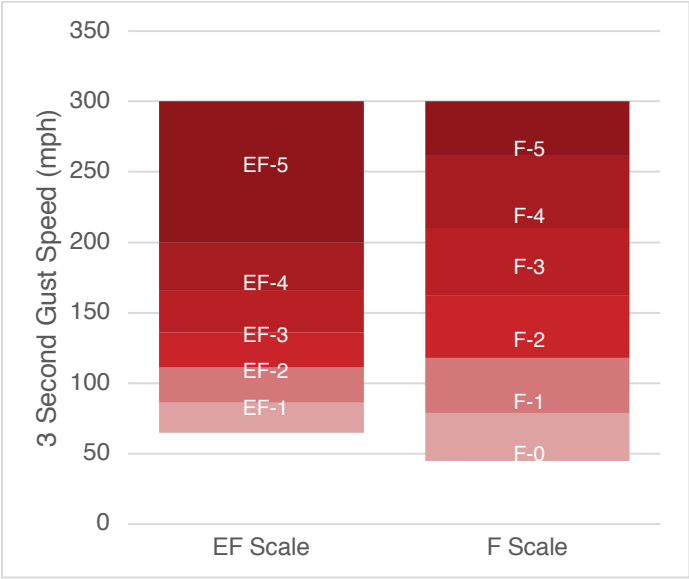
[68] NOAA, Storm Prediction Center, 2018. Enhanced F Scale for Tornado Damage. Retrieved at: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

Table 3.24 Enhanced Fujita (EF) Scale for Tornado Magnitude (NWS, 2018)[69]

EF Rating	3 Second Gust Speed (mph)	Expected Damage
EF-0	65 - 85	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86 - 110	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111 - 135	'Considerable' damage: roofs torn off well-constructed homes, homes shifted off their foundation, mobile homes destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136 - 165	'Severe' damage: entire stories of well-constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	166 - 200	'Extreme' damage: Well-constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	Over 200	'Massive/incredible' damage: Well-constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches, and snapped.

[69] NOAA, NWS, 2018. Explanation of EF-Scale Ratings. Retrieved at: https://www.weather.gov/hun/efscale_explanation

Figure 3.24 Comparison of EF-Scale and F-Scale for Tornado Magnitude (NOAA, 2016)



Thunderstorms are local storms, usually of short duration, that are accompanied by lightning and thunder. The average thunderstorm in the US is about 15 miles in diameter and lasts less than 30 minutes in any one location.[70] Most thunderstorm winds that cause severe damage result from the spreading out of downbursts and microbursts. Downburst winds are strong straight-line winds that can reach speeds of 125 mph, while microburst winds are more concentrated winds affecting a smaller area that can reach speeds of 150 mph.[71] According to the NWS, damage from severe thunderstorm winds accounts for half of all severe weather reports in the continental US and is more common than damage from tornadoes.[72]

A tropical cyclone is "a low-pressure area of closed circulation winds that originates over tropical waters."[73] The four building blocks for a tropical cyclone are: 1) a low-pressure disturbance, 2) warm sea surface temperature, 3) rotational force from the rotation of the earth, and 4) the absence of wind shear in the lowest 50,000 feet of the atmosphere. Tropical cyclones are often classified according to their wind speeds. Storms with wind speeds between 25 and 38 mph are known as tropical depressions, storms with wind speeds of 39 to 73 mph are known as tropical

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[70] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library/assets/documents/7251
[71] Ibid.
[72] NOAA, The National Severe Storms Laboratory, 2018. Severe Weather 101. https://www.nssl.noaa.gov/education/svrwx101/wind/
[73] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library/assets/documents/7251

storms, and storms with wind speeds of 74 mph or more are known as hurricanes. This section describes the high wind hazards associated with hurricanes.

Hurricanes are intense tropical cyclones with maximum sustained winds over water of 74 mph or higher. These storms are much larger than thunderstorms or tornadoes. The eye of a hurricane typically ranges from 10 to 30 nautical miles in diameter, and the surrounding storm may be 100 to 500 nautical miles in diameter.[74] These storms can cause extensive loss of life and property through several related hazards, including high winds, storm surge, flooding, coastal erosion, and lightning. This section, however, addresses only high wind. Flooding and storm surge hazards related to hurricanes and severe storms are discussed in Section 3.2.5.

In the US, the Atlantic coast is most prone to tropical cyclones, and the communities along the Gulf Coast are most prone to landfall by a hurricane.[75] The hurricanes that strike this region originate as tropical storms in the warm waters of the Gulf of Mexico, Caribbean Sea, or tropical Atlantic, then gain in intensify as they traverse the ocean. Atlantic hurricanes can occur from June through November, but hurricane activity is most intense in August and September. Since 1900, the US has experienced an average of 1.7 landfalling hurricanes per year.

The Saffir-Simpson scale is used to classify hurricanes according to their strength and expected damages. The scale uses information on central pressure, wind speed, storm surge height, and damage potential to assign each storm to one of five categories. It is important to note that the measure of wind speed used to classify hurricanes is different than the measure of wind speed used in the EF tornado scale and in engineering standards. While the Saffir-Simpson scale uses 1-minute sustained wind speeds over water, the EF tornado scale and engineering standards use the 3-second gust wind speed over land. Table 3.25 shows both the sustained wind speeds and level of damage corresponding to each Saffir-Simpson hurricane category, and the 3-second gust speeds that correspond to the sustained wind speeds.

Table 3.25 Saffir-Simpson Scale for Hurricane Magnitude (NWS, 2018)[76]

Saffir-Simpson Hurricane Category	Sustained Wind Speed over Water (mph)	3-Second Gust Wind Speed over Land (mph)	Damage Level
Category 1	74 - 95	82 - 108	Minimal
Category 2	96 - 110	109 - 130	Moderate
Category 3	111-130	131 - 156	Extensive

[74] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library/assets/documents/7251
[75] Ibid.
[76] NOAA, NWS, 2018. Explanation of EF-Scale Ratings. Retrieved at: https://www.weather.gov/hun/efscale_explanation

Saffir-Simpson Hurricane Category	Sustained Wind Speed over Water (mph)	3-Second Gust Wind Speed over Land (mph)	Damage Level
Category 4	131-155	157 - 191	Extreme
Category 5	>155	>191	Catastrophic

3.2.7.2 Nature of the Hazard in Alabama

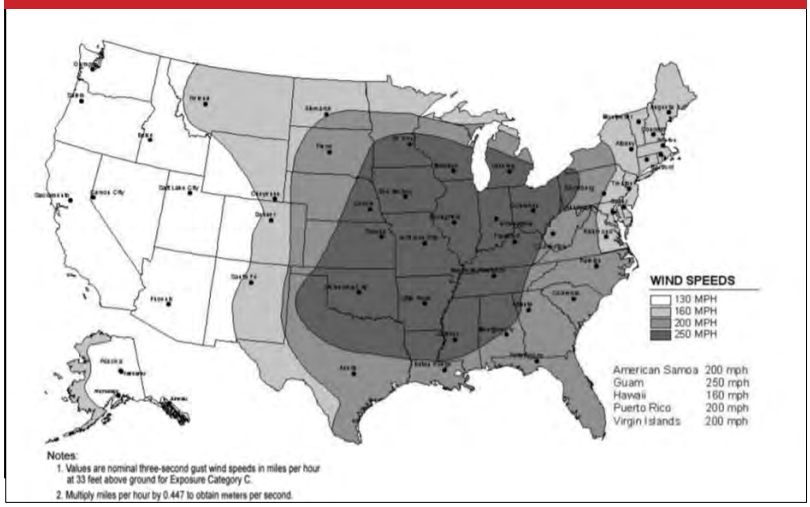
High winds from thunderstorms, tornadoes, and hurricanes are the largest loss-producing natural hazard in Alabama. According to NOAA's Storm Events Database, high winds caused nearly 700 fatalities between 1950 and 2017 and more than $15 billion in direct economic losses (adjusted to 2017 dollars). The most damaging events were tornadoes, which accounted for 92% of the wind-related fatalities and 66% of direct economic losses. Thunderstorm winds were also deadly, accounting for 7% of wind-related fatalities. While hurricane winds were less deadly, they were costlier in terms of economic loss. Between 1950 and 2017, hurricanes accounted for more than $5 billion in direct damage to property and crops.

Tornado frequency and intensity varies across Alabama, but is generally associated with the frequency and intensity of thunderstorms. The non-coastal regions of Alabama have a disproportionately high frequency of intense thunderstorms, and thus a disproportionately high frequency of strong tornadoes. Although tornadoes are most common between March and August, they can occur at any time.

The best protection against tornadoes is provided by a safe room built to the FEMA recommended criteria in FEMA P-361 or the International Code Council (ICC) Standard for the Design and Construction of Storm Shelters (ICC 500-2014). The ICC Standard provides criteria for the design, construction, and installation of shelters from high winds. For tornado safe rooms, the standard divides the US into four zones based on tornado threat and establishes a design wind speed for each zone (Figure 3.25). The design wind speeds range from 250 mph for the zone determined to have the greatest tornado threat, to 130 mph for the zone determined to have the least tornado threat. The entire state of Alabama falls into the highest and second highest tornado wind speed zones. While the state's coastal region lies in the 200-mph design wind speed zone, the non-coastal region lies in the 250-mph design wind speed zone.

Figure 3.25 Tornado Safe Room Design Wind Speeds (ICC 500-214)

ICC 500-2014 Reference Map



Alabama Detail

Alabama's coastal region is subject to the highest risk from hurricane winds. Wind speeds tend to decrease significantly within 12 hours of landfall, as drier and cooler air begins to power the eyewall. Depending on a hurricane's strength and forward motion, however, hurricane force winds (winds greater than or equal to 74 mph) can extend well inland. NOAA scientists developed the Inland Wind Model to estimate the maximum sustained surface wind as a storm moves inland. Model results show that hurricane force winds can extend inland under a range of conditions (Figure 3.26 and Figure 3.27). A Category 4 Hurricane with 24 knots of forward motion, for example, could produce hurricane force winds as far north as Birmingham.

Figure 3.26 Maximum Envelop of Winds for Category 2 Hurricane at 16 Knots (Inland Wind Model)

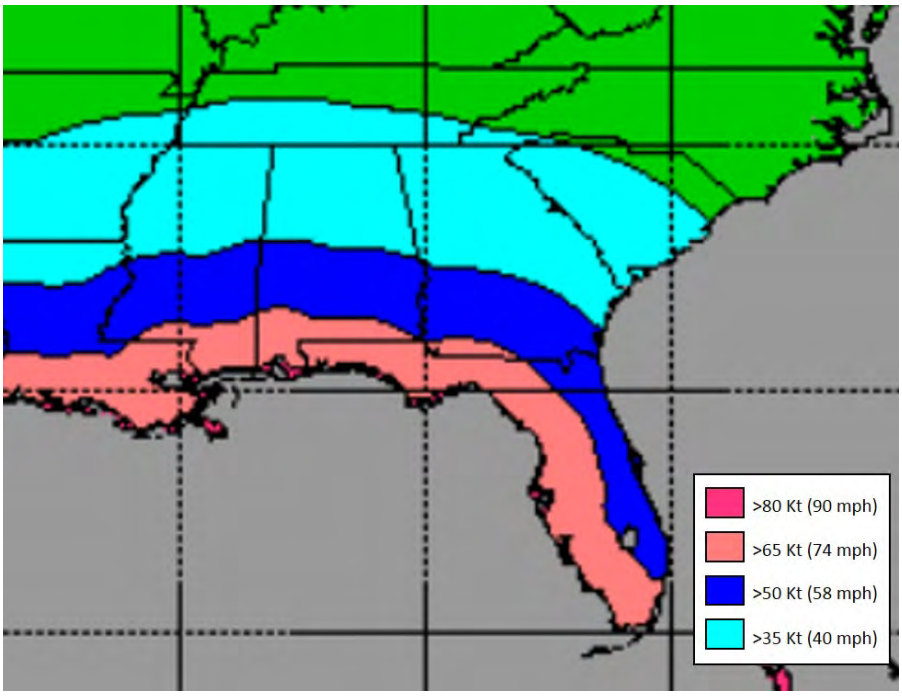
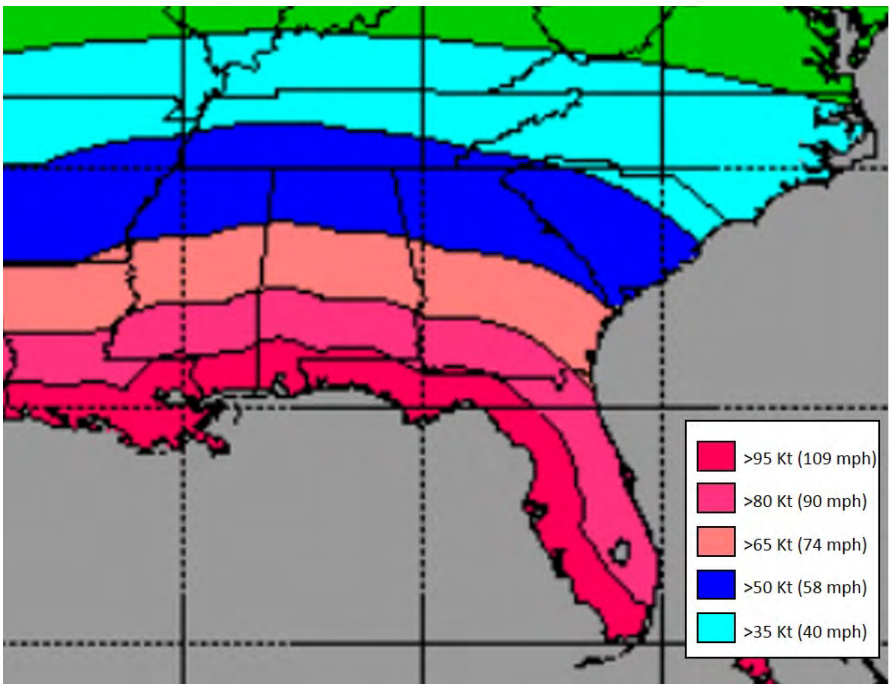
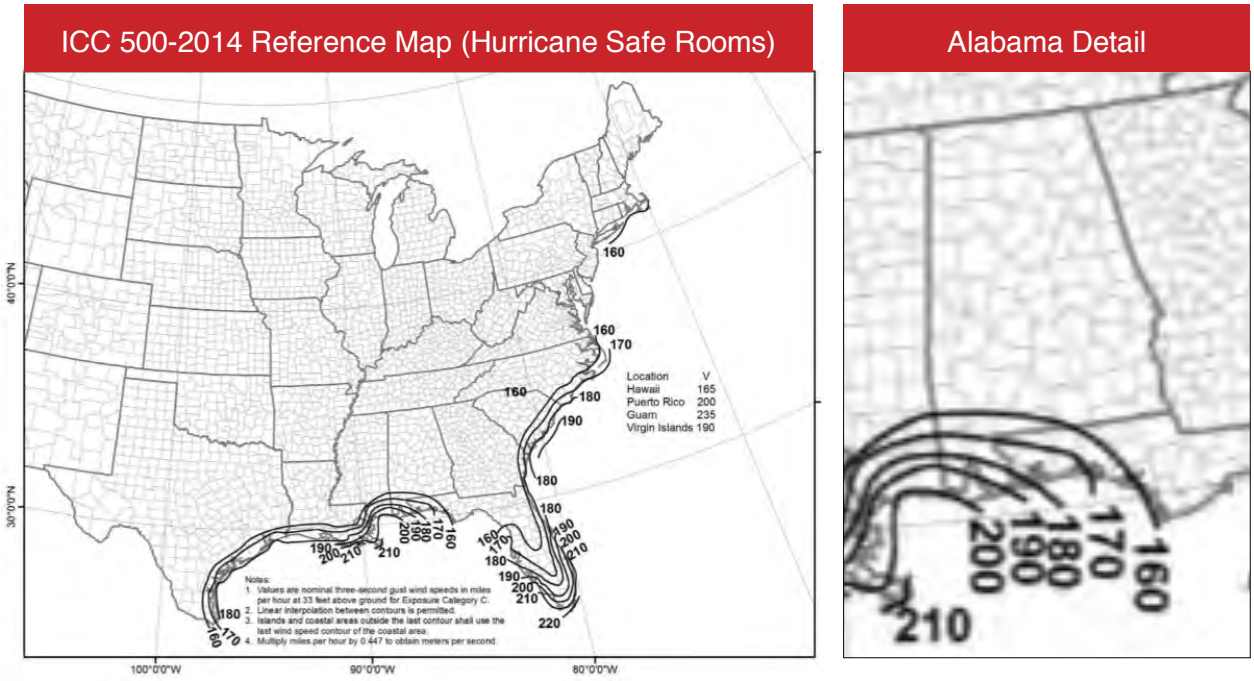


Figure 3.27 Maximum Envelop of Winds for Category 4 Hurricane at 24 Knots (Inland Wind Model)



As with tornadoes, the best protection from extreme hurricane winds is provided by a safe room built to the FEMA or ICC standards. For hurricane safe rooms, the design wind speed at a given location is the wind speed with a 0.5% probability of exceedance in 50 years (Figure 3.28). The design wind speeds range from 220 mph for the southern Florida coast, to 150 mph for interior regions. Most of Alabama falls into the lowest design wind speed zones for hurricane safe rooms, with only the coastal counties having higher design wind speeds.

Figure 3.28 Hurricane Safe Room Design Wind Speeds (ICC 500-214)

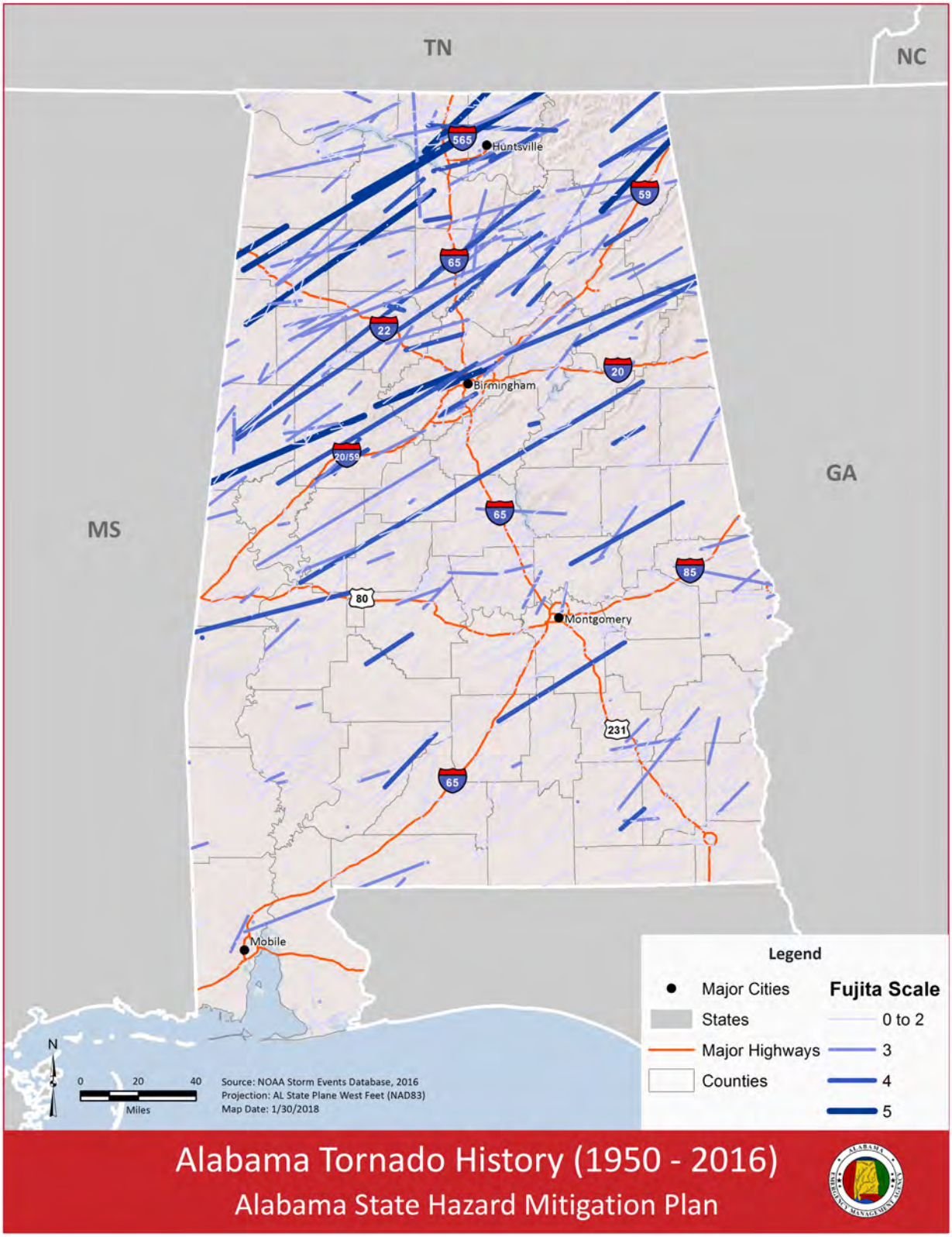


3.2.7.3 High Wind History in Alabama

3.2.7.3.1 Tornado Related High Wind History in Alabama

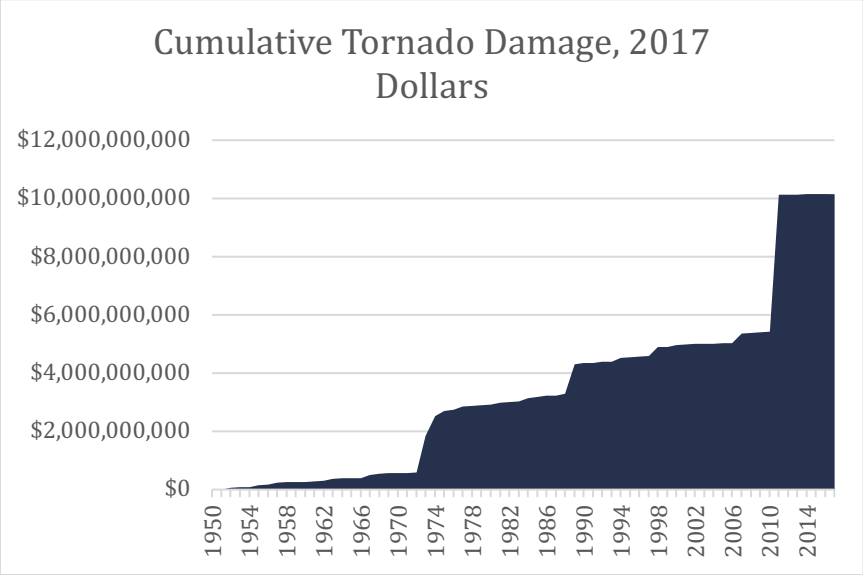
Between 1950 and 2017, the NWS Storm Events Database recorded 2,454 tornadoes in Alabama. Most of these were less damaging tornadoes measuring between F-0 and F-2 on the Fujita Scale and EF-0 to EF-2 on the Enhanced Fujita Scale, but 277 were more damaging tornadoes measuring greater than F-3 or EF-3 (Figure 3.29). The months of March and April had the highest frequency of strong tornadoes (with 43 and 109 tornadoes measuring 3 or greater, respectively), followed by the months of November and December (with 38 and 18 tornadoes measuring 3 or greater, respectively). Note that these counts reflect the number of observed tornadoes, rather than the number of tornadoes that occurred throughout the state. Note also that counting tornadoes is complicated by the occurrence of clusters of tornadoes that strike at about the same time, and by tornadoes that cross political boundaries.

Figure 3.29 Tornado History in Alabama (NOAA, 2016)



NOAA's Storm Events Database has collected data on tornado events since 1950. Between 1950 and 2017, tornadoes in Alabama caused at least $10.1 billion dollars in direct property damage, 629 deaths, and 8,132 injuries (Figure 3.30 and Figure 3.31). Fourteen of the most significant tornadoes to strike Alabama, as defined by the damage reported in the Storm Events Database, are described below. As discussed in the Introduction, property damage estimates from the Storm Events Database come with some limitations. The damage estimates are collected from diverse sources by staff with little or no training in damage estimation and are not compared with actual costs. In addition, the damage estimates only include direct physical damage to property, crops, and public infrastructure. Although damage estimates for individual events may be quite inaccurate, as estimates from many events are added together the errors become progressively smaller.[77]

Figure 3.30 Cumulative Property Damage (NOAA, 2017)



[77] Downton, M., Miller, Z., and Pielke, R., 2005. Reanalysis of US NWS Flood Loss Database. Natural Hazards Review, Vol. 6, No. 1.

Figure 3.31 Cumulative Deaths and Injuries (NOAA, 2017)

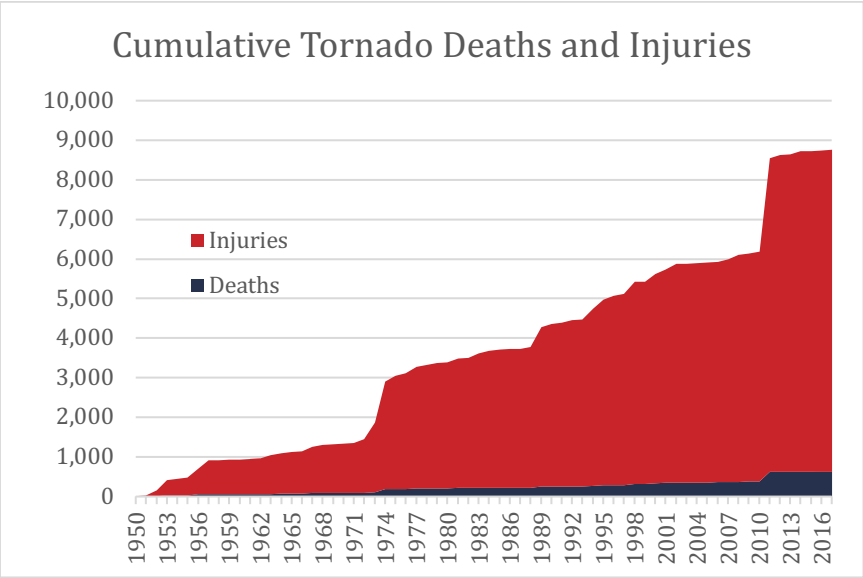


Table 3.26 Historical Tornado Events in Alabama (NWS, 2017)

Year	Location	Description
1932	Central and Northeastern Alabama	On March 21, 1932, seven tornadoes ripped through a dozen central and northeastern Alabama counties, leaving 268 people dead and 1,834 injured.
1974	Northwestern Alabama	A "Super Outbreak" occurred on April 3, 1974, between 3 and 9 p.m. At least seven tornadoes killed 86 people and injured 938. The following day, April 4, 1974, 20 counties were declared federal disaster areas.
1994	Northern Alabama	On March 30, 1994, the President declared seven counties in north Alabama major disaster areas resulting from tornadoes, flooding, and severe storms that struck the region on March 27, 1994. The storms moved across northeast Alabama to the Georgia state line, spawning tornadoes, flooding, and straight-line winds. These events were responsible for 22 deaths, over 150 injuries, and caused extensive property damage. The 50-mile long tornado path of the Cherokee County storm places it among the longest tornado tracks ever recorded in Alabama.
1995	Northern Alabama	Severe storms that began on February 15 and continued through February 20, 1995, produced high winds, rain, and tornadoes across north Alabama. The NWS confirmed three tornadoes, one of which was an F3 event that passed through the northern part of the state. On April 21, 1995, President Clinton issued a major disaster declaration for the five Alabama counties of Cullman, DeKalb, Marion, Marshall, and Winston. In the community of Arab, five people died as a result of the storms. Across the five counties, more than 30 people were injured and close to 300 homes and farm buildings were damaged.
2007	Throughout Alabama, including Wilcox and Coffee counties	On March 1, 2007, 12 tornadoes touched down throughout the State of Alabama, two of which were rated EF-4. The first EF-4 tornado occurred in Wilcox County causing one death and significant damage to about 70 residential properties. The second developed near the Enterprise Municipal Airport in Coffee County, causing 8 deaths, 121 injuries, and damage to at least 370 houses.
2007	Southern Alabama	On April 14, 2007, an EF-1 tornado struck parts of Bullock, Conecuh, Crenshaw, Dale, and Monroe counties. The tornado damaged residences, churches, and a poultry farm and left trees uprooted along its path. Property damage from this event totaled $1.26 million ($1.46 million in 2017 dollars).

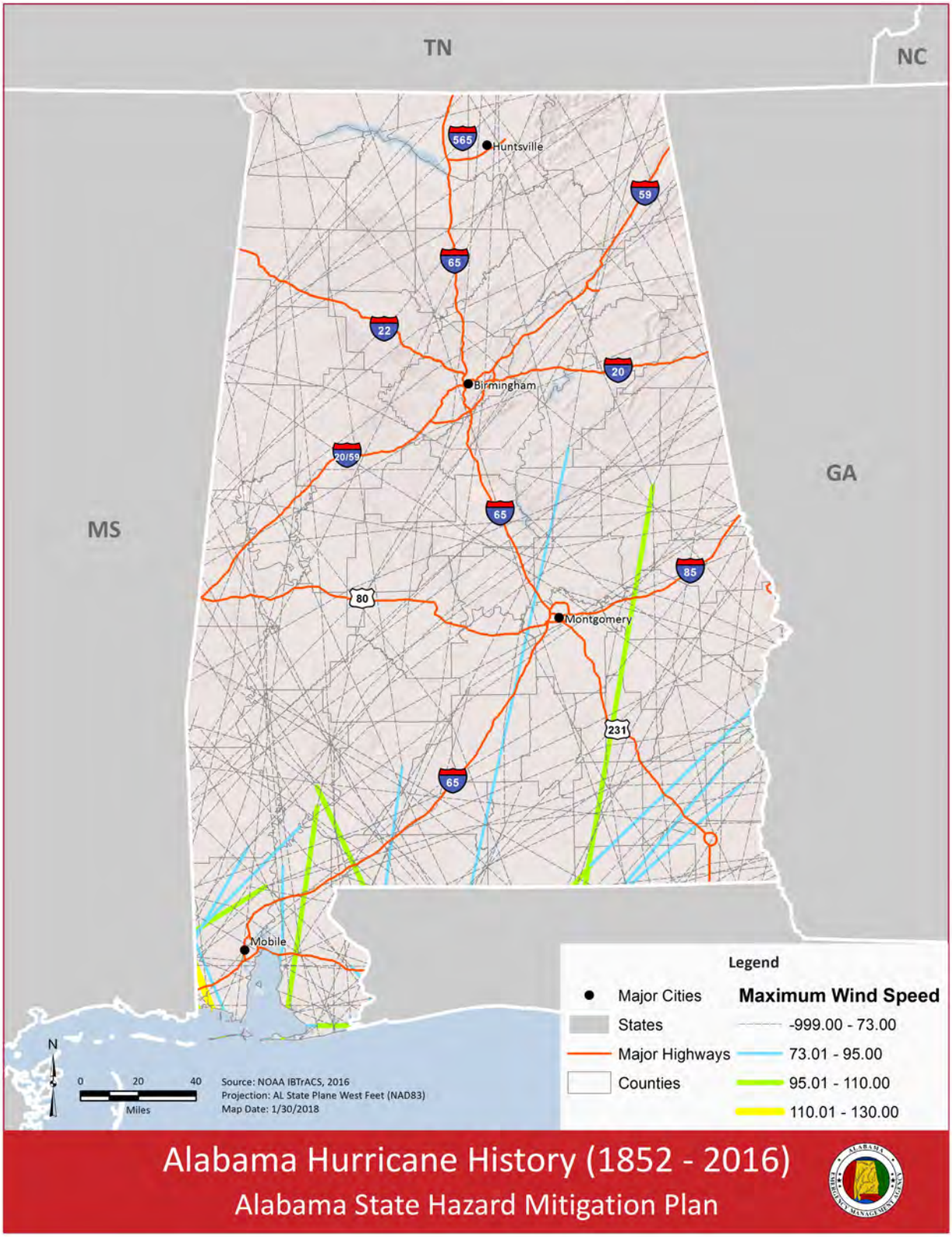
Year	Location	Description
2008	Northern Alabama	On February 6, 2008, the Weather Forecast Office (WFO) for the Huntsville County Warning Area experienced a tornado outbreak. While most of the tornadoes were minor EF-0 and EF-1 tornadoes, two EF-4 tornadoes were reported. The EF-4 tornadoes caused five fatalities and dozens of injuries in Walker, Lawrence, and Jackson counties. Property damage was estimated at $525,000 ($583,000 in 2012 dollars).
2008	Central Alabama	A long-lived supercell moved through Florida and into Alabama on February 17, 2008, producing a tornado outbreak along with hail and wind damage. The most significant tornado damage was associated with an EF-3 tornado in Autauga County, where an estimated 200 residences and 40 businesses were damaged or destroyed, and 50 people reported injuries. Property damages were estimated at $12.3 million ($13.9 million in 2017 dollars), with $10 million ($11.2 million in 2017 dollars) attributed to Autauga County alone.
2009	Northwestern Alabama	On April 19, 2009, supercells erupted across northwest Alabama. Initially, these storms were large hail producers, with up to baseball-sized hail reported in Franklin County. As the early evening progressed, this supercell tracked into Lawrence and Morgan counties producing wind damage and at least six tornadoes (the most severe measuring EF-2) as it moved east. The tornadoes caused two fatalities and produced property damage of $1.162 million ($1.27 million in 2017 dollars).
2010	Northeast Alabama	At least eight tornadoes hit northeast Alabama on the evening of April 24, 2010. Marshall County and DeKalb County were hardest hit. Some of the tracks were several miles long and reached EF-4 strength. No fatalities were reported but damage was severe including $15.8 million (2017 dollars) in property damage and over ninety-three homes destroyed in Marshall County alone.
2011	Central and Southwest Alabama	A strong line of thunderstorms produced several tornadoes in Central and Southwest Alabama on April 15, 2011. A total of forty tornadoes were recorded in the state, thirty of which touched down in Central Alabama. This set a (short-lived) record of tornadoes within the state from one event. Several injuries were reported as well as three fatalities in Washington County. These tornadoes largely spared populated areas, but damaged rural homes and timber holdings. According to the Alabama Forestry Commission, the tornadoes produced nearly $7.3 million (2017 dollars) in timber losses.

Year	Location	Description
2011	Throughout Alabama	The tornado events of April 27, 2011 impacted the most populous areas in the state and are the worst recorded in Alabama history. A total of 62 confirmed tornadoes were reported, with magnitudes ranging from EF-1 to EF-5. The tornadoes caused 248 fatalities and 2,219 injuries throughout the state. In all, thirty-five of Alabama's sixty-seven counties had damage, though the overall events (which also included straight-lines winds, severe storms, and flooding) led to disaster declarations in forty-three of the counties. AEMA estimates damage at $1.2 billion (2017 dollars), though the Storm Events Database estimates damage as high as 4.6 billion (2017 dollars). According to the Insurance Information Institute, almost $3 billion of the $3.2 billion that Alabama insurers paid out for catastrophe losses in 2011 can be traced directly to the tornadoes, hail, and thunderstorms associated with this super outbreak. The April 25-28th, 2011 super outbreak was the largest single-system tornado outbreak ever recorded and the second deadliest tornado outbreak in US history.
2014	Northern and Eastern Alabama	The deadly tornado outbreak of April 28-29, 2014 produced EF-3 tornadoes in four Alabama counties: Limestone, Cullman, Etowah, and Lee. These counties reported a total of 6 fatalities and 39 injuries. The outbreak was part of a larger storm system that generated 84 tornadoes over a period of 4 days, collectively causing 35 fatalities and over 300 injuries.
2016	Central Alabama	From November 29-30, 2016, a slow-moving weather system produced tornadoes, damaging winds, and some hail across Central Alabama. EF-3 tornadoes were reported in Morgan and Dekalb counties and were responsible for one death and nine injuries.
2018	Northern Alabama	On March 19, 2018, a powerful severe weather system produced a broken line of supercell thunderstorms and affected areas near and north of I-20. Fifteen tornado touchdowns were confirmed across the state, ranging in magnitude from EF-0 to EF-3. The most intense damage was located near and north of I-20, and near and east of I-65, but damage also occurred in the northwest sections of the state.

3.2.7.3.2 Hurricane Related High Wind History in Alabama

Between 1852 and 2016, NOAA recorded 120 tropical cyclone tracks in Alabama. Most of these tropical cyclones had maximum sustained wind speeds below 64 knots, but 18 struck the Alabama coast with hurricane force winds (Figure 3.32). The hurricanes that struck Alabama included one Category 3 hurricane (Frederic in 1979, which crossed the western end of Dauphin Island as a Category 4 hurricane), and nine Category 2 hurricanes (including Eloise in 1975, Opal in 1995, Ivan in 2004, and Dennis in 2005).

Figure 3.32 Hurricane History in Alabama (NOAA, 2016)



NOAA's Storm Events Database has collected data on hurricane events since 1996. Before summarizing this data, it is important to understand the way the Storm Events Database defines different hazard categories. Hurricanes are complicated events that involve multiple hazards, including storm surge, flooding, high winds, and tornadoes. To prevent double-counting of damages, the NWS instructs its field offices to separate damages caused by different hazards, and to assign only wind-related damages to the hurricane category. The NWS also advises its field offices to choose the hazard category based on the strength of the storm at their location. As hurricanes move inland and weaken, wind-related damages may therefore be assigned to other hazard categories (such as Tropical Storm or Strong/High Wind). Between 1996 and 2017, hurricane winds caused more than $5 billion dollars in direct economic losses in Alabama and two deaths. According to the Storm Events Database, the two hurricane seasons in which hurricane winds caused the most direct damage were 2004 ($3.25 million) and 2005 ($1 million). Six of the most significant hurricanes to affect Alabama, as defined by the estimated damage, are described below:

Table 3.27 Historical Hurricane Events in Alabama (NWS, 2017)

Year	Estimated Damage (2017 dollars)	Description
1979	$7.7 billion	One of Alabama's costliest hurricanes was Hurricane Frederic, a Category 3 event that resulted in widespread damage in south and southwest Alabama. Frederic came ashore on September 12, 1979, and caused enormous damage to parts of Alabama, Florida, and Mississippi. With winds reaching 145 miles per hour, Hurricane Frederic moved over Dauphin Island (near the mouth of Mobile Bay) and inland just west of Mobile, Alabama. The damage estimate of Frederic was $2.3 billion ($7.7 billion in 2017 dollars). Based on information from emergency preparedness officials, 250,000 people were safely evacuated in advance of Frederic. Eleven counties were included in the federal disaster declaration: Baldwin, Choctaw, Clarke, Conecuh, Covington, Escambia, Geneva, Marengo, Mobile, Monroe, and Washington. The hurricane impact area comprised 20.5 percent of the total land area of the State of Alabama. AEMA reports that more than 250 deaths were caused by the storm.
1997	$92.6 million	Hurricane Danny came ashore through Mobile Bay beginning during the evening of July 18 and continuing through the morning of July 19, 1997. Danny had sustained winds of approximately 85 miles per hour. The most severe wind damage was concentrated in the Fort Morgan and West Beach areas of Gulf Shores and Dauphin Island. Most of the damage to residential and commercial buildings was roof and water damage and broken windows. Most of the businesses were able to reopen within a day or two after the storm with the exception of some condominiums and hotels. As a result of the

Year	Estimated Damage (2017 dollars)	Description
		storm, three counties were declared disaster areas and received federal assistance to help aid in repairs.
1998	$269 million	Hurricane Georges made landfall near Biloxi Mississippi on September 28, 1998, and then weakened to a tropical depression before drifting to the east. In coastal Alabama, heavy rainfall and strong waves caused extensive property damage. Further inland, high winds downed power lines and trees, leaving 177,000 people without power after the storm. 17 shelters housed 4,977 people in the aftermath of the storm. Damage to the buildings was minimal to non-existent, with the only direct effect from the hurricane being a brief interruption of electricity. The damage estimate for Hurricane Georges reflects damage caused by storm surge as well as high winds.
2004	$3.26 billion	Hurricane Ivan made landfall on September 16, 2004, near Gulf Shores in Baldwin County as a strong Category 3 hurricane. In Baldwin County, the coastal areas from Fort Morgan to Gulf Shores to Orange Beach saw the worst damage from a hurricane in over a hundred years. Fallen trees caused extensive structural damage and power outages over inland areas. Agriculture interests also suffered major losses with significant damages to the cotton, soybean, and pecan crops. In fact, the soybean and pecan crops were nearly destroyed. Seven deaths in Alabama were attributed to Hurricane Ivan in Alabama, with six due to high storm surge levels and one due to a fallen tree. The entire state was declared a federal disaster area. Property damage was estimated at more than $3.2 billion, and the crop damage at more than $32 million, in 2017 dollars.
2005	$1.25 billion	Hurricane Katrina made landfall along the Louisiana and Mississippi Gulf Coasts on August 29, 2005, as a strong Category 3 hurricane before moving inland along the Mississippi-Alabama border. Katrina's winds had impacts that were widespread across western and central Alabama. Thousands of trees and power lines were brought down, minor to major structural damage occurred, and power outages were lengthy and widespread. Several locations remained without power for over a week. Six tornadoes occurred across central Alabama in association with Katrina (four F-0s and two F-1s). Alabama Power reported that this was the worst event in their history for damage and power outages statewide. Twenty-two counties in the western half of the state were declared a federal disaster area.

Year	Estimated Damage (2017 dollars)	Description
2017	Not yet available	The unusually active 2017 hurricane season saw Hurricane Nate striking the northern Gulf Coast on October 7-8. Hurricane Nate made two landfalls as a Category 1 hurricane, first in southeast Louisiana and then near Biloxi, Mississippi. The storm then tracked inland, spawning several tornadoes and causing tree damage, structural damage, and power outages across Alabama.

3.2.7.4 Probability of High Winds in Alabama

The best available guide to the probability of high winds in Alabama is the design wind speed maps produced for the ASCE standard on *Minimum Design Loads for Buildings and Other Structures*. ASCE standards provide technical guidelines for promoting safety and reliability in civil engineering, and are updated or reaffirmed at least every five years. The standard on *Minimum Design Loads for Buildings and Other Structures* was last updated in coordination with the ASCE Structural Engineering Institute (SEI) in 2016 and is generally referred to as ASCE/SEI 7-16. Chapters 26 through 31 of ASCE/SEI 7-16 address the design of buildings and other structures to resists wind loads.

The ASCE/SEI 7-16 standard includes wind speed maps for three probabilities of occurrence: the 300-year event (15% probability of exceedance in 50 years), the 700-year event (7% probability of exceedance in 50 years) and the 1,700-year event (3% probability of exceedance in 50 years). These frequencies reflect the average design life of a building (50 years) and the different levels of risk tolerance for different types of buildings. The highest level of risk (300-year event) is appropriate for buildings whose failure poses a low hazard to human life (e.g., agricultural facilities and minor storage facilities), while the lowest level of risk (1,700-year event) is appropriate for essential facilities (e.g., fire stations, police stations, and emergency shelters). It is important to note that the design wind speed maps do incorporate hurricane hazard data, but do not incorporate tornado hazard data. These maps can therefore be used to assess the threat of high winds from hurricanes, tropical storms, or thunderstorms, but cannot be used to assess the threat from tornadoes.

Figure 3.33 shows the ASCE/SEI 7-16 design wind speeds in Alabama with a recurrence interval of 700 years (7% probability of exceedance in 50 years). Wind speeds are estimated as 3-second gust wind speeds at a height of 33 feet (or 10 meters). The coastal counties have the highest probability of high winds from hurricanes, tropical storms, or thunderstorms.

Modeling and mapping the probability of tornado wind hazards is complicated by the lack of available data. The information available on tornadoes is limited by shorter periods of record, lower data archival requirements, and the inability to accurately measure tornado wind speeds. Furthermore, because the area of land directly affected by tornadoes is relatively small, tornado-

related winds have a significantly lower probability of occurrence at any given point than the high winds associated with other meteorological events. A general understanding of the probability of tornado wind hazards, however, can be derived from the record of historic tornado events maintained by the NWS Storm Events Database. Figure 3.34 shows the number of tornado touchdowns per 100 square miles by county between 1950 and 2016. The counties with the highest density of touchdowns are Limestone and Cullman counties. Note that the density of observed tornadoes reflects both the spatial distribution of the hazard, and the spatial distribution of monitoring and reporting capabilities.

Figure 3.33 Alabama High Winds with a Recurrence Interval of 700 Years (ASCE/SEI 7-16, 2016)

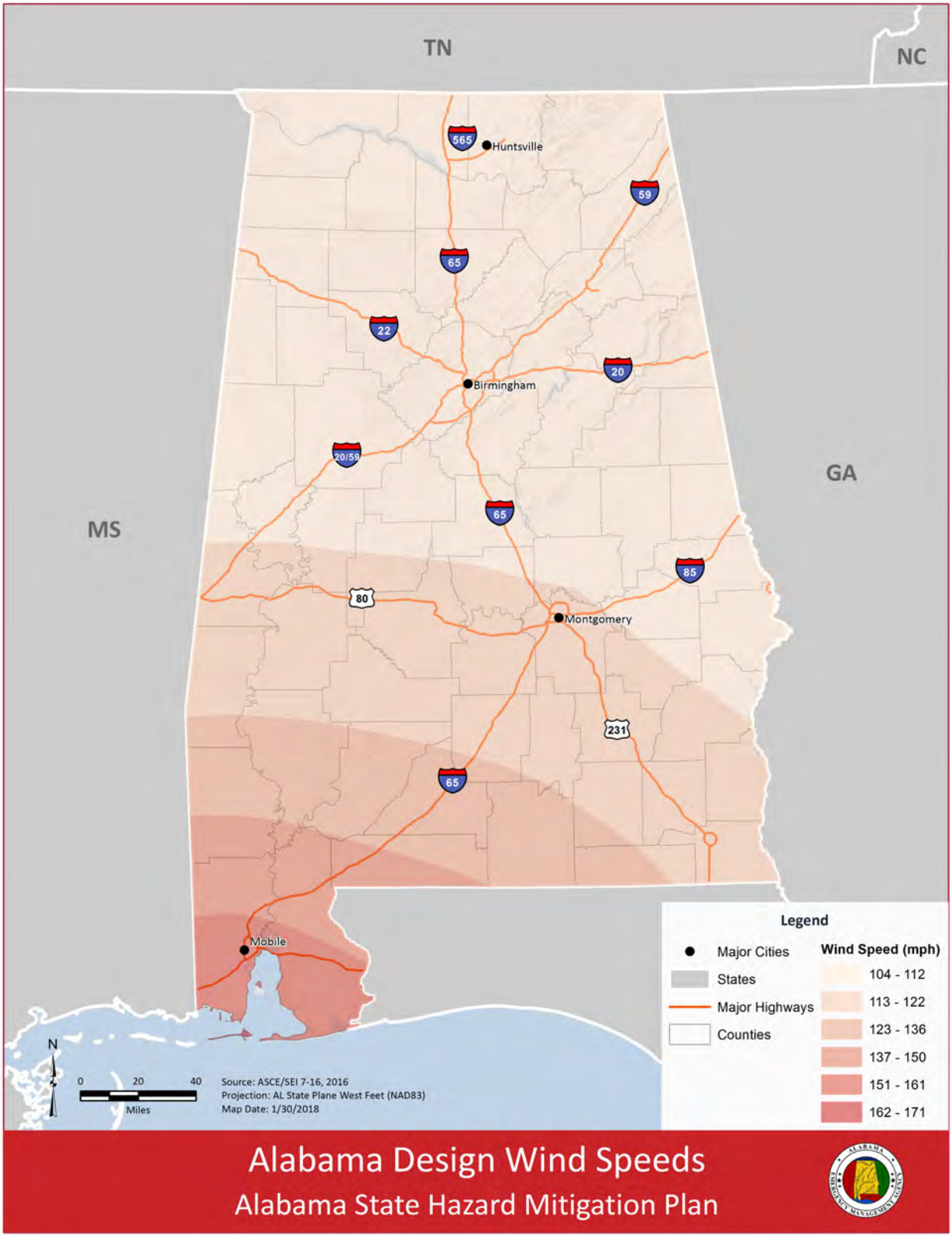
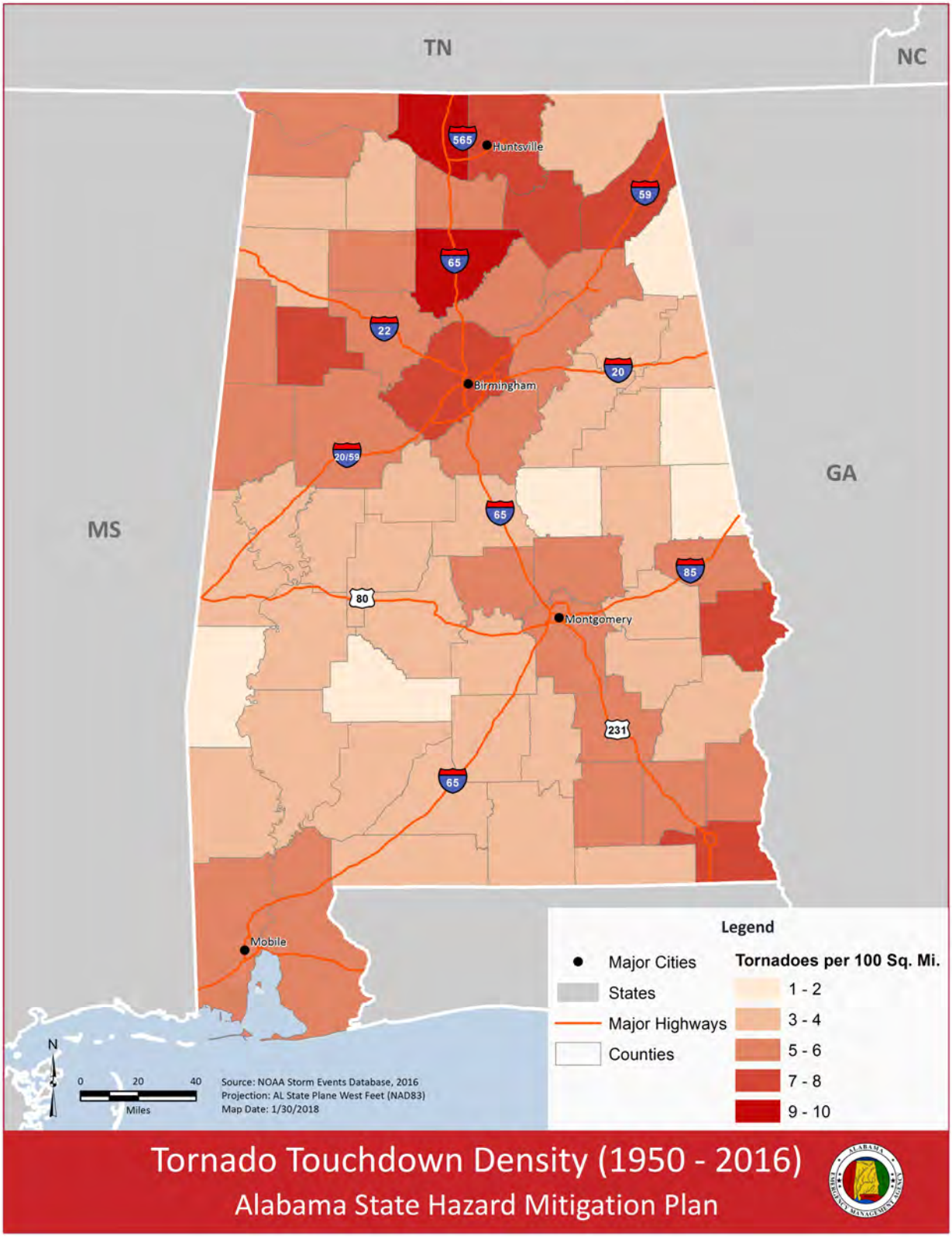


Figure 3.34 Alabama Tornado Touchdowns by County (NOAA, 2016)



3.2.7.4.1 Future Probability

The FEMA State Plan Review Guide requires states to consider changes to climate conditions that may affect their vulnerability to natural hazards. A review of the literature suggests that hurricane hazards in Alabama are likely to increase, while changes in tornado hazards remain uncertain.

The building blocks for tornadoes are atmospheric instability and wind shear. Atmospheric instability results when warm, moist air near the Earth's surface rises and interacts with cooler and drier air higher in the atmosphere. While the frequency of unstable conditions is expected to increase throughout the twenty-first century, global climate models suggest significant variability from one year to the next. In addition to atmospheric instability, tornadoes need strong vertical wind shear to provide a rotational source. While some studies anticipate a decrease in vertical wind shear due to a weakening of the pole-to-equator temperature gradient, other studies anticipate an increase in wind shear on days with high atmospheric instability.[78,79] Adding to these uncertainties, available tornado records are not long or reliable enough to detect long-term trends, and tornadoes are too small to be simulated by climate models. Until scientists develop a better understanding of historic trends and/or projected changes in the physical processes that drive tornadoes, the impact of climate change on tornado hazards will remain uncertain.

In contrast to the uncertainty regarding tornado hazards, hurricane hazards are generally expected to increase through the twenty-first century. The measures of hurricane activity include intensity, frequency, and duration. Since high-quality satellite data first became available in the early 1980s, scientists have observed a substantial increase in all of these measures of hurricane activity for North Atlantic hurricanes, as well as an increase in the frequency of the strongest (Category 4 and 5) hurricanes.[80] Although simulations of future hurricane activity span a range of possible outcomes, on average the models project an increase in the annual number of Category 4 and 5 hurricanes by the late twenty-first century, as well as a slight decrease in the number of tropical cyclones.[81] Changes in the storm tracks of North Atlantic hurricanes are less well understood. The storm tracks of North Atlantic hurricanes are shaped by both atmospheric

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[78] Emrich C. T., Morath D. P., Bowser G. C., and Reeves R. (2014). Climate-Sensitive Hazards in Florida: Identifying and Prioritizing Threats to Building Resilience against Climate Effects. University of South Carolina, Hazards and Vulnerability Research Institute. Retrieved from http://www.floridahealth.gov/environmental-health/climate-and-health/vulnerability/index.html

[79] Diffenbaugh, N. S., Scherer, M., and Trapp R. J. (2013) Robust increases in severe thunderstorm environments in response to greenhouse forcing. Proceedings of the National Academy of Sciences 110(41) 16361 – 16366.

[80] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the US: The Third National Climate Assessment. US Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

[81] *Ibid.*

dynamics and ocean circulation, and projected changes in ocean circulation remain poorly constrained.[82]

In short, emergency managers in Alabama can expect the probability of damaging high winds associated with hurricanes to increase through the twenty-first century and should adopt mitigation measures accordingly.

3.2.7.4.2 Risk and Vulnerability

A detailed assessment of vulnerability to high winds in Alabama is provided in Section 3.3.

[82] Woolings, T., Gregory, J. M., Pinto, J. G., Reyers, M., and Brayshaw, D. J. (2012). Response of the North Atlantic storm track to climate change shaped by ocean–atmosphere coupling. Nature Geoscience volume 5, pages 313–317.

3.2.8 Landslides

3.2.8.1 Description

"Landslide" is a general term that refers to the "downward and outward movement of slope-forming soil, rock, and vegetation under the influence of gravity."[83] There are many types of landslides, but some of the most common are rock falls, debris flows, mud flows, slides, and creep. Table 3.28 defines these types of landslides in terms of their material type, movement velocity, and movement character, and shows schematic diagrams developed by the USGS to illustrate each landslide type[84]. Debris flows are considered one of the most dangerous forms of landslides. This type of landslide usually starts on steep slopes during heavy rainfall, and often follows roadway drainage networks and streams. Because debris flows move rapidly and with great force, they can destroy almost everything in their path. Debris flows and mud flows differ only in the materials that flow downslope and are depicted by the same schematic.

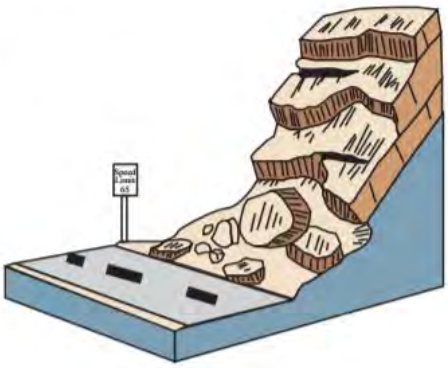
Table 3.28 Landslide Types

Landslide Type	Material	Movement Velocity	Movement Character
Rock Fall	Masses of rock	Varies	Material falls freely
Debris Flow	Loose soil, rock, and organic matter combined with water	Rapid	Material flows like a viscous fluid
Mud Flow	Slurry of water and fine sediment	Rapid	Material flows like a viscous fluid
Slide	Intact masses of soil or rock	Varies, generally moderate	Material slides downslope as a coherent unit
Creep	Masses of soil or rock	Very slow, generally imperceptible	Material moves slowly downslope, often causing leaning utility poles, trees, and retaining walls along the slope

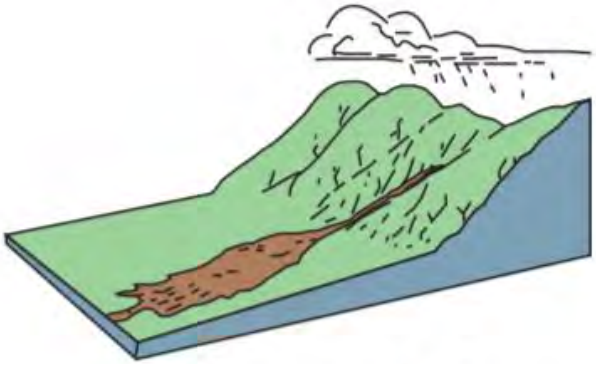
[83] Geological Survey of Alabama, 2018. Geologic Hazards: Landslide Science and Types. Website accessed at: https://www.gsa.state.al.us/gsa/geologic/hazards/landslides
[84] US Geological Survey, 2004. Landslide Types and Processes. Fact Sheet 2004-3072. Retrieved at: https://pubs.usgs.gov/fs/2004/3072/pdf/fs2004-3072.pdf

Figure 3.35 Landslide Types (USGS, 2004)

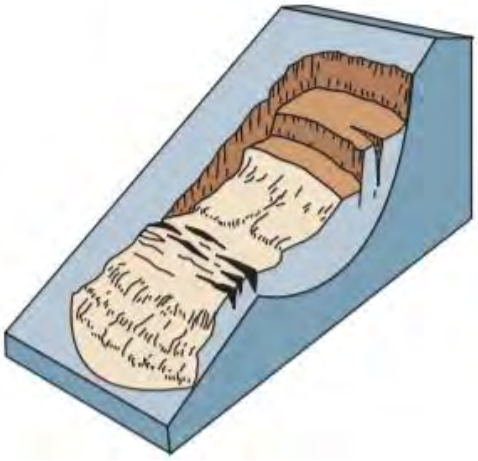
Rockfall



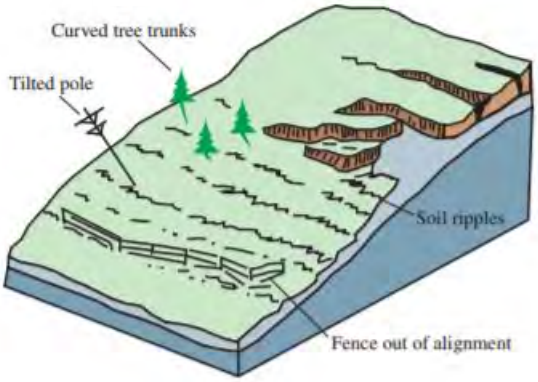
Debris Flow or Mud Flow



Slide



Creep



Landslides pose a risk to both property and life. They can damage or destroy homes, roads, infrastructure, forests, and farms. Because landslides are often triggered or exacerbated by other natural hazards, including flooding, earthquakes, and wildfires, the damage they cause is often attributed to the triggering events. In addition, landslides can contribute to other hazards, such as dam failure.

Landslides happen when areas that are landslide-prone are subject to natural and/or human-induced changes in the environment. Landslide-prone areas can be identified based on rock strength, slope, land cover, and known historical landslides. In general, landslides are more likely in areas with steeper slopes, weaker rocks, and sparser vegetation. Future landslides are also more likely to occur in areas with known historical landslides. Although landslides are most common in mountainous regions, they can also occur in areas with low relief as well, particularly

when natural or human-induced triggers are present. The environmental changes that can trigger a landslide include:[85]

- High precipitation
- Changes in groundwater level
- Seismic activity
- Construction or mining activity
- Over-steepening of slopes
- Changes in surface water runoff
- Heavy loads on slopes

It is important to emphasize that the likelihood of landslides is enhanced when slopes are destabilized by construction or erosion. Road cuts and other excavated areas are particularly susceptible to landslides.

3.2.8.2 Nature of the Hazard in Alabama

The geologic units that are most prone to landslides are those characterized by strongly cemented rocks and very steep slopes (more than thirty degrees); weakly cemented rocks and moderately steep slopes (more than fifteen degrees); and shales, clayey soils, or poorly compacted fills and slightly steep slopes (more than ten degrees). The GSA has developed a map of landslide susceptibility based on state data on Alabama rock types and USGS data on topography (Figure 3.35). Much of the state is underlain by weak rocks and shallows slopes, and the many of the geologic provinces with steeper slopes are also characterized by stronger rocks. Areas of steeper slopes tend to be concentrated in the Piedmont Upland, Valley and Ridge, and Cumberland Plateau geologic provinces located in the northeastern part of the state, as well as along river bluffs and roadcuts throughout the state. Areas of strongly cemented rock tend to be concentrated in the Piedmont Upland geologic province in the eastern part of the state and the Highland Rim geologic province in the northern part of the state. The GSA map shows how the interaction of geology and slope throughout the state produces highly localized areas of landslide susceptibility. In addition to geology and slope, mapping known historical landslides helps assess where landslides are likely to occur in the future. Points on the map show the incidence of past landslides as determined from historic topographic maps by Pomeroy (1982), Rheams (1982), and Thomas (1979, 1982). Notable geologic units with a documented history of landslides include (but are not limited to): the Tuscaloosa Group, Pottsville Formation, Parkwood Formation, Pennington Formation, Bangor Limestone, and Pride Mountain Formation. For details on the soil, clays,

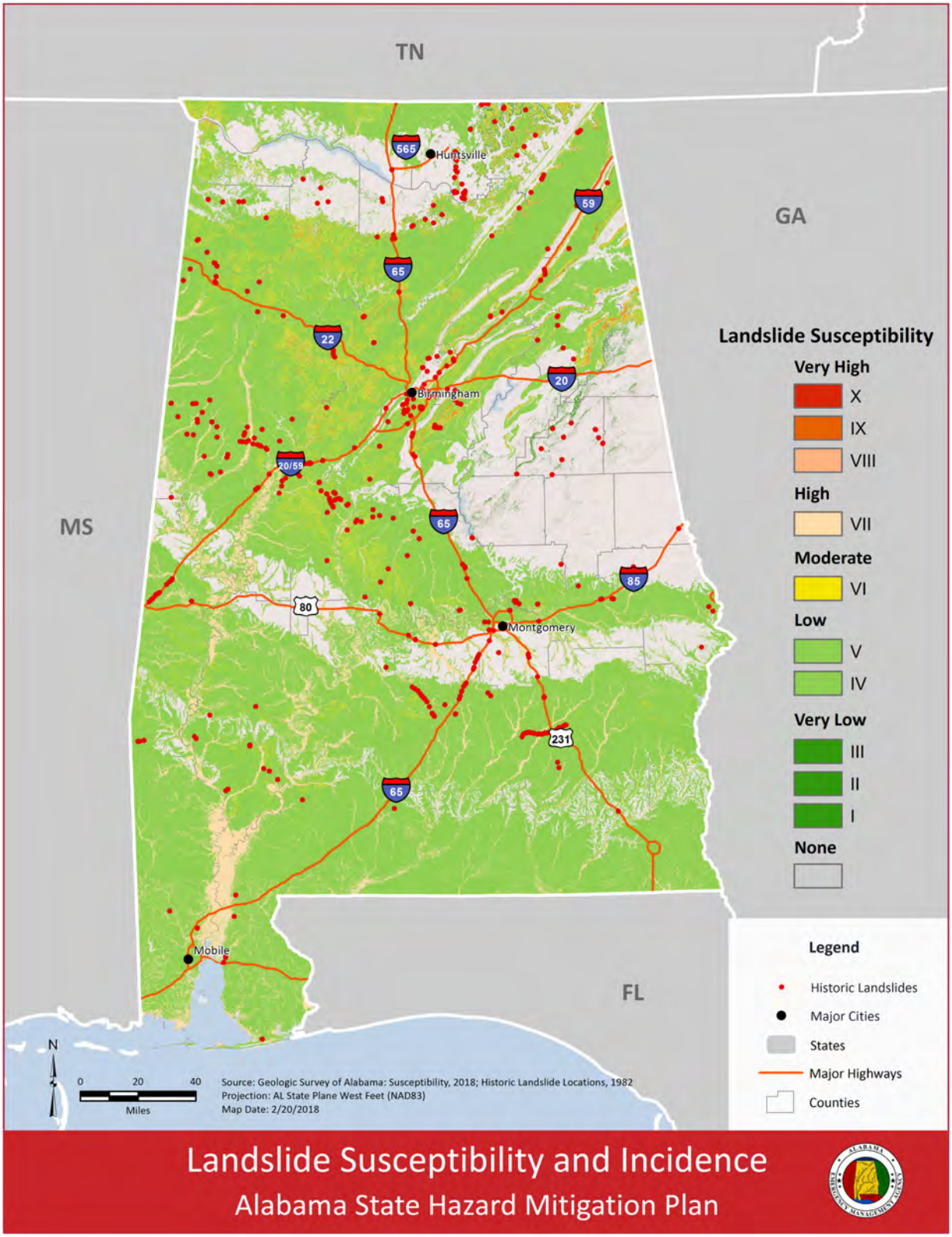
[85] Geological Survey of Alabama, 2018. Geologic Hazards: Landslide Science and Types. Website accessed at: https://www.gsa.state.al.us/gsa/geologic/hazards/landslides

shales, slopes, and fractures of these units and how these factors contribute to slide susceptibility, see USGS Bulletin 1649.[86]

Landslides become more likely during heavy rainfall. Annual rainfall averages indicate that the southwestern part of Alabama receives the most rainfall.

[86] John S. Pomeroy and Roger E. Thomas, 1985, Geologic Relationships of Slope Movement in Northern Alabama, US Geological Survey Bulletin 1649.

Figure 3.36 Landslide Incidence and Susceptibility (GSA, 2018)



3.2.8.3 Landslide History in Alabama

Alabama does not maintain a statewide real-time or near real-time record or reporting system of landslide events throughout the state. In the late 1970s and early 1980s, however, scientists at the GSA developed a map of historical landslide events based on historic topographic maps. Historical landslide events were identified by examining the contour lines in the 1:24,000-scale topographic maps published by the US Geological Survey through 1982 and identifying all features with curvatures characteristic of landslide events. The location of these historical landslides is shown in Figure 3.36.

To illustrate the potential impacts of landslides, Table 3.29 describes several historical events in Alabama that were reported to be geologically significant or to cause property damage. Images were available for the 1998 DeKalb County landslide and the 1998 Madison County landslide and are reproduced below the table (Figure 3.37). No new major landslide events were reported by the GSA for the 2018 plan update. Landslides reported in local newspapers were added to the table.

Table 3.29 Landslide History in Alabama

Date	Location	Description
Ancient	Hokes Bluff Etowah County	In 1996, geologists discovered the remnant of an ancient landslide at Hokes Bluff which formed a 140-foot hill. This massive landslide once ripped apart Colvin Mountain and sent millions of tons of rock sliding down into the valley floor.
1886	Bogan Mountain Cherokee County	The largest landslide in Alabama to be documented by the press was a large landslide (reported to be 1 mile long) along the side of Bogan Mountain that temporarily dammed up the Chattooga River. This landslide was described in an article in The New York Times on January 30, 1886. While the slide is not apparent on the topographic maps, the mountain does have steep slopes with a relatively high landslide susceptibility.
1972	North of Gadsen Etowah County	In 1972, the southbound lane of Interstate 59 slid from its perch on a mountainside down into the valley below. The landslide resulted in $1.3 million in repairs ($7.6 million in 2017 dollars) and prolonged disruption of traffic.
1988	Birmingham Jefferson County	In 1988, a landslide destroyed apartment buildings during the construction of an adjacent Festival Center. Estimated damages were over $10 million ($20.7 million in 2017 dollars).
1997 and 1998	Monte Sano Mountain Madison County	In 1997, 400,000 pounds of rock broke away from Monte Sano Mountain and crashed into Governors Drive. In 1998, extensive rainfall associated with a hurricane resulted in a major landslide with large fissures on Monte Sano Mountain. The slide, about 750 feet long and 200 feet wide, began near the top of the mountain in a relatively new neighborhood and threatened to wipe out an older residential area at the base of the mountain. Extensive dewatering and eventual removal of the affected rock prevented a major disaster.
1998	Lookout Mountain DeKalb County	In 1998, a landslide in DeKalb County wiped out County Highway 81 on Lookout Mountain. The landslide moved more than 117,000 cubic yards of rock and cost $1.7 million to repair ($2.5 million in 2017 dollars). Another landslide on Highway 35 between Rainsville and Fort Payne cost between $1-2 million to repair ($1.5 to $3 million in 2017 dollars).

Date	Location	Description
2005	Near Prattville Autauga County	In 2005, County Road 47 was closed by a landslide. The problem stemmed from unconsolidated sediments that move underneath the road when it rains. A temporary repair was implemented which cost between $150,000 and $200,000 ($184,000 and $246,000 in 2017 dollars). The Alabama Department of Transportation has since completed a permanent repair for a cost of approximately $1.5 million (according to the 2015 proposal).
March 2009	City of Alexander Tallapoosa	Rain-soaked ground led to the failure of an embankment on Morgan Street in Alexander City. The mudslide caused a portion of building to collapse, leaving large holes in the exterior walls of two businesses. Rain and mud then entered the businesses, heavily damaging or destroying much of the merchandise, and covering the floor with a layer of mud. The estimated property damage was $114,000 (or $130,000 in 2017 dollars).
January 2010	City of Daphne, Baldwin County	Daphne Police report a mudslide on the by-pass in Spanish Fort. The west bound lanes were blocked. The mudslide was caused by excessive heavy rainfall.
September 2011	City of Cordova, Walker County	Due to persistent, heavy rainfall from the remnants of Tropical Storm Lee, a mudslide occurred along River Road, northeast of Cordova. The road was closed until the debris could be removed. River Road and the surrounding area sustained extensive damage from two tornadoes on April 27, 2011, which stripped the land of most of the vegetation.
September 2011	Near Leeds Jefferson County	Rainfall amounts of 6 inches occurred near Leeds, causing a landslide to occur. Several large rocks blocked Dunnavant Road.
November 2011	Town of Section, Jackson County	A landslide along State Highway 35 occurred near the town of Section on the side of Sand Mountain in the early morning hours. At least two large boulders, one the size of a pickup truck, along with a large quantity of smaller rocks, dirt and trees slid into the road. A car was trapped under the landslide, and rescue crews were able to get the driver out unharmed. The road was not cleared and reopened until the afternoon.

Date	Location	Description
February 2012	City of Hartselle Morgan County	A landslide along I-65 closed the northbound lanes of the interstate between Hartselle and Priceville for about two weeks. Officials with the Alabama Department of Transportation first noticed the landslide encroaching on the shoulder of the road when they were repairing a sinkhole in the area. Traffic was detoured for two weeks while crews worked round the clock on the repair project.
April 2014	City of Vestavia Hills Jefferson County	Soil from a hillside slumped onto US 31 during heavy rains. The landslide buried a section of the highway near Brookwood Hospital under trees, mud and rock, blocking the highway's northbound lanes. Repairs were complete within a day.
December 2015	City of Attalla, Etowah County	A landslide along US 431 occurred near the city of Attalla, shutting down traffic in two lanes. The landslide occurred in the evening when a 50-foot section of rock, brush, tree limbs and soil came tumbling down the mountainside and covered two lanes of southbound traffic. No injuries were reported, but some cars were damaged by falling rocks.

Figure 3.37 Historical Landslides that Caused Property Damage

1998 DeKalb County Landslide

Source: GSA, 2018

1998 Madison County Landslide

Source: Alabama HMP, 2013

3.2.8.4 Probability of Landslides in Alabama

The probability of landslides cannot be expressed in terms of specific frequencies or return periods. These events are the culmination of multiple naturally-occurring and human-induced geological processes that play out over a range of timescales and can be highly localized. Areas

that are more landslide-prone can be identified, however, based on geologic characteristics and historic landslide events (Figure 3.36).

3.2.8.4.1 Future Probability

Some of the processes that increase the likelihood of landslides may be impacted by future climate change. These include high precipitation and changes in groundwater levels. If rainfall events become more intense in the future, the incidence of landslides in Alabama may increase. At the same time, more prolonged and intense drought events could lead to more groundwater withdrawals and the lowering of some water tables. In some instances, this effect could reduce the likelihood of landslides.

3.2.8.4.2 Risk and Vulnerability

A community's vulnerability to loss from landslides is a function of the probability of landslides, the exposure of structures to landslides, and the susceptibility of structures to landslides. In Alabama, landslide risk is highly site-specific and difficult to generalize. To the extent that new development takes place near steep slopes, drainage ways, or natural erosion valleys, it will be more vulnerable to loss from landslides. In addition, roadways are particularly vulnerable to disruption from landslides. Roadway systems with more redundancy will be more resilient to temporary closures.

3.2.9 Lightning

3.2.9.1 Description

Lightning is a discharge of electricity in the atmosphere that occurs between clouds, the air, or the ground. While lightning can occur during such events as volcanic eruptions, intense forest fires, and large hurricanes, lightning most typically occurs during a thunderstorm. In a thunderstorm, rising and descending air separates positive and negative charges. Additionally, the presence of water and ice particles may also affect this distribution of the electrical charge. The subsequent discharge of energy between these positive and negative charge areas results in lightning (Figure 3.38). Thunder is a by-product of lightning. In only a few millionths of a second, the air surrounding a lightning strike is heated to 50,000°F, a temperature five times hotter than the surface of the sun.[87] Thunder is the result of this rapid heating and cooling of air near the lightning that causes a shock wave.[88]

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[87] NOAA, The National Severe Storms Laboratory. Severe Weather 101 – Lightning. Retrieved at https://www.nssl.noaa.gov/education/svrwx101/lightning/basics/

[88] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

Figure 3.38 Formation of Lightning (University Corporation for Atmospheric Research (UCAR))

The risk posed by lightning is often underestimated by people in the vicinity. High winds, rainfall, and a darkening cloud cover are the warning signs for possible cloud-to-ground lightning strikes. While many lightning casualties happen at the beginning of an approaching storm, a significant number of lightning deaths occur after a thunderstorm has passed. Although the lightning threat diminishes after the last sound of thunder, the threat may persist for more than 30 minutes after the storm.[89] When thunderstorms are in the area, but not overhead, the lightning threat may still exist. Lightning can strike outward of ten miles from the storm.[90] Additionally, although most lightning-related deaths and injuries have occurred during the summer season, weather conditions conducive to thunderstorms and lightning can occur throughout the year.[91]

According to the NWS, there are approximately 25 million cloud-to-ground flashes detected every year in the US. However, approximately half of all cloud-to-ground lightning flashes have more than one ground strike point, resulting in at least 30 million points on the ground struck on average each year. In addition, there are roughly five to ten times as many cloud-to-cloud flashes as there are to cloud-to-ground flashes.[92] Although cloud-to-cloud lightning occurs more frequently, cloud-to-ground lightning flashes are those that pose a threat to human life.

Cloud-to-ground lightning can kill or injure people through a direct or indirect strike. Although not as common, a direct strike is potentially the most deadly. However, a portion of lightning current that has struck a taller object, such as a tree or pole, can branch off to a nearby person, generally within two feet of the object. In addition, electrical current from a lightning strike may be conducted

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[89] NOAA, NWS. Lightning Safety for You and Your Family. Retrieved at http://www.lightningsafety.noaa.gov/resources/Lightning-Brochure17.pdf
[90] NOAA, NWS. Understanding Lightning Science. Retrieved at http://www.lightningsafety.noaa.gov/science/science-overview.shtml
[91] NOAA, The National Severe Storms Laboratory. Severe Weather 101 – Lightning. Retrieved at https://www.nssl.noaa.gov/education/svrwx101/lightning/faq/
[92] NOAA, The National Severe Storms Laboratory. Severe Weather 101 – Lightning. Retrieved at https://www.nssl.noaa.gov/education/svrwx101/lightning/faq/

through the ground to a person after striking a nearby object. Lightning current may also travel longer distances through power lines or plumbing pipes to a person who is in contact with an electric appliance or plumbing fixture; this is known as conduction. Lightning may also directly and indirectly damage property through similar processes and may result in an explosion, fire, or destruction.[93]

Lightning is a significant cause of weather-related deaths in the US. Between 1987 and 2016, there was an average of 47 reported lightning fatalities per year in the US according to the NWS Storm Data. This number has decreased more recently to an annual average of 30 reported lightning fatalities between 2000 and 2016. However, only approximately ten percent of people struck by lightning are killed. Therefore, the total number of people struck by lightning in the US on average is approximately 300 per year. Those that are struck by lightning, but do not suffer fatal injuries, may sustain long-term injuries.[94]

3.2.9.2 Nature of the Hazard in Alabama

Although lightning can occur anywhere throughout the US, lightning is more likely to occur in areas with conditions conducive to thunderstorm cloud formation. This happens when a large amount of moisture is present low within the atmosphere, surface temperatures are higher, and there is sufficient upward air movement.[95] These conditions are often met along the Gulf of Mexico, which has high frequencies of cloud-to-ground lightning flashes with Florida having the greatest annual average cloud-to-ground flashes per square mile (20.8 flashes per square mile). Alabama, in close proximity to the Gulf of Mexico, ranks seventh of the 48 continental states in annual average cloud-to-ground flashes per square mile (14 flashes per square mile).[96]

Between 1959 and 2016, Alabama ranked twelfth in the US in the number of deaths from lightning; when weighted by population, Alabama ranked fifteenth. In the past decade, between 2007 and 2016, Alabama has ranked in the top ten in terms of number of deaths per lightning including

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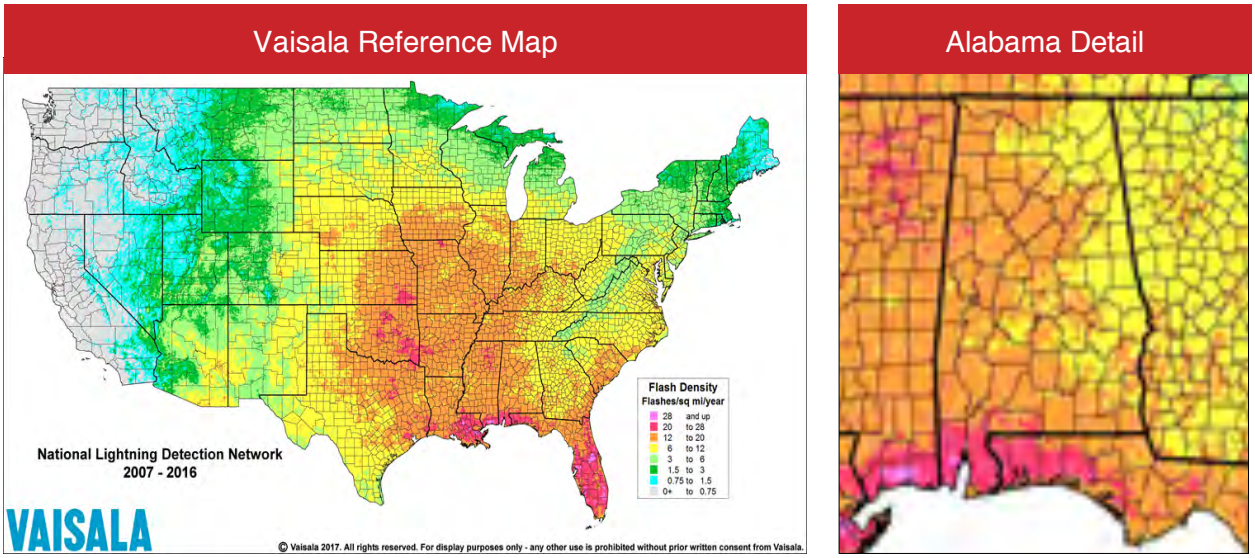
[93] NOAA, NWS. Lightning Science: Five Ways Lightning Strikes People. Retrieved at http://www.lightningsafety.noaa.gov/struck.shtml
[94] NOAA, NWS. How Dangerous is Lightning? Retrieved at http://www.nws.noaa.gov/om/lightning/odds.shtml
[95] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf
[96] Vaisala Inc. Number of Cloud-To-Ground Flashes by State from 2007 to 2016 and Rank of Cloud-To-Ground Flash Densities by State from 2007 To 2016, March 2017. Retrieved at http://www.lightningsafety.noaa.gov/stats/07-16_Flash_Density_State.pdf

when weighted by population.[97] In 2017, there were 16 lightning-related deaths in the US, three of which occurred in Alabama, which was had second highest number after Florida.[98]

The frequency and duration of thunderstorms are the main factors that influence the frequency of lightning strikes. Based on historic data collected by the NWS, southern counties near the Gulf of Mexico have the highest frequency of thunderstorms in the state. These counties include Baldwin, Mobile, Washington, and Escambia. While the remainder of the state also experiences high frequencies of thunderstorms, counties located in the northern half of the state have more frequent thunderstorms than counties that are centrally located. Unlike thunderstorm frequency, thunderstorm duration is generally uniform throughout the state.[99] In addition to thunderstorm frequency and duration, past lightning strikes can help determine where lighting is more likely to occur in the future. According to the National Lightning Detection Network (NLDN), between 2007 and 2016, the average annual density of lightning flashes, expressed as flashes per square mile, was highest in the southern-most counties of the state, specifically in Mobile and Baldwin Counties. Figure 3.39 provides a map of average annual density of lightning flashes in the US. As illustrated in Figure 3.39, the southern and western portions of the state have high densities of lightning flashes. Lightning density decreases in the eastern portion of the state approaching the border with Georgia.

Figure 3.39 Average Annual Density of Lightning Flashes (Vaisala, 2018)



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[97] Vaisala Inc. Lightning Fatalities by State. April 2017. Retrieved at http://www.lightningsafety.noaa.gov/stats/07-16_State_Ltg_Fatality_Fatality_Rate_Maps.pdf
[98] NOAA, NWS. Lightning Fatalities 2017 by State. http://www.lightningsafety.noaa.gov/fatalities/fatalities17.shtml
[99] FEMA, 1997. Multihazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy. Retrieved at: https://www.fema.gov/media-library-data/20130726-1545-20490-4487/mhira_in.pdf

3.2.9.3 Lightning History in Alabama

NOAA's National Centers for Environmental Information (NCEI) maintains the Storm Events Database that records storms occurrences and other severe weather events including lightning strikes that have led to casualties, injuries, property damage, and/or disruption to commerce. According the NOAA's Storm Events Database, between 1996 and August 2017, there were 651 lightning strikes reported in Alabama that resulted in 33 fatalities and 164 injuries. Additionally, lightning caused nearly $29 million in property damages and more than $25,000 in damages to crops. More than 87 percent of the lightning events recorded in the State between 1996 and 2017 occurred during the six-month period between March and August. Further, more than 60 percent of the events occurred in the summer months between June and August.

To illustrate the impacts of lightning events, Table 3.30 provides select incidents of lightning strikes that have resulted in death, injuries, and/or property damage in the state. The information in the table includes the date and location of the strike, the number of fatalities and/or injuries, the value of property damage adjusted for inflation, and a brief description of the impact. This information was obtained from NCEI's Storm Events Database. These select incidents show the severity and potential widespread damage resulting from a lightning strike.

Table 3.30 Select Past Occurrences of Lightning Events in Alabama

Date	Location	Fatalities	Injuries	Property Damage (in 2017 dollars)	Event Details
March 2001	Beatrice, Monroe County	0	0	$690,000	Lightning struck a tree near Beatrice Elementary School just before school opened. The lightning ran through the roots of a tree causing the gymnasium to catch on fire, which was destroyed. The remainder of the school suffered only minor damage from the fire.
June 2002	Hamilton, Marion County	3	4	$54,400	Lightning was believed to be responsible for a fire in a mobile home, resulting in the death of three children and two adults, two other children were injured in the fire. The State Fire Marshall said the preliminary investigation indicated the fire started in the general area of the living room around the television. A burn at the base of the utility box outside the residence indicated that lightning could have been involved in starting the fire.
July 2005	Etowah County	0	0	$137,500	An auto body shop in Attalla was struck by lightning. The ensuing fire destroyed the entire business. Another lightning strike hit a clothes drier in a home in Gadsden. The residents were able to extinguish the fire after it caused minor damage.
April 2006	Semmes, Mobile County	0	0	$960,000	Lightning struck an elementary school just north of Semmes. The lightning struck the roof starting a fire in the ceiling. It took several hours to put the fire out. Most of the damage was confined to the roof and ceiling area.
August 2006	Mount Vernon, Mobile County	0	0	$600,000	Lightning struck a church in the Mount Vernon area in Mobile County. The strike started a fire and the church was destroyed by the blaze.

Date	Location	Fatalities	Injuries	Property Damage (in 2017 dollars)	Event Details
June 2007	Hueytown, Jefferson County	0	6	0	Lightning struck a drilling rig at the Shoal Creek Mine in western Jefferson County. The lightning ignited methane gas in the mine and six miners were injured by the subsequent fire.
February 2008	DeKalb, Jackson, and Marshall Counties	0	0	0	A lightning strike knocked out the main switching facility of Farmer Telecommunications Cooperative, resulting in loss of phone service over much of DeKalb, Jackson, and Marshall counties. The general manager was quoted as saying this was the worst severe weather-related damage to the main switch in 30 years.
July 2009	Atmore, Escambia County	1	0	0	A woman was struck and seriously injured while taking out the garbage at her residence on the morning of July 6th. She later died on July 8th.
July 2010	Cottonville, Marshall County	1	4	0	Five people including a 15-year old were struck by lightning from a thunderstorm at a campground along Lake Guntersville. A fifteen-year-old from this group was killed and four were injured. They were swimming near the water's edge. The storm also knocked down some trees and produced intense lightning.
April 2011	Pumpkin Center, Morgan County	0	0	$540,000	Lightning sparked a fire at the Bellview Baptist Church on Old Moulton Road. The fire destroyed the education building and fellowship hall.

Date	Location	Fatalities	Injuries	Property Damage (in 2017 dollars)	Event Details
March 2012	Morgan County	0	1	$21,400	Lightning struck a female who was taking photos with a cell phone of a storm with her arm outside the home through a doorway. The female felt a surge of electricity through her arm, into her neck and out her wrist which appeared bruised. She then suffered a seizure for several minutes. She was hospitalized overnight. The Morgan County emergency manager reported at least 3 fires sparked by lightning the county.
August 2013	Jasper, Walker County	0	0	$813,750	Lightning struck the First Church of the Nazarene, causing a fire that destroyed the building.
June 2015	Covington County	2	0	0	A male and female were struck and killed by lightning as they were attempting to cover a chicken coup which was by a tree.
July 2016	Madison County	1	3	0	Lightning killed a man working outdoors at Redstone Arsenal in Huntsville with minor injuries to three others.
August 2017	Gulf Shores, Baldwin County	1	5	0	A group of 6 men were struck by lightning on the beach in Gulf Shores. There were 5 injuries and 1 died.

3.2.9.4 Probability of Lightning in Alabama

Areas that have a high density of cloud-to-ground lightning strikes are at a greater risk for potential property damage, injuries, or fatalities. Between 2007 and 2016, an average of 726,033 cloud-to-ground flashes occurred in the state each year, which is a density of 14 flashes per square mile. As discussed above, Alabama ranked seventh of the 48 continental states in terms of the average annual density of cloud-to-ground flashes.[100] Therefore, the probability of a cloud-to-ground lightning strike and the potential for lightning to result in damage are relatively high in the state of Alabama.

As discussed above and as shown in Figure 3.39, Alabama's southern-most counties have the highest average annual densities of lightning flashes in the state. Therefore, the probability of a cloud-to-ground lightning strike is likely highest in Mobile and Baldwin Counties. However, other counties near the southern border of the state and counties located in the western half of the state also have high densities of lightning flashes and have a higher probability of a lightning strike than those in the eastern portion of the state where lightning flash densities diminish.

However, because the impacts of a lightning strike are so localized, the site-specific incidence of a lightning strike occurring is considered very low. For example, while on average over one-quarter of a million cloud-to-ground lightning strikes are recorded annually, between 1996 and 2017, only approximately 30 lightning occurrences each year were reported to result in property damage, fatalities, or injuries according to NCEI's Storm Events Database.

3.2.9.4.1 Future Probability

Since the probability of a lightning event is influenced by the probability of a severe thunderstorm occurrence, potential future changes in climate and weather conditions may impact the future probability of cloud-to-ground lightning strikes. However, future projections in the severity and frequency of thunderstorms are uncertain in the Southeast US. Although the number of severe thunderstorms reported in this region has increased in the last 50 years, it has largely been attributed to advancement in reporting technologies.[101] Further, the future probability of lightning activity is not forecasted as lightning strikes are frequent and widespread. Additionally, forecasters' understanding of the cloud electrification process is incomplete.[102]

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[100] Vaisala Inc. Number of Cloud-To-Ground Flashes by State from 2007 to 2016 and Rank of Cloud-To-Ground Flash Densities by State from 2007 To 2016, March 2017. Retrieved at http://www.lightningsafety.noaa.gov/stats/07-16_Flash_Density_State.pdf

[101] Ingram, K., K. Dow, L. Carter, J. Anderson, eds. 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

[102] NOAA, The National Severe Storms Laboratory. Severe Weather 101 – Lightning. Retrieved at https://www.nssl.noaa.gov/education/svrwx101/lightning/forecasting/

3.2.9.4.2 Risk and Vulnerability

A community's vulnerability to loss from lightning strikes is a function of the probability of lightning strikes, the exposure of structures and people to the hazard, and the susceptibility of structures and infrastructure to the hazard. Although the southern and western portions of the state have the highest probability of cloud-to-ground lightning flashes, the large percentage of plans that recognize lightning as a significant hazard indicates that the risk of lightning is high throughout the state. People and property throughout the state are vulnerable to loss of life, injury, or property damage from lightning. The people who are most susceptible to death or injury from lighting strikes are those who are engaged in outdoor activities and/or exposed to the outdoors. Therefore, vulnerability at the individual level is influenced by the ability to seek suitable shelter and the level of understanding of lightning safety procedures.

3.2.10 Sea Level Rise and Coastal Land Change

3.2.10.1 Description

Sea level rise is a global phenomenon with varying local impacts. At the global scale, climate change is driving the rising seas. Warming oceans are causing ocean waters to expand, and the melting of land-based ice (glaciers and ice sheets) is causing ocean volumes to rise.[103] At the local scale, however, a range of local factors can hasten or slow the rate of sea level rise seen by communities. Depending on the direction and magnitude of these local factors, local sea level can be observed to rise faster or slower than the global average and can even be observed to fall.[104]

In the US, observed rates of sea level rise range from an average increase of 9.65 mm/year at Eugene Island, Louisiana to an average decrease of 17.53 mm/year at Skagway, Alaska.[105] Figure 3.40 shows local sea level trends across the US, with the arrows representing the direction and magnitude of change. The highest rates of sea level rise are seen along the Texas and Louisiana coastlines.

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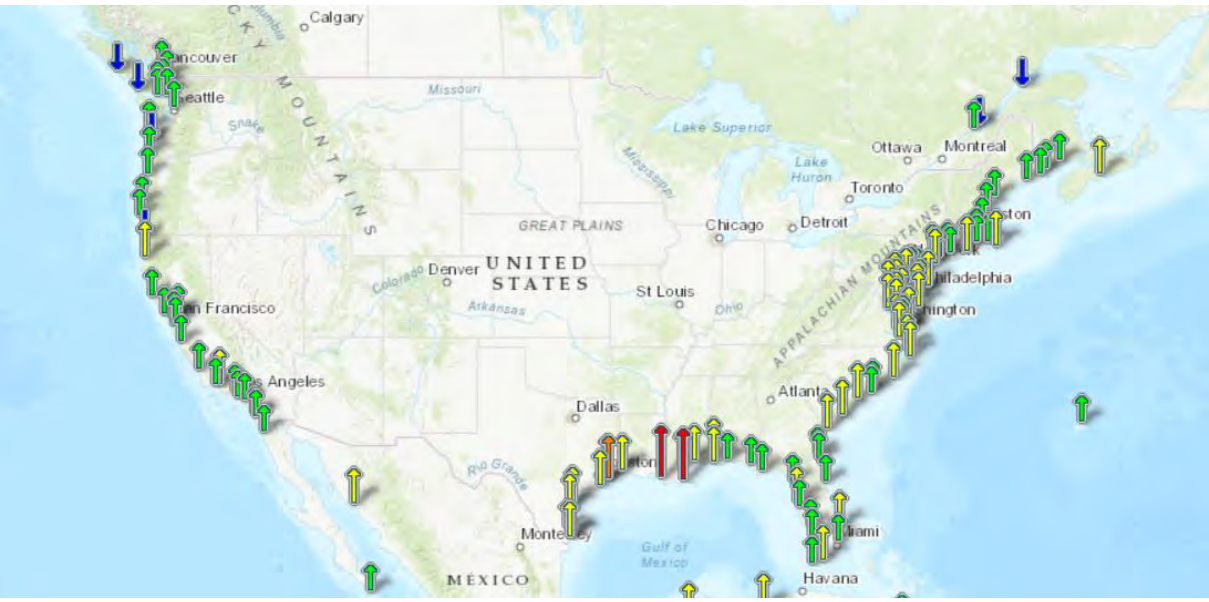
[103] NOAA, 2018. Is sea level rising? Website accessed at: https://oceanservice.noaa.gov/facts/sealevel.html

[104] NOAA, 2018. What is the difference between local sea level and global sea level? Website accessed at: https://oceanservice.noaa.gov/facts/sealevel-global-local.html

[105] NOAA, 2018. US Linear Relative Sea Level (RSL) trends. Website accessed at: https://tidesandcurrents.noaa.gov/sltrends/mslUSTrendsTable.htm

Figure 3.40 Local Sea Level Trends (NOAA, 2018)



The local factors that shape the height of water along a coast include regional ocean currents and regional changes in ground elevation (i.e., land subsidence or uplift). Regional changes in ground elevation can be caused by many different natural processes and human activities. The most common natural causes are fault processes, sediment compaction, sediment loading, and glacial isostatic adjustment, while the most common human causes are fluid withdrawal (i.e., the extraction of oil, gas, and groundwater) and surface water drainage. Table 3.31 provides a brief summary of each of these processes.[106]

Table 3.31 Causes of Vertical Land Movement in Coastal Environments

Process	Typical Location	Description
Fault Processes	Faults	The movement of the earth's crust along faults can cause changes in land elevation. This process can cause either land subsidence or uplift.
Sediment Compaction	River deltas	River deltas are landforms created over time by the deposition of river sediments. As these sediments settle, their volume is reduced and the land surface sinks.

[106] Yuill, B., Lavoie, D., and Reed, J., 2009. Understanding Subsidence Processes in Coastal Louisiana. Journal of Coastal Research, Special Issue No. 54.

Process	Typical Location	Description
Sediment Loading	River deltas, lakes, valleys	In places where large sediment loads are deposited over a relatively small area, the weight of the sediment load can deform the earth's crust. If the bending of the underlying crust is not balanced by the accumulation of new sediment deposits, the land surface will sink.
Glacial Isostatic Adjustment	Glaciated and forebulge areas	During the last Ice Age, glaciers covered much of the northern half of North America. Even though these glaciers retreated long ago, the earth's crust is still adjusting to the removal of their weight. Similar to a soft mattress, the areas that were once beneath the glaciers are slowly rising, while the areas that were once pressed up around the edges (the forebulge areas) are slowly sinking.
Fluid Withdrawal	Areas mined for hydrocarbons or groundwater	The extraction of water, oil, and natural gas removes the support provided by the fluid and can cause the ground to sink.
Surface Water Drainage	Areas dewatered with subsurface drainage systems	When organic soils are dewatered, their volume is reduced and the land surface sinks.

Local sea level rise will fundamentally change coastal environments in the US, exacerbating existing flooding hazards and creating new coastal change hazards. While Section 3.2.5 discusses the acute but episodic hazards posed by the flooding impacts of sea level rise, this section discusses the slow-moving but enduring hazards posed by the coastal change impacts of sea level rise. Some overlap is inevitable, but the goal of this section is to highlight the profound and irreversible impacts of local sea level rise on coastal environments and to highlight where communities can intervene to interrupt positive feedback loops and preserve coastal resources.

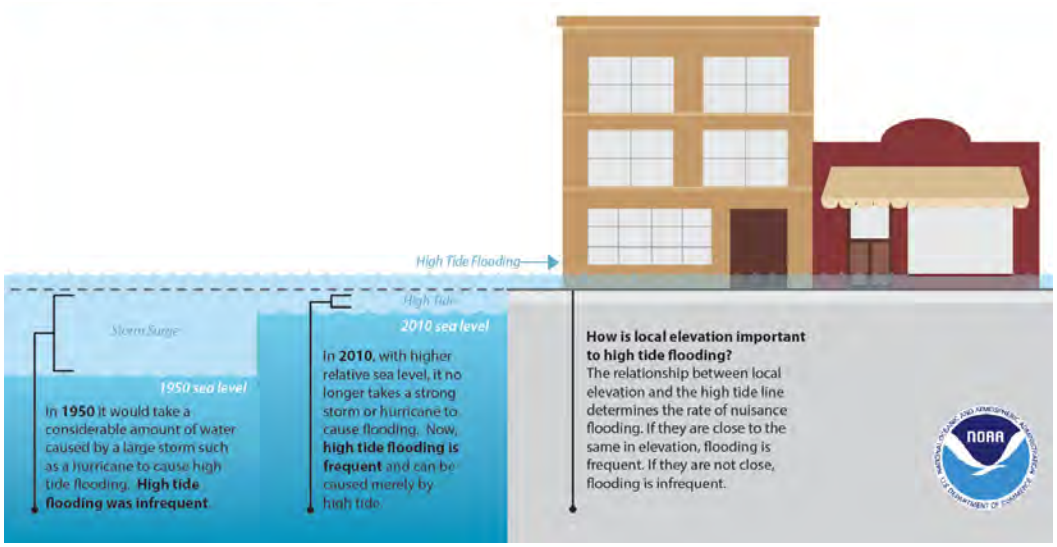
As local sea levels rise, changes in the form and function of coastal environments will lead to more and more property damage and economic disruption. The physical effects of local sea level rise will progress from more frequent and extensive “nuisance flooding,” to chronic inundation, to coastal land loss (these terms will be defined in the subsections below). Along the way, the coastal ecosystems that communities depend on for critical ecosystem services will also be transformed. These effects will be felt by a large share of the nation’s population. Nearly 40 percent of Americans live in densely populated coastal areas.[107]

[107] NOAA, 2018. Is sea level rising? Website accessed at: https://oceanservice.noaa.gov/facts/sealevel.html

3.2.10.1.1 Nuisance Flooding

Nuisance flooding refers to shallow coastal flooding that causes significant public inconvenience, but generally does not cause significant structural damage to buildings. The impacts of nuisance flooding include temporary road and business closures, overwhelmed stormwater systems, damage to transportation infrastructure, and coastal erosion. Figure 3.41 illustrates how local sea level rise leads to more nuisance flooding. In the past, the gap between mean sea level and nuisance water levels was larger, and it would take an extreme event such as a tropical storm coinciding with high tide to produce nuisance flooding. As local sea levels rise, however, the gap between mean sea level and nuisance water levels is shrinking. This means that now less extreme events, such as the extreme high tides that occur every year when the Earth is nearest the sun (or "king tides"), can also cause nuisance flooding.

Figure 3.41 Sea Level and Nuisance Flooding (NOAA, 2018)



Since 1950, communities across the US have seen a significant and accelerating increase in the frequency of nuisance flooding. Whereas in 1950 events causing nuisance flooding typically had return periods of 1 to 5 years, in 2008 these events had return periods of less than three months at most NOAA gauges.[108]

3.2.10.1.2 Chronic Inundation

Chronic inundation is a term coined by the Union of Concerned Scientists (UCS) to refer to episodic coastal flooding that is so frequent it makes normal routines impossible. UCS defines "chronic inundation" as flooding that occurs, on average, once every other week, and defines a "chronically inundated community" as any coastal community that experiences this frequency of

[108] NOAA, 2014. Sea Level Rise and Nuisance Flood Frequency Changes around the US. NOAA Technical Report NOS CO-OPS 073.

flooding over 10 percent of its area or more.[109] Chronic inundation is more than an inconvenience, and causes significant disruption to people's routines, livelihoods, homes, and communities.[110] The effects of chronic inundation depend on the character and density of exposed communities. For more urban communities, impacts may include lower home values and inaccessible business districts. For more rural communities, in contrast, impacts may include lower farm productivity and homes that are isolated from emergency services.

Based on an analysis of three different sea level rise scenarios developed for the Third National Climate Assessment (the Intermediate-Low, Intermediate-High, and High scenarios), UCS determined that the number of coastal communities exposed to chronic inundation could increase by two-fold in the next twenty years, and by more than seven-fold by the end of the century. Table 3.32 shows the estimated number of communities that would be exposed to chronic inundation under the Intermediate-High and High sea level rise scenarios.

Table 3.32 US Communities Exposed to Chronic Inundation with Sea Level Rise (UCS, 2017)

Scenario/Year	Today	2035	2060	2100
Intermediate-High	90	167	272	489
High	90	180	360	668

3.2.10.1.3 Coastal Land Loss

Coastal land loss refers to the permanent loss of low-lying coastal land and is the final step in the transition from dry land to open water. Local sea level rise is a contributor to coastal land loss, but it is not the only factor that determines the location and extent of this transition. Coastal environments are complex and dynamic systems shaped by interacting natural and human factors, and many of these factors play a role in coastal land loss. The natural factors at play include erosion, reductions in sediment supply, and wetland deterioration, while the human factors include sediment excavation, river modification, and coastal construction. According to the USGS, "the exact causes of land loss are uncertain," so predicting future change requires an understanding of all the causes of land loss.[111]

Coastal land loss can have devastating social and economic impacts, from destroying homes to reshaping regional economies. At the household level, coastal land loss can destroy properties located near the waterfront. Based on Zillow research, a 6-foot rise in sea levels could submerge

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[109] Union of Concerned Scientists, 2017. When Rising Seas Hit Home.
[110] Ibid.
[111] US Geological Survey, 2003. An Overview of Coastal Land Loss: With Emphasis on the Southeastern US. Open File Report 03-337.

1.9 million homes by 2100. This loss would account for 1.8 percent of the nation's housing stock, representing a value of $916 billion.[112] At the regional level, coastal land loss can expose areas further inland to flooding and erosion hazards. This is because wetlands and barrier islands act as natural buffers to storm surge and wave impacts, and the loss of these buffers exposes more upland areas. Coastal land loss also can compromise critical regional lifelines, such as water supply, energy infrastructure, and evacuation routes. Water-dependent infrastructure, including port facilities, thermal power plants, and bridges, is particularly vulnerable to coastal land loss. At the national level, coastal land loss can impact the national economy through its impacts on nationally-important port assets and economic activity. In 2010, for example, more than $1.9 trillion in imports came through US ports, providing 90% of consumer goods and supporting more than 13 million jobs.[113]

In Alabama, the Port of Mobile is an important driver of the state and regional economy. Located on the western shore of Mobile Bay, at the confluence of several rivers flowing into the Gulf of Mexico, the port has both inland waterway and ocean access. Major commodities handled at the port include coal, petroleum products, iron and steel, paper, aluminum, and some perishable foodstuffs. In 2016, more than 10,000 vessels called at the Port of Mobile, and the cargo throughput exceeded 58 million short tons.[114] According to the Alabama State Port Authority, the port has a total economic value of $19.4 billion, supports 124,328 direct and indirect jobs, and has a direct and indirect tax impact of more than $459 million.[115]

3.2.10.1.4 Coastal Ecosystem Transformation

Coastal ecosystems provide many valuable ecosystem services, from supporting recreation and tourism to protecting the built environment from storm surge and waves. Human activities are already placing significant stresses on these ecosystems and their services and rising local sea levels will exacerbate these stresses.[116] Consider salt marsh systems, for example. As the local sea level rises, the marsh will begin to migrate landward. If the uplands are developed, however, and not available for migration, the marsh may drown. The loss of coastal ecosystems represents not only an aesthetic and cultural loss, but an important economic loss as well. In many coastal

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[112] Zillow Research, 2017. Climate Change and Homes: Who Would Lose the Most to a Rising Tide. Retrieved at: https://www.zillow.com/research/climate-change-underwater-homes-2-16928/.
[113] Moser, S. C., M. A. Davidson, P. Kirshen, P. Mulvaney, J. F. Murley, J. E. Neumann, L. Petes, and D. Reed, 2014: Ch. 25: Coastal Zone Development and Ecosystems. Climate Change Impacts in the US: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., US Global Change Research Program, 579-618.
[114] US Department of Transportation, 2017. Port Performance Freight Statistics Program: Annual Report to Congress. Retrieved at: https://www.bts.gov/sites/bts.dot.gov/files/docs/browse-statistical-products-and-data/port-performance/216906/port-performance-2017-revised-2-12-18.pdf
[115] Alabama State Port Authority, 2018. Port Facts. Retrieved at: http://www.asdd.com/portfacts.html
[116] Moser, S. C., M. A. Davidson, P. Kirshen, P. Mulvaney, J. F. Murley, J. E. Neumann, L. Petes, and D. Reed, 2014: Ch. 25: Coastal Zone Development and Ecosystems. Climate Change Impacts in the US: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., US Global Change Research Program, 579-618.

communities, commercial fisheries, recreation, and tourism are important components of the local economy – and Alabama is no exception.

Every year NOAA publishes a report on the Fisheries Economics of the United States, providing a detailed look at the economic performance of commercial and recreational fisheries on a state, regional, and national basis. According to the 2016 report, fishing and seafood industries are a strong part of the Alabama economy. Alabama fishermen harvested more than 25 million pounds of finfish and shellfish in 2014, earning $68.8 million for their catch. In the report, the seafood industry is defined as the commercial harvest sector, seafood processors and dealers, seafood wholesalers and distributors, importers, and seafood retailers. In 2014, the Alabama seafood industry supported 15,059 full- and part-time jobs and generated $661 million in sales, $252 million in income, and $333 million in value-added impacts. In the same year, approximately 853,000 recreational saltwater anglers took 2.2 million saltwater fishing trips in Alabama. These anglers spent $141 million on fishing trips and $1.3 billion on durable fishing-related equipment. These expenditures contributed $1.1 billion in sales impacts to the state economy, generated $828 million in value-added impacts, and supported approximately 14,124 jobs.[117] Artificial reefs are an important part of the recreational fishing economy in Alabama. To date, Alabama's artificial reef program has included an estimated 15,000 artificial reefs offshore of Alabama, and 33 inshore reefs in the Mississippi Sound, Mobile Bay, and Perdido/Wolf Bay. These artificial reefs proved to be valuable to the fishing industry, increasing habitat complexity and promoting oyster production.[118]

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[117] National Marine Fisheries Service. 2016. Fisheries Economics of the United States, 2014. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-163, 237p.
[118] Alabama Marine Resources Division, 2018. Alabama's Artificial Reef Plan. Retrieved at: http://www.alreefs.com/resources/submitted_plan.pdf

Figure 3.42 Coastal Ecosystem Services (NOAA, 2018)

3.2.10.2 Nature of the Hazard in Alabama

Alabama has approximately 607 miles of Gulf Coast shoreline, including the state's offshore islands and the tidal shorelines of Mobile and Baldwin counties.[119] Local sea level rise along the Gulf Coast is occurring more quickly than the global average because of relatively high rates of land subsidence. The best-understood cause of land subsidence along the Gulf Coast is the long-term rebound of the earth's crust following the retreat of the glaciers. This phenomenon is known as glacial isostatic adjustment and is described in Table 3.31. Throughout the Gulf of Mexico, glacial isostatic adjustment is driving land subsidence at a rate of at least 0.4 mm/year.[120]

Other causes of land subsidence on the Gulf Coast may include growth faulting and fluid extraction, but "the relative importance of these processes is still poorly understood because of their spatial and temporal variability."[121] Fluid extraction is most likely to be a contributor to land subsidence in areas where the density of oil and gas wells is highest and where the geotechnical properties of the substrate are most conducive to compaction. To show the areas in Alabama where fluid extraction is most likely to be a contributor to land subsidence, Figure 3.43 maps the location of oil and gas wells relative to the location of substrates prone to compaction. The location of substrates prone to compaction was derived from a 2004 USGS karst map depicting the location of thick, unconsolidated sediments with signs of subsidence.[122] Based on this overlay, the southern portions of Baldwin County are most likely to experience land subsidence caused by fluid extraction.

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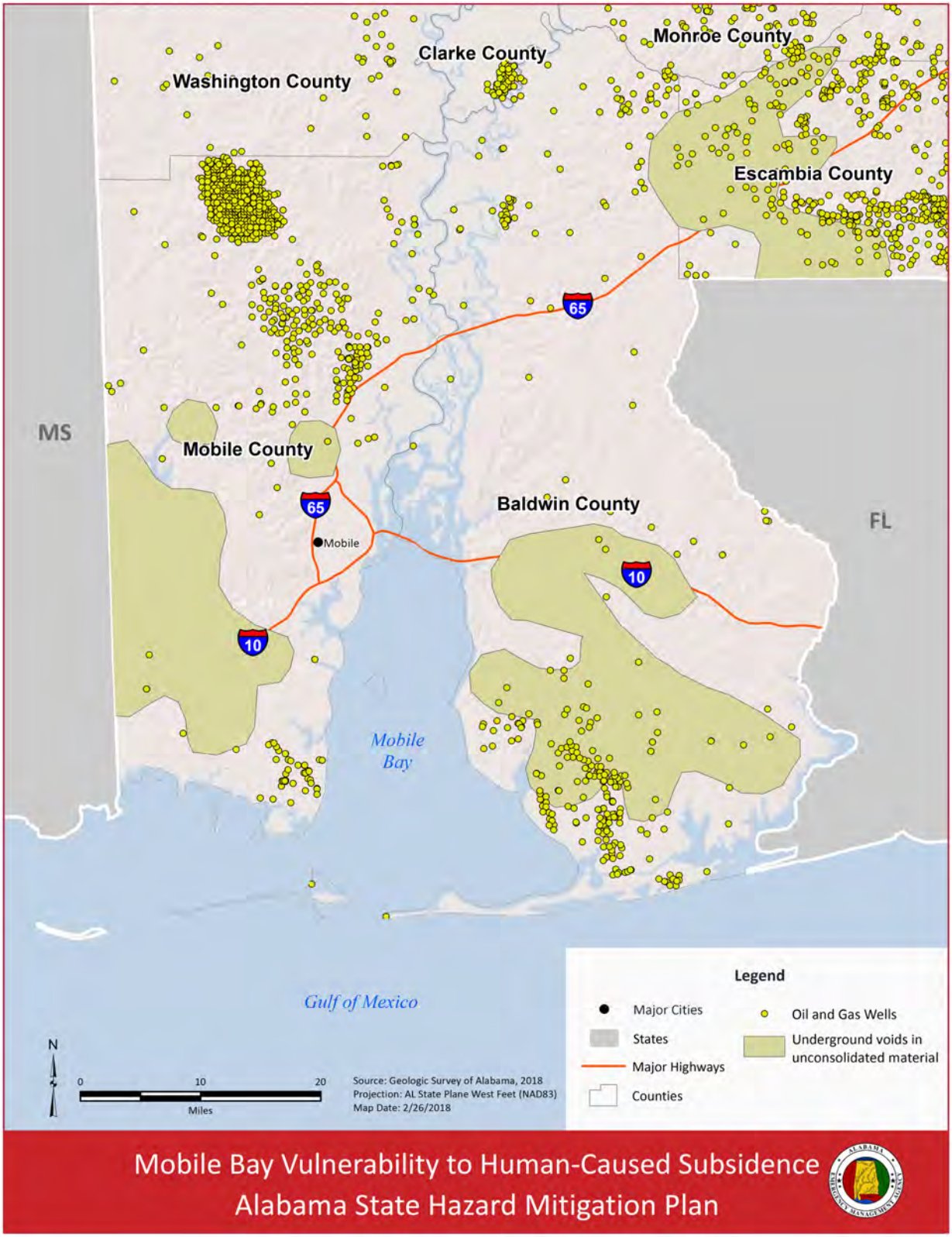
[119] NOAA, 2018. Shoreline Mileage of the US. Retrieved at: https://coast.noaa.gov/data/docs/states/shorelines.pdf

[120] US Geological Survey, 2016. Subsidence and Coastal Geomorphic Change in South-Central Louisiana. Retrieved at: https://coastal.er.usgs.gov/geo-evo/research/la-subsidence.html

[121] Ibid.

[122] US Geological Survey, 2004. Engineering aspects of karst. Open-File Report 2004-1352, Retrieved at: https://pubs.usgs.gov/of/2004/1352/data/USA_karst.pdf

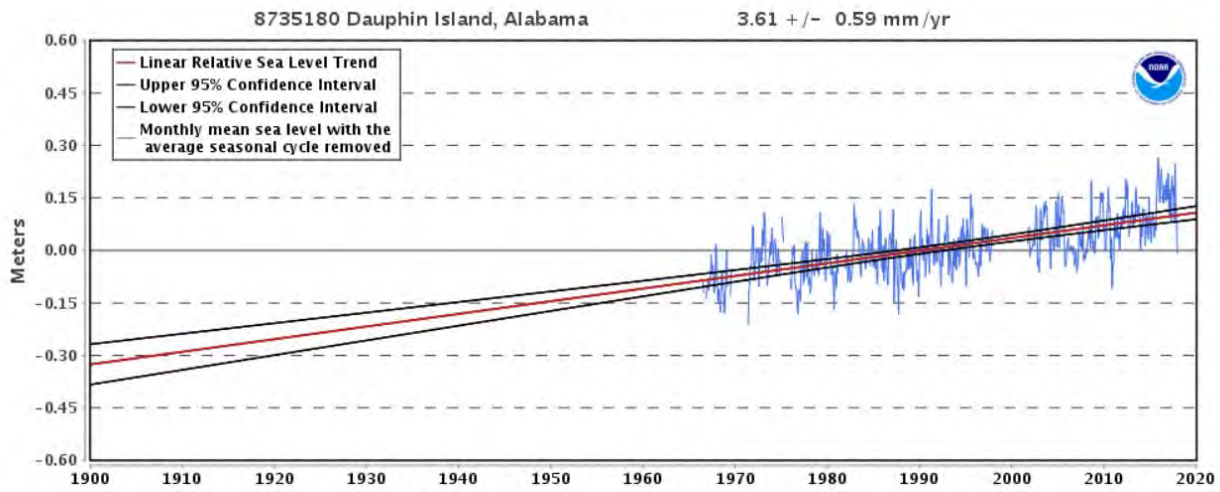
Figure 3.43 Vulnerability to Human-Caused Coastal Subsidence (GSA, 2018 and USGS, 2004)



3.2.10.3 Sea Level Rise History in Alabama

NOAA tracks local sea level rise through its National Water Level Observation Network (NWLON). This network includes nine tide stations in Alabama. Only the Dauphin Island and Mobile State Docks, however, have records long enough to detect long-term trends in local sea level. Figure 3.44 shows the long-term trend in mean sea level measured by the station at Dauphin Island.

Figure 3.44 Dauphin Island Sea Leve Trend (NOAA, 2018)



Based on a comprehensive analysis of observed sea levels, NOAA determined that local sea levels at Dauphin Island are rising at an average rate of 3.61 mm/year (with a 95% confidence interval of +/- 0.59 mm/year), while local sea levels at the Mobile State Docks are rising at an average rate of 3.45 mm/year (with a 95% confidence interval of +/- 1.62 mm/year).[123] These local trends exceed the global average of 1.7 mm/year, but are lower than some of the local trends observed in Louisiana and Texas. By separating the various components of local sea level rise, NOAA has also developed estimates of the rate of vertical land motion for the tide stations with the longest records. Based on data collected between 1966 and 2006, the land surface at the Dauphin Island station was estimated to be subsiding at an average rate of 1.22 mm/year.[124]

3.2.10.4 Probability of Sea Level Rise in Alabama

Sea level rise is a certainty along the Alabama coast. The important questions in assessing the hazards posed by local sea level rise are:

- How quickly is local sea level expected to rise, and

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[123] NOAA, 2018. Sea Level Trends, Retrieved at: https://tidesandcurrents.noaa.gov/sltrends/
[124] NOAA, 2013. Estimating Vertical Land Motion from Long-Term Tide Gauge Records. Technical Report NOS CO-OPS 065. Retrieved at: https://tidesandcurrents.noaa.gov/publications/Technical_Report_NOS_CO-OPS_065.pdf

- How much time do coastal communities have to prepare for the different levels of coastal change (i.e., nuisance flooding, chronic inundation, and coastal land loss)

The future rate of local sea level rise along a particular coast will depend on the future rate of global sea level rise, as well as the future rate of local land subsidence. Each of these rates could follow a range of trajectories, depending on what stresses human activities exert on natural systems and how those systems respond. Key determinants of the rate of global sea level rise include how aggressively greenhouse gas emissions are reduced and how quickly land-based glaciers and ice sheets melt. Key determinants of the rate of local subsidence include how aggressively underground oil, gas, and water resources are extracted and how quickly regional land elevations fall.

To help communities plan for and adapt to the risk of rising sea levels, NOAA has developed local sea level rise scenarios for tide stations across the US. These local scenarios begin in the year 2000 and account for global sea level rise, changes in regional ocean circulation, and local vertical land motion. [125] Six scenarios were developed to reflect the many possible futures that could result from human interaction with the global climate system – Low, Intermediate-Low, Intermediate, Intermediate-High, High, and Extreme. While each scenario is designed to be scientifically plausible, each has a different probability of being equaled or exceeded. Table 3.33 presents the probabilities for each NOAA scenario and shows how those probabilities differ under two different greenhouse gas emissions scenarios: a moderate and a high emissions scenario. [126] The moderate scenario assumes that moderate greenhouse gas mitigation policies are put in place through the rest of the century, limiting greenhouse gas emissions through the year 2100. The high scenario assumes an upper bound of business-as-usual greenhouse gas emissions through the rest of the century with no additional greenhouse gas mitigation policies put in place.

Table 3.33 Probability of exceeding Global Mean Sea Level Rise scenarios in 2100

NOAA Sea Level Rise Scenario	Moderate Emissions Scenario (RCP 4.5)	High Emissions Scenario (RCP 8.5)
Low	98%	100%
Intermediate-Low	73%	96%
Intermediate	3%	17%
Intermediate-High	0.5%	1.3%
High	0.1%	0.3%
Extreme	0.05%	0.1%

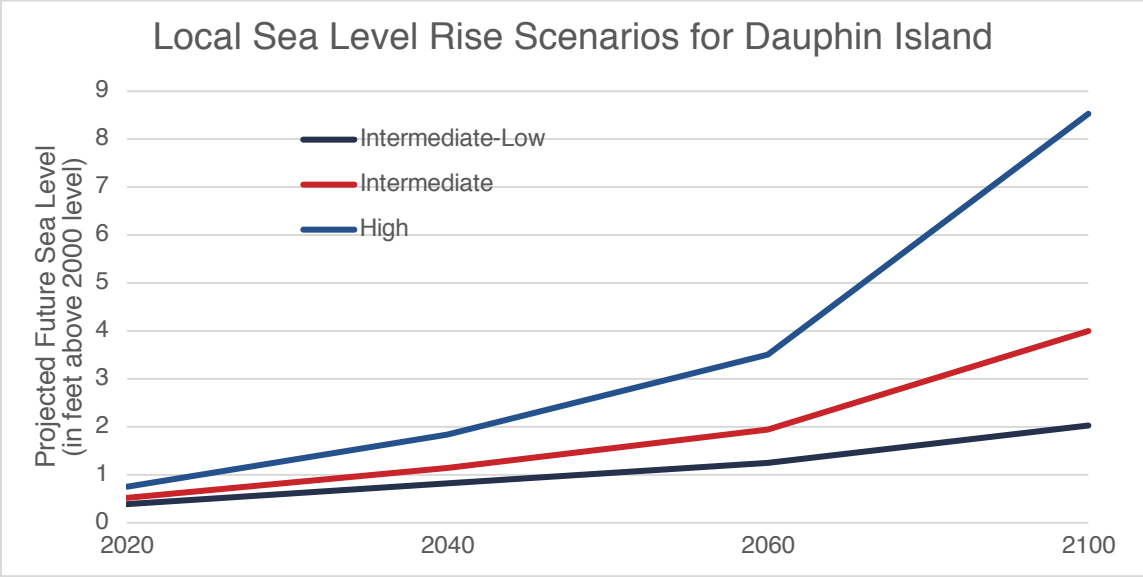
[125] Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekera, J., Horton, R. M., Thieler, E. R., & Zervas, C. (2017). Global and regional sea level rise scenarios for the US. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.
[126] Kopp, R.E., Horton, R.M., Little, C.M., Mitrovica, J.X., Oppenheimer, M., Rasmussen, D.J., Strauss, B.H., and Tebaldi, C. 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. Earth's Future, v. 2, p. 383–406.

For the purposes of this plan update, the Intermediate-Low, Intermediate, and High sea level rise scenarios were selected for further analysis. As shown in Table 3.33, these scenarios span a range of probabilities under business-as-usual greenhouse gas emissions. While the Intermediate-Low sea level rise scenario has a 96% chance of being equaled or exceeded, the Intermediate scenario has a 17% chance of being equaled or exceeded, and the High scenario has a 0.3% chance. In Alabama, NOAA developed local sea level rise projections for the tide station located on Dauphin Island. Table 3.34 and Figure 3.45 show the local sea level rise projections for Dauphin Island in both a table and chart format. Note that NOAA also provides guidelines to help decision-makers choose sea level rise scenarios that are compatible with local priorities and risk tolerances. These guidelines can be found in Section 6 of the 2017 NOAA technical report: Usage of Scenarios within a Risk-Based Context.[127]

Table 3.34 Sea Level Rise Scenarios for Dauphin Island (in feet above 2000 level) (NOAA, 2017)

Scenario/Year	2020	2040	2060	2100
Intermediate-Low	0.39	0.82	1.25	2.03
Intermediate	0.52	1.15	1.94	4.00
High	0.75	1.84	3.51	8.53

Figure 3.45 Sea Level Rise Scenarios for Dauphin Island (NOAA, 2017)



[127] Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekera, J., Horton, R. M., Thieler, E. R., & Zervas, C. (2017). Global and regional sea level rise scenarios for the US. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.

In all scenarios, local sea levels are expected to rise to one foot above the 2000 level in the relatively near future (between 2025 and 2045). More divergence is seen among the scenarios, however, with time. According to the three selected scenarios, two feet of sea level rise could occur between 2040 and 2100, and three feet of sea level rise could occur between 2055 and well past 2100.

Translating the rate of local sea level rise in Alabama into the amount of time that coastal communities must prepare for different levels of coastal change would require complex, high-resolution analyses that are beyond the scope of this hazard mitigation plan. To illustrate the extent of the communities that will be affected by sea level rise, however, Figure 3.46 shows the land area that would be permanently submerged by one, three, and six feet of local sea level rise. The darker the color, the smaller the rise in sea level that is necessary to submerge the area, and the sooner the area will be impacted.

It is important to remember that permanent submergence is the final step in a progression of increasingly costly and disruptive impacts. Consider the areas shown as submerged with six feet of local sea level rise—while permanent inundation may not occur until 2100, the interim effects of nuisance flooding and chronic inundation will occur well before that time.

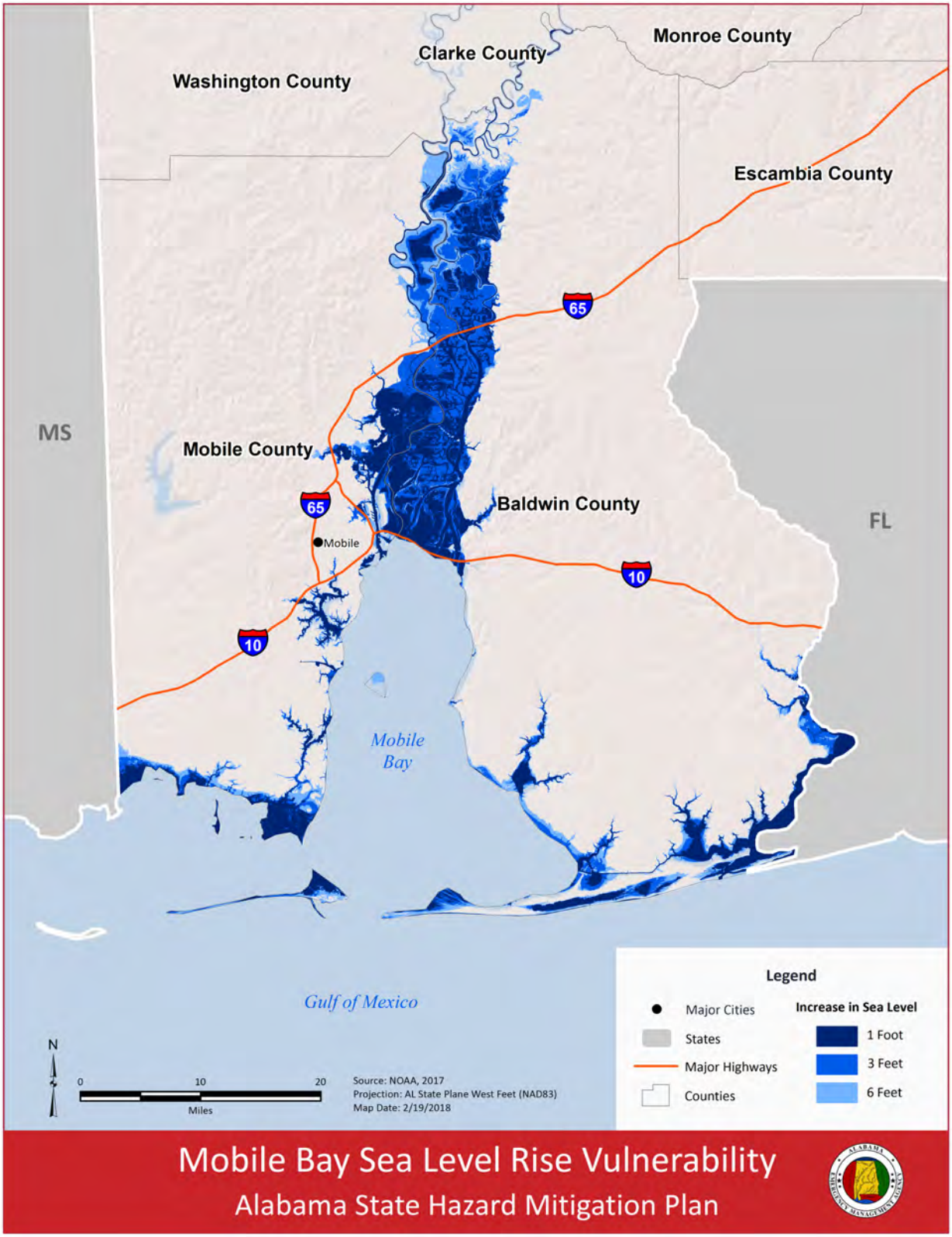
3.2.10.4.1 Future Probability

Sea level rise differs from the other hazards profiled in this plan update in that the hazard is a gradual process moving forward over time, as opposed to a discrete and episodic event. The concept of future change is therefore embedded in this hazard, and a discussion of its future probability would be redundant.

3.2.10.4.2 Risk and Vulnerability

A detailed assessment of vulnerability to sea level rise in Alabama is provided in Section 3.3

Figure 3.46 Alabama Sea Level Rise Scenarios (NOAA, 2017)



3.2.11 Sinkholes and Land Subsidence

3.2.11.1 Description

Land subsidence is the loss of surface elevation due to the removal of subsurface support. This geologic hazard can be caused by many different natural processes and human activities, and ranges from slow, regional lowering of the land surface to sudden, localized collapse. Table 3.35 summarizes the nature and causes of several types of land subsidence.

Table 3.35 Types of Land Subsidence

Subsidence Type	Nature	Cause	Description
Sinkhole	Sudden or slow-growing sinkhole or collapse	Naturally-occurring	Collapse of surficial material into underground voids usually created by the dissolution of soluble bedrock. Most of the sinkhole-related subsidence in the US is associated with areas underlain by carbonates such as limestone. These areas are also known as karst areas.
Mining	Sudden, local collapse	Human-induced	Collapse of surficial material into underground voids created by abandoned mines. Most of the mining-related subsidence in the US is associated with coal mines.
Underground Fluid Withdrawal	Broad, regional lowering	Human-induced	Sediment compaction caused by the removal of fluid from an underground reservoir. This type of subsidence is commonly associated with the extraction of groundwater and petroleum.
Natural Compaction	Broad, regional lowering	Naturally-occurring	Sediment compaction that occurs as older sediment is buried by younger sediment. In the US, this type of subsidence is occurring most rapidly in the Mississippi River Delta area.
Draining of Organic Soils	Broad, regional lowering	Human-induced	Elevation loss caused by the dewatering of organic soils, which then lose their volume. In the US, this type of subsidence is occurring most rapidly in the greater New Orleans area, the Everglades, and the Sacramento-San Joaquin River Delta area.

Subsidence poses a greater risk to property than to life. Local collapse can damage or destroy buildings, roads, or utilities and can remove land from productive use. Broad, regional lowering can aggravate flood risk in an area or even permanently inundate an area. Damage can also include business and personal losses that accrue during periods of repair.

This section addresses the localized subsidence associated with mining and sinkholes (see Section 3.2.10 for additional information on subsidence in coastal areas). The potential for sinkholes is highest in areas with a type of terrain known by geologists as karst. The USGS defines karst as "distinctive surficial and subterranean features...characterized by closed depressions, sinking streams, and cavern openings."[128] Karst terrain usually occurs where the surface is underlain by rocks that are easily dissolved by water, such as carbonates, sulfates, and halides. Karst terrain can also develop, however, through processes other than the dissolution of rocks that create underground voids.

The underground voids in karst range in size from small fissures and tubes to large caves and caverns. For underground voids caused by the dissolution of soluble rock, the number and size of solution features tends to be larger at lower latitudes and in younger rocks. The underground voids in karst terrain give rise to many problems for structural and civil engineers. Large caves increase the potential for sinkhole collapse and gradual subsidence; solution tubes can lead to subsidence, flooding of excavations, leaks in reservoirs, and weakening of retaining walls; and solution fissures can lead to leaks in reservoirs and instability in cuts, bridge abutments, piers, and dam foundations and abutments.

While sinkholes are a naturally occurring geologic process, the rate of sinkhole growth can be increased in populated areas where groundwater conditions are altered by excessive pumping or subsurface drainage systems (such as tile drainage systems on farms). The lowering of the water table removes the support provided by the hydrostatic pressure of water, and the loss of support can result in the collapse of the surface into underground voids. Drought, excessive rainfall, and construction activities can also create conditions favorable to sinkhole development.

3.2.11.2 Nature of the Hazard in Alabama

Alabama, in particular the north and northeastern part of Alabama, is part of the well-known Tennessee-Alabama-Georgia area of caves and sinkholes (TAG area). The TAG area is one of the densest karst areas of the US. The karst areas in Alabama most prone to sinkhole formation are concentrated in four physiographic sections: the Highland Rim, with the greatest sinkhole density in a West-to-East band associated with the geologic unit Tuscumbia Limestone; the Cumberland Plateau, with the greatest density in the northern plateau and Northeast to Southwest trending units of the Bangor Limestone and Knox Group; parts of the Alabama Valley and Ridge, with greatest density in the Knox Group, Chepultepec Dolomite, and Copper Ridge Dolomite; and

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[128] US Geological Survey, 2004. A GIS version of Davies, W.E., Simpson, J.H., Ohlmacher, G.C., Kirk, W.S., and Newton, E.G., 1984, Engineering aspects of karst. Open-File Report 2004-1352.

the southern part of the Coastal Plain, including residuum of the Eocene-Oligocene units, Miocene Series, and parts of the Citronelle Formation.

Figure 3.47 shows the distribution of karst areas and sinkhole incidence in Alabama. The karst areas are shaded according to the type of underlying rock. The band of karst areas in the center of the state consists mostly of unconsolidated calcareous or carbonate rocks and tends to be least prone to sinkhole development. The karst areas in the Coastal Plains consist mostly of carbonate rock buried deeply beneath insoluble sediments. These areas are prone to broad, slowly-developing, shallow sinkholes. The karst areas in the northern part of the state can be prone to sudden sinkhole collapse. In the Valley and Ridge and Cumberland Plateau physiographic sections, sinkholes are often related to carbonate geology with and without complex structures and faults. In the Highland Rim and northern Cumberland Plateau physiographic sections, cave density and sinkhole density are well correlated, with some sinkholes being connected to caves in deep vertical shafts. The northern tier of Alabama includes some of the state's most populous areas (including Huntsville), and is among the most intensely developed karst areas in the US.

Localized subsidence is also common in those areas of the state underlain by abandoned coal and iron mines. Pillars left for roof support in the mines generally deteriorate over time and eventually collapse, removing support. This is particularly a problem where mines underlie more recently developed residential areas and roads. Abandoned coal mines in Alabama are concentrated in the northeast and central Alabama, especially in areas underlain by the Pottsville Formation geologic unit.

Groundwater withdrawal is an important driver of sinkhole development in Alabama. A previous study estimated that more than 4,000 human-induced sinkholes and areas of subsidence have occurred in Alabama since 1900.[129] Most have occurred since 1950, and most have resulted from a decline in the water table associated with groundwater withdrawals. Sinkholes related to wells tend to be located within 150 meters of the site of withdrawal, while sinkholes related to quarry operations tend to be located within 600 meters of the site of withdrawal. Recent sinkholes associated with groundwater withdrawal have ranged from 1 to 90 meters in diameter, and from 0.3 to 30 meters in depth.[130]

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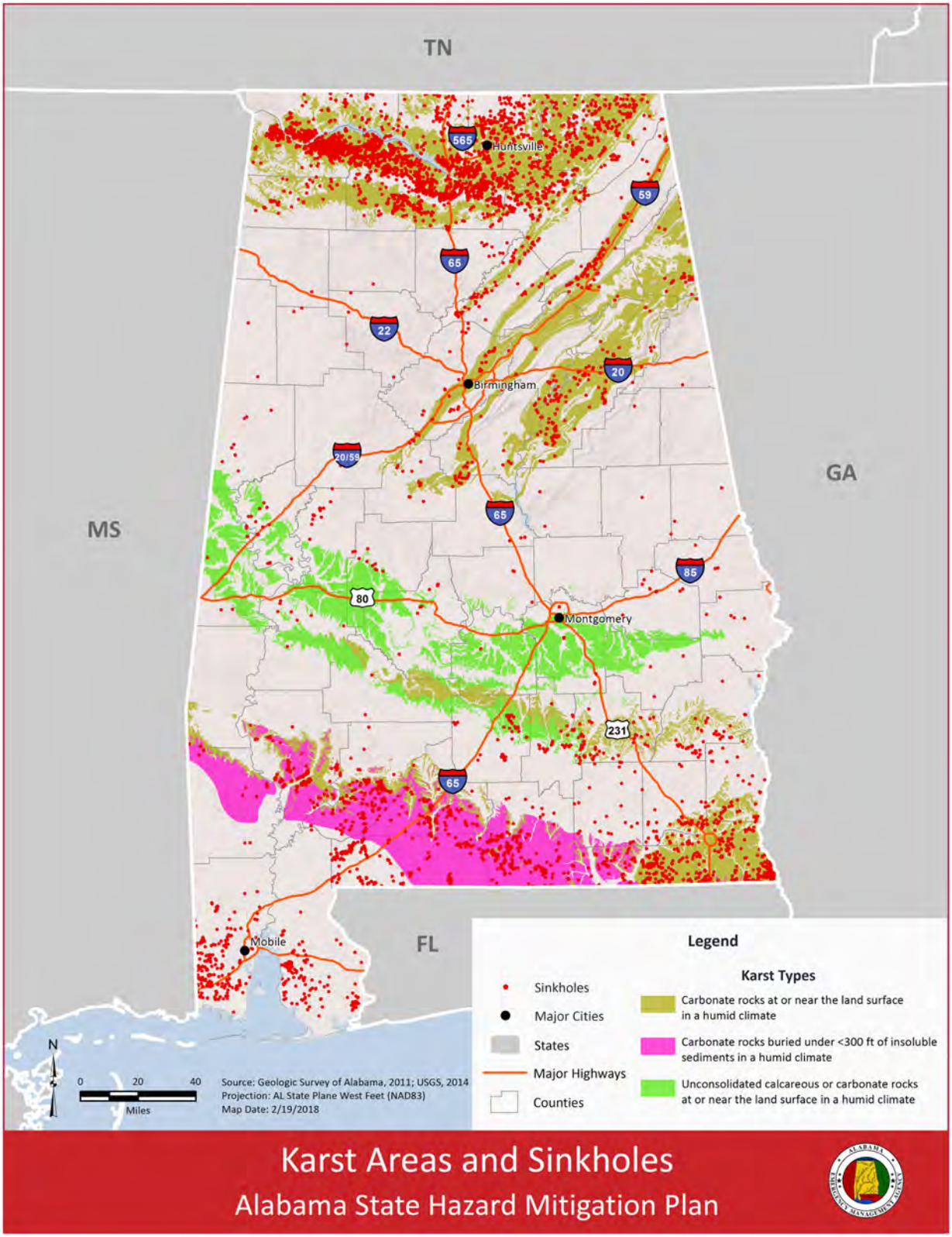
[129] Netwon, J.G. (1976). Induced and Natural Sinkholes in Alabama–A Continuing Problem Along Highway Corridors, in Subsidence Over Mines and Caverns, Moisture and Frost Action, and Classification: National Academy of Science Transportation Research Rec. 612, p.9-16.
[130] Poland, J. F., & International Hydrological Programme. (1984). Guidebook to studies of land subsidence due to ground-water withdrawal. Paris: Unesco.

Figure 3.47 Karst Terrain and Active Sinkholes (USGS, 2014)



3.2.11.3 Sinkholes and Land Subsidence History in Alabama

Sinkholes are becoming an increasing problem in Alabama as the population encroaches on scenic rural valleys underlain by limestone in the Valley and Ridge province, and as large metropolitan areas in the Cumberland Plateau of north Alabama continue to expand. In addition, as water demand for agricultural production continues to increase, the state is seeing more sinkhole growth associated with groundwater withdrawals. Recent years have seen sinkholes reported throughout the state, and periods of drought have aggravated the problem.

Alabama does not maintain a statewide real-time or near real-time record or reporting system of sinkhole events throughout the state. The GSA has, however, developed a map of sinkholes. This map was prepared by examining the 1:24,000-scale topographic maps published by the US Geological Survey between 1938 and 1987 and identifying all topographic depressions that were likely produced by naturally-occurring sinkholes. The location of these historical sinkholes is shown in Figure 3.47.

Despite the lack of a real-time reporting system, sinkholes in Alabama are known to cause costly damage and accidents. Collapses have occurred beneath highways, streets, railroads, buildings, sewers, gas pipelines, and vehicles.[131] The cost of road repairs related to sinkhole development demonstrate the considerable damage that sinkholes can cause. In 2013, a sinkhole affecting the northbound lane of Interstate 65 in Morgan County cost $1.2 million to repair. Other sinkholes costing hundreds of thousands of dollars to repair have occurred along Interstate 59 in Birmingham, near Regions Field in Birmingham, and along Weaver Road in Anniston.

To illustrate the potential impacts of sinkholes in Alabama, Table 3.36 describes several of the most widely-reported sinkhole events throughout the state. Images are available for two of the sinkholes and are reproduced below the table. Since 2012, the GSA has received over 203 requests for information on sinkholes. Of these, at least 135 pertained to sinkholes on personal property that sustained damage (this includes damage to land as well as structures).

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[131] Poland, J. F., & International Hydrological Programme. (1984). Guidebook to studies of land subsidence due to ground-water withdrawal. Paris: Unesco.

Table 3.36 Historical Sinkhole Events

Date	Location	Description
1972	City of Calera Shelby County	A large sinkhole developed near Calera in a matter of seconds in December 1972. The sinkhole is about 425 feet long, 350 feet wide and 150 feet deep. Called the "December Giant" or the "Golly Hole," the sinkhole is the largest on record in the US. This sinkhole occurred during a drought when the water table was much lower than normal. It was found by hunters two days after someone reported hearing a roaring noise, trees breaking, and his house shaking.
1990	Hale County	In 1990, a sinkhole was formed in Hale County. An oil and gas drill rig had reached a depth of 755 feet when the drilling fluid was lost in the hole. In a period of two hours, unconsolidated sediments overlying carbonate rock sunk into subsurface cavities, carrying the drill rig downward with them. The weight of the fluids in the adjacent mud pit facilitated the rapid downward movement of the sediments. Another well was successfully drilled across the road to a total depth of 12,000 feet.
Late 1990s	City of Trussville Jefferson County	Trussville provides a prime example of the impact sinkholes can have on a growing community where land and groundwater are both in great demand. Sinkholes first formed beneath and around the Trussville Middle School, forcing closure and rebuilding of the school at another site. Sinkholes continued to develop in a nearby park and neighborhood and emptied a pond. Damage has been estimated to be millions of dollars.
2007	City of Madison Madison County	During an extreme drought in northern Alabama, a sinkhole formed beneath the corner of a house in a new subdivision, and the house tipped into the depression. More than $100,000 was spent to repair the house and protect it from future impacts.
2008	City of Birmingham Jefferson County	In January 2008, a Bush Hills homeowner lost his house when it was swallowed by a massive sinkhole. The sinkhole was 75 feet wide at its widest and 30 feet deep.
2013	City of Hartselle, Morgan County	A sinkhole measuring 4 feet deep and 3 feet wide developed in the southbound lane of Interstate 65. An emergency lane closure was implemented while crews repaired the highway. Road closures for sinkhole repair are not uncommon in northern Alabama.

Figure 3.48 Widely-Reported Sinkholes

1972 Calera Sinkhole ("Golly Hole")

Source: Time Magazine, 1973

1990 Hale County Sinkhole

Source: Alabama HMP, 2013

2008 Birmingham Sinkhole

Source: Birmingham News, 2008

3.2.11.4 Probability of Sinkholes and Land Subsidence in Alabama

The probability of sinkholes and land subsidence cannot be expressed in terms of specific frequencies or return periods. These events are the culmination of multiple naturally-occurring and human-induced geological processes that play out over a range of timescales and can be highly localized. Areas that are more sinkhole-prone can be identified, however, based on geologic characteristics and historic sinkhole events (Figure 3.47). As discussed above, the karst areas in the northern part of the state, in the Valley and Ridge and Cumberland Plateau provinces, are most prone to sinkholes.

3.2.11.4.1 Future Probability

Some of the processes that tend to accelerate sinkhole development may be impacted by future climate change. These include drought conditions and groundwater withdrawals, both of which can remove the support provided by water pressure and lead to the collapse of underground voids. If drought periods become more intense and prolonged in the future, the incidence of sinkholes in Alabama may increase, particularly in the state's northern counties.

3.2.11.4.2 Risk and Vulnerability

A community's vulnerability to sinkhole loss is a function of the probability of sinkholes, the exposure of structures to sinkholes, and the susceptibility of structures to sinkholes. In Alabama, the communities in the greater Huntsville area and the greater Birmingham area are more vulnerable to loss from sinkholes due, in part, to larger populations. However, other populations mentioned in Section 3.2.11.2 and shown in Figure 3.47 are also vulnerable.

Another important consideration is the environmental risk posed by sinkholes. Groundwater is the main water resource for 44% of the state's population, including several large cities and many smaller towns. Since sinkholes are direct conduits to the state's groundwater supply, dumping in sinkholes and spills in karst areas have the potential to contaminate the public's water supply. this makes them (and the public's water supply) highly vulnerable to contamination. Recognizing the potential for contamination, Alabama has a state law that prohibits dumping in sinkholes.

3.2.12 Tsunamis

3.2.12.1 Description

A tsunami is a series of long waves generated in the ocean by a sudden displacement of a large volume of water. Underwater earthquakes, landslides, volcanic eruptions, meteor impacts, or onshore slope failures can cause this displacement. Most tsunamis originate in the Pacific "Ring of Fire," the area of the Pacific bounded by the eastern coasts of Asia and Australia and the western coasts of North America and South America, which is the most active seismic feature on earth. Tsunami waves can travel at speeds averaging 450 to 600 miles per hour. As a tsunami nears the coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. Unusual heights have been known to be over 100 feet high. However, waves that are 10 to 20 feet high can be very destructive and cause many deaths and injuries.

After a major earthquake or other tsunami-inducing activity occurs, a tsunami could reach the shore within a few minutes. From the source of the tsunami-generating event, waves travel outward in all directions in ripples. As these waves approach coastal areas, the time between successive wave crests varies from 5 to 90 minutes. The first wave is usually not the largest in the series of waves, nor is it the most significant. One coastal community may experience no damaging waves while another may experience destructive deadly waves. Some low-lying areas could experience severe inland inundation of water and deposition of debris of more than 1,000 feet inland.

Along the West Coast, the Cascadia Subduction Zone threatens California, Oregon, and Washington with devastating local tsunamis. Earthquakes of magnitude of 8 or more have happened in the zone, and there is a 35 percent chance that an earthquake of this magnitude could occur before 2045 (estimated between the years 1995 and 2045).

3.2.12.2 Nature of the Hazard in Alabama

According to the US States and Territories National Tsunami Hazard Assessment, tsunami risk on the US Gulf Coast is Very Low.[132] Since the Gulf Coast is not near an active tectonic plate boundary, the chance of an underground earthquake causing a tsunami is minimal. Geologic studies indicate that a submarine landslide is the region's most likely tsunami source. Large submarine landslides occurred throughout the Gulf of Mexico more than 7,500 years ago. Figure 3.49 shows the locations of submarine landslides that occurred in the Gulf of Mexico during the Quaternary period (the last 2.588 million years). Landslide deposits are marked in red, and the dashed lines indicate geologic provinces.

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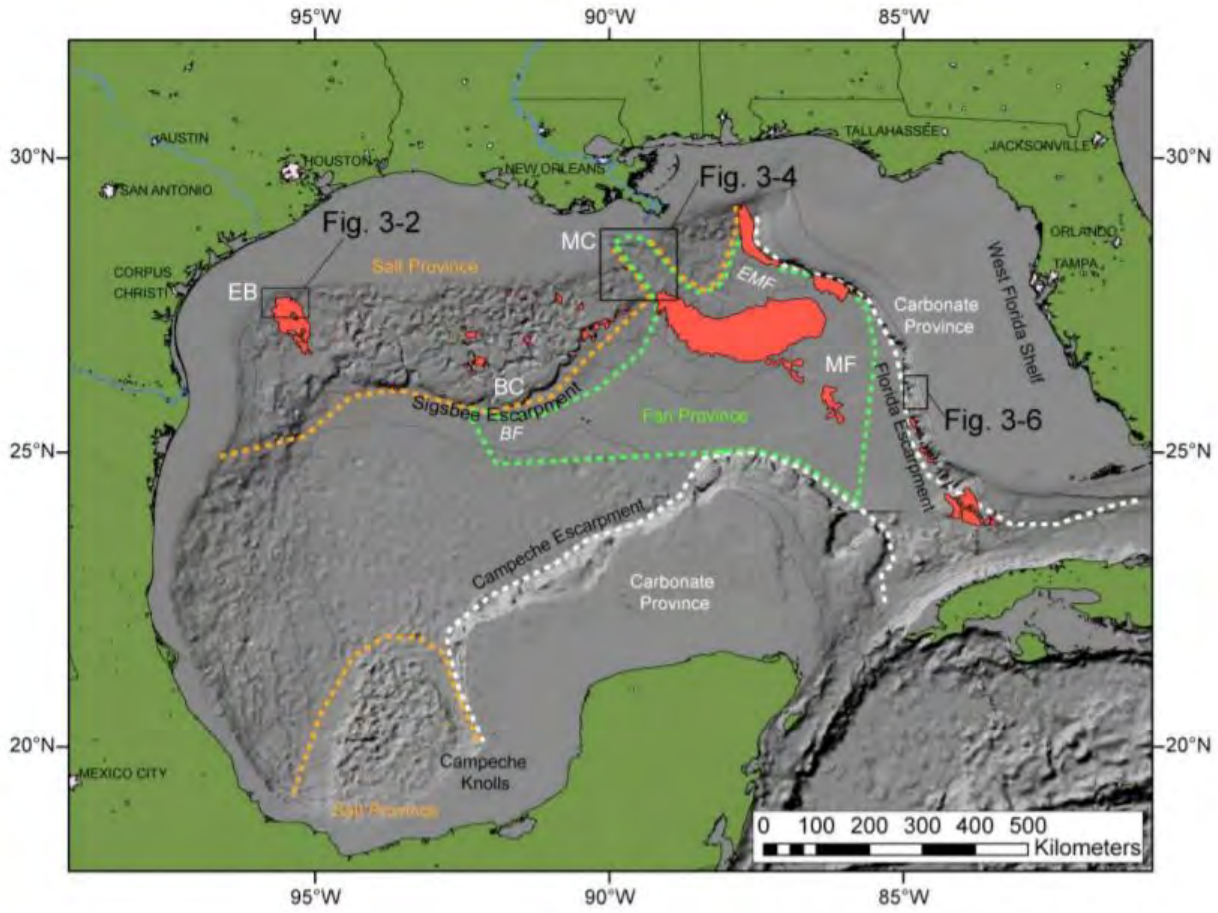
[132] NOAA and US Geological Survey, 2015. US and Territories National Tsunami Hazard Assessment: Historical Record and Sources for Waves – Update. Retrieved at: http://nws.weather.gov/nthmp/documents/Tsunami_Assessment_2016Update.pdf

Figure 3.49 Large Submarine Landslides in the Gulf of Mexico (USGS, 2008)



Although the tsunami risk in Alabama is low, the consequences would be significant. If a tsunami were to reach Alabama, the state's relatively shallow shoreline relief and densely populated coastal areas would expose coastal communities to significant losses. In addition, rare tsunami events must be considered in long-range planning, such as in the placement of nuclear power plants. Scientists are continuing to study the threat of landslide-generated tsunamis along the Gulf Coast, and future hazard mitigation plans should be updated to reflect their findings.

3.2.12.3 Tsunami History in Alabama

No tsunamis are recorded as occurring in Alabama. Along the Gulf Coast, the only confirmed tsunami observation is from an aftershock of the 1918 Mona Passage earthquake. The Mona Passage connects the Atlantic Ocean and the Caribbean Sea, separating the islands of Puerto Rico and Hispaniola. This earthquake generated a small tsunami that was recorded by a tide gauge at Galveston, Texas.

3.2.12.4 Probability of Tsunamis in Alabama

Landslide tsunamis represent the most significant tsunami hazard to the Gulf Coast. The likelihood of a landslide tsunami in the Gulf Coast, however, is very small. Scientists studying

Quaternary landslides in the Gulf of Mexico have determined that the large landslides have not been active for more than 7,500 years.[133]

3.2.12.4.1 Future Probability

The future probability of tsunamis in Alabama is not expected to change with climate change.

3.2.12.4.2 Risk and Vulnerability

A community's vulnerability to tsunamis is a function of the probability of the hazard, the exposure of people and structures to the hazard, and the susceptibility of people and structure to tsunamis. In Alabama, the coastal communities of Mobile and Baldwin counties are most vulnerable to loss from tsunamis.

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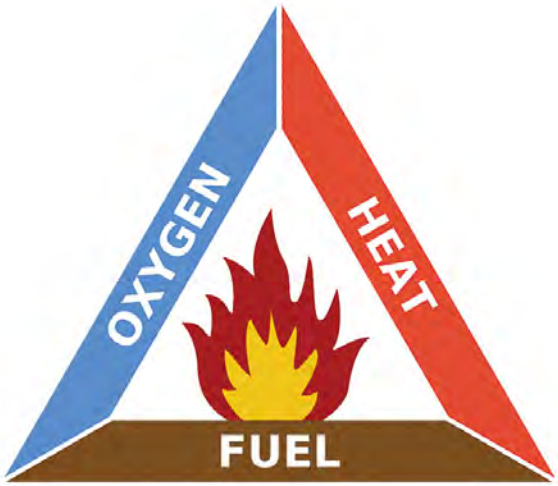
[133] NOAA and US Geological Survey, 2015. US and Territories National Tsunami Hazard Assessment: Historical Record and Sources for Waves – Update. Retrieved at: http://nws.weather.gov/nthmp/documents/Tsunami_Assessment_2016Update.pdf

3.2.13 Wildfire

3.2.13.1 Description

A wildfire can be defined as any non-structural fire that occurs in the wild. Wildfires are uncontrolled blazes fueled by weather, wind, and dry underbrush that have the ability to burn a significant amount of land in a very short period of time. Three conditions need to be present for a wildfire to burn: fuel, oxygen, and a heat source.[134] Figure 3.50 illustrates these three required conditions referred to as the fire triangle.

Figure 3.50 The Fire Triangle (Sonoma County Gazette, 2017)



Wildfires have a significant impact on the US. Over 100,000 wildfires clear up to 5 million acres of US land every year. Wildfires have the ability to destroy everything in their path. Three distinct types of wildland fires have been defined and include: naturally occurring wildfire, human-caused wildfire, and prescribed fire. Wildfires are typically human-caused, which distinguishes them from other natural disasters.[135]

The US Department of Agriculture Fire Service has adopted a National Fire Danger Rating System. The purpose of the system is to help prevent human-caused wildfires from occurring. This system allows fire managers to express the level of fire danger in an area (and the need for fire protection) in terms of qualitative or numeric indices. Knowledge of the fire danger level in

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[134] National Geographic, 2018. Learn More About Wildfires. Retrieved at: https://www.nationalgeographic.com/environment/natural-disasters/wildfires/
[135] National Geographic, 2018. Learn More About Wildfires. Retrieved at: https://www.nationalgeographic.com/environment/natural-disasters/wildfires/

an area can help people make decisions on whether it is safe to have a campfire, burn debris, etc. If the fire danger level is very extreme, the National Forest has the ability to restrict certain activities. Table 3.37 provides an explanation of the different danger levels established by the National Fire Danger Rating System.[136]

Table 3.37 National Fire Danger Rating System (USFS)

Fire Danger Rating and Color Code	Description
Low	Fuels do not ignite easily from small embers, but a more intense heat source, such as lightning, may start fires in duff or dry rotten wood. Fires in open, dry grasslands may burn easily a few hours after a rain, but most wood fires will spread slowly, creeping or smoldering. Control of fires is generally easy.
Moderate	Fires can start from most accidental causes, but the number of fire starts is usually pretty low. If a fire does start in an open, dry grassland, it will burn and spread quickly on windy days. Most wood fires will spread slowly to moderately. Average fire intensity will be moderate except in heavy concentrations of fuel, which may burn hot. Fires are still not likely to become serious and are often easy to control.
High	Fires can start easily from most causes and small fuels (such as grasses and needles) will ignite readily. Unattended campfires and brush fires are likely to escape. Fires will spread easily, with some areas of high-intensity burning on slopes or concentrated fuels. Fires can become serious and difficult to control unless they are put out while they are still small.
Very High	Fires will start easily from most causes. The fires will spread rapidly and have a quick increase in intensity, right after ignition. Small fires can quickly become large fires and exhibit extreme fire intensity, such as long-distance spotting and fire whirls. These fires can be difficult to control and will often become much larger and longer-lasting fires.
Extreme	Fires of all types start quickly and burn intensely. All fires are potentially serious and can spread very quickly with intense burning. Small fires become big fires much faster than at the "very high" level. Spot fires are probable, with long-distance spotting likely. These fires are very difficult to fight and may become very dangerous and often last for several days.

The occurrence of wildfires is monitored and reported by many different state and federal agencies. To consistently report the size of wildfires, all federal agencies use a fire size

[136] US Department of Agriculture, Forest Service, 2018. National Fire Rating System. Retrieved at: https://www.fs.usda.gov/detail/inyo/home/?cid=stelprdb5173311

classification system developed by the National Wildfire Coordinating Group. This system assigns fires to one of several ranges of fire size based on the number of acres within the final perimeter. The largest fires are assigned to Class D (100 to 300 acres), Class E (300 to 1,000 acres), Class F (1,000 to 5,000 acres), or Class G (5,000 acres or more).

3.2.13.2 Nature of the Hazard in Alabama

Approximately 71 percent of Alabama's land area is forestland, and 85 percent of this forestland is owned by nonindustrial private landowners.[137] Therefore, the vast majority of wildland fires in Alabama occur on privately owned lands. Additionally, the majority of the wildland fires in Alabama occur in areas where residential properties or other structures are endangered. Areas where homes are built near or among lands prone to wildland fire are known as the wildland-urban interface. As more people move into natural areas for their privacy, beauty, recreational opportunities, and affordable real estate, the wildland-urban interface in Alabama is growing and now faces the risk of major losses from wildfires. In Alabama, most wildland-urban interface areas are considered "intermixed." Instead of large forest areas surrounding an isolated town, the pattern of development in Alabama is characterized by many scattered residences and farms distributed throughout the forest areas. The state's extensive wildland-urban interface is shown in Figure 3.51.

Based on an analysis by the Alabama Forestry Commission, there are 1,350 potential wildland-urban interface communities at risk of wildfire damage in Alabama, and the number of these communities is projected to increase with time.[138] Figure 3.52 illustrates how housing density in Alabama has changed since 1990 and how it is expected to change through 2030. Decentralized growth patterns around Decatur and Huntsville in the state's north; Birmingham, Tuscaloosa, Montgomery, and Auburn in the state's center; and Mobile and Dothan in the state's south have led to the spread of urban areas throughout the state's rural landscapes. Much of this development is encroaching into forest lands, particularly in the northeastern portion of the state where the Appalachians extend into Alabama. This decentralized growth is driving the growth of the wildland-urban interface and increasing the risk of loss from wildfires.

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[137] Alabama Cooperative Extension System, 2014. Meet the Neighbors: Understanding Who Owns Alabama's Woodlands. Retrieved at: https://www.researchgate.net/publication/278020431_Meet_the_Neighbors_Understanding_Who_Owns_Alabama's_Woodlands

[138] Southern Group of State Foresters, 2008. Fire in the South 2: The Southern Wildfire Risk Assessment. Retrieved at: http://www.southernforests.org/resources/publications/fire-in-the-south-2-pdf/view

Figure 3.51 Wildland-Urban Interface in Alabama (Alabama Forestry Commission)

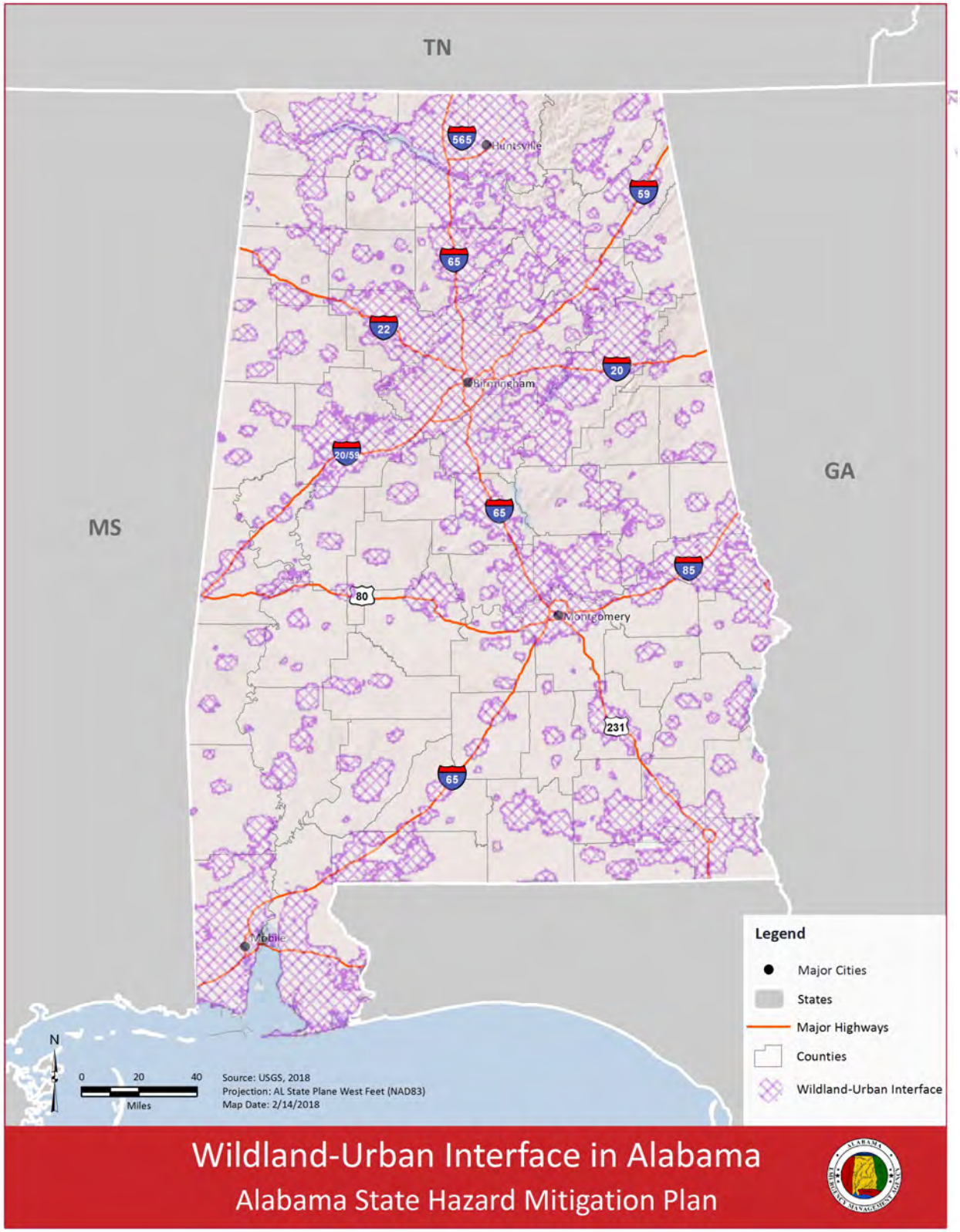
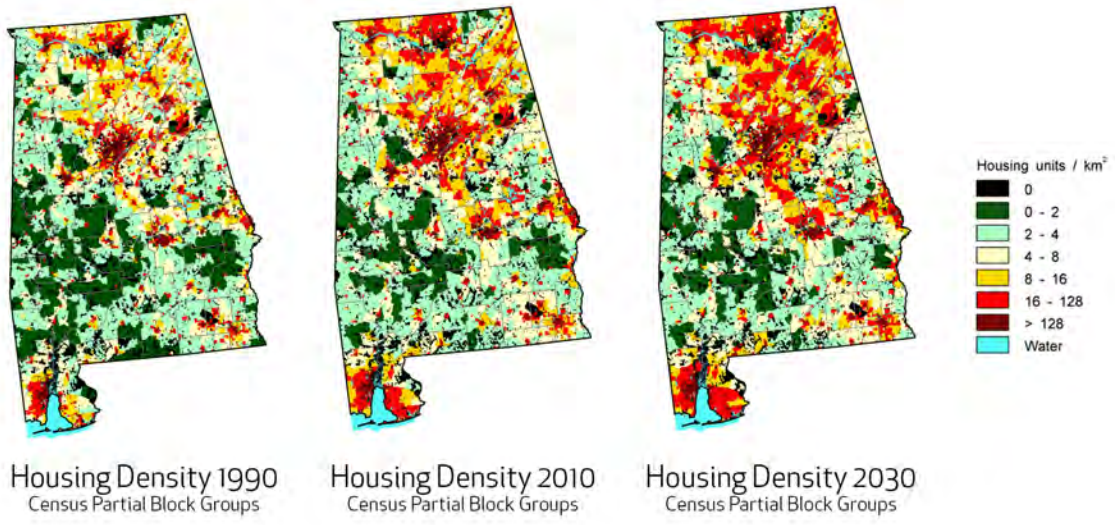


Figure 3.52 Alabama Housing Density Over Time (Hammer and Radeloff, 2005)



The following two factors contribute significantly to wildfire behavior in Alabama:

1. **Fuel:** The type of fuel and the fuel loading (measured in tons of vegetative matter per acre) have a direct impact on fire behavior. Fuel types vary from light fuels (grass) to moderate fuels (Southern Rough, or flammable evergreen shrubs) to heavy fuels (slash, or woody debris). The type of fuel and the fuel load determines the potential intensity of the wildfire and how much effort must be expended to contain and control it.
2. **Weather:** The most variable factor affecting wildfire behavior is weather. Important weather variables are precipitation, humidity, and wind. Weather events ranging in scale from localized thunderstorms to large cold fronts can have major effects on wildfire occurrence and behavior. Extreme weather, such as extended drought and low humidity can lead to extreme wildfire activity.

In addition to affecting people, wildfires may severely impact livestock. Wildfires often destroy food crops and supplies which inflicts severe economic losses on farmers. The forest resources of Alabama also supply one of the main industries of the state. Timber loss to fire creates an economic loss to both the private landowner and the state's economy. The forestry industry in Alabama directly creates 70,000 jobs, and another 100,000 jobs are associated with the industry. In total the industry adds about $12.2 billion to the economy each year.[139] Therefore, wildfires can potentially have a significant economic impact on the economy of the state.

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[139] Southern Group of State Foresters, 2008. Fire in the South 2: The Southern Wildfire Risk Assessment. Retrieved at: http://www.southernforests.org/resources/publications/fire-in-the-south-2-pdf/view

Wildfires in Alabama generally are moderate in intensity, resulting in destruction of undergrowth and some timber. With Alabama's long growing season, the soil surface layer of the forest recovers quickly, minimizing erosion and water quality impacts.

3.2.13.3 Wildfire History in Alabama

The frequency and severity of wildfires is dependent on weather and on human activity. Table 3.38 shows the number of fires and acres burned from January 2009 through February 2018 recorded by the Alabama Forestry Commission. Alabama had a total of 18,807 fires during this 10-year period, affecting a total of 287,237 acres. [140] Table 3.39 shows data on wildfire size and cause for wildfires that occurred in Alabama between 1980 and 2016. This data was collected from fire records from the US Fish and Wildlife Service, the National Park Service and the US Forest Service within the US Department of Interior, and the US Department of Agriculture.[141] Nearly all wildfires in Alabama are human-caused. If not promptly controlled, wildfires may grow into an emergency or disaster. During a series of severe fire situations between 1999 and 2001, nine wildfires in Alabama were declared fire disaster emergencies by FEMA.[142] Even small fires, however, can threaten lives, damage forest resources, and destroy structures.

In Alabama, there are an average of 4,000 wildfires that burn 40,000 acres a year. On average, wildfires destroy 46 homes, 114 structures, and 1,100 vehicles per year.[143] The Alabama Forestry Commission's Annual Reports provide a wide variety of statistics related to wildfire occurrence and prevention. According to the Alabama Forestry Commission Annual Report for Fiscal Year 2016, between October 2015 and September 2016 1,793 wildfires burned 22,252 acres in Alabama. This caused the destruction or damage of 33 homes, 3,404 other structures, and 107 vehicles. However, about 1,265 homes were saved as a direct result of firefighter response.

The Forestry Commission is also heavily involved in mitigation activities. During the 2016 Fiscal Year, The Forestry Commission completed 27,492 acres in prescribed burns. Furthermore, the commission administered $1,042,810 in grant money appropriated by the Alabama Legislature. This grant money was used, among other things, to provide and maintain county-wide communication systems for volunteer fire departments in 37 counties and assisted in federal fire and in-state responses.[144]

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[140] Alabama Forestry Commission, 2018. Wildfire Information by Date Range. Retrieved at: http://www.forestry.alabama.gov/fire_totals_date_range.aspx?bv=1&s=4
[141] Department of the Interior, 2017. Federal Fire Occurrence Website. Retrieved at: https://wildfire.cr.usgs.gov/firehistory/about.html
[142] FEMA, 2018. FEMA Disaster Declarations Summary. Retrieved at: https://www.fema.gov/media-library/assets/documents/28318
[143] The Southern Group of State Foresters. Fire in the South. http://www.forestry.alabama.gov/PDFs/fire_in_the_south.pdf
[144] Alabama Forestry Commission, 2016. 2016 Annual Report. Retrieved at: http://www.forestry.state.al.us/PDFs/AFCAnnualReport2016.pdf

Table 3.38 Wildfires in Alabama, 2009 to 2018 (Alabama Forestry Commission, 2018)

County	Number of Fires	Acres Affected
Autauga County	217	1,673
Baldwin County	1,230	22,031
Barbour County	214	2,940
Bibb County	231	2,405
Blount County	209	4,055
Bullock County	137	2,615
Butler County	367	3,461
Calhoun County	314	11,259
Chambers County	250	2,144
Cherokee County	392	14,430
Chilton County	436	2,752
Choctaw County	317	2,202
Clarke County	259	2,216
Clay County	224	2,979
Cleburne County	328	9,515
Coffee County	134	1,291
Colbert County	202	1,611
Conecuh County	404	5,614
Coosa County	246	3,785
Covington County	241	2,973
Crenshaw County	168	963
Cullman County	237	4,391
Dale County	94	408
Dallas County	242	1,561
DeKalb County	625	6,725
Elmore County	114	1,376
Escambia County	478	9,687
Etowah County	153	2,449
Fayette County	164	1,450
Franklin County	176	3,265
Geneva County	155	1,593
Greene County	160	1,422
Hale County	234	1,072
Henry County	157	1,166

County	Number of Fires	Acres Affected
Houston County	122	855
Jackson County	205	3,009
Jefferson County	404	10,832
Lamar County	138	1,145
Lauderdale County	186	2,947
Lawrence County	135	3,386
Lee County	171	2,735
Limestone County	117	736
Lowndes County	169	1,847
Macon County	444	10,966
Madison County	57	209
Marengo County	214	2,146
Marion County	383	3,271
Marshall County	173	1,536
Mobile County	1,038	29,027
Monroe County	256	2,057
Montgomery County	157	1,669
Morgan County	157	1,443
Perry County	282	2,259
Pickens County	153	1,615
Pike County	152	1,351
Randolph County	225	1,846
Russell County	333	7,972
Saint Clair County	223	4,432
Shelby County	273	2,798
Sumter County	80	881
Talladega County	619	8,773
Tallapoosa County	314	3,534
Tuscaloosa County	326	3,634
Walker County	651	11,240
Washington County	640	12,750
Wilcox County	320	3,295
Winston County	181	1,570
Total	**18,807**	**287,237**

Table 3.39 shows the fire size, total acres burned, and cause of fire for wildfires that occurred in Alabama from 1980 to 2016, and Figure 3.53 displays the location of the largest recorded events. The largest recorded events were defined as those with fire size classes of D, E, or F. The data used for this analysis is a collection of fire records from the US Fish and Wildlife Service, the National Park Service, the Bureau of Indian Affairs, the Bureau of Land Management, and the US Forest Service within the US Department of Interior and the US Department of Agriculture. Because these agencies only complete fire records when they participate in the fire response, this data represents a sample of all the fires that have occurred in Alabama. This sample, however, provides insight into the location and extent of past fires.[145]

[145] Department of the Interior, 2017. Federal Fire Occurrence Website. Retrieved at: https://wildfire.cr.usgs.gov/firehistory/about.html

Figure 3.53 Major Wildfire Occurrences (USGS, 2018)

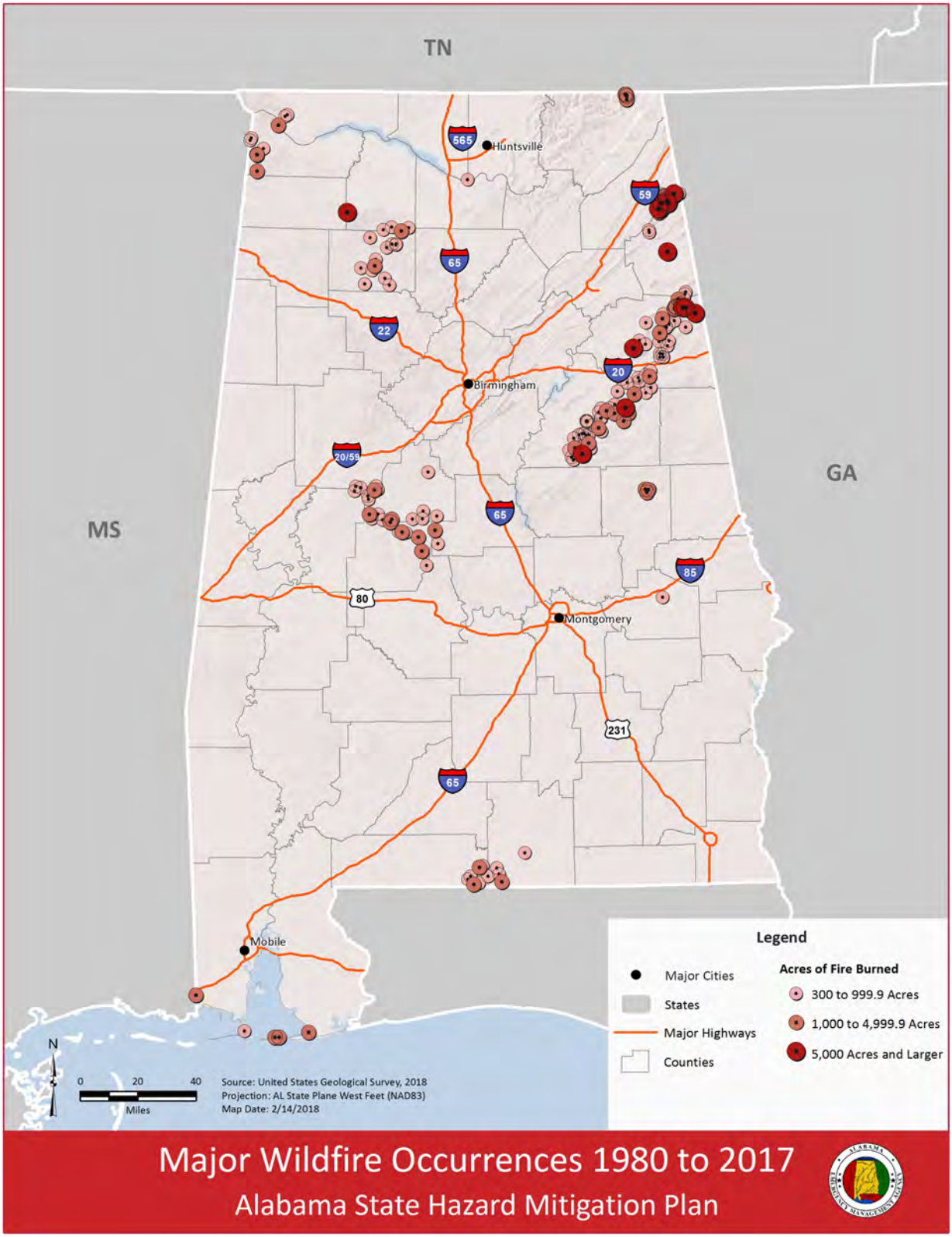

Table 3.39 Wildfire Size and Cause (USGS, 2018)

Fire Size Class	Class Description	Total Fires	Total Acres Burned	Percent Naturally Caused	Percent Human Caused
A	0.1 to 0.2 Acres	396	46	6%	94%
B	0.3 to 9.9 Acres	1,620	4,780	9%	91%
C	10.0 to 99.9 Acres	904	28,703	12%	88%
D	100.0 to 299.9 Acres	143	24,643	11%	89%
E	300.0 to 999.9 Acres	67	32,277	9%	91%
F	5,000.0 Acres and Larger	13	22,652	0%	100%
Not Rated	Not Reported	6	1,892	0%	100%
Total	**All Classes Combined**	**3,150**	**114,993**	**10%**	**90%**

3.2.13.4 Probability of Wildfires in Alabama

Unlike other natural hazards, the probability of wildfires cannot be expressed in terms of specific frequencies or return periods. These events are the culmination of multiple natural and human-caused factors that play out over a range of timescales and can be highly localized. Regions that are more prone to wildfires can be identified, however, based on historic wildfire events. Analysis of these events indicates that the counties that are more likely to experience wildfires include Cherokee, Calhoun, Cleburne, Clay, Talladega, Bibb, Hale, Winston, Escambia, Covington, Baldwin and Mobile Counties. Figure 3.54 shows the number of acres burned by wildfires from 2009 to 2018 by county, and Figure 3.55 maps the frequency of wildfire events that have triggered a federal response. In Figure 3.54, frequency of fire occurrences is determined based on geospatial analysis of the density of occurrences. Even though shaded areas may not have experienced an event, these areas are located in regions where events are frequent. Refer to Figure 3.53 for the location and extent of the large-scale events included in this analysis.

3.2.13.4.1 Future Probability

As with most natural hazards, wildfires are strongly influenced by weather phenomena. As the climate changes, Alabama is projected to become more prone to wildfire occurrences. Alabama is at risk of facing considerable increasing threat levels from wildfire between now and 2050. According to research conducted by Climate Central and ICF, by 2050 the average number of

days with high wildfire potential is projected to double from 25 to 50 days a year.[146] Therefore, Alabama should anticipate that the probability of wildfires occurring will increase in the future.

3.2.13.4.2 Risk and Vulnerability

A community's vulnerability to fire loss is a function of the probability of wildfires, the exposure of structures and assets to wildfires, and the susceptibility of structures and assets to wildfires. The state of Alabama is highly vulnerable to losses from wildfires. The southern US often leads the nation in the number of wildfires that occur each year. In Alabama, the high vulnerability to wildfires is driven by the state's extremely hot summers, extensive forest cover, and large and growing wildland-urban interface.[147] As population growth and development continue to gravitate towards more remote and rural landscapes, more of Alabama's people, infrastructure and assets will become vulnerable to loss from wildfires.[148]

Wildfires also pose a risk to Alabama's forestry industry, which represents the second largest sector of the state's economy. Alabama's forestry industry provides over 122,000 jobs in timber production and processing and contributes over $21 billion to the state's economy each year. This industry is supported by 23 million acres of timberland (about 69 percent of the total land area in the state) managed by 440,000 forestland owners.[149] Wildfires pose a risk not only to the assets of these forestland owners, but to a principal sector of the state's economy.

Based on the drivers of wildfire risk and loss, wildfire vulnerability in Alabama is likely to grow most in the state's northeast and in its coastal region. While Northeast Alabama is likely to become more vulnerable due to its high growth rates, decentralized development patterns, and growing wildland-urban interface, coastal Alabama is likely to become more vulnerable due to its very hot climate and the more severe impacts that climate change may have on the region. Although vulnerability may grow most in these two regions, the risk of wildfire loss is expected to grow throughout the state.

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[146] Climate Central, 2018. States at Risk Alabama Report Card. Retrieved at: http://assets.statesatrisk.org/summaries/Alabama_report.pdf
[147] The Southern Group of State Foresters. Fire in the South. http://www.forestry.alabama.gov/PDFs/fire_in_the_south.pdf
[148] Alabama Forestry Commission, 2010. 50 Ways to Make Your Woodland Home Firewise. http://www.forestry.alabama.gov/PDFs/50_Ways_to_Protect_Your_home.pdf
[149] Alabama Forestry Commission, 2016. 2016 Annual Report. Retrieved at: http://www.forestry.state.al.us/PDFs/AFCAnnualReport2016.pdf

Figure 3.54 Acres Burned by Wildfire by County 2009 to 2018 (Alabama Forestry Commission)

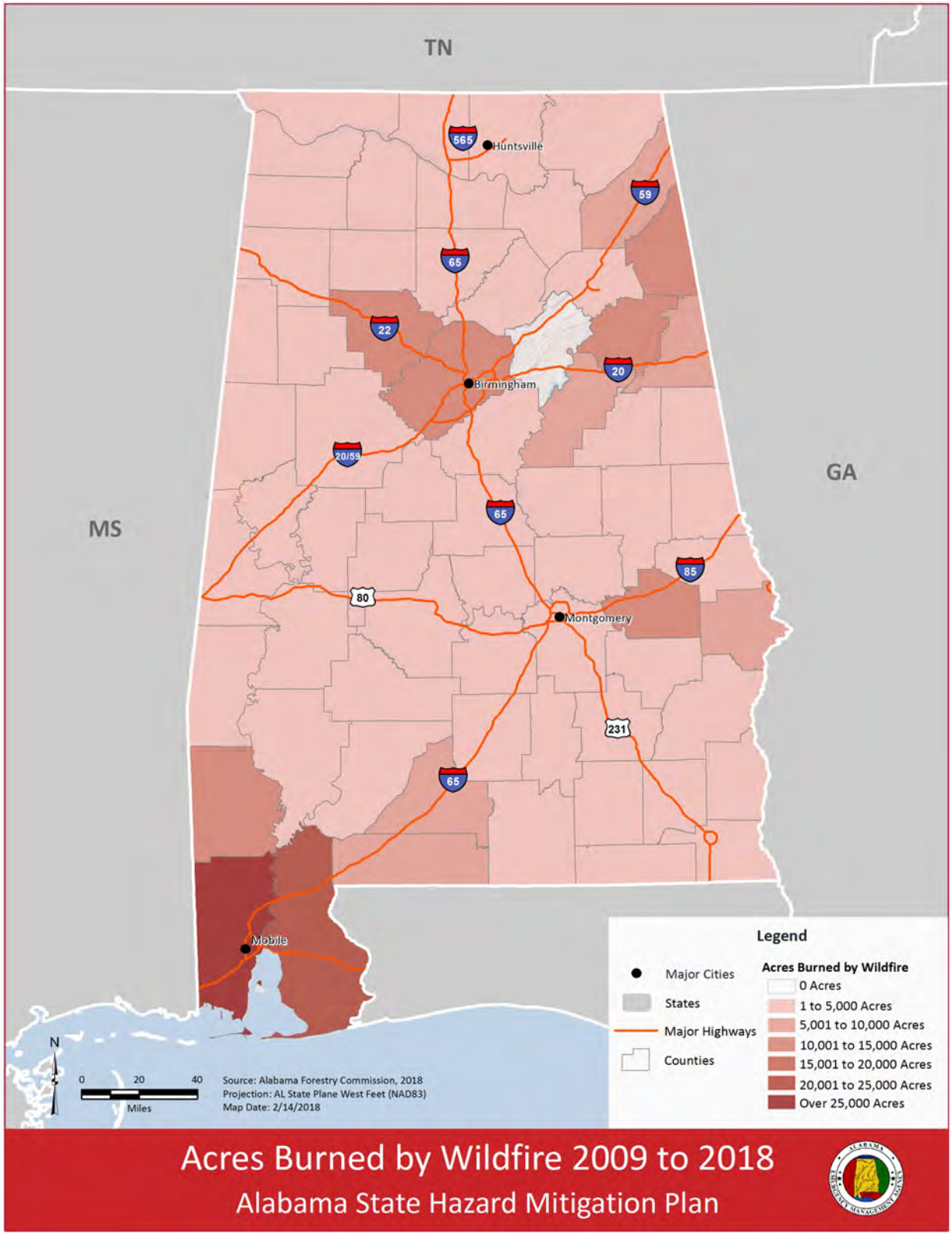
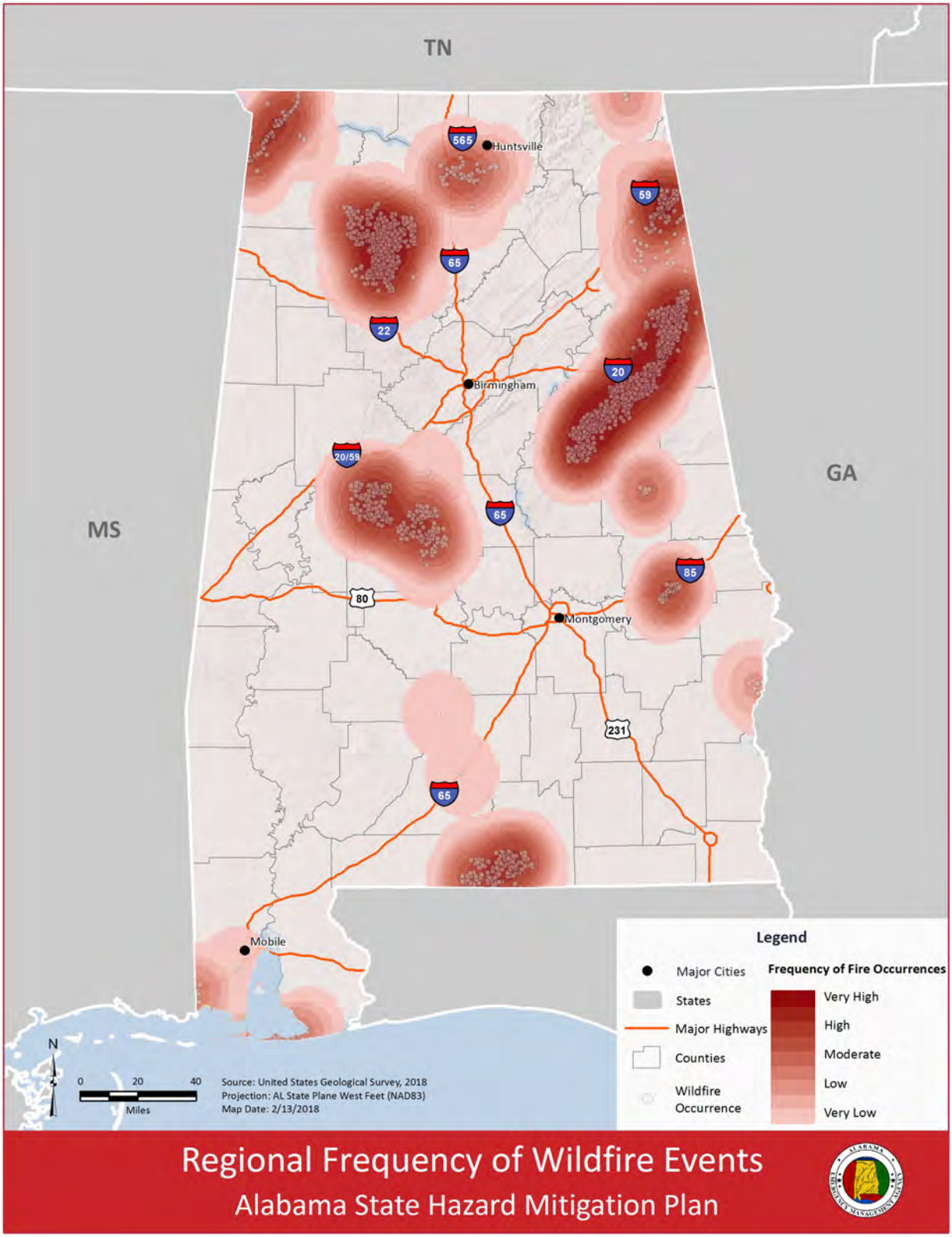


Figure 3.55 Frequency of Wildfire Occurrences that Warranted Federal Response (USGS, 2018)



3.2.14 Winter Storms

3.2.14.1 Description

Winter storms are storm events characterized by extreme cold and precipitation in the form of snow, ice, and/or sleet (Table 3.40). Winter storms can also spawn other natural hazards, such as coastal flooding and erosion, severe thunderstorms and tornados, and extreme winds. These storm events can have significant impacts in terms of human life, economic loss, and disruption of transportation and commerce. Accumulations of snow and ice can lead to vehicle and pedestrian accidents, collapsed roofs, and felled trees or other debris that impact utility systems and transportation routes.

Table 3.40 Winter Storm Precipitation Types

Precipitation Type	Description
Snow	Snow occurs when the temperature remains at or below 32°F from the cloud base to the ground. Snow reaches the ground as soft, white flakes.
Ice Storm	An ice storm (or freezing rain) occurs when snowflakes completely melt as they fall through a layer of warm air, then enter a shallow layer of cold air near the surface. The water droplets reach the ground as supercooled liquid then re-freeze on contact, creating a glaze of ice on the ground, trees, and power lines.
Sleet	Sleet occurs when snowflakes partially melt as they fall through a shallow layer of warm air, then refreeze as they fall through a deep layer of freezing air above the surface. Sleet reaches the ground as frozen rain drops that bounce on impact.

The disruption caused by a winter storm depends on the amount of precipitation, the affected population, and the regional climatology. Areas where winter storms are rare, such as the southeastern US, tend to be less prepared for these events and therefore tend to experience greater disruption.

3.2.14.2 Nature of the Hazard in Alabama

Winter storms in Alabama are not as severe or common as winter storms in the northern states. Typically, a winter storm in Alabama consists of freezing rain or a few inches of snow that may or may not be accompanied by frozen roadways. Because Alabama is not accustomed to these events, however, winter storms tend to be very disruptive to transportation and commerce. The local warning criteria established by the Mobile, AL and New York, NY Weather Forecast Offices illustrate how the amount of snow or ice that poses a risk to life and property varies from state to state (Table 3.41). While expected snow accumulation of 2 inches in 24 hours is enough to trigger a warning in Mobile, snow accumulation of 6 inches in 12 hours is required to trigger a warning in New York.

Table 3.41 Local Warning Criteria for Winter Storms

Warning Type	New York, NY Warning Criteria	Mobile, AL Warning Criteria
Winter Storm	Snow accumulation of 6 inches in a 12-hour period or 8 inches in a 24-hour period; Ice accumulation of 1/2 inch or more	Snow accumulation of 2 inches in a 12-hour period; Sleet/ice pellet accumulation of 1/2 inch or more
Ice Storm	Freezing rain with ice accumulations of 1/2 inch or more	Freezing rain with ice accumulations of 1/4 inch or more

Ice storms pose a particularly great risk to life and property. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs and heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. Because of severe ice storms, telecommunications and power can be disrupted for days. Such storms can also cause exceptionally high rainfall that persists for days, resulting in heavy flooding.

3.2.14.3 Winter Storm History in Alabama

Winter storms in Alabama are moderate loss-producing atmospheric hazards. According to NOAA's Storm Events Database, winter storms caused more than $32 million in direct economic losses (adjusted to 2017 dollars) between 1996 and 2017. The most damaging events were ice storms, which accounted for nearly $28 million in direct economic losses, followed by winter storms with a mix of precipitation types, which accounted for nearly $5 million. Between 1996 and 2017, the most frequently recorded events were winter storms with a mix of precipitation (23 events), heavy snow (13 events), and ice storms (10 events).

Since the Storm Events Database began collecting data on winter storms in 1996, Alabama has had five winter storms that were reported to cause more than $1 million in estimated damage (adjusted to 2017 dollars). In addition, Alabama had one federal emergency declaration for severe snowfall in 1993. Table 3.42 summarizes these historical storms and their reported impacts.

Table 3.42 Historical Winter Storms with Damage Exceeding $1 million (1993 – 2017)

Date	Type	Estimated Damage (2017 dollars)	Description
March 12, 1993	Snow Storm	$85 to $170 million	A winter storm described as the worst in Alabama history struck on March 12, 1993 and lasted through mid-day March 13, 1993. Snow accumulated to 6 to 12 inches over North Alabama and 2 to 4 inches over the Gulf Coast. A 40-mile-wide band of 12 to 20 inches fell from the Birmingham area northeastward to DeKalb and Cherokee counties, generally following the Appalachian Mountains. It was estimated that 400,000 residences were without electricity, and many remained so for several days. Compounding the snow and power problems, temperatures fell well into the single digits and teens across much of the state. There were at least 14 deaths associated with exposure or stress due to the storm. The entire state was declared a federal disaster area.
December 23, 1998	Ice Storm	$21.6 million	A winter storm brought a mixture of freezing rain, sleet, and rain to the northern half of Alabama. The northwestern quarter of Alabama was especially hard hit. The northwestern quarter of the state saw temperatures at or below freezing for the majority of the event, as well as significant ice accumulations of one half to one inch. Numerous trees were down across every county. Significant power outages were encountered in all counties and many locations did not return to service until the 26th or 27th. The National Guard was activated in a few northwestern counties to help with the cleanup duties. Numerous roads were closed during the event which included Interstate 65 and 565 in the Huntsville area. One fatality occurred in Huntsville when a homeless man died of exposure. Numerous multiple vehicle and single automobile accidents occurred due to the icy road conditions. These accidents resulted in at least 5 fatalities and numerous minor injuries.

Date	Type	Estimated Damage (2017 dollars)	Description
January 22, 2000	Ice Storm	$3.8 million	A light mixture of rain, freezing rain, sleet, and snow fell on the morning of the 22nd. Several bridges became ice covered and numerous trees received a glaze of ice. Several trees and tree limbs started breaking and falling on roads by the evening, causing scattered power outages. In the early morning of the 23rd, temperatures cooled off to the point where significant icing began taking place. Numerous locations received icing up to at least one inch. Trees and power lines were downed throughout the area and many downed trees blocked roads. Numerous roads were closed, especially at higher elevations. The Alabama National Guard was activated and dispatched to northeast Alabama to help in tree removal and cleanup. Thousands of customers were without power for several days. Numerous homes and automobiles were damaged by falling trees. An Alabama man was killed when he drove his car into a large mass of tree limbs covering SR 71 near Rosalie. Numerous other traffic accidents were reported, and several people had minor injuries.
January 28, 2000	Ice Storm	$1.6 million	Very light precipitation started falling early in the morning of the 28th. The precipitation was initially a mix of rain, sleet, and snow. Little to no accumulation of snow occurred across the area. As the day progressed, the precipitation changed to light freezing rain and lasted until the afternoon of the 29th. Significant accumulation of ice occurred on trees and bridges mainly in the higher elevations. Most of this same area was hit very hard by an ice storm on the 22nd and 23th and had not recovered yet. Numerous trees and power lines went down across the area and several homes and automobiles were damaged by the falling trees. Many roads were impassable and closed. A young man was killed in Dekalb County when a car slid into him while he was riding a four-wheeler. Thousands of people were without power for several hours.

Date	Type	Estimated Damage (2017 dollars)	Description
January 28, 2014	Winter Storm	$1.0 million	A mixture of winter precipitation fell across Central Alabama beginning on January 28th. Travel conditions quickly deteriorated as snow, sleet, and ice began to accumulate. Brief periods of freezing rain resulted in a light glaze of ice on area roadways and bridges at the onset of precipitation. As precipitation transitioned to all snow, it melted and refroze quickly on area roadways, further deteriorating travel conditions. In many locations across Central Alabama, snow accumulated on top of a layer of ice. Hundreds of wrecks and hazardous road conditions left thousands of people stranded in their vehicles on area roadways for hours; many remained there overnight. Many others abandoned their vehicles in favor of walking to nearby shelters. As temperatures remained below freezing through January 30th, there was only slight improvement in icy road conditions. Seven fatalities (indirect) were attributed to vehicle accidents on icy roads in Central Alabama. One fatality (indirect) resulted from a male slipping on ice outside his home. One fatality (direct) resulted from severe hypothermia. Due to the high number of vehicle accidents and vehicles abandoned in favor of walking to shelters, there were likely unreported indirect injuries numbering in the dozens across the affected area.

3.2.14.4 Probability of Winter Storms in Alabama

Winter storms have historically affected northern counties more frequently than southern counties (Figure 3.56). Because winter temperatures in Alabama are primarily a function of latitude, this pattern is expected to continue in the future.

3.2.14.4.1 Future Probability

According to the Southeast Regional Report prepared for the Third US National Climate Assessment, average annual snowfall totals across the northern tier of the southeastern states have fallen at a rate of about 1% per year since the late 1930s.[150] At the same time, snowstorms exceeding 6 inches have declined in frequency. These two trends have accompanied a trend towards warmer winters in the second half of the twentieth century. These declines in snowfall stand in contrast to positive trends in snowfall across the northeastern and midwestern regions of the US. The frequency of days with freezing rain, however, has shown little overall change since the middle of the 20th century. If these trends continue, Alabama can expect the probability of hazardous ice storms to remain relatively constant, and the probability of hazardous snow storms to fall.

3.2.14.4.2 Risk and Vulnerability

A community's vulnerability to winter storms is a function of the probability of winter storms; the exposure of transportation, energy, and telecommunication infrastructure to winter storms; and the susceptibility of this infrastructure to winter storms. In Alabama, the northern counties are most likely to experience severe winter storms, and the population centers in these counties have the highest density of exposed infrastructure. The susceptibility of infrastructure systems to disruption is a complex property, however, that must be modeled at the community level. Relevant characteristics include the availability of alternate routes or connections, and the availability of substitutes (such as public transportation in the case of roadways, or generators in the case of power lines).[151]

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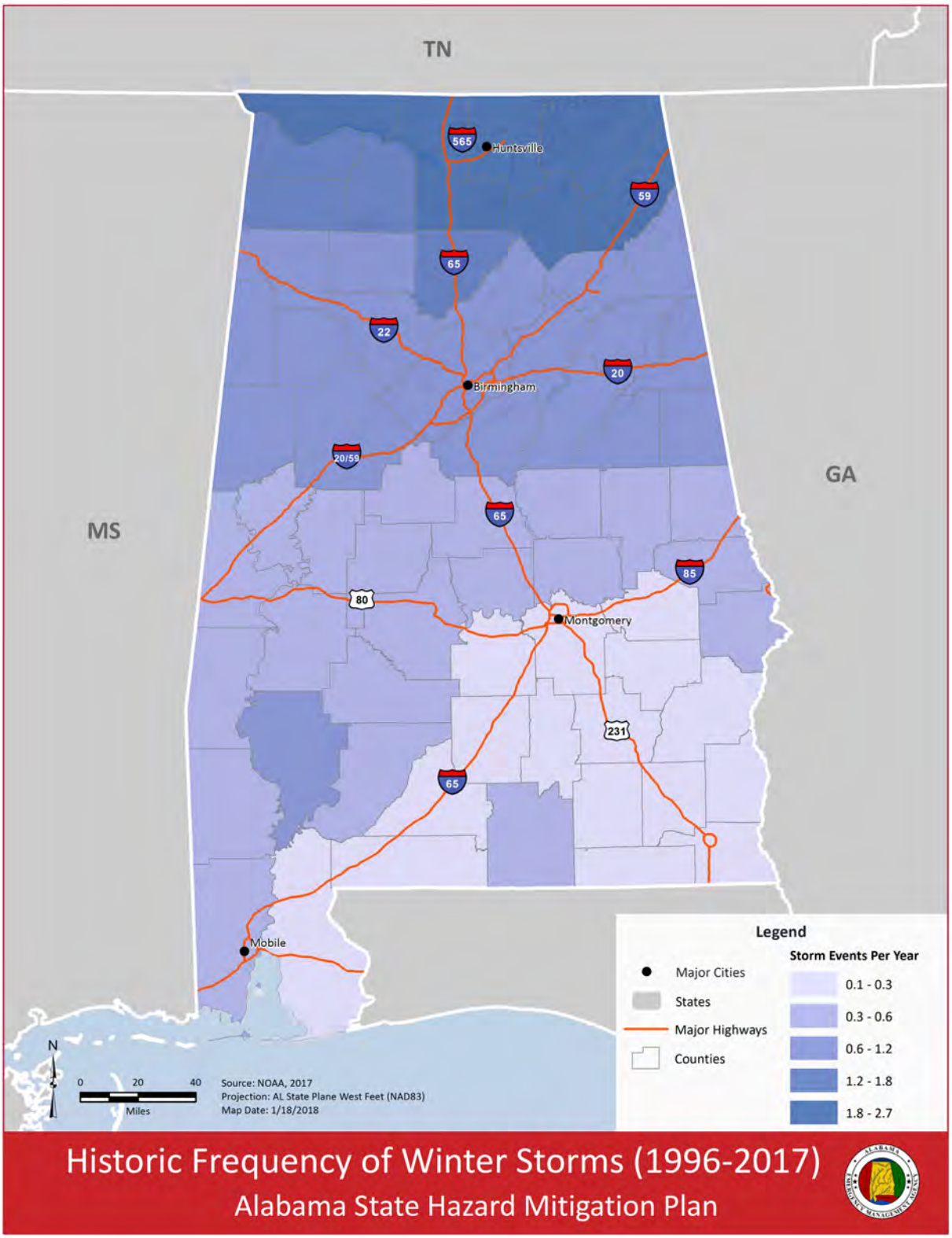
[150] Ingram, K., K. Dow, L. Carter, J. Anderson, eds. 2013. Climate of the Southeast US: Variability, change, impacts, and vulnerability. Washington DC: Island Press.

[151] Ganin, A., Kitsak, M., Marchese, D., Keisler, J., Seater, T., and Linkov, I., 2017. Resilience and efficiency in transportation networks. Science Advances 3(12). Retrieved at: http://advances.sciencemag.org/content/3/12/e1701079.full

Figure 3.56 Historic Frequency of Winter Storms (NOAA, 2017)



3.3 Vulnerability Assessment & Loss Estimation

3.3.1 Methodology

Vulnerability assessment is the process of evaluating the potential loss to a community from natural hazards. As discussed above, vulnerability depends on the probability of occurrence of a hazard event, the exposure of people and property to the hazard, and the susceptibility of people and property to the hazard. Different methodologies exist for assessing the risk posed by natural hazard events, ranging from qualitative to quantitative. In this section, quantitative methodologies are applied to the four hazards identified by the SHMT as having a high probability, high mitigation potential, and/or well-developed assessment methodology.

As in previous plans, floods and high winds were selected for further analysis based on their high probability of occurrence and high ease of mitigation, while earthquakes were selected based on the well-developed Hazus loss estimation methodology. Unlike in previous plans, sea level rise was also selected for further analysis. In developing this plan update, the SHMT determined that sea level rise has a high probability of occurrence in Alabama and a high ease of mitigation through planning and design approaches. Quantitative methodologies were applied to determine the vulnerability of both state assets and local jurisdictions.

3.3.1.1 Methodology for State Assets

According to FEMA guidance, state assets "may include state-owned or operated buildings, infrastructure, and critical facilities" and critical facilities are those "structures that the state determines must continue to operate before, during, and after an emergency."[152] After discussing the FEMA guidance with partners in state agencies, the SHMT decided to assess the vulnerability of two types of state assets: state-insured facilities and state-identified CIKR. CIKR refers to assets that are essential to the nation's security, public health and safety, economic vitality, and way of life. These assets are mostly privately-owned and operated, and include facilities such as power grids and water filtration plants; national monuments and government facilities; telecommunications and transportation systems; and chemical facilities.

An inventory of state-insured facilities was obtained from DORM. This inventory includes 12,144 structures and contains information on structure type, name, location, and replacement value. Table 3.43 shows the number and value of the different types of structures in the inventory of state-insured facilities.

[152] FEMA, 2015. State Mitigation Plan Review Guide.

Table 3.43 State-Insured Facilities (DORM, 2018)

Type	Number	Replacement Value
Agriculture	20	$34,156,212
Transportation	545	$321,675,019
Education	8,917	$20,436,058,471
Government	243	$2,331,312,345
Healthcare	304	$767,790,626
Military	102	$340,088,064
Parks & Recreation	1,224	$350,486,368
Port Authority	168	$348,956,567
Public Safety	621	$766,604,173
Total	**12,144**	**$25,697,127,845**

An inventory of CIKR was obtained from the ALEA. This inventory includes 150 facilities and contains information on structure type, name, and location. Table 3.44 shows the number of each type of facilities in the inventory of CIKR.

Table 3.44 Critical Infrastructure and Key Resources (ALEA, 2018)

Type	Number
Agriculture & Food	6
Banking & Finance	11
Chemical	17
Commercial	35
Critical Manufacturing	6
Dams	18
Defense Industrial Base	2
Emergency Services	2
Energy	7
Government Facilities	12
Healthcare & Public Health	13
Information Technology	1
National Monuments & Icons	4
Nuclear Reactors, Materials, & Waste	2
Transportation Systems	12
Water	2
Total	**150**

The quantitative methodology for assessing the vulnerability of state assets consisted of geocoding all inventoried assets and performing a GIS analysis. For each hazard, the methodology mapped the magnitude of the largest event expected to occur within the design life of a building, identified the areas where the magnitude of this event would cause significant damage, and intersected this area with the location of state assets.

3.3.1.2 Methodology for Local Jurisdictions

According to State Mitigation Plan Review Guide, state hazard mitigation plans "must provide a current summary of the most vulnerable jurisdictions," and vulnerability should be analysed in terms of "damage and loss…related to populations and assets".[153] To meet these criteria, the SHMT decided to apply FEMA's Hazus loss estimation software. Hazus (Hazard US) is an integrated GIS-based simulation system that was designed to promote more consistent and standardized assessments of vulnerability, and more transparent and effective approaches to setting local and state priorities.

The methodology embedded in the Hazus software divides the loss estimation process into three phases. The first phase is the hazard analysis phase. In this phase, the model analyses the physical processes that determine loss. In the case of flood hazards, for example, the model would determine the depth and velocity of flooding associated with different flood frequencies.

The second phase is the damage estimation phase. In this phase, the model overlays the hazard layer with an inventory layer to identify the buildings and infrastructure exposed to the hazard, then uses vulnerability curves to estimate the extent of structural damage. Each of the Hazus analyses conducted for Alabama used the default Hazus inventory. This inventory includes information on 1) the general building stock (the number and characteristics of residential, commercial, industrial, agricultural, and other buildings), 2) essential facilities (e.g., police stations), 3) high potential loss facilities (e.g., dams), and 4) selected transportation and utility systems (e.g., highway bridges and water treatment plants). Hazus uses census data to determine the distribution of residential structures, and Dun & Bradstreet data to determine the distribution of non-residential structures. The version of Hazus applied for this plan update uses data from the 2010 Census.

The third phase is the loss estimation phase. In this phase, the model quantifies the economic losses caused by the estimated structural damage. Each of the Hazus analyses conducted for Alabama used the damage estimates to calculate two kinds of economic losses: 1) immediate losses related to the damage to structures and their contents (building loss, content loss, and business inventory loss); and 2) business interruption losses related to how long businesses remain inoperable (relocation loss, wage loss, income loss, and rental income loss. Note that income loss refers to business owners' income). The spatial resolution of the modelled losses

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[153] FEMA, 2015. State Mitigation Plan Review Guide.

depends on the modelled hazard. While losses related to flooding and high winds are calculated at the census block level (the smallest census geography), losses related to earthquakes are calculated at the census tract level. The frequency of the modelled losses can also vary depending on the available data. When data is available on the extent of the natural hazard at different probability levels, it is common to present loss estimates in terms of the average annualized loss (AAL). This value condenses the estimated losses at each modelled probability level into a single value representing the average annual loss. Only two of the three Hazus analyses conducted for Alabama present the loss estimates in terms of average annualized loss – the earthquake analysis and the high winds analysis. While data for these hazards was available at a series of probability levels, data for flood hazards was only available for the 1%-annual-chance flood. Loss estimates for flood hazards are therefore presented for only the 1%-annual-chance event.

3.3.2 Earthquakes

Seismic risk is a function of the probability and frequency of the earthquake hazard, exposure, and susceptibility. While the probability and frequency of earthquake hazards is essentially constant on human timescales, the vulnerability to damage and loss can increase with population growth and development. The following sections summarize potential earthquake impacts to both state assets and jurisdictions throughout Alabama.

3.3.2.1 Vulnerability of State Assets

To assess the vulnerability of state-insured facilities and critical infrastructure to earthquakes, all structures located in areas characterized by high earthquake hazard and high susceptibility to liquefaction were identified. Relative earthquake hazard was derived from the 2014 USGS National Seismic Hazard Map for the shaking event with a recurrence interval of 2,500 years (2% probability of exceedance in 50 years) (Figure 3.11). As described above, PGA is expressed as a percentage of the force of gravity, or %g, and damage to buildings of poor construction generally begins at a PGA of 10% g. Relative susceptibility to liquefaction was derived from the GSA modeling study (Figure 3.9). As described above, liquefaction is one of several secondary hazards that can increase the impact of an earthquake. While the GSA has recommended projects to study additional secondary hazards in Alabama, the distribution of other secondary hazards in Alabama is not currently available. Vulnerable assets were defined as those assets located in areas with a PGA exceeding 10% g, and a high or very high susceptibility to liquefaction.

Of the more than 12,000 state-insured facilities, 557 are located in areas with a relatively high probability of strong ground shaking and a high susceptibility to ground failure through liquefaction (Table 3.45). These facilities have a combined replacement value of more than $1 billion, or approximately 4% of the value of all state-insured facilities.

Table 3.45 State-Insured Facilities Vulnerable to Earthquake Hazard

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Education	416	3.4%	$869,298,236	3.4%
Government	4	0.03%	$12,439,604	0.05%
Healthcare	26	0.2%	$152,728,695	0.6%
Military	8	0.1%	$19,700,722	0.1%
Parks/Recreation	47	0.4%	$12,724,178	0.05%
Port Authority	2	0.02%	$247,097	0.001%
Public Safety	40	0.3%	$46,938,393	0.2%
Transportation	14	0.1%	$3,935,358	0.02%
Total	**557**	**4.6%**	**$1,118,012,283**	**4.4%**

Of the 150 structures identified as critical infrastructure by the state, 16 are located in areas with a relatively high probability of strong ground shaking and a high susceptibility to ground failure through liquefaction (Table 3.46). Most of these facilities are dams.

Table 3.46 Critical Infrastructure Vulnerable to Earthquake Hazard

Facility Type	# of Vulnerable Structures
Chemical	2
Dams	11
Energy	1
Healthcare & Public Health	1
Nuclear Reactors, Materials, & Waste	1
Total	**16**

3.3.2.2 Vulnerability of Jurisdictions

FEMA's Hazus software version 3.2 was used to estimate seismic vulnerability across the state. The methodology uses Hazus default data on seismic hazards along with state-wide building stock data (based on 2010 US Census data) and the software's standard algorithms. The calculation algorithms quantify the potential losses associated with seismic hazards using information about shake probabilities, soil characteristics, and other parameters. As discussed in Section 3.3.1, Hazus was used to calculate two kinds of economic losses: 1) immediate losses related to the damage to structures and their contents, and 2) business interruption losses related to how long businesses remain inoperable.

The tables below show the average annualized earthquake losses for Alabama aggregated to the county scale. While Table 3.47 shows immediate economic losses (building loss, contents loss, and business inventory loss), Table 3.48 shows business interruption losses (relocation costs, income loss, rental loss, and wage loss). Figure 3.57 shows the spatial distribution of the total average annualized losses (the sum of immediate losses and business interruption losses). Note that losses are shown at the census tract level. While the county-level tables show the highest annualized losses in Jefferson and Madison counties, the census-tract level map shows the highest annualized losses in census tracts located in Madison, Morgan, Colbert, and Lauderdale counties.

Table 3.47 Potential Immediate Losses from Earthquake Hazards (AAL)

County	Building Loss	Content Loss	Inventory Loss	Total Immediate Losses
Jefferson County	$4,290,101	$1,352,500	$41,661	$5,684,262
Madison County	$2,344,360	$663,410	$22,258	$3,030,028
Tuscaloosa County	$1,007,327	$299,523	$10,992	$1,317,841
Shelby County	$961,436	$301,031	$9,498	$1,271,966
Lauderdale County	$879,092	$254,376	$10,492	$1,143,960
Morgan County	$763,510	$224,569	$11,980	$1,000,059
Colbert County	$545,717	$164,295	$9,152	$719,164
Dekalb County	$458,350	$151,462	$12,486	$622,299
Etowah County	$455,049	$137,793	$5,549	$598,391
Marshall County	$444,723	$130,903	$7,126	$582,751
Limestone County	$443,752	$117,813	$4,241	$565,806
Cullman County	$425,070	$122,152	$7,557	$554,779
Calhoun County	$421,389	$120,947	$5,280	$547,617
Walker County	$360,179	$102,977	$4,327	$467,482
Jackson County	$338,489	$104,383	$5,593	$448,465
St. Clair County	$286,090	$77,650	$3,139	$366,879
Talladega County	$280,486	$80,784	$5,041	$366,311
Montgomery County	$277,706	$66,404	$2,594	$346,705
Franklin County	$228,858	$66,209	$3,910	$298,977
Marion County	$220,657	$62,729	$4,734	$288,121
Blount County	$212,105	$58,301	$1,988	$272,393
Lawrence County	$184,519	$47,566	$1,507	$233,591
Winston County	$172,190	$50,597	$4,798	$227,586
Cherokee County	$167,867	$47,564	$2,451	$217,881
Mobile County	$164,183	$34,563	$1,414	$200,159
Lee County	$127,229	$26,715	$1,076	$155,020
Chilton County	$105,654	$27,117	$1,079	$133,851
Fayette County	$91,904	$26,993	$1,920	$120,817
Elmore County	$88,413	$20,026	$556	$108,995

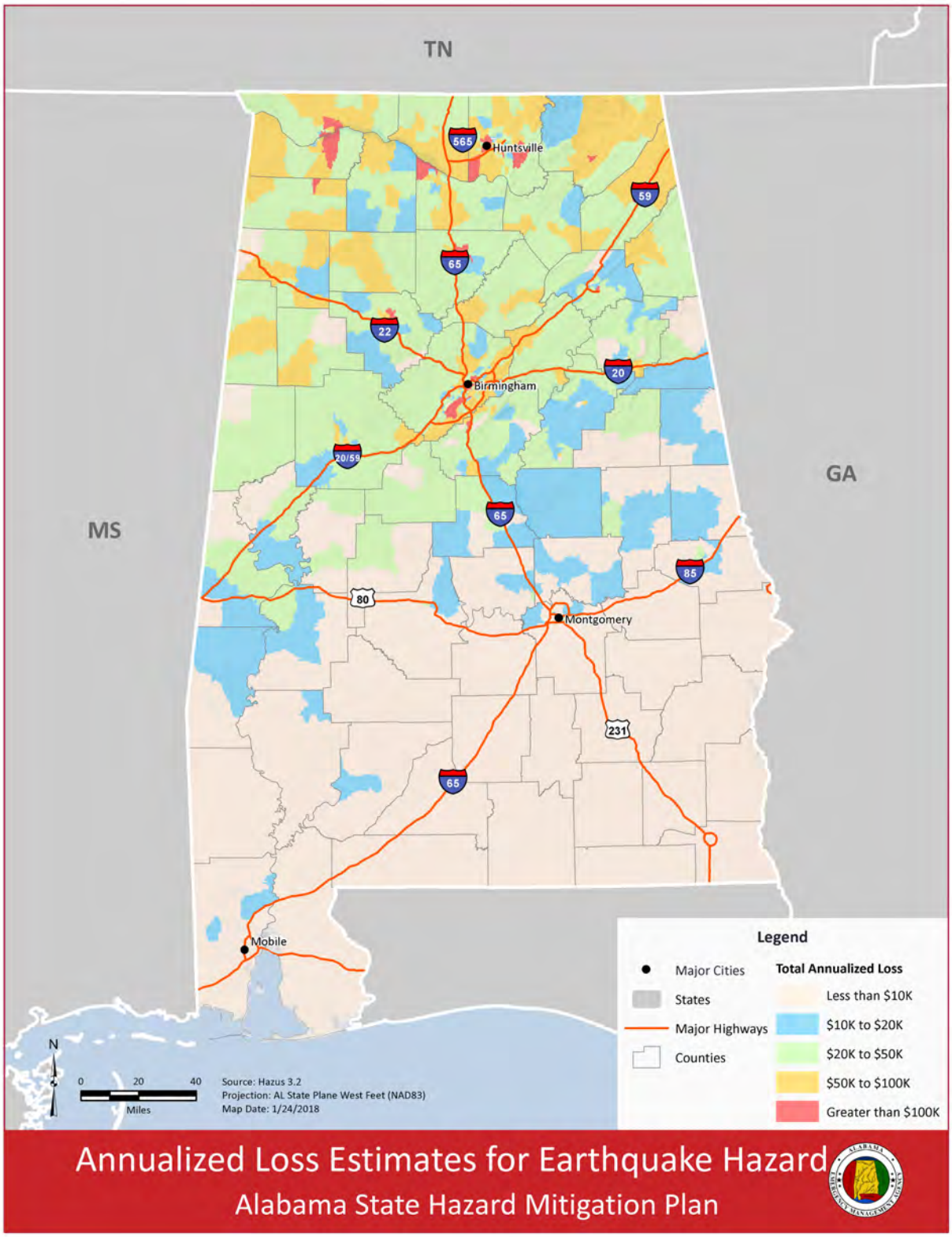
County	Building Loss	Content Loss	Inventory Loss	Total Immediate Losses
Lamar County	$75,288	$21,056	$1,371	$97,715
Tallapoosa County	$70,500	$16,773	$629	$87,903
Pickens County	$69,047	$17,399	$554	$86,999
Bibb County	$67,872	$18,324	$464	$86,661
Dallas County	$66,273	$16,867	$703	$83,843
Autauga County	$62,373	$14,372	$503	$77,247
Baldwin County	$62,547	$12,293	$344	$75,183
Hale County	$40,744	$10,306	$485	$51,535
Randolph County	$41,192	$9,615	$354	$51,160
Chambers County	$38,974	$9,294	$656	$48,924
Clay County	$36,284	$10,331	$1,028	$47,643
Marengo County	$36,750	$9,027	$279	$46,056
Cleburne County	$33,988	$8,663	$372	$43,022
Sumter County	$33,053	$7,547	$296	$40,896
Russell County	$32,429	$6,734	$268	$39,431
Houston County	$32,270	$5,916	$214	$38,399
Greene County	$24,850	$6,264	$254	$31,368
Perry County	$23,249	$5,805	$166	$29,220
Coosa County	$22,962	$5,426	$203	$28,591
Clarke County	$21,582	$4,755	$171	$26,508
Choctaw County	$19,424	$4,610	$325	$24,359
Macon County	$17,462	$3,534	$134	$21,130
Escambia County	$15,772	$3,397	$196	$19,365
Pike County	$15,830	$2,934	$113	$18,877
Coffee County	$15,925	$2,808	$82	$18,815
Dale County	$15,900	$2,630	$86	$18,616
Covington County	$13,905	$2,607	$101	$16,613
Monroe County	$13,569	$2,819	$101	$16,488
Barbour County	$12,705	$2,431	$153	$15,289
Butler County	$11,960	$2,427	$101	$14,488
Washington County	$10,133	$2,105	$54	$12,293
Wilcox County	$9,635	$2,034	$99	$11,768
Lowndes County	$8,681	$1,820	$88	$10,588
Crenshaw County	$6,526	$1,184	$48	$7,758
Geneva County	$6,077	$941	$22	$7,040
Conecuh County	$5,688	$1,096	$48	$6,833
Bullock County	$5,574	$1,044	$45	$6,663
Henry County	$5,509	$899	$32	$6,441
Total	**$17,848,907**	**$5,199,436**	**$215,539**	**$23,263,882**

Table 3.48 Potential Business Interruption Losses from Earthquake Hazards (AAL)

County	Income Loss	Relocation Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Jefferson County	$383,743	$683,622	$352,124	$521,650	$1,941,140
Madison County	$204,151	$347,810	$184,169	$252,787	$988,917
Tuscaloosa County	$84,367	$158,261	$81,587	$114,925	$439,141
Lauderdale County	$77,392	$142,471	$66,753	$107,303	$393,919
Morgan County	$69,312	$127,787	$61,005	$102,652	$360,756
Shelby County	$66,318	$129,978	$61,934	$83,744	$341,973
Colbert County	$50,199	$90,079	$40,855	$66,686	$247,817
Etowah County	$42,761	$80,209	$35,720	$63,891	$222,580
Marshall County	$40,005	$77,853	$34,298	$53,278	$205,435
Calhoun County	$34,551	$73,722	$33,396	$50,031	$191,700
Dekalb County	$30,191	$79,564	$31,426	$47,726	$188,906
Cullman County	$33,179	$72,979	$29,556	$51,302	$187,016
Limestone County	$28,965	$72,591	$31,639	$35,075	$168,271
Walker County	$28,044	$67,344	$26,533	$41,432	$163,352
Montgomery County	$28,120	$51,932	$28,300	$38,258	$146,610
Jackson County	$20,969	$56,299	$21,233	$31,012	$129,512
Talladega County	$20,078	$51,916	$18,843	$31,084	$121,920
Franklin County	$20,812	$39,698	$16,540	$29,350	$106,400
St. Clair County	$15,828	$48,150	$16,899	$22,091	$102,968
Marion County	$18,624	$37,454	$16,988	$28,589	$101,654
Blount County	$12,996	$35,483	$13,212	$17,570	$79,261
Mobile County	$13,655	$30,921	$15,666	$18,809	$79,050
Lawrence County	$13,223	$34,246	$12,069	$18,022	$77,560
Winston County	$9,612	$28,639	$10,555	$14,661	$63,467
Cherokee County	$8,794	$29,754	$9,853	$13,561	$61,961
Lee County	$10,053	$24,932	$11,775	$12,812	$59,572
Chilton County	$7,814	$19,714	$7,104	$12,724	$47,355
Fayette County	$6,626	$16,277	$6,334	$10,656	$39,893
Dallas County	$6,168	$15,936	$6,041	$9,136	$37,281
Tallapoosa County	$5,768	$14,467	$5,977	$8,946	$35,158
Elmore County	$5,109	$15,767	$6,581	$6,845	$34,302
Lamar County	$4,898	$13,652	$5,497	$7,447	$31,493
Pickens County	$3,937	$13,379	$4,956	$7,144	$29,416
Baldwin County	$4,442	$11,202	$5,615	$6,002	$27,261
Bibb County	$3,779	$12,112	$4,371	$5,549	$25,811
Autauga County	$3,826	$11,366	$4,110	$5,062	$24,364
Houston County	$3,646	$7,472	$3,724	$5,531	$20,372
Chambers County	$3,216	$8,005	$3,104	$4,947	$19,271

County	Income Loss	Relocation Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Marengo County	$3,106	$8,376	$3,008	$4,770	$19,260
Randolph County	$2,304	$8,679	$2,885	$4,110	$17,978
Hale County	$2,331	$8,620	$2,690	$3,817	$17,458
Sumter County	$2,656	$7,115	$2,837	$4,034	$16,641
Russell County	$2,600	$7,171	$2,927	$3,901	$16,599
Clay County	$1,896	$6,621	$2,311	$3,378	$14,207
Cleburne County	$1,741	$6,685	$2,155	$2,896	$13,477
Clarke County	$1,673	$4,889	$1,969	$2,676	$11,206
Greene County	$1,575	$4,941	$1,576	$2,246	$10,338
Perry County	$1,404	$4,575	$2,183	$2,041	$10,203
Choctaw County	$1,429	$4,200	$1,456	$2,465	$9,549
Macon County	$1,357	$3,811	$1,779	$1,885	$8,832
Escambia County	$1,406	$3,637	$1,547	$2,201	$8,791
Pike County	$1,360	$3,528	$1,707	$1,949	$8,544
Dale County	$1,277	$3,196	$1,662	$2,124	$8,259
Coffee County	$1,236	$3,348	$1,504	$1,820	$7,908
Covington County	$1,100	$3,069	$1,290	$1,806	$7,265
Coosa County	$665	$4,326	$1,079	$1,185	$7,254
Monroe County	$1,050	$3,217	$1,169	$1,740	$7,175
Barbour County	$1,031	$2,965	$1,302	$1,607	$6,905
Butler County	$1,045	$2,567	$1,154	$1,561	$6,327
Wilcox County	$644	$2,339	$775	$1,170	$4,927
Washington County	$407	$1,989	$646	$685	$3,726
Lowndes County	$345	$2,100	$651	$614	$3,710
Geneva County	$307	$1,413	$524	$475	$2,719
Bullock County	$374	$1,216	$511	$619	$2,719
Crenshaw County	$273	$1,397	$487	$480	$2,638
Conecuh County	$297	$1,274	$425	$466	$2,463
Henry County	$227	$1,193	$414	$319	$2,154
Total	**$1,462,283**	**$2,951,494**	**$1,370,958**	**$2,017,329**	**$7,802,062**

Figure 3.57 Total Potential Losses for Earthquake Hazard (Average Annualized Loss)



3.3.3 Flooding

The risk of damage and loss from flooding is a function of the flood hazard; the exposure of people, buildings and infrastructure; and the susceptibility of the exposed communities and structures. As discussed in Section 3.2.5, the probability of both riverine and coastal flooding will likely increase with climate change. The precise amount by which the probability of high winds will increase, however, is uncertain. This section therefore summarizes the potential impacts of flooding on state assets and jurisdictions under present conditions.

3.3.3.1 Vulnerability of State Assets

The vulnerability of state assets to flooding was determined based on the flood zones mapped by FEMA's Risk MAP program. As discussed in Section 3.2.5, the flood zones delineated by the Risk MAP program include areas with a 1%-annual-chance of flooding, areas with a 0.2%-annual-chance of flooding, and Coastal High Hazard Areas. Coastal High Hazard Areas are areas with a 1%-annual-chance of flooding that are subject to additional hazards associated with storm-induced waves.

Of the more than 12,000 state-insured facilities, 547 are located within the 1%-annual-chance floodplain and 672 are located within the 0.2%-annual-chance floodplain (Table 3.49 and Table 3.50). These facilities consist mostly of park and recreation facilities, education facilities, and port facilities, and have a combined replacement value of more than $610 million for the 1%-annual-chance flood, and more than $860 million for the 0.2% annual chance flood. Only 94 state-insured facilities are located within the Coastal High Hazard Area, all of which are park and recreation facilities.

Table 3.49 State-Insured Facilities Vulnerable to 1%-Annual-Chance Flood

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	0	0.0%	$0	0.0%
Education	138	1.5%	$200,667,785	1.0%
Government	5	2.1%	$13,887,883	0.6%
Healthcare	9	3.0%	$7,481,032	1.0%
Military	0	0.0%	$0	0.0%
Parks/Recreation	227	18.5%	$65,586,581	18.7%
Port Authority	136	81.0%	$309,870,329	88.8%
Public Safety	32	5.2%	$16,277,829	2.1%
Transportation	21	3.9%	$9,530,477	3.0%
Total	**547**	**4.7%**	**$613,771,439**	**2.4%**

Table 3.50 State-Insured Facilities Vulnerable to 0.2%-Annual-Chance Flood

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	1	5.0%	$53,900	0.2%
Education	216	2.4%	$407,301,142	2.0%
Government	14	5.8%	$22,119,211	0.9%
Healthcare	14	4.6%	$15,279,243	2.0%
Military	0	0.0%	$0	0.0%
Parks/Recreation	241	19.7%	$71,481,920	20.4%
Port Authority	152	90.5%	$328,076,621	94.0%
Public Safety	34	5.5%	$17,651,279	2.3%
Transportation	26	4.8%	$12,340,424	3.8%
Total	**672**	**5.8%**	**$861,963,316**	**3.4%**

Of the 150 structures identified as critical infrastructure by the state, 32 are located within the 1%-annual-chance floodplain, and 36 are within the 0.2%-annual-chance floodplain (Table 3.51 and Table 3.52). Most of these facilities are dams, transportation systems, or commercial facilities.

Table 3.51 Critical Infrastructure Vulnerable to 1%-Annual-Chance Flood

Facility Type	# of Vulnerable Structures
Agriculture & Food	0
Banking & Finance	0
Chemical	1
Commercial	7
Critical Manufacturing	0
Dams	14
Defense Industrial Base	0
Emergency Services	0
Energy	1
Government Facilities	0
Healthcare & Public Health	1
Information Technology	0
National Monuments & Icons	1
Nuclear Reactors, Materials, & Waste	0
Transportation Systems	7
Water	0
Total	**32**

Table 3.52 Critical Infrastructure Vulnerable to 1%-Annual-Chance Flood

Facility Type	# of Vulnerable Structures
Agriculture & Food	0
Banking & Finance	1
Chemical	1
Commercial	8
Critical Manufacturing	0
Dams	14
Defense Industrial Base	1
Emergency Services	0
Energy	2
Government Facilities	0
Healthcare & Public Health	1
Information Technology	0
National Monuments & Icons	1
Nuclear Reactors, Materials, & Waste	0
Transportation Systems	7
Water	0
Total	**36**

3.3.3.2 Vulnerability of Jurisdictions

The relative vulnerability of jurisdictions to flood hazards can be estimated based on both historic losses and Hazus modeling of potential losses. As discussed in Section 3.2.5, the NFIP is a program established by the federal government to reduce and insure flood losses. Through this program, FEMA collects extensive data on the location of NFIP insurance claims. In addition to tracking the location of claims and the value of payments for building and contents losses, FEMA tracks the number of repetitive loss (RL) and severe repetitive loss (SRL) properties and the claims associated with them. The distribution of NFIP claims and RL/SRL claims indicates where the historical vulnerability to flood events was greatest.

Figure 3.58, Figure 3.59, Figure 3.60, Figure 3.61, and Table 3.53 show the distribution of NFIP claims, NFIP repetitive loss claims, NFIP claims per 1,000 persons, NFIP repetitive loss claims per 1,000 persons, and Summary of Severe Repetitive Loss Properties and Claims. The first two figures in the series highlight that all the major metropolitan areas have seen high numbers of insurance claims, but the coastal counties and the counties in the greater Birmingham area have seen the highest numbers of repetitive loss claims. The third and fourth figures in the series take population density into account and show the counties where the number of per capita claims is

highest. These figures reveal that per capita losses are particularly high in Greene and Coffee counties. The table summarizes the total SRL properties and losses by county and summarizes the total and average payments. The coastal counties of Baldwin and Mobile have the highest total payments and average payments for SRL properties. While Jefferson has less SRL properties, the average claim payment per property is the third highest due to increased property values in this area of Alabama.

Figure 3.58 Distribution of NFIP Claims (1978-2017)

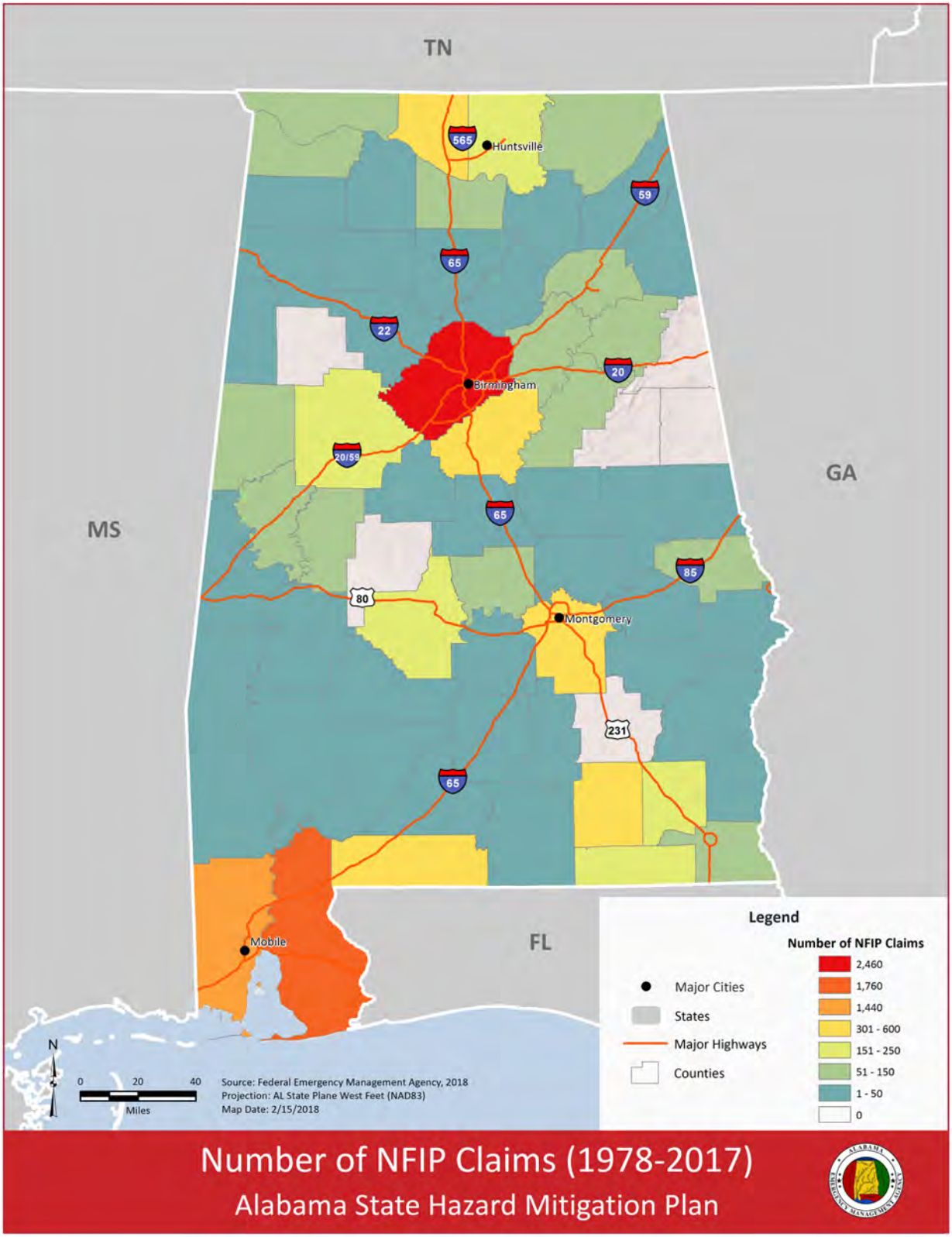


Figure 3.59 Distribution of NFIP Repetitive Loss Claims (1978-2017)

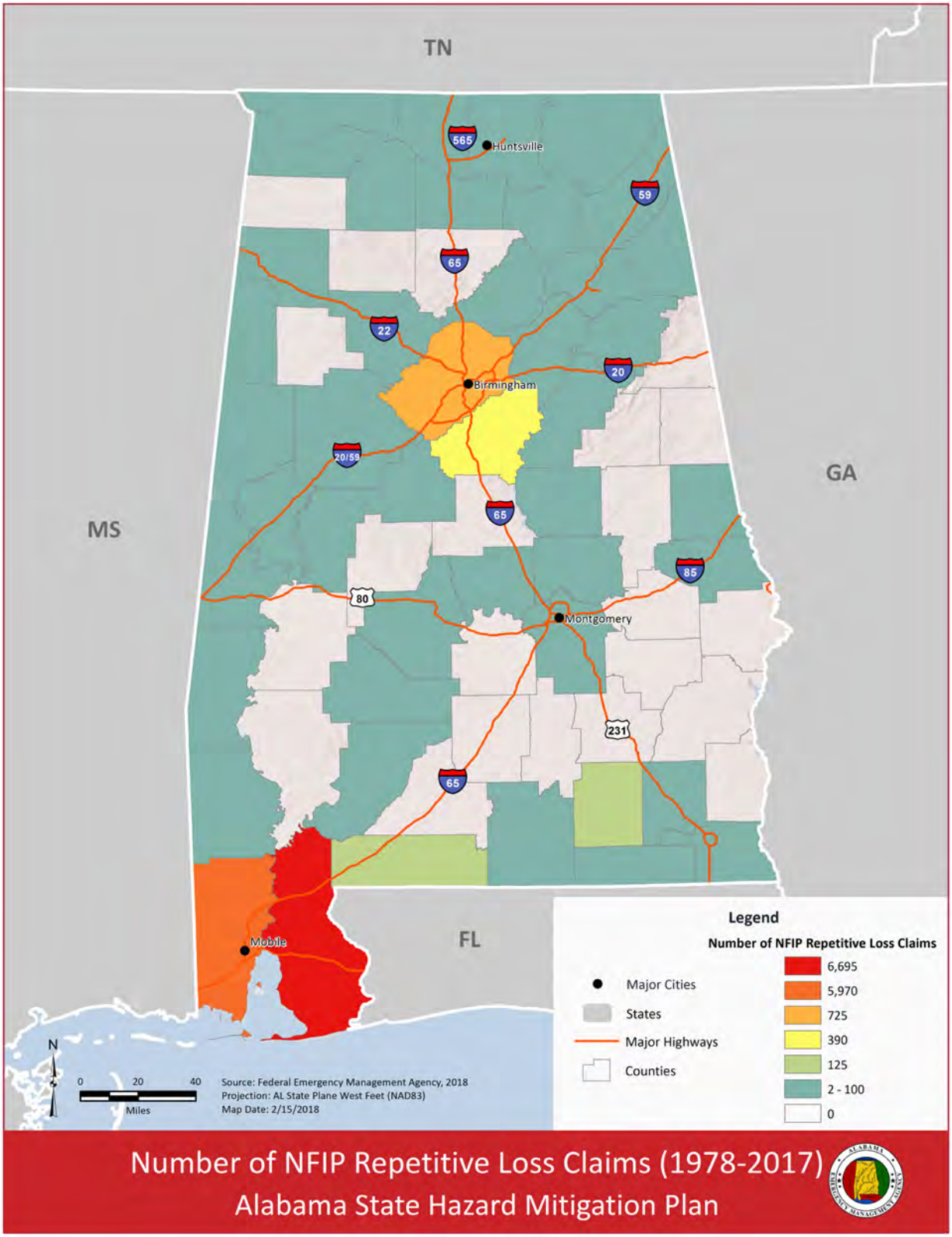


Figure 3.60 Distribution of NFIP Claims per 1,000 Persons (1978-2017)

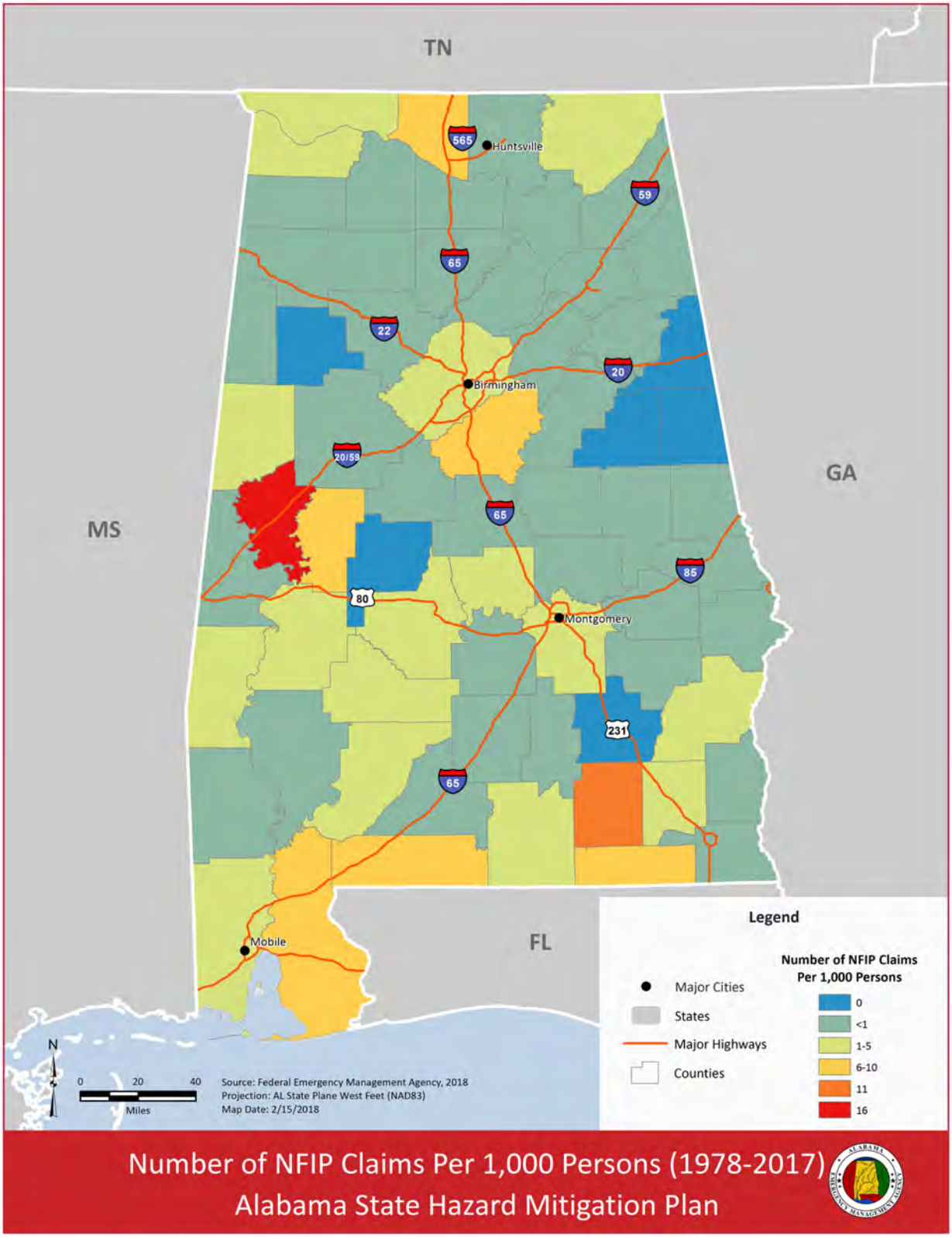


Figure 3.61 Distribution of NFIP Repetitive Loss Claims per 1,000 Persons (1978-2017)

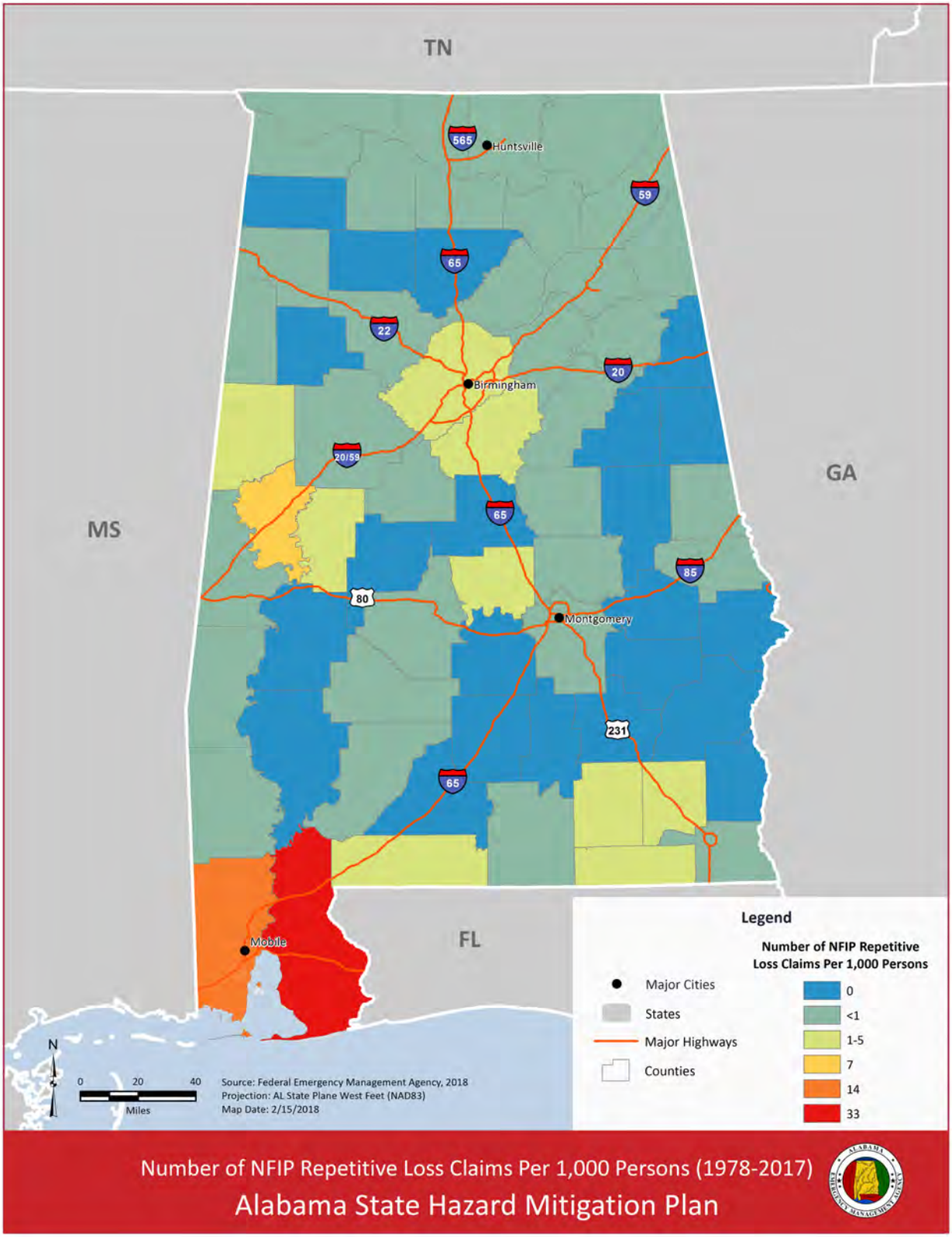


Table 3.53 Summary of NFIP Severe Repetitive Loss Properties and Claims

County	Total Properties	Total Losses	Total Claim Payments	Average Claim Payment
Autauga	1	5	$190,403.28	$38,080.66
Baldwin	129	661	$38,097,096.68	$503,857.47
Coffee	1	4	$110,067.96	$27,516.99
Colbert	1	11	$279,449.21	$25,404.47
Coosa	1	5	$158,193.13	$31,638.63
Dale	1	4	$232,691.82	$58,172.96
Geneva	1	4	$148,194.41	$37,048.60
Jefferson	5	29	$573,312.63	$107,860.96
Lauderdale	1	4	$84,481.04	$21,120.26
Lawrence	1	5	$61,787.14	$12,357.43
Limestone	1	5	$30,650.04	$6,130.01
Madison	2	15	$176,692.13	$11,779.48
Marshall	1	4	$171,677.96	$42,919.49
Mobile	128	766	$25,917,766.47	$132,524.65
Shelby	18	109	$1,924,094.49	$17,652.24
Total	**292**	**1631**	**$68,156,558.39**	**$1,074,064.29**

FEMA's Hazus software version 3.2 was also used to estimate potential flood losses across the state. The methodology used a Level II analysis for riverine flooding. The latest available FEMA flood maps and the best available ground elevation data were used to derive local flood depths. This data was combined with the default Hazus inventory data and the default depth-damage curves to estimate damages and associated losses. As discussed in Section 3.3.1, Hazus was used to calculate two kinds of economic losses: 1) immediate losses related to the damage to structures and their contents, and 2) business interruption losses related to how long businesses remain inoperable.

The tables below show the flood losses associated with the 1%-annual-chance flood event aggregated to the county scale. As discussed in Section 3.3.1, flood depth data was not available for multiple flood frequencies, and the average annualized loss therefore could not be calculated. While Table 3.54 shows immediate economic losses (building loss, contents loss, and business inventory loss), Table 3.55 shows business interruption losses (relocation costs, income loss, rental loss, and wage loss). The estimated immediate losses for the 1%-annual-chance flood are highest for Baldwin, Madison, and Jefferson counties, while the estimated business interruption losses are highest for Mobile, Jefferson, and Madison counties.

Figure 3.62 shows the spatial distribution of the total average annualized losses (the sum of immediate losses and business interruption losses). Note that losses are shown at the census tract level. The census tracts with the highest estimated losses are located in the coastal areas of Mobile and Baldwin counties and in the western part of the greater Montgomery area.

Table 3.54 Potential Immediate Losses from Flood Hazards (1%-Annual-Chance Flood)

County	Building Loss	Content Loss	Inventory Loss	Total Immediate Losses
Baldwin County	$696,401,000	$547,000,000	$6,745,000	$1,250,146,000
Madison County	$445,387,000	$516,059,000	$14,023,000	$975,469,000
Jefferson County	$438,565,000	$499,846,000	$15,375,000	$953,786,000
Mobile County	$388,880,000	$505,967,000	$17,469,000	$912,316,000
Montgomery County	$294,327,000	$343,971,000	$16,145,000	$654,443,000
Shelby County	$179,183,000	$188,123,000	$6,088,000	$373,394,000
Tuscaloosa County	$151,093,000	$158,182,000	$9,853,000	$319,128,000
Talladega County	$151,788,000	$153,406,000	$6,955,000	$312,149,000
Calhoun County	$128,546,000	$137,830,000	$7,390,000	$273,766,000
Morgan County	$110,951,000	$105,795,000	$4,580,000	$221,326,000
Cherokee County	$106,628,000	$72,555,000	$1,799,000	$180,982,000
Dallas County	$86,770,000	$82,292,000	$3,852,000	$172,914,000
St. Clair County	$89,338,000	$71,970,000	$1,384,000	$162,692,000
Lauderdale County	$81,602,000	$63,042,000	$2,146,000	$146,790,000
Jackson County	$62,544,000	$77,880,000	$2,419,000	$142,843,000
Elmore County	$67,016,000	$64,018,000	$2,496,000	$133,530,000
Etowah County	$61,655,000	$67,206,000	$2,690,000	$131,551,000
Escambia County	$49,245,000	$69,803,000	$8,149,000	$127,197,000
Choctaw County	$67,251,000	$55,861,000	$1,683,000	$124,795,000
Russell County	$44,628,000	$67,057,000	$702,000	$112,387,000
Dekalb County	$40,687,000	$60,755,000	$5,220,000	$106,662,000
Colbert County	$46,816,000	$54,815,000	$1,847,000	$103,478,000
Limestone County	$50,223,000	$44,877,000	$1,432,000	$96,532,000
Autauga County	$45,749,000	$42,087,000	$3,289,000	$91,125,000
Lee County	$52,703,000	$37,145,000	$943,000	$90,791,000
Hale County	$48,513,000	$32,599,000	$367,000	$81,479,000
Houston County	$35,579,000	$35,155,000	$1,369,000	$72,103,000
Marengo County	$35,965,000	$31,760,000	$806,000	$68,531,000
Cleburne County	$37,984,000	$26,744,000	$944,000	$65,672,000
Lowndes County	$32,222,000	$32,009,000	$846,000	$65,077,000
Marion County	$28,395,000	$33,678,000	$2,258,000	$64,331,000
Marshall County	$34,658,000	$28,694,000	$688,000	$64,040,000
Walker County	$35,572,000	$26,841,000	$860,000	$63,273,000
Greene County	$38,325,000	$22,911,000	$128,000	$61,364,000
Blount County	$33,875,000	$26,156,000	$362,000	$60,393,000
Bibb County	$33,312,000	$26,249,000	$479,000	$60,040,000
Coffee County	$29,134,000	$26,686,000	$1,560,000	$57,380,000
Sumter County	$30,373,000	$26,104,000	$615,000	$57,092,000
Pickens County	$26,260,000	$25,331,000	$685,000	$52,276,000

County	Building Loss	Content Loss	Inventory Loss	Total Immediate Losses
Lawrence County	$28,440,000	$23,113,000	$580,000	$52,133,000
Chilton County	$23,745,000	$23,882,000	$1,004,000	$48,631,000
Wilcox County	$24,840,000	$20,774,000	$1,611,000	$47,225,000
Tallapoosa County	$26,843,000	$19,832,000	$218,000	$46,893,000
Chambers County	$21,642,000	$23,398,000	$769,000	$45,809,000
Franklin County	$20,351,000	$22,540,000	$1,237,000	$44,128,000
Cullman County	$24,124,000	$19,078,000	$582,000	$43,784,000
Randolph County	$23,335,000	$18,049,000	$755,000	$42,139,000
Lamar County	$21,033,000	$18,842,000	$642,000	$40,517,000
Covington County	$20,254,000	$14,902,000	$181,000	$35,337,000
Washington County	$20,679,000	$13,610,000	$150,000	$34,439,000
Coosa County	$19,857,000	$13,667,000	$275,000	$33,799,000
Macon County	$18,641,000	$14,785,000	$273,000	$33,699,000
Geneva County	$19,361,000	$12,924,000	$198,000	$32,483,000
Fayette County	$16,159,000	$14,220,000	$420,000	$30,799,000
Clay County	$16,926,000	$12,416,000	$423,000	$29,765,000
Barbour County	$12,096,000	$13,946,000	$745,000	$26,787,000
Clarke County	$17,214,000	$9,284,000	$56,000	$26,554,000
Dale County	$12,322,000	$9,993,000	$291,000	$22,606,000
Monroe County	$13,468,000	$8,236,000	$78,000	$21,782,000
Perry County	$8,898,000	$10,371,000	$319,000	$19,588,000
Butler County	$7,428,000	$9,215,000	$137,000	$16,780,000
Bullock County	$6,736,000	$5,931,000	$185,000	$12,852,000
Henry County	$6,167,000	$5,617,000	$187,000	$11,971,000
Pike County	$7,060,000	$4,789,000	$62,000	$11,911,000
Winston County	$6,525,000	$4,572,000	$134,000	$11,231,000
Crenshaw County	$5,504,000	$4,306,000	$114,000	$9,924,000
Conecuh County	$3,035,000	$2,287,000	$65,000	$5,387,000
Total	**$4,870,826,000**	**$4,863,038,000**	**$168,332,000**	**$9,902,196,000**

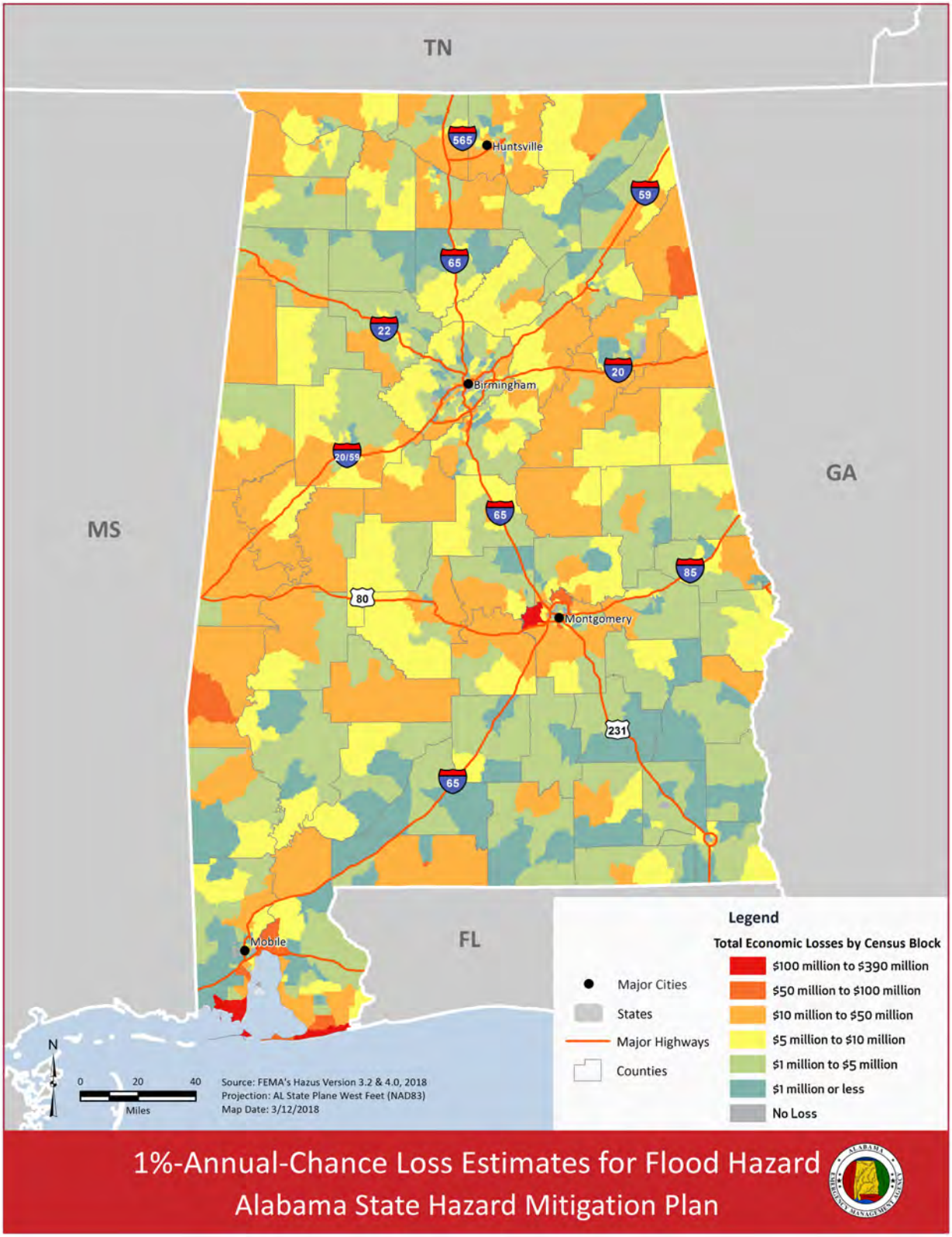
Table 3.55 Potential Business Interruption Losses from Flood Hazards (1%-Annual-Chance Flood)

County	Income Loss	Relocation Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Mobile County	$1,724,000	$949,000	$340,000	$4,835,000	$7,848,000
Jefferson County	$2,030,000	$856,000	$330,000	$3,778,000	$6,994,000
Madison County	$1,446,000	$739,000	$280,000	$2,906,000	$5,371,000
Baldwin County	$1,195,000	$1,423,000	$858,000	$1,561,000	$5,037,000

County	Income Loss	Relocation Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Montgomery County	$917,000	$499,000	$228,000	$1,523,000	$3,167,000
Shelby County	$385,000	$216,000	$59,000	$670,000	$1,330,000
Talladega County	$230,000	$143,000	$31,000	$656,000	$1,060,000
Russell County	$131,000	$69,000	$8,000	$757,000	$965,000
Calhoun County	$226,000	$112,000	$34,000	$522,000	$894,000
Morgan County	$124,000	$114,000	$27,000	$598,000	$863,000
Tuscaloosa County	$195,000	$131,000	$47,000	$394,000	$767,000
Choctaw County	$51,000	$47,000	$10,000	$626,000	$734,000
Cherokee County	$38,000	$119,000	$15,000	$519,000	$691,000
Dallas County	$132,000	$121,000	$21,000	$410,000	$684,000
Hale County	$19,000	$62,000	$4,000	$489,000	$574,000
Jackson County	$170,000	$55,000	$21,000	$322,000	$568,000
Elmore County	$79,000	$55,000	$5,000	$315,000	$454,000
Escambia County	$82,000	$42,000	$12,000	$316,000	$452,000
Etowah County	$107,000	$39,000	$17,000	$285,000	$448,000
Fayette County	$20,000	$5,000	$1,000	$416,000	$442,000
Colbert County	$153,000	$34,000	$9,000	$236,000	$432,000
Dekalb County	$100,000	$29,000	$8,000	$239,000	$376,000
St. Clair County	$54,000	$67,000	$8,000	$239,000	$368,000
Sumter County	$34,000	$12,000	$8,000	$314,000	$368,000
Lowndes County	$33,000	$44,000	$5,000	$278,000	$360,000
Marengo County	$39,000	$27,000	$2,000	$233,000	$301,000
Limestone County	$66,000	$48,000	$10,000	$171,000	$295,000
Marion County	$99,000	$25,000	$16,000	$136,000	$276,000
Lauderdale County	$50,000	$40,000	$6,000	$176,000	$272,000
Greene County	$20,000	$40,000	$3,000	$201,000	$264,000
Autauga County	$38,000	$39,000	$3,000	$172,000	$252,000
Tallapoosa County	$20,000	$14,000	$3,000	$158,000	$195,000
Washington County	$1,000	$10,000	$0	$172,000	$183,000
Barbour County	$9,000	$6,000	$0	$158,000	$173,000
Lawrence County	$23,000	$10,000	$1,000	$131,000	$165,000
Houston County	$33,000	$22,000	$8,000	$88,000	$151,000
Butler County	$6,000	$0	$1,000	$132,000	$139,000
Chambers County	$36,000	$14,000	$1,000	$87,000	$138,000
Bibb County	$12,000	$5,000	$0	$120,000	$137,000
Pickens County	$47,000	$18,000	$4,000	$62,000	$131,000
Lee County	$27,000	$50,000	$8,000	$45,000	$130,000
Coffee County	$25,000	$17,000	$2,000	$78,000	$122,000
Blount County	$26,000	$13,000	$3,000	$66,000	$108,000
Walker County	$8,000	$12,000	$2,000	$78,000	$100,000

County	Income Loss	Relocation Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Marshall County	$16,000	$16,000	$3,000	$62,000	$97,000
Chilton County	$18,000	$12,000	$3,000	$54,000	$87,000
Franklin County	$30,000	$7,000	$1,000	$46,000	$84,000
Randolph County	$11,000	$9,000	$1,000	$62,000	$83,000
Clay County	$3,000	$2,000	$0	$73,000	$78,000
Cullman County	$7,000	$9,000	$2,000	$58,000	$76,000
Wilcox County	$10,000	$15,000	$0	$51,000	$76,000
Covington County	$6,000	$8,000	$6,000	$50,000	$70,000
Macon County	$9,000	$5,000	$1,000	$54,000	$69,000
Perry County	$22,000	$9,000	$3,000	$30,000	$64,000
Bullock County	$0	$2,000	$0	$53,000	$55,000
Monroe County	$7,000	$14,000	$3,000	$27,000	$51,000
Coosa County	$8,000	$5,000	$1,000	$32,000	$46,000
Crenshaw County	$2,000	$0	$0	$44,000	$46,000
Henry County	$6,000	$5,000	$1,000	$34,000	$46,000
Lamar County	$9,000	$3,000	$3,000	$29,000	$44,000
Cleburne County	$5,000	$7,000	$0	$30,000	$42,000
Geneva County	$12,000	$10,000	$0	$18,000	$40,000
Dale County	$12,000	$5,000	$0	$20,000	$37,000
Clarke County	$3,000	$8,000	$1,000	$21,000	$33,000
Pike County	$4,000	$0	$0	$5,000	$9,000
Winston County	$2,000	$0	$0	$7,000	$9,000
Conecuh County	$0	$0	$0	$4,000	$4,000
Total	**$10,462,000**	**$6,543,000**	**$2,488,000**	**$26,532,000**	**$46,025,000**

Figure 3.62 Total Potential Losses for Flood Hazard (1%-Annual-Chance Flood)



3.3.4 High Winds

The risk of damage and loss from high winds is a function of the high wind hazard; the exposure of people, buildings and infrastructure; and the susceptibility of the exposed communities and structures. As discussed in Section 3.2.7, the probability of damaging high winds will likely increase with climate change. The precise amount by which the probability of high winds will increase, however, is uncertain. This section therefore summarizes the potential impacts of high winds on state assets and jurisdictions under present conditions.

3.3.4.1 Vulnerability of State Assets

The vulnerability of state assets to high winds was determined based on the design wind speed maps published in ASCE/SEI 7-16. As discussed in Section 3.2.7, ASC3.2.7E/SEI 7-16 reflects the wind hazard posed by all storm events except tornadoes and shows the distribution of wind speeds at three probabilities of occurrence. The 700-year wind event (or the wind event with a 7% probability of exceedance in 50 years) was determined to be most appropriate for this analysis. This is the design wind event recommended for structures whose failure would pose a moderate risk to life and safety. Within the 700-year design wind speed map, all locations with wind speeds exceeding 137 mph were selected for further analysis. According to the Enhanced Fujita Tornado Scale, wind speeds of 137 mph or more can cause severe damage, destroying entire stories of well-constructed houses, lifting heavy cars off the ground, and blowing away structures with weak foundations.

Of the more than 12,000 state-insured facilities, 1,741 were located in areas with a 700-year design wind speed exceeding 137 mph (Table 3.56). These facilities consist mostly of education facilities and have a combined replacement value of more than $3 billion, or 12% of the value of all state-insured facilities.

Table 3.56 State-Insured Facilities Vulnerable to High Wind Hazard

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	3	15.0%	$882,917	2.6%
Education	1,183	13.3%	$2,499,710,321	12.2%
Government	22	9.1%	$18,650,346	0.8%
Healthcare	64	21.1%	$117,519,947	15.3%
Military	9	8.8%	$39,228,539	11.5%
Parks/Recreation	193	15.8%	$70,903,674	20.2%
Port Authority	151	89.9%	$339,159,167	97.2%
Public Safety	71	11.4%	$79,509,213	10.4%
Transportation	45	8.3%	$30,406,270	9.5%
Total	**1,741**	**14.3%**	**$3,195,970,394**	**12.4%**

Of the 150 structures identified as critical infrastructure by the state, 37 are located in areas with a 700-year design wind speed exceeding 137 mph (Table 3.57). Most of these facilities are commercial or chemical facilities.

Table 3.57 Critical Infrastructure Vulnerable to High Wind Hazard

Facility Type	# of Vulnerable Structures
Agriculture & Food	1
Banking & Finance	1
Chemical	8
Commercial	11
Critical Manufacturing	2
Defense Industrial Base	1
Energy	3
Government Facilities	1
Healthcare & Public Health	3
Transportation Systems	6
Total	**37**

3.3.4.2 Vulnerability of Jurisdictions

FEMA's Hazus software version 3.2 was used to estimate high wind vulnerability across the state. The methodology uses Hazus default data on high wind hazards along with state-wide building stock data (based on 2010 US Census data) and the software's standard algorithms. The calculation algorithms quantify the potential losses associated with hurricane using information about sea surface temperature, central pressure, translation speed, and surface roughness. As discussed in Section 3.3.1, Hazus was used to calculate two kinds of economic losses: 1) immediate losses related to the damage to structures and their contents, and 2) business interruption losses related to how long businesses remain inoperable.

The tables below show the average annualized hurricane wind losses for Alabama aggregated to the county scale. While Table 3.58 shows immediate economic losses (building loss, contents loss, and business inventory loss), Table 3.59 shows business interruption losses (relocation costs, income loss, rental loss, and wage loss). Figure 3.63 shows the spatial distribution of the total average annualized losses (the sum of immediate losses and business interruption losses). Note that losses are shown at the census tract level. Both the county-level tables and the census-tract level map show the highest annualized losses in Mobile and Baldwin counties.

It is instructive to compare the magnitude of average annualized losses for earthquake hazards and high wind hazards. While the potential immediate losses across the state of Alabama total

more than half a trillion dollars for high wind hazards, they total slightly more than $20 million for earthquake hazards. This finding reflects the lower probability of earthquake hazards discussed in the Section 3.2.3.

Table 3.58 Potential Immediate Losses from High Wind Hazards (AAL)

County	Building Loss	Contents Loss	Business Inventory Loss	Total Immediate Losses
Mobile County	$196,582,066	$88,212,640	$1,385,249	$286,179,954
Baldwin County	$119,042,397	$49,264,936	$527,422	$168,834,756
Escambia County	$4,300,417	$1,692,897	$43,174	$6,036,488
Montgomery County	$3,412,464	$975,674	$6,262	$4,394,400
Jefferson County	$3,149,302	$1,061,238	$2,605	$4,213,145
Houston County	$3,193,780	$1,007,426	$10,203	$4,211,409
Covington County	$2,320,227	$914,451	$9,754	$3,244,432
Coffee County	$1,963,972	$775,056	$4,205	$2,743,233
Dale County	$1,405,434	$517,485	$3,684	$1,926,603
Geneva County	$1,336,960	$486,258	$3,199	$1,826,417
Washington County	$1,282,189	$514,268	$2,216	$1,798,673
Shelby County	$1,276,801	$385,100	$1,110	$1,663,011
Monroe County	$1,240,029	$398,968	$5,116	$1,644,114
Tuscaloosa County	$1,184,358	$390,524	$1,531	$1,576,413
Lee County	$1,074,127	$421,158	$1,728	$1,497,012
Clarke County	$1,017,491	$366,554	$3,275	$1,387,320
Elmore County	$908,142	$367,870	$715	$1,276,727
Conecuh County	$686,509	$262,398	$2,139	$951,046
Autauga County	$670,383	$199,782	$1,139	$871,303
Madison County	$712,526	$153,554	$415	$866,495
Butler County	$520,401	$197,788	$1,347	$719,536
Pike County	$528,973	$149,904	$1,581	$680,458
Dallas County	$462,005	$141,958	$1,059	$605,022
Crenshaw County	$349,699	$135,659	$737	$486,095
Henry County	$381,497	$89,404	$1,006	$471,908
Russell County	$336,849	$116,034	$796	$453,679
Calhoun County	$350,761	$100,870	$468	$452,099
Tallapoosa County	$315,030	$127,818	$218	$443,066
Talladega County	$326,124	$111,570	$762	$438,456
Choctaw County	$320,496	$104,242	$964	$425,701
Etowah County	$293,765	$122,839	$232	$416,835
Chilton County	$310,242	$100,167	$462	$410,871
Barbour County	$292,423	$98,902	$1,239	$392,564
St. Clair County	$278,852	$110,450	$200	$389,502
Marengo County	$301,471	$85,097	$476	$387,044

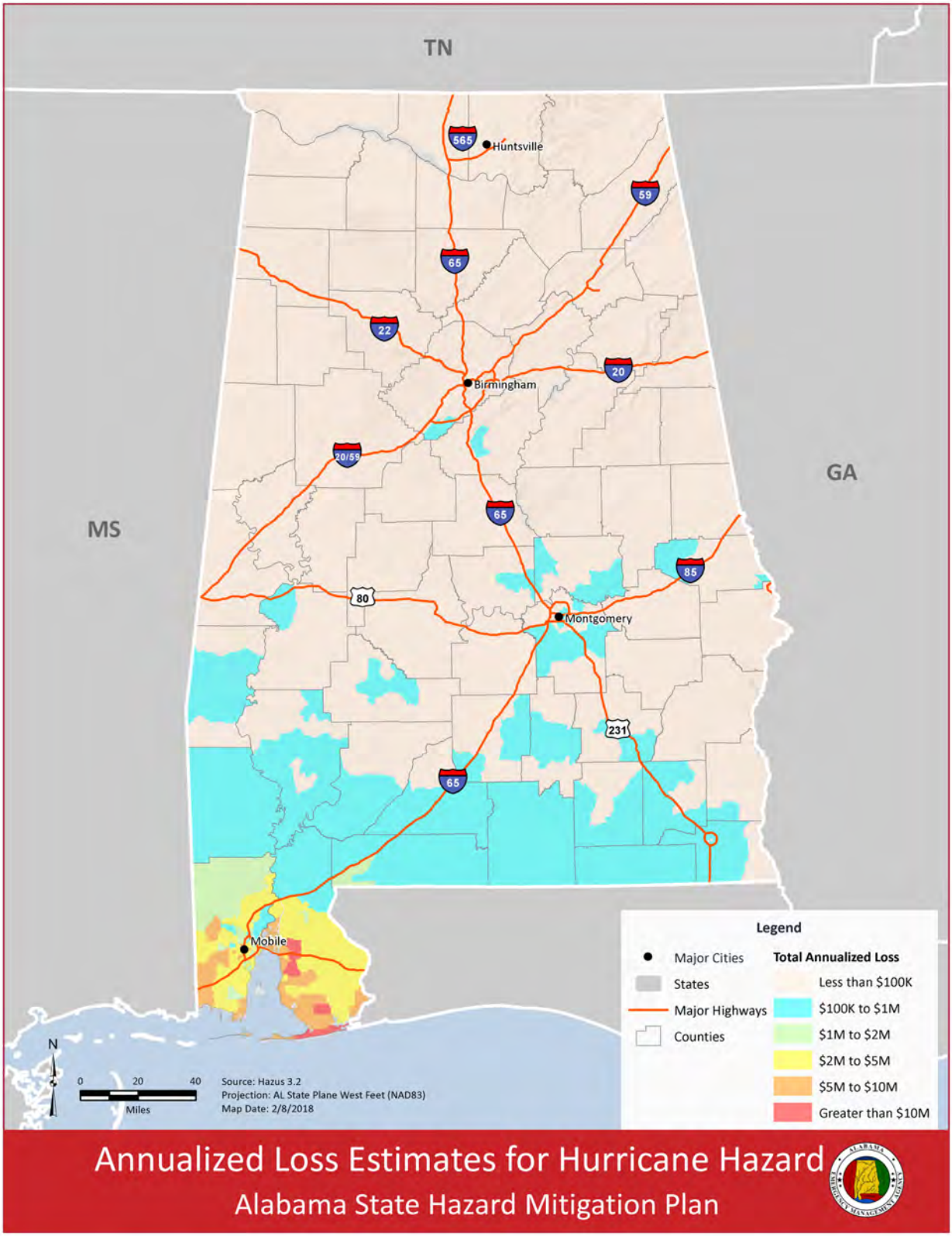
County	Building Loss	Contents Loss	Business Inventory Loss	Total Immediate Losses
Morgan County	$236,816	$68,430	$178	$305,424
Wilcox County	$220,909	$80,266	$514	$301,689
Cullman County	$204,546	$59,165	$343	$264,053
Walker County	$192,786	$63,979	$182	$256,946
Chambers County	$176,045	$53,932	$681	$230,658
Limestone County	$174,818	$52,165	$110	$227,093
Macon County	$157,763	$55,774	$278	$213,814
Hale County	$146,681	$64,024	$241	$210,946
Blount County	$155,855	$50,927	$84	$206,866
Marshall County	$163,163	$38,289	$233	$201,686
Bibb County	$126,913	$51,370	$94	$178,376
Sumter County	$131,562	$45,669	$318	$177,548
Lauderdale County	$137,404	$19,156	$120	$156,681
Bullock County	$105,196	$43,346	$239	$148,782
Randolph County	$105,347	$41,194	$101	$146,642
Lowndes County	$121,239	$23,709	$362	$145,310
Perry County	$90,072	$30,082	$77	$120,231
Pickens County	$86,824	$32,386	$67	$119,277
Dekalb County	$99,834	$16,393	$312	$116,540
Coosa County	$80,978	$32,625	$57	$113,659
Colbert County	$93,508	$17,511	$168	$111,186
Jackson County	$79,975	$28,246	$84	$108,305
Marion County	$78,804	$28,800	$154	$107,757
Cherokee County	$77,804	$26,490	$113	$104,406
Greene County	$63,338	$21,224	$66	$84,628
Lawrence County	$66,509	$17,380	$34	$83,923
Lamar County	$52,570	$27,241	$71	$79,881
Fayette County	$57,536	$21,532	$130	$79,197
Winston County	$59,846	$16,096	$178	$76,120
Clay County	$52,907	$19,340	$230	$72,477
Franklin County	$50,722	$11,356	$73	$62,151
Cleburne County	$40,092	$16,801	$29	$56,922
Total	**$355,816,521**	**$151,335,832**	**$2,032,609**	**$509,184,962**

Table 3.59 Potential Business Interruption Losses from High Wind Hazards (AAL)

County	Relocation Loss	Income Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Mobile County	$25,144,094	$3,697,339	$9,488,505	$4,663,572	$42,993,510
Baldwin County	$13,630,220	$1,770,962	$5,682,085	$2,179,425	$23,262,691
Escambia County	$533,627	$66,437	$191,257	$100,323	$891,643
Houston County	$275,866	$34,377	$112,069	$52,575	$474,888
Covington County	$220,217	$19,331	$76,496	$33,158	$349,202
Montgomery County	$187,566	$24,321	$97,637	$31,472	$340,996
Coffee County	$150,925	$12,939	$55,936	$18,041	$237,841
Monroe County	$141,633	$11,998	$47,172	$23,829	$224,633
Geneva County	$136,265	$8,505	$44,493	$15,238	$204,501
Jefferson County	$109,601	$13,547	$46,031	$15,925	$185,104
Washington County	$120,291	$5,681	$36,367	$16,017	$178,356
Dale County	$97,411	$7,337	$40,178	$11,799	$156,725
Clarke County	$85,363	$6,908	$30,520	$15,168	$137,959
Conecuh County	$58,369	$3,228	$19,450	$6,382	$87,429
Tuscaloosa County	$47,926	$4,500	$20,264	$5,613	$78,303
Lee County	$48,149	$3,597	$19,025	$4,595	$75,366
Pike County	$39,779	$3,991	$17,395	$6,030	$67,195
Shelby County	$40,672	$2,638	$13,881	$2,934	$60,124
Elmore County	$40,040	$2,429	$13,493	$3,516	$59,477
Butler County	$34,282	$3,253	$14,661	$5,403	$57,600
Dallas County	$31,896	$4,314	$13,683	$7,499	$57,392
Henry County	$35,607	$2,270	$11,587	$3,265	$52,730
Autauga County	$34,722	$2,061	$11,371	$2,875	$51,029
Choctaw County	$23,067	$1,802	$7,649	$5,740	$38,258
Crenshaw County	$23,280	$1,326	$8,012	$3,016	$35,634
Barbour County	$19,488	$2,020	$8,533	$4,193	$34,235
Marengo County	$21,206	$1,968	$7,353	$3,314	$33,840
Russell County	$20,592	$1,422	$7,129	$2,771	$31,913
Madison County	$19,721	$2,005	$7,604	$1,999	$31,330
Wilcox County	$14,764	$1,103	$5,601	$2,747	$24,215
Chilton County	$15,646	$996	$4,669	$1,853	$23,165
Talladega County	$13,717	$1,055	$4,626	$1,662	$21,060
Calhoun County	$13,470	$1,072	$4,917	$1,496	$20,954
Tallapoosa County	$10,716	$654	$3,533	$1,150	$16,054
Sumter County	$8,902	$812	$3,289	$2,202	$15,206
Lowndes County	$9,688	$606	$2,979	$1,285	$14,559
Macon County	$8,848	$688	$3,336	$1,295	$14,167
Etowah County	$8,219	$706	$2,969	$1,045	$12,938

County	Relocation Loss	Income Loss	Rental Income Loss	Wage Loss	Total Business Interruption Losses
Chambers County	$8,270	$516	$2,764	$927	$12,476
Hale County	$7,765	$467	$2,346	$1,305	$11,882
St. Clair County	$8,150	$372	$2,565	$540	$11,627
Walker County	$7,469	$484	$2,400	$763	$11,115
Cullman County	$6,900	$485	$2,225	$907	$10,517
Morgan County	$6,368	$602	$2,290	$653	$9,912
Bullock County	$5,813	$394	$1,947	$781	$8,935
Marshall County	$5,747	$442	$1,918	$628	$8,735
Limestone County	$5,734	$373	$1,826	$423	$8,356
Perry County	$5,330	$355	$1,888	$622	$8,196
Lauderdale County	$5,224	$410	$1,884	$568	$8,086
Bibb County	$5,171	$298	$1,683	$558	$7,711
Blount County	$4,542	$257	$1,383	$299	$6,481
Dekalb County	$4,045	$284	$1,239	$870	$6,438
Randolph County	$4,189	$212	$1,297	$610	$6,308
Colbert County	$4,072	$314	$1,408	$419	$6,213
Pickens County	$3,734	$167	$1,249	$424	$5,574
Greene County	$3,426	$122	$1,092	$447	$5,087
Cherokee County	$2,844	$144	$817	$289	$4,093
Marion County	$2,497	$198	$889	$362	$3,946
Coosa County	$2,822	$63	$798	$214	$3,897
Lawrence County	$2,479	$136	$727	$251	$3,592
Winston County	$2,459	$97	$750	$184	$3,490
Franklin County	$2,159	$132	$719	$215	$3,224
Jackson County	$2,105	$132	$655	$185	$3,077
Fayette County	$1,921	$98	$644	$278	$2,941
Clay County	$1,868	$101	$620	$248	$2,837
Lamar County	$1,616	$90	$524	$182	$2,412
Cleburne County	$1,312	$44	$397	$147	$1,900
Total	**$41,601,875**	**$5,737,986**	**$16,226,700**	**$7,274,723**	**$70,841,284**

Figure 3.63 Total Potential Losses for High Wind Hazard (Average Annualized Loss)



As discussed in Section 3.2.7, modeling and mapping the probability of tornado wind hazards is complicated by the lack of available data. In the absence of accurate models of tornado hazard, it is not possible to model the future vulnerability of people and property across Alabama counties. Historic vulnerability to tornado hazards, however, can be used as a rough guide to future vulnerability. Table 3.60 shows the tornado-related property damage sustained be each county in Alabama between 1950-2017, as recorded in the Storm Events Database. It is important to note that the damage estimates in the Storm Events Database are collected from diverse sources by staff with little or no training in damage estimation, and that these estimates are often not compared with actual costs. Nevertheless, this dataset represents the most complete and consistent available record of tornado damage in the US. Based on their historical vulnerability, the counties of Tuscaloosa, Jefferson, Limestone, and Madison are likely to be the most vulnerable to tornado damage and loss.

Table 3.60 Historical Tornado Damage by County, 2017 Dollars

County	Property Damage	Crop Damage	Total Damage
Tuscaloosa County	$1,926,382,495	$1,000,710	$1,927,383,205
Jefferson County	$1,426,772,700	$3,300,000	$1,430,072,700
Limestone County	$1,136,279,350	$76,500	$1,136,355,850
Madison County	$1,088,373,665	$0	$1,088,373,665
St. Clair County	$383,918,555	$27,507,500	$411,426,055
Coffee County	$369,128,263	$82,500	$369,210,763
Walker County	$298,507,265	$120,000	$298,627,265
Cullman County	$297,430,748	$64,830	$297,495,578
Marion County	$204,230,125	$0	$204,230,125
Calhoun County	$153,017,336	$27,530,000	$180,547,336
Hale County	$168,315,635	$0	$168,315,635
Perry County	$163,519,160	$39,000	$163,558,160
Shelby County	$161,491,258	$0	$161,491,258
Bibb County	$155,738,533	$0	$155,738,533
Pickens County	$153,921,040	$22,500	$153,943,540
Talladega County	$152,051,615	$0	$152,051,615
Fayette County	$143,804,610	$0	$143,804,610
Clay County	$143,322,305	$3,990	$143,326,295
Tallapoosa County	$131,198,639	$65,520	$131,264,159
Dale County	$119,194,900	$0	$119,194,900
Elmore County	$86,187,192	$156,000	$86,343,192
Marshall County	$75,850,993	$82,830	$75,933,823

County	Property Damage	Crop Damage	Total Damage
Russell County	$74,440,665	$3,000	$74,443,665
Morgan County	$69,869,103	$0	$69,869,103
Dekalb County	$63,043,875	$45,300	$63,089,175
Blount County	$62,250,890	$81,410	$62,332,300
Franklin County	$59,674,600	$0	$59,674,600
Cherokee County	$26,420,800	$27,500,000	$53,920,800
Lawrence County	$51,665,395	$12,240	$51,677,635
Lee County	$50,775,135	$0	$50,775,135
Henry County	$46,771,350	$805	$46,772,155
Etowah County	$41,338,933	$109,020	$41,447,953
Montgomery County	$40,463,945	$0	$40,463,945
Jackson County	$40,395,810	$7,650	$40,403,460
Dallas County	$39,886,735	$93,600	$39,980,335
Marengo County	$31,530,450	$0	$31,530,450
Autauga County	$30,424,631	$0	$30,424,631
Baldwin County	$28,462,027	$0	$28,462,027
Chilton County	$24,712,440	$7,800	$24,720,240
Winston County	$24,280,898	$34,320	$24,315,218
Sumter County	$23,166,828	$0	$23,166,828
Coosa County	$19,943,928	$31,200	$19,975,128
Colbert County	$19,813,893	$7,650	$19,821,543
Monroe County	$19,137,123	$0	$19,137,123
Houston County	$19,019,453	$0	$19,019,453
Choctaw County	$18,951,640	$0	$18,951,640
Mobile County	$17,267,667	$0	$17,267,667
Covington County	$16,960,238	$0	$16,960,238
Greene County	$13,369,209	$0	$13,369,209
Pike County	$12,559,335	$15,000	$12,574,335
Randolph County	$12,541,300	$0	$12,541,300
Chambers County	$10,293,420	$82,500	$10,375,920
Lamar County	$10,059,100	$67,500	$10,126,600
Escambia County	$9,917,135	$0	$9,917,135
Clarke County	$6,194,790	$3,240,000	$9,434,790
Lauderdale County	$9,316,818	$0	$9,316,818
Conecuh County	$8,740,120	$0	$8,740,120

County	Property Damage	Crop Damage	Total Damage
Crenshaw County	$8,542,950	$0	$8,542,950
Barbour County	$8,324,045	$5,550	$8,329,595
Lowndes County	$7,892,180	$45,000	$7,937,180
Washington County	$7,693,933	$0	$7,693,933
Butler County	$7,139,969	$0	$7,139,969
Geneva County	$5,983,715	$0	$5,983,715
Cleburne County	$5,615,350	$23,760	$5,639,110
Wilcox County	$3,319,325	$0	$3,319,325
Macon County	$3,280,875	$0	$3,280,875
Bullock County	$2,832,670	$13,500	$2,846,170
Total	**$10,052,921,067**	**$91,478,685**	**$10,144,399,752**

3.3.5 Sea Level Rise and Coastal Land Change

The risk of damage and loss from sea level rise is a function of the hazard; the exposure of people, buildings and infrastructure; and the susceptibility of the exposed communities and structures. As discussed in Section 3.2.10, sea level rise is a certainty in Alabama, but its rate could increase or decrease depending on human activities and the response of natural systems. To inform coastal planning, scientists have developed a range of sea level rise scenarios. This section examines the impacts of a one-foot, three-foot, and six-foot rise in local sea levels to illustrate the range of possible impacts. The only jurisdictions vulnerable to sea level rise are Mobile and Baldwin counties.[154]

3.3.5.1 Vulnerability of State Assets

Of the more than 12,000 state-insured facilities, 5 would be vulnerable to a 1-foot rise in local sea level, 94 would be vulnerable to a 3-foot rise, and 125 would be vulnerable to a 6-foot rise (Table 3.61, Table 3.62, and Table 3.63). These facilities consist mostly of park and recreation facilities and port facilities and have a combined replacement value of more than $7 million for a 1-foot rise in local sea level, more than $25 million for a 3-foot rise, and more than $74 million for a 6-foot rise.

[154] Due to limitations in the floodplain mapping data available, sea level rise products have only been produced for Mobile and Baldwin counties and are not currently available for other counties near the coast. The availability of data in other counties does not mean that these counties do not face risk from sea-level risk.

Table 3.61 State-Insured Facilities Vulnerable to 1-Foot Local Sea Level Rise

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	0	0.0%	$0	0.0%
Education	3	0.0%	$7,056,445	0.0%
Government	0	0.0%	$0	0.0%
Healthcare	0	0.0%	$0	0.0%
Military	0	0.0%	$0	0.0%
Parks/Recreation	1	0.1%	$285,242	0.1%
Port Authority	1	0.6%	$33,117	0.0%
Public Safety	0	0.0%	$0	0.0%
Transportation	0	0.0%	$0	0.0%
Total	**5**	**0.0%**	**$7,374,804**	**0.0%**

Table 3.62 State-Insured Facilities Vulnerable to 3-Foot Local Sea Level Rise

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	0	0.0%	$0	0.0%
Education	3	0.0%	$7,056,445	0.0%
Government	0	0.0%	$0	0.0%
Healthcare	0	0.0%	$0	0.0%
Military	0	0.0%	$0	0.0%
Parks/Recreation	87	7.1%	$16,765,186	4.8%
Port Authority	2	1.2%	$559,849	0.2%
Public Safety	2	0.3%	$639,477	0.1%
Transportation	0	0.0%	$0	0.0%
Total	**94**	**0.8%**	**$25,020,957**	**0.1%**

Table 3.63 State-Insured Facilities Vulnerable to 6-Foot Local Sea Level Rise

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Agriculture	0	0.0%	$0	0.0%
Education	6	0.1%	$8,390,383	0.0%
Government	0	0.0%	$0	0.0%
Healthcare	0	0.0%	$0	0.0%
Military	0	0.0%	$0	0.0%
Parks/Recreation	104	8.5%	$19,913,037	5.7%

Facility Type	# of Vulnerable Structures	% of Total Structures for Facility Type	Replacement Value	% of Total Value for Facility Type
Port Authority	13	7.7%	$45,883,729	13.1%
Public Safety	2	0.3%	$639,477	0.1%
Transportation	0	0.0%	$0	0.0%
Total	**125**	**1.1%**	**$74,826,626**	**0.3%**

Very few critical facilities are located in areas that would be inundated by local sea level rise. No critical facilities would be submerged by a 1- or 3- foot rise in sea level, and only two commercial facilities would be submerged by a 6-foot rise in local sea level. Recall, however, that state assets and critical facilities could face severe impacts well before they become submerged, from the amplified coastal flooding and storm surge discussed in Section 3.2.5, to the increasing frequency and extent of episodic tidal flooding discussed in Section 3.2.10.

3.4 Impacts of Development Trends on Vulnerability

As discussed in Section 3.1, the structure of the risk assessment chapter is intended to support the development of effective mitigation strategies and to demonstrate compliance with federal regulations and policy. While Sections 3.2 and 3.3 profile the hazards that affect Alabama, assess the vulnerability of the state and its counties, and provide loss estimates, this section discusses the impacts of development trends on vulnerability.

3.4.1 Population and Development Trends

When a hazard strikes, the characteristics of the people, property, and infrastructure exposed to the hazard event are key determinants of the extent of damage and loss. High growth in high-risk areas can increase Alabama's vulnerability to hazards, while appropriately-sited and designed growth can reduce future losses.

This plan recognizes that development patterns change over time, and that state and local planning processes must monitor and adapt to these changes. The series of maps below illustrate the distribution of people and land uses across the state today and show how this distribution is projected to change in the future. As described in Current Conditions (Section 2.1.1) the most densely populated counties in Alabama are those surrounding the major metropolitan areas of Birmingham, Huntsville, and Mobile. While these counties have more urbanized area than other parts of the state, they still have significant amounts of forest and farm lands and are characterized by decentralized development patterns that extend the built environment into rural areas (Section 2.1.3).

In the next twenty to thirty years, population growth rates are expected to vary widely across the state (Section 2.2.1). Decentralized growth patterns, however, are expected to continue to prevail. The counties adjacent to the state's largest cities are expected to experience the highest growth rates, while the counties encompassing these cities are expected to experience only moderate growth. The one exception to this trend is Huntsville, where high growth rates are expected in both Madison and Limestone counties.

3.4.2 Intersections between High Growth Areas and High-Risk Areas

The growth patterns projected for Alabama are likely to intersect with high risk areas throughout the state, placing more people and property at risk. Some aspects of the projected trends in population and development that can be expected to exacerbate future losses include the following:

- New population growth is often concentrated along economically desirable coastal areas that are at high risk of coastal flooding, storm surge, and wind damages;
- New development and associated parking, roads, and other impervious surfaces can increase urban runoff, exacerbating flooding hazards;
- New construction in previously rural areas can expand the wildland urban interface, increasing exposure to wildfires;
- Population growth across the unconsolidated aquifers of the Coastal Plan can increase the demand for limited water resources in times of drought;
- Ongoing beach development and construction can increase risk of beach erosion; and
- More development in the state's karst areas, particularly in the Huntsville area, can increase the probability of property and infrastructure damages.

4 Capability Assessment

4.1 Emergency Management Accreditation Program (EMAP) Assessment

Since November 2002, AEMA has used the Emergency Management Accreditation Program (EMAP) assessment process to evaluate its pre- and post-disaster hazard management policies, programs, and capabilities. The EMAP assessment has most recently been completed on April 27, 2017. EMAP provides AEMA with a baseline for continuing assessments that will be considered in future plan reviews and updates. AEMA is an active participant in EMAP, and in the past the AEMA Director served on the EMAP Commission. Findings from the EMAP assessment are highlighted throughout this section.

The 2017 EMAP evaluation found the State's emergency management program strategy to be compliant in all areas, and AEMA is therefore EMAP certified based on the results of an all-hazards identification, risk assessment, and impact analysis (as required by the EMAP standard). The State complies with all the other qualifying "sub-elements", including:

a) Use of appropriate building construction standards;
b) Hazard avoidance through appropriate land use practices;
c) Relocation, retrofitting, or removal of structures at risk;
d) Removal or elimination of the hazard;
e) Reduction or limitation of the amount or size of the hazard;
f) Segregation of the hazard from that which is to be protected;
g) Modification of the basic characteristics of the hazard;
h) Control of the rate of release of the hazard (met for natural hazards);
i) Provision of protective systems or equipment;
j) Establishment of hazard warning and communication procedures; and
k) Redundancy or duplication of critical systems, equipment, information, operations or materials.

4.2 Laws, Regulations, Policies, and Programs for Pre- and Post-Disaster Hazard Management

4.2.1 Laws

The following is a review of the State laws of pre-disaster and post-disaster hazard management. AEMA was established through Section 4 of Alabama Law, 1955, Act No. 47, commonly known as the Alabama Emergency Management Act of 1955 (also as Code of Alabama 31-9, 1955).[1]

Section 10, Alabama Law, 1955, Act No. 47, authorized and directed local governments to establish organizations for emergency management.[2] Under this legislation, each county is required to have an emergency management organization, either individually or jointly. Appropriate ordinances and/or resolutions are required to establish each local organization and must provide for the organization, powers, duties, divisions, services, and staff of the agency. The Emergency Management Agency (EMA) office must maintain and display current functional statements and organizational charts. Initial submittals of annual budgets must be accompanied by a functional statement and an organizational chart. Subsequent submissions of the organizational chart and functional statement are required only when a change/revision is published. FEMA Form 85-17, Staffing Pattern for each participating political jurisdiction, is a required part of the State's annual Comprehensive Cooperative Agreement. Thus, the current annual State submission reflects local agencies meeting eligibility criteria to receive EMA funds.

One of the most significant state enabling statutes related to hazard mitigation can be found in Title 11, Chapter 52, *Planning, Zoning, and Subdivisions* of the Code of Alabama. Section 11-52 et seq. is the State planning enabling legislation for municipalities only. First enacted in 1935, the statute provides municipalities' broad powers for comprehensive planning, capital improvements programming and the regulation of land use, development, and conservation of land areas through zoning ordinances and subdivision regulations. It permits municipalities to create planning commissions to oversee planning and land use controls, and Boards of Adjustments to hear appeals. It is the basis for floodplain management regulations within all municipalities and provides additional powers to control the location and types of development activities that might be affected by other natural hazards, including landslides and land subsidence.

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[1] AL Code § 31-9-4, 1955. Retrieved at: https://law.justia.com/codes/alabama/2012/title-31/chapter-9/section-31-9-4/.
[2] AL Code § 31-9-10, 2012. Retrieved at: https://law.justia.com/codes/alabama/2012/title-31/chapter-9/section-31-9-10/.

Unincorporated areas of counties in Alabama are severely restricted by the lack of a state planning enabling statute. Only three counties statewide – Baldwin, Jefferson, and parts of Shelby County – are permitted to establish zoning ordinances by special acts adopted by the State. County regulation of subdivisions within unincorporated areas, however, is granted by Title 11, Chapter 24 of the Code of Alabama. County commissions are permitted to regulate the subdivision of land and the construction of streets and utilities with the advice of an advisory board. Municipalities may enforce subdivision regulations within its police jurisdictions, which extend two miles beyond the municipal boundaries within unincorporated areas of a county.

Code of Alabama, Title 11, Chapter 19, Sections 11-19-1 through 11-19-24, entitled *The Comprehensive Land Use Management Act* was enacted to prevent economic and human loss in flood-prone areas and permit counties to manage floodplain development within unincorporated areas. This act provides the established county commission the authority to create a comprehensive land-use management program for floodplain management, in accordance with the NFIP criteria. As a result, unincorporated communities are eligible for flood insurance through the NFIP. The program helps mitigate damages caused by floods by controlling land use and development and improving the long-range management of flood prone areas. The statute authorizes each county commission to adopt floodplain management ordinances for unincorporated areas. County Planning Commissions are granted broad authority to control development in flood-prone zones by adopting ordinances and Flood Insurance Rate Maps that delineate the various flood zones controlled by the adopted ordinances. Each county must appoint an administrator of the program and provide for a Board of Adjustment to hear appeals to the ordinance requirements.

Title 41, Article 6, Code of Alabama, establishes a State Building Commission (Department of Finance Division of Construction Management). The Standard Building Code has since been superseded in 2016 by the 2015 International Code Series of the International Code Council. The Building Commission oversees the planning, acquisition, and construction of all state buildings, schools, hotels, and theaters (§41-9-162). There is no statewide commercial building code. Section 41-9-166 of Article 6 authorizes municipalities and counties to adopt and enforce building and technical codes.

Title 41, Chapter 23, Article 5 of the Code of Alabama establishes the Alabama Energy and Residential Codes (AERC) Board. The AERC Board is granted the authority to adopt and implement the Alabama Energy and Residential Codes, which include mandatory residential building codes for jurisdictions that had not implemented these prior to 2010. The AERC Board adopted the 2015 International Residential Code, which has been adopted by many local governments in the state.

Title 24, Chapters 4, 4A, and 5, Code of Alabama, establishes the Alabama Manufactured Housing Commission to regulate manufactured and modular homes and buildings, including

anchoring requirements. Manufactured Homes must meet Federal specifications of the U.S. Department of Housing and Urban Development.

Executive Order No. 14 June 14, 1971 provides for "Assignment of Emergency Preparedness Functions to State Departments and Agencies," as of June 14, 1971, and was adopted by reference by AEMA.

Executive Order No. 27 March 3, 1966 provides for the "Creation of the State Office of Emergency Planning," as of March 3, 1966, and was adopted by reference by the Alabama Emergency Management Agency. Executive Orders 27 and 14 authorize the Governor to use the services, equipment, supplies and facilities of existing State departments, offices and agencies for emergency management purposes. In the event of an impending or actual attack or manmade, technological or natural disaster, Section 4 of Executive Order 14 authorizes the transfer of direction, personnel or functions of state agencies, boards, and commissions for performing or facilitating disaster or emergency services.

Executive Order No. 40, July 23, 1985 states that AEMA shall act as the coordinating agency for the state in the event of an incident/accident involving a leak, spill, or release of hazardous material, or threat of same. AEMA shall develop, in cooperation with other departments and agencies of State government, the necessary plans, rules and procedures for responding to these incidents/accidents. AEMA will be responsible for ensuring that these plans, rules, and procedures are implemented and carried out in the State of Alabama. This executive order further requests that departments and agencies of state government who have response capability cooperate with the AEMA, the Department of Public Safety, and the Department of Environmental Management in the establishment of a coordinated and unified system that will assure the citizens of Alabama have the best protection available from hazardous materials, spills, leaks, and releases. This executive order was adopted by AEMA.

Executive Order 19, February 24, 2004 established Alabama's State Hazard Mitigation Team directing all State agencies to participate in development of the State Hazard Mitigation Plan. The SHMT is directed to develop the Plan, and to assist in prioritizing and selecting of hazard and pre-disaster mitigation grant program project applications. The SHMT is intended to function for the duration of Plan development and remain in place until the three-year plan to update the hazard mitigation plan has been approved by FEMA. The SHMT is active in development of local plans statewide, with a focus on information sharing, issues resolution, and commonality of approach and objectives.

The Alabama Drought Planning and Response Act (Code of Alabama, 1975, §§9-10C-1 et seq.) became law on April 9, 2014 and formally established the state government's role in planning, monitoring, and responding to severe drought conditions. This law replaced a previously issued executive order, established the ADAPT, and defined permanent roles for the ADECA-OWR as well as other state agencies.

4.2.2 Regulations

Much of the authority to perform pre-disaster planning and mitigation through development regulations is allocated to the local level counties and municipalities. Alabama has granted localities very limited authority to regulate development through its planning enabling legislation. Based on the New York City Zoning Ordinance of 1925, Alabama's 1935 enabling legislation has remained virtually unchanged to this day. It restricts enabling authority to cities and towns only, requiring counties to seek special acts to extend zoning controls to unincorporated communities. "Smart Growth" efforts have recently begun to examine and modernize the State legislation to better promote improved land development practices.

While Smart Growth efforts have not amended the State planning legislation, it is improving land development practices. One example of this is the 2003 Alabama Land Recycling and Economic Redevelopment Act. This legislation established a revolving loan program (funded by a $1 million EPA grant) to be administered through the ADEM. The purpose of legislations is to encourage voluntary cleanup and reuse of Brownfield sites in Alabama.

Alabama enacted the Comprehensive Land Use Management Act to give individual counties the right to establish commissions to control development in flood-prone and hazard areas through land use planning and zoning. Each commission has the right to establish and enforce zoning and construction limits in flood-prone areas. While this method is a reasonable approach for permitting floodplain management within unincorporated areas, a state-wide program to enable localities to plan for and manage the full range of land use and development in all areas, both incorporated and unincorporated areas, should be considered.

Administered by the State's Department of Conservation and Natural Resources and enforced by ADEM, the ADEM Division 8 Coastal Program Regulations contain explicit guidance on regulation of development in the Coastal Zone, mandating specific requirements and restrictions relevant to building in flood prone or storm surge vulnerable areas. Development throughout Alabama's coastline in Mobile and Baldwin Counties continues to accelerate, illustrating the conflicting objectives of community development and natural resource protection under hazard mitigation guidelines.

4.2.3 Policies

Alabama has instituted hazard management policies through various state agencies and authorities to properly address and manage projects that reduce risk to natural and manmade hazards. Each agency is responsible for drawing up guidelines to mitigate and manage hazards associated with operations normally handled through the agency's daily functions and operations as well as while recovering from a disaster. Agencies with these hazard management/mitigation policies include AEMA, DCNR, ADEM, and ADECA. The relevant policies of each agency are discussed below.

While appropriate policies appear to be in place, funding mechanisms are substantially reliant on Federal funding with local match requirements. To achieve the desired result these sound policies, some additional dedicated State funding source would be beneficial from a management, enforcement, and implementation standpoint. Current policies describe comprehensive organizational responsibilities and interactive capabilities between state and local authorities, coordinating agencies and local populations. Disaster response policies, it may be noted, are particularly established.

4.2.3.1 Alabama Emergency Management Agency

AEMA is the leading agency responsible for coordinating the hazard management activities for Alabama. As previously described, the Alabama Emergency Management Act of 1955 (Code of Alabama 31-9, 1955), first established the AEMA and defined the roles, powers, and duties for emergency management within the state. Furthermore, as a result of the state's continuing legislative review process, Code of Alabama 31-9, Act 522 was signed into law by Governor Bob Riley on April 20, 2006.[3] The act amended Sections 31-9-3, 4, 8, and 10, related to state emergencies and AEMA were strengthened to provide for emergency proclamations, expand the authority of state and local responders, establish degrees of emergency classifications, and provide for the powers of political subdivisions for emergency management.

In 2004, AEMA began to comprehensively review Alabama's legislation related to their emergency management responsibilities. Prior to Hurricane Ivan, AEMA's Director formed the AEMA Legislation Committee. The purpose for this committee was to review current Alabama Emergency Management statutes (Code of Alabama 31-9, 1975, as amended) and compare them to emergency management statutes of other states to determine if new legislation (or amendments to existing legislation) were needed to better support the mission and goals of AEMA in its service to the citizens of Alabama. For the 2013 Plan update process, the legislative committee became a single individual.

As of the 2018 Plan update, that legislative contact has left AEMA. However, the same review process continues as needed. Between the 2007 and 2010 update, only one piece of AEMA-related legislation was reviewed – The Alabama Disaster Recovery Program (Act 342). This legislation and the program are discussed in more detail in Section 4.2.4.6. No additional legislation was reviewed between 2010 and this update in 2018.

The Alabama Emergency Operations Plan (EOP) is the primary guiding document for Alabama's post-disaster hazard management policy. In June 2017, Governor Kay Ivey issued the 2017 State of Alabama EOP to replace the previous plan approved in 2012. According to the 2017 EOP:

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[3] Code of Alabama 31-9, 1975. Retrieved at: http://alisondb.legislature.state.al.us/alison/codeofalabama/1975/coatoc.htm.

The EOP, using the National Response Plan (NRP) and the National Incident Management System (NIMS), establishes the mechanisms to:

- Maximize the integration of incident-related prevention, preparedness, response, and recovery activities;
- Improve coordination and integration of State, County, local, Tribal, private-sector, and nongovernmental organization partners;
- Maximize efficient utilization of resources needed for effective incident management;
- Improve communications and increase situational awareness;
- Facilitate mutual aid and State support to County, local, and Tribal governments;
- Facilitate State-to-State support;
- Provide proactive and integrated State response to catastrophic events; and
- Determine priorities and coordinate protection, response, and recovery of critical infrastructure.[4]

This EOP is based upon guidelines contained in the NRP and the CPG 101 version 2. The NRP, as a core plan for national incident management, is linked to an array of incident or hazard-specific federal contingency plans that are designed to implement the specific statutory authorities and responsibilities of various departments and agencies. Therefore, state agencies that partner with federal agencies should be operating under the same guidelines to ensure complete and comprehensive coordination.

Alabama Emergency Support Functions (ESFs) are functional and expand upon the concept of operations contained in the basic plan. Annexes provide specific responses for agencies of government and define their responsibilities. The Standard Operating Guidelines (SOGs) required for the implementation of the state EOP are not included because of their voluminous nature. SOGs are the general operating guidelines for departments and agencies and are maintained by those departments and agencies.

An annual review of the EOP will be undertaken by the AEMA director and those agencies and departments of State government having emergency assignments. The director will insure that a list of all plan holders is maintained at the AEMA Office and that updates are sent to each one of these individuals. AEMA intends to continuously update and revise the EOP to reflect current emergency management requirements and conditions. The most recent update of Alabama's EOP included the National Response Framework (NRF) 2nd Edition and the FEMA Region IV Response Plan.[5] The next revision of the State's EOP is anticipated in 2018 and will incorporate concepts/elements of the National Frameworks and associated Response Support Functions.

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[4] AEMA, 2012. State of Alabama Emergency Operations Plan. Retrieved at: https://alabamaema.files.wordpress.com/2017/11/alabama-eop-11-basic-plan-final.pdf.
[5] AEMA, 2017. State of Alabama Emergency Operations Plan.

This includes the National Disaster Recovery Framework, NRF 3rd Edition, and the other three Frameworks (Prevention, Protection, and Mitigation) as they become available.

This plan requires fair and equal treatment to all regardless of race, creed, color, national origin, sex, age, or handicap. The priorities will be life safety, incident stabilization, and the protection of property and the environment.

4.2.3.2 Alabama Department of Conservation and Natural Resources

The DCNR State Lands Division (SLD)-Coastal Section, is the lead agency for the Alabama Coastal Area Management Program (ACAMP) which is described further in Section 4.2.4.2**.** As such, the SLD-Coastal Section is responsible for developing policies and programs, coordinating fiscal management, conducting education and outreach, managing state submerged lands and leading the overall administration of the ACAMP. The policies of the ACAMP recommend pre-disaster mitigation planning and are intended to discourage development in higher risk coastal zones, which are more vulnerable to natural threats such as flooding and hurricanes. The primary authority for the coastal management program is the Alabama Coastal Area Act of 1976 (Act 534). The Alabama coastal zone extends inland to the continuous 10-foot contour in Mobile and Baldwin Counties.

4.2.3.3 Alabama Department of Environmental Management

ADEM, through its Administrative Code and Division 8 Coastal Program Regulations, permits, regulates, and monitors uses and activities having a direct or significant impact on coastal Alabama and its resources. These regulations specifically control development in higher risk coastal zones, which are more vulnerable to natural threats such as flooding and hurricanes. Activities regulated under these regulations include construction and other activities on Gulf of Mexico beaches and dunes in the Alabama Coastal Zone. The Division 8 regulations address construction along beaches and dunes and any developments greater than five acres to provide protection for the primary dunes, beach sands, and covering vegetation by regulating construction or alteration of the beach from the mean high tide line to the Construction Control Line (CCL). The CCL is a defined, surveyed line essentially paralleling, and setback from, the Gulf shoreline. Structures located seaward of this line are not permitted by the program. The CCL was designed to provide long-term protection of the beaches and dunes by prohibiting construction seaward of this established setback line. The CCL helps protect property values and minimize damage from storm surge and other natural hazards. Developers are not allowed to remove primary dune or beach sands and/or vegetation between the CCL and the mean high tide.

The regulations relevant to the CCL require an environmental impact and natural hazards study for any condominium, motel, hotel, or similar development located on a property intersected by the CCL. This requirement includes a wave height study addressing the flood and erosion potential at the project site using eroded beach profiles for pre- and post-development. Additional components of the Division 8 regulations include:

- A beach and dune enhancement plan which calls for dune fencing, dune walkovers and planting of vegetation to control shoreline erosion and minimize impacts to beaches and dunes;
- Control of the use of bulkheads, retaining walls and similar structures which could impact beaches, dunes and structures during storm surge; and
- Permitting and certification requirements for dredging and fill in the coastal area.

For the most part, coastal communities follow ADEM guidelines and restrictions for coastal construction, and most coastal communities have adopted the 2009 International Building Code Series to replace the previous Standard Building Codes of the Southern Building Code Congress.[6] Mobile County, Baldwin County, and the City of Mobile have adopted 2012 International Building Codes and International Residential Code. Enforcement of local building codes is included in all local mitigation plans, and in addition, all coastal municipalities have zoning and subdivision regulations in effect. Mobile and Baldwin, the coastal counties, both have flood hazard ordinances in effect for unincorporated areas, but, of these two, only Baldwin County is authorized by State law to administer comprehensive zoning regulations within its unincorporated jurisdiction.

4.2.4 Programs

In the past, primary responsibility for coordination and facilitation of hazard mitigation activities was assigned to AEMA, with the primary focus on responding to local requests from private citizens, citizen groups, planning agencies, and municipal and county governments for assistance with grant applications and coordination with FEMA for judgment on applicability and justification. Transition from a reactive to a more pre-emptive hazard mitigation protocol currently is underway, as local plans are developed and updated and more specific and detailed risk assessment models are developed in accordance with ongoing State Plan initiatives.

Pre-disaster management programs in Alabama are established primarily at the local, rather than State or Federal level. However, the State of Alabama does manage two programs aimed at pre-disaster mitigation planning: the Alabama Shoreline Erosion and Hazard Mitigation Plan and the ACAMP. In addition, the State of Alabama promotes FEMA grant programs (Section 4.4.2) and the Community Rating System (CRS) program as Federal pre-disaster management programs.

Post-disaster management programs in Alabama are established primarily at the State level. The State of Alabama manages the Alabama Emergency Operations Plan program aimed at post-disaster response and mitigation (Section 4.2.3.1). In addition, Alabama has the Disaster Recovery Program and the Emergency Watershed Protection Program. Other programs relevant

[6] International Code Council, 2018. Alabama. Retrieved at: https://www.iccsafe.org/about-icc/government-relations/map/alabama/.

to hazard mitigation include those of the USACE and the Property Assessed Clean Energy Financing.

4.2.4.1 Alabama Floodplain Management Program

FEMA created and funded the Map Mod program (FY 2003 – FY 2008) through the recognized connection between reliable flood maps and effective flood damage reduction. Map Mod focused on updating existing Special Flood Hazard Areas (SFHAs) and converting paper flood maps to a digital platform. The Cooperating Technical Partners (CTPs) program was created through Map Mod, providing opportunities to states and jurisdictions to manage flood map development at the local level, realizing that local involvement leads to increased flood risk awareness and product acceptance. The Alabama OWR entered into a CTP agreement with FEMA on September 30, 2002, assuming responsibility for the technical accuracy of the Flood Insurance Rate Maps (FIRMs) across the State.[7] The OWR's FY17 FEMA Risk Mapping, Assessment, and Planning (Risk MAP) Program Business Plan was referenced in this plan update and outlines the Alabama OWR's floodplain management capabilities and accomplishments (see Section 7.10).

The Alabama Floodplain Management Program (AFPMP) was created by the OWR to effectively and efficiently deliver the Map Mod program within the State of Alabama. Over the years, AFPMP has grown to include a variety of floodplain management activities including flood hazard mapping, community engagement and risk communication, outreach, community trainings, data management, program management, project planning, project management, Letter of Map Revision (LOMR) review partnership, and state coordination of the NFIP.

In FY 2010, FEMA transitioned into the Risk MAP Program. The Risk MAP program focuses on increasing flood risk awareness and resilience at the local level through effective community engagement and sustainable mitigation actions, and the development of enhanced risk identification products, including watershed-based studies that cross political boundaries. To allow for the successful implementation of the Risk MAP vision within the State of Alabama, OWR further expanded the AFPMP to include a Risk MAP Coordinator role, the production of flood risk assessment data, hazard mitigation planning coordination activities, and mitigation action tracking at the local level.

Risk MAP projects in Alabama are underway in several watersheds throughout the state. Since the previous plan update, the joint storm surge study with Florida has been completed and Preliminary FIRMs were released for Mobile and Baldwin counties at the end of 2017 and early 2018. In Mobile County, public meetings to review new maps were held throughout February and

[7] State of Alabama Office of Water Resources Risk MAP Program Business Plan, FY 2017

March of 2018.[8] While in Baldwin County, public meetings to review new maps were held throughout late summer and early fall of 2017.[9] The maps in Mobile and Baldwin are anticipated to be adopted and go effective by the end of 2018 and early 2019.

There are also several new flood insurance studies that have been completed recently in the northern counties of Alabama, including the two large metropolitan areas of Birmingham and Huntsville. New FIRMs are pending adoption in the City of Huntsville and surrounding Madison county as well as several other counties that border the Tennessee River. The City of Birmingham and Jefferson County's Preliminary FIRMs were released for review in March of 2017.

In accordance with FEMA guidance, all watersheds within the State have been prioritized for study based on current flooding risk, the need for engineering updates, and the availability of quality topographic data, parcel data and building footprints. Alabama's FY17 Risk MAP Business Plan outlines the state's plan to restudy various watersheds and build capabilities related to flood risk analysis. According to the plan, Alabama estimates that approximately 47% (2,378 miles) of existing AE Zones (detailed) studies are still in need of updated engineering to meet FEMA's New, Validated or Updated (NVUE) goals. To meet these NVUE requirements and the additional program goals and performance measures outlined in this Business Plan, OWR estimates that approximately $5,100,000 will be needed each year over the next five years, and the total program funding level required for FY 2017 to FY 2021 is estimated to be approximately $25,500,000. Figure 4.1 below shows the year each HUC-8 watershed in the state was funded or will be funded in the future for a new flood insurance study.

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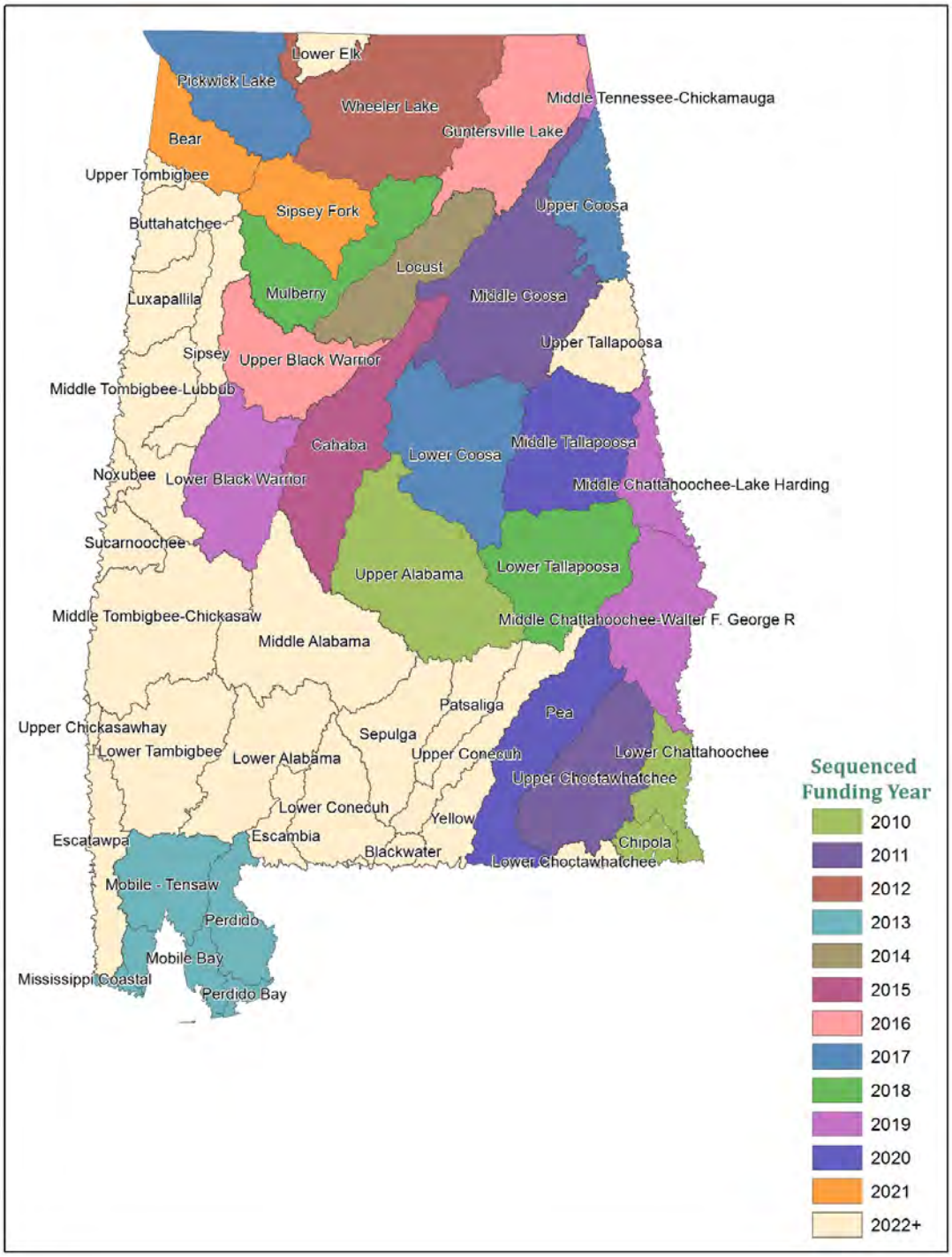
[8] Specker, Lawrence, 2018. New FEMA flood maps coming for Mobile County; public meetings start today. Retrieved at: https://www.al.com/news/index.ssf/2018/02/new_fema_flood_maps_coming_for.html.

[9] Mullen, John, 2017. Baldwin County's Federal Flood Maps Revamped. Retrieved at: https://lagniappemobile.com/baldwin-countys-federal-flood-maps-revamped/.

Figure 4.1 HUC 8 Watershed Sequencing for Fiscal Funding Years 2010 to 2022+[10]



[10] State of Alabama Office of Water Resources Risk MAP Program Business Plan, FY17

The AFPMP is also responsible for overseeing the implementation of the NFIP. The NFIP provides affordable insurance for property owners, renters, and business owners to reduce the financial impact of flooding. As of 2018, 433 Alabama communities participate in the NFIP with more than 54,800 flood insurance policies in force.[11] Also, since 2013, 23 individuals have earned their Certified Floodplain Manager (CFM) certification. This brings the total number of CFMs in the State to 135.

The State has added new engineers, planners, and administrative support personnel to the State NFIP Coordinator's office to enhance its technical capabilities. The OWR, through FEMA's Community Assistance Program funding process, provides technical assistance to communities to achieve and maintain compliance and good standing in the NFIP program. The primary objectives of the NFIP are:

- Reducing flood losses in participating communities through adherence to participating communities' Flood Damage Prevention Ordinance, NFIP regulations, mitigation planning, education, and awareness,
- Working with communities during post disaster operations to provide needed technical assistance to address NFIP issues; and
- Recruiting nonparticipating communities into the NFIP program.[12]

In partnership with FEMA, the OWR uses federal and state funds to meet the overall objective of reducing flood hazards in communities participating in the NFIP. Each year, the state NFIP staff conduct approximately 20 in-depth Community Assistance Visits (CAV) and 65 Community Assistance Contacts (CAC) through telephone contact or a brief visit with public officials. The outreach efforts of this program include technical consultations with public officials, telephone contact providing published material to the public, and presenting seminars and conferences on floodplain management and mitigation. The State NFIP Coordinator also conducts floodplain management and NFIP training courses such as Floodplain Management 101 and L273: Managing Floodplain Development through the NFIP. These courses target floodplain administrators throughout the State to provide them with a working understanding of their position and responsibilities and the tools available to them to perform their duties.[13]

In June 2013, OWR prepared a Strategic Plan for NFIP State Coordination to evaluate the current role of the State NFIP Coordinator within the comprehensive AFPMP and to form recommendations so this role may be improved and/or expanded to ensure coordination efforts of the NFIP are effective and best serve the citizens, property, and resources within the State. The NFIP coordination efforts were reviewed and evaluated per the elements of the Community

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[11] Ibid.
[12] Ibid.
[13] Ibid.

Assistance Program – State Support Services Element (CAP-SSSE) methodology, and both long-term and short-term strategies are identified including defining the overall goals of the Alabama program, while identifying specific actions and implementation schedules, deliverables, budget, staffing, and support monitoring and evaluating tasks, as necessary.[14]

In January 2015, OWR developed an automated process for performing CACs to obtain and/or confirm floodplain management statistics and practices for NFIP communities within Alabama. The process also provides the local floodplain administrators with educational resources and updated information on the NFIP. The Alabama CAC survey system streamlines the interview process for communities identified as Tier 2 by FEMA's CAV Tier 1 Prioritization Tool; increases the number of communities reached each year; and allows OWR to maintain a good understanding of the current status of compliance for rural and smaller communities in Alabama. In 2016, OWR continued to update the functionality of the CAC survey system improving upon management and filtering of community contact and response information; streamlining email communication and storage; and enhancing capabilities for reporting community metrics.[15]

The CRS Program was implemented by the FEMA through the NFIP and allows policy holders within participating communities to receive a discount on NFIP policies after communities implement community level flood mitigation solutions. Any NFIP community may apply for inclusion in the CRS Program and be credited for a range of flood hazard mitigation activities that exceed NFIP minimum standards.

Through the Insurance Services Office (ISO), a community applicant is graded based on criteria set forth in CRS guidelines for flood hazard mitigation. The grade assigned to each community results in a CRS classification. The CRS class determines the applicable insurance discount for the policy holders within the community.

The CRS class rating is a scale of one through ten, with Class 1 communities receiving a 45 percent discount and Class 10 communities receiving no discount. Table 4.1 summarizes each CRS class and the applicable discount.

Table 4.1 CRS Class and Discount

CRS Class	Discount (percent)
1	45
2	40
3	35

[14] State of Alabama Office of Water Resources Risk MAP Program Business Plan, FY17
[15] Ibid.

CRS Class	Discount (percent)
4	30
5	25
6	20
7	15
8	10
9	5
10	0

According to data compiled by FEMA through October 1, 2017, Alabama has 15 communities participating and three communities whose eligibility was rescinded for non-compliance with continuing program eligibility requirements. Three new communities have joined the CRS program since the 2013 State Hazard Mitigation Plan Update. Table 4.2 lists the participating communities in Alabama and the current CRS class and status of each community.

Table 4.2 Alabama Participating CRS Communities and CRS Class[16]

FEMA Community Number	Community Name	CRS Entry Date	Current Effective Date	Current CRS Class	Status
010146	Athens, City of	10/1/91	10/1/98	10	Rescinded
010071	Atmore, City of	05/1/02	10/1/13	9	Current
010144	Auburn, City of	05/1/14	05/1/14	7	Current
015000	Baldwin County	10/1/95	05/1/17	7	Current
010116	Birmingham, City of	10/1/94	10/1/17	5	Current
010418	Dauphin Island, Town of	04/1/01	05/1/01	8	Current
010176	Decatur, City of	10/1/91	10/1/05	10	Rescinded
010007	Foley, City of	05/1/17	05/1/17	8	Current
015005	Gulf Shores, Town of	10/1/93	10/1/13	8	Current
015006	Homewood, City of	10/1/01	10/1/01	9	Current
010123	Hoover, City of	10/1/91	10/1/91	9	Current
010153	Huntsville, City of	10/1/91	10/1/12	8	Current
010151	Madison County	05/1/14	05/1/14	9	Current
015007	Mobile, City of	10/1/92	10/1/93	10	Rescinded
015011	Orange Beach, City of	10/1/91	10/1/07	7	Current
010189	Pell City, City of	10/1/92	5/1/12	8	Current

[16] Community Rating System. FEMA, 2017. Retrieved at: https://www.fema.gov/media-library-data/1503240360683-30b35cc754f462fe2c15d857519a71ec/20_crs_508_oct2017.pdf

FEMA Community Number	Community Name	CRS Entry Date	Current Effective Date	Current CRS Class	Status
010002	Prattville, City of	10/1/91	5/1/08	8	Current
010203	Tuscaloosa, City of	05/1/16	05/1/17	8	Current
010070	Wetumpka, City of	10/1/91	10/1/91	9	Current

According to FEMA, each community must submit a recertification document by October 1 each year to maintain eligibility for the program. The recertification requirement includes documentation that mitigation program activities initially credited to the community have continued, in addition to documenting any new strategies implemented since the previous October 1. Any community that has received a Class 9 or better classification will revert to Class 10 on the following May 1 unless it submits the signed recertification worksheet by October 1 of each year. If the recertification does not include all the needed documentation, the community may lose enough points to cause a retrograde in its CRS classification. A repetitive loss community that fails to submit a copy of its annual outreach project or a community that fails to submit its annual progress report will revert to a Class 10.

4.2.4.2 Alabama Coastal Area Management Program

The ACAMP was approved by NOAA in 1979 as part of the National Coastal Zone Management Program.[17] ACAMP is a joint effort: ALDCNR State Lands Division is responsible for planning and policy development while ADEM is responsible for permitting, monitoring and enforcement activities, as detailed in the ADEM Division 8 Coastal Programs Rules (ADEM Admin. Code R 335-8).

The ACAMP consists of comprehensive management policies and guidance for the protection and enhancement of the quality, quantity, and viability of coastal resources and the management of the uses of these resources. Resource protection includes addressing such issues as shoreline erosion, water and air quality, wildlife habitat protection, wetland protection, dune protection, urban development, and hazard management. This program also helps protect coastal resources by providing technical assistance on zoning regulations and hazard mitigation to local governments. ACAMP has an annual grant program that provides funding for projects that protect coastal environments and communities.

The ACAMP Strategic Plan (2013-2018) describes actions the ACAMP staff plan to undertake to achieve the goals and objectives of the program. In fiscal year 2016, NOAA evaluated the ACAMP performance, focusing on three target areas: program administration, state and local partnerships, and the coastal nonpoint pollution control program. Overall, the evaluation concluded that the

[17] http://www.adem.state.al.us/programs/coastal/default.cnt

ACAMP was successfully implementing and enforcing its federally approved coastal management program.

In 1996, the State of Alabama applied to FEMA to receive funding to develop the Alabama Shoreline Erosion and Hazard Mitigation Plan. The plan addresses inlet management, dredge, dredge fill, monitoring, building codes, erosion rates, and hazard mitigation. The plan also incorporates several hazard mitigation strategies into the ACAMP. Development of the plan involved the work of local planners coordinating the central storage of GIS data, review of the effectiveness of local building codes, and promotion of land use management, density, and development restrictions that mitigate coastal hazards.[18]

4.2.4.3 Alabama Drought Management Plan

On June 24, 2011, Governor Bentley issued Executive Order 19 on Drought Planning and Management, formally tasking OWR to support drought planning throughout the state and streamlining the organizational structure. The OWR completed the most current version of the Alabama Drought Management Plan in 2013. The risk assessments and mitigation strategies of the drought plan are integrated into the mitigation strategies of the 2013 Plan and were updated in this update. According to the plan,

> *The Alabama Drought Management Plan defines a process to address drought and drought related activities, such as monitoring climatic conditions, vulnerability assessments, impact assessments, response, and mitigation. This plan creates a statewide regional structure to identify the different areas impacted by drought conditions, identify risks associated with drought conditions and identify ways to possibly avoid droughts and when drought emergencies cannot be avoided, identify ways to mitigate the impacts of droughts. These objectives are accomplished through the development of drought triggers and indicators and by providing guidance on responses to drought conditions for the various sectors impacted by droughts.*[19]

On April 9, 2014 the Alabama Drought Planning and Response Act formally established the State of Alabama's role in drought management.

4.2.4.4 Alabama Dam Security and Safety Program Creation

Over the years, Alabama has tried to organize an Alabama Dam Security and Safety Program. There has been less progress in recent years to develop legislation to establish this program.

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[18] Alabama Coastal Hazards Assessment, n.d. Alabama Shoreline Erosion and Hazard Mitigation Plan Summary. Retrieved at: http://webapp1.dlib.indiana.edu/virtual_disk_library/index.cgi/4288138/FID1019/HTM/alshore.htm.

[19] ADECA, 2004. Alabama Drought Management Plan. Retrieved at: http://www.allianceforwaterefficiency.org/uploadedFiles/Resource_Center/Library/United_States/Alabama/Alabama-Statewide-Drought-Plan-2004.pdf.

Starting in 2008, ADECA-OWR began an effort to inventory the dams in Alabama and categorize them based on their hazard potential. ADECA-OWR continues to move forward with the inventory despite the dam safety legislation. The program proposes an up-to-date inventory and survey of private dams in Alabama. This inventory should strengthen public safety and emergency response operations in the event of a dam related disaster. In addition to the inventory, the program proposes regular inspections and permitting (certification) of certain dams for increased protection of life and property in the event of dam failure. The creation of this dam security and safety program was an action on the 2013 action plan and remains an on-going action on the 2018 action plan.

4.2.4.5 Alabama Disaster Recovery Program

The Alabama Disaster Recovery Program was created in April of 2009 through Act 342. This Act also established the Disaster Recovery Fund to fund the program and assist counties and municipalities in satisfying local needs during and "immediately following certain disasters when an emergency or major disaster declaration is not requested by the Governor or has been denied by the President. The act also creates the Alabama Disaster Recovery Program Committee and provides for the disbursement of funds upon a proclamation of the Governor or Legislature and a proclamation by the affected local governing body." To receive funds, local governments have a hazard mitigation plan in place. As of the 2018 plan update, the state legislature has not funded the Disaster Recovery Fund.

4.2.4.6 Alabama Long-Term Recovery Program

ADECA established a Long-Term Recovery program with a full time State Coordinator in response to Hurricane Katrina in 2005 to coordinate long term disaster recovery planning. ADECA worked alongside the FEMA Long Term Recovery Team to prepare a Long-Term Recovery Plan for the communities of Mobile County. The plan was adopted by all communities and incorporated by amendment into local mitigation plans. Following the April 2011 tornadoes, the Governor established ADECA as the official coordinating agency for long term community recovery efforts through Executive Order 18, which was signed on June 13, 2011.[20] During this process, six areas of recovery were identified, and task forces assigned to each: housing, economic recovery, infrastructure, health and social services, community planning and capability building and natural and cultural resources. The long-term recovery program is locally driven but draws on guidance from ADECA. Nine communities participated in long-term recovery efforts following the April 2011 tornadoes: Cordova, Geiger, Hackleburg, Holt, Jefferson County, Phil Campbell, Pleasant Grove, Rainsville and DeKalb County, and Sipsey. Planning is currently still in progress.

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[20] Executive Order Number 18 by Governor Robert Bentley. Alabama Department of Archives & History. Retrieved at: http://digital.archives.alabama.gov/cdm/singleitem/collection/executive/id/540/rec/20

4.2.4.7 USDA Natural Resources Conservation Service (NRCS) Emergency Watershed Program (EWP)

The USDA NRCS is authorized under the 1996 Farm Bill to provide technical and financial assistance for emergency watershed protection. The rules for administration of this Emergency Watershed Protection (EWP) program are codified under 7 CFR 624. The EWP program "consists of measures to reduce hazards to life and property from floods, drought, and the products of excessive runoff or erosion on any watershed impaired by a natural occurrence."[21] The program offers technical and financial assistance to land owners and land managers, through a sponsor (state or local government or Indian tribe), upon a Presidential Emergency Declaration or an emergency declaration by the state conservationist. The Alabama Natural Resources Conservation Service developed an Emergency Recovery Plan (ERP) in 2017 that outlines guidance and establishes responsibilities for the administration of the EWP program in Alabama.[22] This plan addresses the recovery actions and inter-agency coordination that the Alabama NRCS will follow when an emergency is declared, and the Emergency Watershed Protection Program is initiated and/or implemented. Alabama NRCS worked with a variety of cooperating technical partners to develop this plan, including AEMA, Alabama Soil and Land Water Conservation Committee, USACE, ADEM, AFC, DCNR, and USFWS.

According to the 2017 plan, the EWP program has been primarily used in Alabama to recovery from heavy rainfall events, flooding, hurricanes, and tornados. Typical recovery projects largely include stabilizing gully erosion, removing sediment from drainage ways, removing log jams (especially from under bridges), and installing stream bank protection.

4.2.4.8 U.S. Fish and Wildlife Service Coastal Impact Assistance Program

The U.S. Congress authorized the Coastal Impact Assistance Program (CIAP) in October 2000, pursuant to the H.R. 5548-2001 Amendment to the Outer Continental Shelf Lands Act. Alabama developed its first CIAP Plan in June 2001. U.S. Congress re-established the CIAP in August 2005 by Section 384 of The Energy Policy Act of 2005 (also known as Public Law 109-59) for funds between 2007 and 2010.[23] The CIAP was passed to assist coastal states with mitigating environmental impacts, related directly or indirectly, to Outer Continental Shelf oil and gas production. Just six states, including 67 coastal political subdivisions, are eligible for these funds. The DCNR, Coastal Section entered into a contract with the South Alabama Regional Planning Commission (SARPC) to assist with the development of the plan and to work with the two county governments in the development of their plans. AEMA is currently working with the DCNR, Coastal Section and the SARPC to identify mitigation opportunities.

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[21] Emergency Watershed Protection (EWP) Program Alabama Emergency Recovery Plan, October 2017
[22] Ibid.
[23] Public Law 109-58, August 8, 2005. Retrieved at: https://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf

A CIAP Plan must be approved by the Bureau of Ocean Energy Management, Regulation and Enforcement before funding can be received. Alabama received $51,000,000 for CIAP projects in FY 2007 and 2008. The money was distributed between the State, Baldwin County Commission, and Mobile County Commission to implement CIAP projects. This is the last finalized CIAP Plan document available. The last noted CIAP Plan was for FY 2010, with all project grants being completed as of 2017. The U.S. Congress authorizes the funds for the following uses:

- Projects and activities for the conservation, protection or restoration of coastal areas, including wetlands;
- Mitigation of damage to fish, wildlife or natural resources;
- Planning assistance and the administrative costs of complying with CIAP;
- Implementation of a federally approved marine, coastal or comprehensive conservation management plan; and
- Mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs.

The CIAP program was closed by the USFWS on September 30, 2017.

4.2.4.9 U.S. Army Corps of Engineers

With respect to flooding, historically, there have been several cooperative ventures initiated by local interests over the past two decades involving the USACE. With the specific intention of mitigating hazards in several notable flood-prone areas within metropolitan areas, several waterway improvement studies, notably in Shelby, Jefferson, Mobile, and Baldwin Counties (which together comprise the majority of flood damage claims in the State) have been prepared. Several studies have performed comprehensive cost/benefit analyses to mitigate prospective flood zones, and some limited structural improvements are on record, but many of the studies have typically culminated prior to execution of specific mitigation actions, due to local funding constraints.

4.2.4.10 Property Assessed Clean Energy Financing Program

The Property Insurance and Energy Reduction Act of Alabama (§11-81-240 through 250/Title 11, Chapter 81, Article 8) established the Property Assessed Clean Energy Financing Program in the State of Alabama. This program allows for property owners to borrow money from local governments in order to fund energy improvements, including resiliency and energy-efficiency improvements.[24]

[24] U.S. Department of Energy, n.d. Local Option – Property Assessed Clean Energy Financing. Retrieved at: https://www.energy.gov/savings/local-option-property-assessed-clean-energy-financing-2.

4.3 Funding Capabilities for Hazard Mitigation Projects

4.3.1 Grant Administration

In Alabama, the Governor has designated the Director of the AEMA as the officer of the State authorized to accept Federal funding for emergency management purposes through Section 18, Alabama Law, 1955, Act No. 47. Funds received are deposited by the State Treasurer and disbursed by the State Comptroller, subject to requisition by the AEMA Director.

AEMA operates its funding mechanisms in accordance with the following enabling state and federal legislation, regulations, and program criteria. Funds for the operation of AEMA are authorized in an appropriation made by the legislature based on a budget submitted in accordance with Code of Ala. 1975, §§ 41-4-80 through 41-4-96. Funding for local emergency management organizations is authorized by Code of Ala. 1975, §§ 31-9-10, 31-9-24. Budgets are submitted as required by the political subdivision, and as specified in paragraph V.C.2c (2) of the *Alabama Emergency Management Agency Administrative Manual*, dated October 1, 1985, and revised December 15, 1988. Accounts to manage local funding should be established within the local government's existing accounting system.

There is a hazard mitigation plan requirement for many emergency related federal grants. This means that the grants are dependent upon the state and local governments' demonstration that a comprehensive management process is in place by applicants and sub-applicants having a FEMA approved hazard mitigation plan in place. States, state agencies, and local jurisdictions are required to have a state hazard mitigation plan in place by the application deadline for PDM and Flood Mitigation Assistance (FMA) funding and at the time of the Presidential major disaster declaration for HMGP funding, with limited exception.[25]

Local jurisdictions desiring project application funds and maintenance and services funds must follow the criteria as outlined in the *Alabama Emergency Management Agency Administrative Manual*, dated October 1, 1985, and revised December 15, 1988. State and local agencies will maintain such accounts, records, papers and other pertinent supporting materials, which will permit an accurate determination of the status of Federal and other contributions

Alabama relies exclusively on a local matching approach to secure appropriate levels of funding. Alabama's current strategy is to access federal funds for qualifying initiatives and facilitate development of local funding sources through municipal and county entities to fund local match

[25] FEMA, 2015. Hazard Mitigation Assistance Guidance. Retrieved at: https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf.

requirements. To date, the State of Alabama has continually met the local match requirements associated with funding of Federal sponsored programs, due in part to the continual financial support of the hazard mitigation programs and initiatives by local city and county governments.

AEMA hosts a robust grants management website, Alabama EMA Grant Manager[26], that includes an online grants management portal to track applications, a wealth of information about the Public Assistance (PA) program and HMGP, template forms and reference documents, and state contact information.

4.3.2 FEMA Funding Opportunities

4.3.2.1 FEMA Hazard Mitigation Grant Program

Some of the most significant mitigation actions in Alabama have been accomplished with the HMGP funding. FEMA uses a sliding scale to determine the amount of HMGP funds that it provides after a presidential disaster declaration. FEMA provides 15 percent of the first $2 billion spent in overall assistance. FEMA then provides 10 percent of each dollar between $2 billion and $10 billion and 7.5 percent for each dollar between $10 billion and $35.3 billion. In the State of Alabama, local governments are currently the prime source of funding for the local match associated with this program. At this time, the SHMT believes that local municipalities will continue at their current level of participation about funding local match requirements.

Since Hurricane Ivan in 2004, a little over half of all HMGP dollars spent in Alabama has gone towards building or retrofitting safe rooms in shelters, public facilities, and private residences. The second largest bucket of HMGP projects have been the acquisition of vulnerable properties or "buyouts" that move people out of damage-prone areas. Two summary tables of Alabama's HMGP projects can be found in Section 5.4 Mitigation Successes. While HMGP funding is not sufficient to accomplish all the desired projects, it continues to be the centerpiece of the Alabama Hazard Mitigation Strategy.

The State of Alabama Hazard Mitigation Administrative Plan documents the State's process for administering HMGP funds. While specifically intended as the primary guidance for state management of HMGP activities only, it represents the current administrative model for the state's acquisition and stewardship of funding mechanisms generally; and, as such, it is the best current framework describing Alabama's financial management capabilities. The plan defines applicant eligibility criteria, the application process, and management procedures for distribution of funding under the program. These plans are used by the State Staff Emergency Coordinators, Emergency Management Coordinators (EMC), the SHMT, and the individual county Emergency Coordinators. On January 9, 2004, the *State of Alabama Hazard Mitigation Administrative Plan* was approved by FEMA. The plan provides procedures at the State level for the management of HMGP funds.

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[26] https://grants.ema.alabama.gov/index.cfm

The plan is designed to interlock the *Public Assistance Plan* and the *Individual and Family Grant Administrative Plan*. These last two mentioned plans are part of the comprehensive approach that AEMA has fostered toward hazard mitigation.

HMGP grants can also be used for funding the development of local hazard mitigation plans. At least 31 counties across Alabama used HMGP grants exclusively to fund the latest update to their local hazard mitigation plans, and another 11 counties used a combination of HMGP grant money and local funds. Appendix C: Funding for Local Hazard Mitigation Projects and Planning provides additional information on how federal grants are used in Alabama to support local hazard mitigation planning.

4.3.2.2 FEMA Flood Mitigation Assistance

The FMA Program provides funding to States and communities so that measures are taken to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the NFIP. FEMA distributes FMA funds to States that, in turn, provide funds to communities. The State serves as the grantee and program administrator for the FMA grant. Federal funding is available for up to 75 percent of the eligible activity costs, however under certain circumstances, FEMA will provide 100 percent Federal cost share for projects that address severe repetitive loss (SRL) properties and 90 percent for repetitive loss (RL) properties. Alabama's mitigation strategy emphasizes the mitigation of RL and SRL properties and includes actions to provide outreach and education to local communities about how to apply for these specific grants.

AEMA has utilized the FMA program grants in association with numerous projects consistent with its purpose of providing funding to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. Typical examples of eligible FMA projects funded in Alabama under this program in recent years include: elevation, acquisition, and relocation projects involving NFIP-insured structures, and advanced assistance to prioritize and develop future mitigation projects. In FY17, eight FMA projects were submitted from Alabama communities. Four projects were identified for further review, two projects were not selected, and two projects did not meet Hazard Mitigation Assistance (HMA) requirements. AEMA actively promotes the FMA grant program every year.

4.3.2.3 FEMA Pre-Disaster Mitigation

The PDM Program was authorized by §203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 USC, as amended by §102 of the Disaster Mitigation Act of 2000 (DMA2K). Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist states and local governments (to include Indian tribal governments) in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. Funds are used for the implementation of pre-disaster hazard mitigation measures that are cost-effective and designed to reduce injuries, loss of life, and damage and destruction of property, including damage to critical services and facilities under the jurisdiction of

the states or local governments. The DMA2K emphasizes the importance of strong state and local planning and comprehensive program management at the state level.

Alabama has facilitated several initiatives consistent with PDM objectives, enabling the State and it's served communities to implement more preventive, pre-disaster activities. Funds are applied for and used to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures, while also reducing reliance on funding from actual disaster declarations. Alabama recognizes that the PDM program provides a significant opportunity to raise risk awareness and to reduce the State's disaster losses through pre-disaster mitigation planning and the implementation of planned, pre-identified, cost-effective mitigation measures, with a focus on funding mitigation projects that address NFIP repetitive flood loss properties.

FEMA made $250,000 in planning grants available to the State to facilitate development of the initial State Plan in 2004, and additional funding for the subsequent plan updates. The State of Alabama has also helped administer PDM funds to local EMA offices and Regional Planning Councils (RPCs) for a variety of mitigation activities, including planning. There are currently 17 open PDM grants related to hazard mitigation plan projects that total about $1 million. Excluding planning grants, there are about $10 million in PDM grants for other activities such as drainage projects, safe rooms, and acquisitions. Section 5.3 contains a table that summarizes these different PDM projects.

PDM grants can also be used for funding the development of local hazard mitigation plans. At least 11 counties across Alabama used PDM grants to fund the latest update to their local hazard mitigation plans. Appendix C: Funding for Local Hazard Mitigation Projects and Planning provides additional information on how federal grants are used in Alabama to support local hazard mitigation planning.

4.3.2.4 FEMA Public and Individual Assistance

The State has performed many projects utilizing PA funding. *The Alabama Public Assistance Plan* provides procedures to manage Public Assistance funds, while *The Individual and Family Grant Plan* provides criteria and procedures for Individual Assistance. The Public Assistance Program provides supplemental Federal disaster grant assistance for the repair, replacement, or restoration of disaster-damaged, publicly owned facilities, and the facilities of certain private non-profit (PNP) organizations. The Federal share of assistance is at least 75 percent of the eligible cost for emergency measures and permanent restoration. The State determines how the non-federal share (up to 25 percent) is split with the applicants (typically half). Eligible applicants include the states, local governments, Indian tribes, and certain PNP organizations. The State is the grant administrator for all funds provided under the Public Assistance Program. Part 13 of the CFR gives the states more discretion to administer federal programs in accordance with their own procedures and thereby simplify the program and reduce delays. As grantee, the State is responsible for administering the programmatic and grants management requirements of the

Public Assistance Program. Key among the programmatic requirements is informing the applicants of the assistance available to them: what is eligible and how to apply for it. Grant management includes applying for federal assistance, monitoring and closing out the grant. The State and FEMA work in partnership to provide prompt and consistent service to all applicants.

Under the revised Public Assistance Program, the State has many of the same roles and responsibilities as the initial system. FEMA recognizes that states have different capabilities to perform their assigned duties. FEMA continues to work in partnership with those states requiring technical assistance to serve the needs of their applicants.

Once insurance requirements are established, FEMA will reduce otherwise eligible costs by the actual or anticipated insurance recoveries the applicant receives. The State must notify FEMA of any entitlement to insurance settlement or recoveries for a facility and its contents. For insurable buildings located in a special flood hazard area and damaged by flood, the reduction is the maximum amount of insurance proceeds the applicant would have received had the building and its contents been fully covered by a standard flood insurance policy under the NFIP. The applicant is required to buy insurance in the amount of the eligible damages for flood and general hazards.

For small projects, a grant is based on an estimate of the cost of the work. For large projects, a final grant is based on actual eligible costs. In large projects, the State disburses progress payments, as required. The dollar amount of a small or large project changes each fiscal year and is based on the Consumer Price Index.

There have been five new federal disaster declarations in Alabama as of January 2018, including emergency declarations and major disaster declarations. At the time when this update was written, $70,874,680.77 have been obligated for Alabama PA projects.[27]

4.3.2.5 FEMA Community Assistance Program State Support Services Element

The CAP-SSSE Program provides funding to states to meet negotiated objectives for reducing flood hazards in NFIP communities. Emphasis is placed on adherence to the NFIP and to floodplain management practices voluntarily adopted by participating NFIP communities. Objectives are to identify, prevent, and resolve floodplain management issues in participating communities before they result in a compliance action by FEMA. In 2011, FEMA Region IV has identified nine core activities and assigned work hours for CAP-SSSE funding: enrollment of NFIP non-participating communities, CAVs, CACs-visits, CACs-phone, ordinance adoption associated with remapping, floodplain management courses, training and education, general technical assistance, and professional development.[28] According to ADECA's FY17 Plan, the agency

[27] FEMA, 2018. Disasters. Retrieved at: https://www.fema.gov/disasters.
[28] https://www.hsdl.org/?abstract&did=787789

received about $250,000 in CAP-SSSE grant money that has gone towards funding these different activities.[29]

4.3.2.6 FEMA Emergency Management Performance Grant Program

Under the Emergency Management Performance Grant (EMPG) Program, funds are provided by FEMA as authorized in Public Law 81-920 for the purpose of increasing operational capability at the state and local level. These funds can be expended for necessary and essential personnel and administrative expenses, including but not limited to salaries, benefits, travel, office supplies, equipment, and administrative communications. The State and/or local governments must match on a one-for-one basis financial assistance provided for EMPG Program purposes. To be eligible to receive EMGP Program funds to support a local emergency management program, a political subdivision must meet the criteria as referenced in the *Alabama Emergency Management Agency Administrative Manual*, dated October 1, 1985, and revised December 15, 1988.

4.3.3 Other Federal Funding Opportunities

4.3.3.1 U.S. Economic Development Administration

The U.S. Economic Development Administration (EDA) supports economically distressed areas of the United states by fostering job creation and attracting investments through a variety of grants and loan programs. The EDA has six funding programs that Alabama can use for hazard mitigation projects:

- **Public Work Grants:** These grants are given to public and private non-profit organizations as well as to Indian Tribes for the building or expansion of public facilities that are essential to industrial and commercial growth.
- **Technical Assistance Grants:** Funding is made available through these grants to communities and firms for economic feasibility studies of resource development in the establishment of jobs. The funding also provides on-sight support for innovative economic development techniques.
- **Planning Grants:** Funding is available through planning grants help to pay for the expertise needed to plan, coordinate, and implement comprehensive economic development programs.
- **University Center Program Grants:** These grants are awarded to colleges and universities to utilize available resources to provide technical assistance to clients and address the economic development problems and opportunities of their service area.
- **Revolving Loan Fund (RLF) Grants:** This funding is aimed at helping depressed areas overcome specific capital market gaps and to encourage greater private sector

[29] http://adeca.alabama.gov/News/cid/Annual%20Reports/2017%20Annual%20Report.pdf

participation in economic development activities. In concert with private leaders, RLF grantees make fixed asset and/or working capital loans to area businesses.

- **Economic Adjustment Program Grants:** Assist state and local governments in solving recent and anticipated severe adjustment problems, resulting in abrupt and serious job losses and to help areas implement strategies to reverse and halt long-term economic deterioration (e.g., natural disasters and military installation closures).

The EDA also has a critical role in disaster recovery by facilitating the delivery of Federal economic development assistance to support the long-term community economic recovery planning, project implementation, redevelopment and resiliency. The EDA's FY16 report for Alabama shows significant investments in disaster relief, public works, and economic adjustment assistance, as summarized in Table 4.3.

Table 4.3 FY16 EDA Investments in Alabama

Program	# of Grants	EDA Funds
Disaster Relief	2	$3,758,725.00
Economic Adjustment Assistance	1	$2,028,092.00
Partnership Planning	2	$123,000.00
Public Works	2	$2,607,093.00
Regional Innovation Strategies	1	$500,000.00
Technical Assistance	1	$128,592.00
Total	9	$9,145,502.00

One of the EDA's Disaster Relief grants listed in the table above is a $2,912,142 investment made September 2016 to Mobile Area Chamber of Commerce Foundation, Inc./Mobile Area Chamber of Commerce to create an innovation hub and support entrepreneurial development. This EDA investment funded the acquisition and renovation of the former Threaded Fasteners Building in Mobile to house Innovation PortAL, a high-tech business incubator and accelerator program. The program included several outreach activities in the surrounding distressed communities to promote workforce development initiatives and strengthen innovation and entrepreneurial capacity.[30]

4.3.3.2 U.S. Department of Housing and Urban Development (HUD)

The Department of Housing and Urban Development's (HUD) annual Community Development Block Grant (CDBG) program funds are administered through ADECA and used for community development projects at the local level. Funds support a variety of projects including, but not limited to, public infrastructure improvements, housing, and economic development initiatives.

[30] Retrieved from https://www.eda.gov/annual-reports/fy2016/states/al.htm

ADECA reserves a portion of CDBG funds for local planning grants. These grants may be used for developing and updating comprehensive plans. Up to $50,000 may be awarded to a community. The grant provides a funding mechanism for addressing hazard risks and incorporating hazard mitigation actions into local comprehensive plans.

CDBG funds can also be allocated following a major disaster through the Community Development Block Grant Disaster Recovery (CDGB-DR) program. The Disaster Relief Initiative for Hurricane Katrina Recovery added approximately $95 million in CDGB-DR funding for recovery and mitigation projects. This funding has gone towards developing long term community recovery plans for the communities of Mobile County as well as towards providing the required local matching funds for HMGP projects. CDBG-DR funding was also allocated to Alabama following the April 2011 tornadoes and after Hurricane Ivan in 2004.

4.3.3.3 NOAA

NOAA's Office for Coastal Management provides funding for a grant program that is available through DCNR's ACAMP. The grants are awarded annually for coastal management projects located in Alabama's Coastal Area (Baldwin and Mobile counties) and can relate to, but are not limited to, planning, coastal hazards, wetland protection, and coastal nonpoint source pollution control.

In addition, NOAA also offers the following potential funding programs:

- **Section 303:** This program focuses on the protection of natural resources that mitigate wind and flooding impacts including beaches, dunes, and barrier islands.
- **Section 305:** States developing coastal programs are eligible to receive funding under this section of the Coastal Zone Management Program (CZMP).
- **Section 306:** Funding is primarily provided through implementation grants to administer State programs, including staff salaries, equipment purchases, public education and outreach, enhancement of public access and the undertaking of projects that monitor and/or enhance elements of the regulatory program.
- **Section 309:** This section provides detailed objectives calling for states to prevent or significantly reduce threats in high hazard areas or manage development in other hazard areas. A portion of this section is the Coastal Zone Enhancement Program (CZEP).
- **Coastal Zone Enhancement Program:** This program allows states to compete for additional funding by creating enhancements to the existing State Coastal Zone Management Program in eight priority areas including coastal hazard mitigation, wetlands protection, and the control of cumulative and secondary impacts of development.

4.3.3.4 US Army Corps of Engineers (USACE)

USACE maintains an active involvement in Alabama activities, particularly waterways and flood control management under its continuing watershed management mission. The State of Alabama can make a unique claim to have more miles of navigable waterways and shoreline than any other

state in the continental US. Accordingly, among other natural hazards, it has numerous locations where population development and floodplain locations overlap and evolve into vulnerabilities. The USACE is active throughout the State supervising Federal waterways management components to prevent and reduce hazards as an ongoing part of maintaining navigation channels and drainage in major watersheds. AEMA works in concert with the USACE in some of these activities and promotes funding of hazard mitigation projects through USACE funding sources when it is possible.

4.3.3.5 US Department of Agriculture (USDA)

In watersheds damaged by severe natural events, the USDA's Natural Resources Conservation Service can provide assistance through the Emergency Watershed Protection (EWP) Program. These funds can be used for activities such as debris removal from streams and culverts, reshape and protect eroded banks, correct damaged drainage facilities, prevent erosion through planting, repair levees and structures, and to repair conservation practices. If funds are available, Natural Resource Conservation Service (NRCS) can provide 100 percent of the cost of exigency situations and 80 percent of the cost of non-exigency situations.

Since the previous plan update in 2013, Alabama has utilized over $3.5 million in NRCS EWP funding to complete projects that removed debris, restored stream corridors and drainage, and prevented future flooding, as summarized in Table 4.4. Typical EWP projects in Alabama include sediment or debris removal, stream bank stabilization, and gully stabilization.[31]

Table 4.4 EWP Recovery Projects in Alabama since 2013

FY	State	NRCS' Investment	Description of Work
2015	Alabama	$2,933,854.00	A 2014 tornado clogged streams and caused other damage in northern Alabama. Work will help remove debris and prevent future flooding. A 2014 storm with torrential rain caused severe erosion in coastal Alabama, threatening public utilities and infrastructure and posing water quality issues. Work will help restore stream corridors, curb erosion and prevent future flooding.
2016	Alabama	$522,337.00	A storm in December 2015 brought heavy rains and resulted in a presidentially-declared disaster in several counties. The resulting runoff caused deep gullies in residential areas of Dale and Jefferson Counties, and within the cities of Mobile and Prattville, threatening

[31] Alabama EWP Recovery Plan 2017

FY	State	NRCS' Investment	Description of Work
			homes and roads. EWP funds will be used to repair the gullies and restore normal drainage.

4.3.3.6 Utility Funding

AEMA negotiates with the Alabama Power Company and the Tennessee Valley Authority for utility funds that are required to support off-site emergency planning at their nuclear power plants. These negotiations are based on Federal mandates for emergency preparedness.

4.4 Local Mitigation Policies, Programs, and Capabilities

The State began the process of local mitigation plan development in early 2003 through planning grants ranging from $10,800 to $15,000 awarded to 22 county EMAs within the most populated and highest risk counties. As a result of this effort, the county EMAs have become the central coordinating agencies for local hazard mitigation planning. The following year, the State entered into an agreement with the Alabama Association of Regional Councils to provide funding, training, and technical support for the regional councils to develop the capabilities to support local mitigation planning. Grants were awarded to complete plans for the remaining 47 counties. Since then, many counties are working with contractors and other mechanism to complete local plan updates though the Regional Councils remain active in hazard mitigation assistance. Details on the status of local planning are contained in Section 7.3.2, which describes the status of each county plan as well as funding sources for each.

The results of the mitigation plan development program in the State have tremendously increased the capabilities for local mitigation and community awareness. EMA staff across the State have become proficient in administering local planning programs and overseeing the activities of local hazard mitigation planning committees. The Regional Planning Counties continue to provide technical assistance where needed. These improvements in technical and administrative capability are continued throughout the local plan update process.

4.4.1 Local Mitigation Policies

The framers of Alabama's 1901 Constitution designed a system of State government that concentrates power at the State level. Alabama is not a "home rule" state, meaning that local authority must be granted by State acts, special legislation, or constitutional amendments. Due to the restraints placed in the Alabama Constitution, all but seven counties (Jefferson, Lee, Mobile, Madison, Montgomery, Shelby, and Tuscaloosa) in the state have little to no home rule. Instead,

most counties in the state must lobby the Local Legislation Committee of the state legislature to get simple local policies such as waste disposal to land use zoning.

Despite the constitutional limitations on home rule, local governments have been able to function adequately. Legislation has been enacted over the years to allow localities with the capabilities to implement planning and regulatory tools for hazard mitigation. In 1935, the State passed legislation that empowered any municipality to establish planning commissions, pursue comprehensive planning, and enforce zoning ordinances and subdivision regulations, among other planning activities. This planning enabling legislation, however, did not include unincorporated areas of counties. Only Jefferson, Shelby, and Baldwin Counties have authority by special legislation to extend planning and zoning regulations into unincorporated areas of these counties only. By State Act, all local governments have authority to enact floodplain management ordinances, building codes, and subdivision regulations.

4.4.2 Local Mitigation Programs and Capabilities

The capabilities of the localities to perform local mitigation measures and implement mitigation projects vary significantly among local governments. Beginning with the 2007 State Plan Update, a table summarizing local capabilities was developed and included as an appendix**.** Subsequent plan versions review and update local capabilities in this table. For the 2018 Plan Update, the summary table lists all counties and municipalities of Alabama and notes various criteria for evaluating the capabilities of each of these localities, including the extent to which regulatory powers such as zoning ordinances, comprehensive plans, and building codes have been adopted, as well as the availability of manpower, such as planners and engineers on staff. A complete list of evaluative criteria is included along with the Local Capability Table in Appendix C.

The Local Capability Table in the 2013 Plan Update indicated that the results of this assessment show a wide disparity in capabilities, and this pattern continues with the 2018 Plan Update. Generally, jurisdictions with the largest populations and revenues have the most capabilities. For instance, the City of Birmingham, the largest urban jurisdiction in the State, possesses significant capabilities that most other jurisdictions do not. Birmingham has participated in the NFIP since 1978 and maintains Floodplain Management and Disaster Mitigation Services within the city's Planning, Urban Design & Watershed Management Division. This includes a full-time CFM with at least two full-time supporting staffers, all of whom are responsible for managing the city's flood hazard mitigation efforts, including ordinance administration, outreach, property acquisitions, FEMA grant administration, and a host of other mitigation activities.[32] The City participated in the development of, and adopted, the Jefferson County hazard mitigation plan and supplemented

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[32] Floodplain Management. City of Birmingham, Alabama, 2018. Retrieved at: https://www.birminghamal.gov/about/city-directory/planning-engineering-permits/floodplain-management/.

that plan with its own Floodplain and Storm Water Management Plan that was funded through an FMA planning grant. Birmingham has a CRS rating of five, which is the lowest of all CRS-rated communities in Alabama; however, only 14 jurisdictions in the state are CRS-rate.[33] It maintains a comprehensive plan and a CIP, administers a zoning ordinance, building codes, and subdivision regulations, and has a staff of professional planners, engineers, and building inspectors. It has extensive experience with FEMA grant programs, having implemented over $12 million in flood hazard mitigation buyouts of structures in Birmingham. Previously, the USACE completed a $30 million flood buyout.

Similar robust mitigation capabilities are reflected in the other large and well-populated jurisdictions in Alabama. For example, Jefferson County, in which Birmingham is located and which ranks as the most densely populated county in Alabama, reflects similar advantages, having implemented over $24 million in flood hazard mitigation buyouts in the county. Other large cities in Alabama, such as the City of Huntsville, also closely follow Birmingham's lead in demonstrating local hazard mitigation capabilities.

In contrast to the larger cities, however, many county and municipal jurisdictions in Alabama have rural populations and very limited revenue resources. Consequently, capabilities in rural counties are typically very low. As shown in the Local Capability Table, typical rural Alabama towns rarely employ any planners, engineers, or building inspectors. Further, many cities and towns in Alabama have no comprehensive plans, building codes, zoning ordinances, subdivision regulations, or other regulatory means to implement mitigation measures. Small communities depend on support from their county governments, which, even in rural locations, have greater means to lend some local support to hazard mitigation.

Another nationwide community preparedness program that Alabama communities participate in is the NWS's StormReady Program (SRP). SRP helps communities develop plans to handle all types of severe weather, including, but not limited to tornadoes and tsunamis. By providing emergency managers with clear guidelines on how to improve their hazardous weather operations, SRP encourages communities to take a proactive approach toward improving their weather operations. These guidelines help communities implement procedures that reduce the potential for disastrous, weather related consequences.

To become a StormReady community, several guidelines must be met. The guidelines include the following:

- Establish a 24-hour warning point and emergency operations center

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[33] Alabama Top 50 National Flood Insurance Program (NFIP) Policy Count Communities and Community Rating System (CRS) Participation, October 2017. https://crsresources.org/files/100/maps/states/alabama_crs_map_october_2017.pdf

- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather local weather conditions
- Promote the importance of public readiness through community seminars and other outreach methods
- Develop a formal hazardous weather plan to include training severe weather spotters and conducing emergency exercises.

Some benefits of being a StormReady community include increased scores on the CRS which in turn can lower NFIP insurance rates, along with maintaining local plans and increased public awareness and preparedness. Counties, communities, and supporters that are StormReady are identified below in Table 4.5.

Table 4.5 Storm Ready Communities in Alabama

Type of Jurisdiction	Name	Date of Recognition
County	Autauga	New to the 2013 Plan Update
County	Baldwin	New to the 2010 Plan Update
County	Blount	January 31, 2006
County	Calhoun	July 17, 2006
County	Cherokee	October 8, 2004
County	Choctaw	New to the 2018 Plan Update
County	Clarke	New to the 2018 Plan Update
County	Cleburne	May 13, 2005
County	Coffee	New to the 2010 Plan Update
County	Colbert	New to the 2010 Plan Update
County	Covington	New to the 2010 Plan Update
County	Cullman	New to the 2010 Plan Update
County	Dale	New to the 2010 Plan Update
County	Dallas	November 16, 2004
County	DeKalb	New to the 2010 Plan Update
County	Elmore	New to the 2010 Plan Update
County	Etowah	August 9, 2007
County	Fayette	December 4, 2006
County	Franklin	New to the 2010 Plan Update
County	Geneva	New to the 2010 Plan Update

Type of Jurisdiction	Name	Date of Recognition
County	Henry	New to the 2010 Plan Update
County	Houston	New to the 2010 Plan Update
County	Jackson	New to the 2010 Plan Update
County	Jefferson	November 16, 2004
County	Lauderdale	New to the 2010 Plan Update
County	Lawrence	New to the 2010 Plan Update
County	Lee	September 19, 2006
County	Limestone	New to the 2010 Plan Update
County	Madison	New to the 2010 Plan Update
County	Marion	December 21, 2005
County	Marshall	New to the 2010 Plan Update
County	Mobile	New to the 2010 Plan Update
County	Monroe	New to the 2010 Plan Update
County	Montgomery	November 16, 2004
County	Morgan	New to the 2013 Plan Update
County	Randolph	New to the 2013 Plan Update
County	Russell	April 8, 2005
County	Shelby	April 8, 2005
County	St. Clair	New to the 2013 Plan Update
County	Talladega	New to the 2013 Plan Update
County	Tallapoosa	May 12, 2006
County	Tuscaloosa	April 14, 2006
County	Winston	January 31, 2006
Community	Oneonta	New to the 2013 Plan Update
University	Alabama AM University	New to the 2018 Plan Update
University	Auburn University	New to the 2010 Plan Update
University	Jacksonville State University	New to the 2010 Plan Update
University	Oakwood University	New to the 2018 Plan Update
University	University of Alabama	New to the 2010 Plan Update
University	University of Alabama, Birmingham	New to the 2018 Plan Update

Type of Jurisdiction	Name	Date of Recognition
University	University of Alabama, Huntsville	New to the 2013 Plan Update
University	University of Montevallo	New to the 2018 Plan Update
University	University of North Alabama	New to the 2013 Plan Update
University	University of South Alabama	New to the 2010 Plan Update
University	University of West Alabama	
Government	Marshall Space Flight Center	New to the 2013 Plan Update
Commercial	Huntsville International Airport	New to the 2018 Plan Update
Supporters	Camp Laney	New to the 2018 Plan Update
Supporters	Eastdale Mall	August 9, 2007
Supporters	General Electric	New to the 2010 Plan Update
Supporters	Huntsville Utilities	New to the 2010 Plan Update
Supporters	Northeast Alabama Community College	New to the 2013 Plan Update
Supporters	Nucor Steel	New to the 2018 Plan Update
Supporters	Quintard Mall	August 25, 2005
Supporters	Sci-Quest Hands on Science Museum	New to the 2010 Plan Update
Supporters	Sport Authority Field at Mile High	New to the 2018 Plan Update
Supporters	Summit Lifestyle Center	December 19, 2004
Supporters	Talladega Superspeedway	September 19, 2006
Supporters	U.S. Space and Rocket Center	New to the 2010 Plan Update

Since the 2013 plan update, there are two new counties (1 county no longer SRP status), no new communities (1 community no longer of SRP status), 3 new universities, no new government/military sites (1 government/military site no longer of SRP status), three new supporters, and 1 new commercial (1 commercial no longer of SRP status) now participating in the program. The new additions are bolded, and specific dates of recognition will be updated as information becomes available. All StormReady participants must be recertified every three years.

This overall state of capabilities in Alabama points to the need for a strong State program of support to increase the capabilities of these rural communities and sustain and strengthen the capabilities of larger jurisdictions. The State EMA fully recognizes these needs for continuing mitigation planning support and has been actively taking steps to expand its technical support and work with locals to identify funding opportunities, as reflected in several new proposed mitigation actions in this plan update. The State intends to increase support for localities to receive professional planning and engineering services for hazard mitigation. This can be accomplished through continuing coordination with county EMAs, increasing participation in NWS's StormReady Program, and working to obtain planning funds (e.g., PDM, CDBG, HMGP) available to improve and expand local mitigation activities.

4.5 Integration into Other Ongoing State Planning Efforts

4.5.1 Ongoing State Planning Efforts and Integration Process

As noted above, AEMA works closely with several agencies to ensure ongoing planning efforts and integration. The agencies with substantial integration into mitigation planning include the Alabama Association of Floodplain Managers (AAFM), ADECA, DCNR, Geological Survey of Alabama (GSA), and AFC. In previous Plan Update cycles, the Regional Planning Councils (RPCs) had provided coordination between local hazard mitigation plans and ongoing state mitigation planning efforts; however, RPCs did not participate in the 2018 Plan Update. More information regarding the past and present role of RPCs in hazard mitigation planning is available in Appendix C. Other hazard mitigation initiatives by Federal agencies are described in Sections 4.3.2 and 4.3.3. These are primarily funding mechanisms to augment state and local mitigation activities.

4.5.1.1 Alabama Association of Floodplain Managers

Alabama established its own chapter of State Floodplain Managers, the AAFM, in 2008. As demonstrated in the past, the Association offers technical support materials for flood hazard mitigation planning and offers a certification program, the CFM, for State and local officials involved with floodplain management. The AAFM works closely with ADECA OWR to provide training courses and webinars for floodplain managers. The AAFM has also contributed to the development of several ADECA OWR publications, including Alabama's Quick Guide to Floodplain Management (2009). AARM has hosted an annual conference for the last 10 years that provides a key opportunity to networking. The most recent conference was held September 25-27, 2017 and had over 100 participants representing 32 different governments and municipalities.

4.5.1.2 Alabama Department of Economic and Community Affairs

ADECA-OWR plays a major role in statewide hazard mitigation planning. ADECA-OWR oversees the Drought Management Program, administers the NFIP), maintains the Alabama Energy and Residential Codes Board, and manages the Dam Inventory. Lastly, ADECA-OWR oversees the State's flood mapping program, including Risk MAP, a FEMA program. ADECA's Community and Economic Development Programs Office administers the CDBG program, including the Disaster Recovery Initiative (DRI) and administers grants for local planning activities.

As discussed above, the Alabama Drought Planning and Response Act of 2014 established the ADAPT. The purpose of the ADAPT is to provide guidance and make recommendations on drought-related matters to the Governor and the ADECA-OWR, and to coordinate intergovernmental drought response, management, and implementation of all drought related activities. ADAPT developed and maintains the Alabama Drought Plan, which establishes state-level operating procedures and a framework for the assessment of drought conditions, assists stakeholders and water managers in mitigating drought conditions, and encourages water conservation practice. Additionally, ADAPT maintains the Alabama Drought Information Center, an online clearinghouse of drought-related information available to the public, including a GIS portal and links to current climactic conditions such as soil moisture, reservoir levels, and stream flows.[34]

4.5.1.3 Alabama Department of Conservation and Natural Resources

The CZMP is jointly administered through DCNR and ADEM. DCNR is responsible for grant management, planning and policy development, and ADEM is responsible for permitting, regulatory, and enforcement.

The DCNR, State Land Division, Coastal Section administers the ACAMP, a program designed to balance preservation, conservation, enhancement and development of coastal resources, while promoting a sustainable economy in coastal areas. An important component of the program is natural hazards mitigation. Considering this, the Commissioner of DCNR is among those designated to participate on the SHMT by EO 19. Planning efforts are coordinated with DCNR through:

- Discussions of planning activities and mitigation plans with key staff;
- Review of the ACAMP; and
- Review of the Alabama CIAP Plan.

In the past, the DCNR, Coastal Section has provided grant funds to local communities to fund hazard mitigation plans and plan updates. This has included Baldwin County, Orange Beach and Gulf Shores. Currently, no such grants are in place. However, prior to each fiscal year, the DCNR,

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[34] Drought Planning and Management in Alabama. ADECA (2015). Retrieved at: http://www.adeca.alabama.gov/Divisions/owr/Pages/Drought.aspx

State Lands, Coastal Section issues a request for proposals under which hazard mitigation projects, plans and plan updates are an eligible category that may receive Federal funding if a project receives a priority ranking.

Projects which have potential impacts on Alabama's coastal resources are regulated through the ADEM permitting and enforcement programs. These regulated projects include the following activities:

- Construction on Gulf-fronting properties;
- Commercial and residential development on properties greater than 5 acres;
- Projects with impacts on wetlands and/or water bottoms;
- Construction of new or expansion of existing marinas;
- Installation of groundwater wells with a capacity greater than 50 GPM;
- Siting, construction and operation of energy facilities;
- Shoreline stabilization projects; and
- Discharges to coastal waters.

4.5.1.4 Geological Survey of Alabama

The Geological Survey of Alabama (GSA) supports mitigation planning for geological hazards including sinkholes, earthquakes, and landslides. GSA has developed and maintains maps showing the distribution of known sinkholes, faults, underground mines, and landslides. The agency also maintains maps of ecologic formations, complete with descriptions of the characteristics, and prepares reports of findings and recommendations. The GSA also maintains records of historical earthquakes and monitors current seismic activity. In March of 2010, GSA completed a statewide basement fault map and is working to complete a soil amplification/liquefaction map. The GSA also has provided data to map earthquake epicenters, liquefaction susceptibility and landslide susceptibility for the 2018 Plan update. Both items have been incorporated into the Risk Assessment. The information and technical resources of the GSA are critical to the statewide risk assessment of this plan and the development of mitigation strategies that respond to pervasive geological hazards across the State. In addition, the GSA conducts public outreach through the distribution of educational brochures on geological hazards.

4.5.1.5 Alabama Forestry Commission

AFC incorporated mitigation elements into its Forestry Resources Handbook. The AFC partnered with several agencies, including AEMA, to complete the handbook. AEMA provided hazard mitigation expertise throughout the development including information from the State Hazard Mitigation Risk Assessment to incorporate into the handbook. AEMA was present during the AFC's strategy development process when the AFC and partnering agencies identified 9 threats, one of which was storms (e.g., catastrophic events, floods, hurricanes). AEMA provided mitigation expertise on the storm section of the Forestry Resources Assessment Handbook. Mitigation was made a priority for both urban and rural settings. In urban setting mitigation priorities were to

remove debris and incorporate lessons learned from previous plans. In rural settings, mitigation priorities included developing community wildfire mitigation plans and incorporating scalability.

4.5.2 Potential Improvements

The State of Alabama has many opportunities to strengthen or improve the integration of its existing statewide planning initiatives. These opportunities were first identified in the 2007 version of the plan and were included in subsequent plan updates. Several items have been completed which are listed in Section 4.5.3 following this subsection. Below lists the potential improvements and their status:

- Continue to use the AARC to disseminate planning information among local government planning. This agency became the main source of information sharing when the All Hazards Task Force dissolved in 2010.
    - This agency continues sharing information as of the 2018 State Plan update.
- Continue NFIP training and enlarge the scope of training to address other natural hazards. The lead hazard mitigation planning agencies (defined as Alabama Department of Economic and Community Affairs, Alabama Department of Environmental Management, Forestry Commission of Alabama, Geological Survey of Alabama, and Alabama Department of Conservation and Natural Resources) can improve coordination and delivery of mitigation planning courses to interested individuals throughout the State. The AARC can also become a partner in enlarging training opportunities along with the Alabama Planning Institute (API). Expanded and coordinated training presents one of the best opportunities to assure integration of planning initiatives among State, Federal, and other interest groups, and best deliver hazard mitigation planning principles at the local level.
    - Floodplain Management 101 was conducted on at least 5 occasions, Managing Floodplain Development through the NFIP (L-273) is held once or twice a year, and Basics of Hydrology and Hydraulics and GIS for the Floodplain Manager has been held three times. There are plans to provide training on NFIP Policy and Reform, Hazus, CRS, Online LOMC, and a Floodplain Management Summary and review in addition to various seminars provided through the Alabama Association of Floodplain Managers conferences.
        - Digital Tools training is tentatively scheduled for Mobile County (10/10/2018) and the Cahaba Watershed (10/3/2019).
    - Additional training is also offered through FEMA's Risk MAP program.
    - The AARC works through the state to provide information to local governments. The state is not currently working with API to providing training exercises specific to hazards.
    - Additional training for earthquake and hurricane hazards continues:
        - Earthquake: There are several counties at risk to earthquake in Alabama. AEMA works primarily through the Central United States Earthquake

Consortium (CUSEC) and FEMA to provided courses to these counties. In the past, seismic courses have also been provided by the Applied Technology Council (ATC). A CUSEC TTX is scheduled for February 2019 and a New Madrid SZ exercise with FEMA, CUSEC states, EMAC states, and other federal, state, and local level agencies is scheduled for June 3-7, 2019.

- Hurricane: HURREVAC training was conducted in the coastal counties (Baldwin and Mobile). AEMA is also working with the National Hurricane Center to provide information to inland counties affected by wind. The last HURREVAC training occurred in 2014, and no future HURREVAC trainings are scheduled at this time.

- Maintain a clearinghouse and repository of hazard mitigation plans and technical support publications. AEMA can serve this function and maintain documents and materials in a centralized location for printed distribution and access through the internet.
  - An official clearinghouse has not been established due to funding.
- Coordinate outreach services among statewide planning agencies. A coordinated public outreach program should more effectively communicate the complete plan and keep the public informed of risks and statewide efforts underway to mitigate those risks.
  - AEMA's website is the primary public outreach tool. It provides information to the public about the different hazards that impact the state, access to the state and county hazard mitigation plans, links to live weather updates, and resources for disaster assistance. AEMA is also continuously working to revise all their documents available on the AEMA website to make them more user-friendly. For example, the documents will be easy to search and broken down into smaller, more manageable documents (by subject area), when appropriate.
- AEMA should work in conjunction with the DCNR, Coastal Section to update the ACAMP program document, specifically those parts related to natural hazard mitigation. The resulting information should be incorporated into the State Hazard Mitigation Plan. Updates to the ACAMP program document should be coordinated with the scheduling of updates to the State Hazard Mitigation Plan to assure consistency. The ACAMP should schedule time updates of the ACAMP program document to allow for a direct feed of the latest data from the State Hazard Mitigation Plan into the ACAMP program document.
  - AEMA provided input on hazard mitigation planning, post-disaster mitigation planning, repetitive flood loss policies including relocations and buyouts.
  - ACAMP updates occur approximately every 5 years; the last completed draft is dated 2013.

4.5.3 Completed Improvements

The State of Alabama has worked to complete many of the potential improvements listed above. The following is a list of those accomplishments.

- State association of Floodplain Managers: The Alabama Association of Floodplain Managers was created in 2008.
- AEMA has continuously added new Certified Floodplain Managers (CFM) to its staff.
- NFIP Training: NFIP seminars are provided through the Alabama Association of Floodplain Managers conferences which began in October 2008. There is a Spring training and a Fall training.
- AEMA website: As of 2009, the AEMA website has become a central location for many hazard mitigation documents. The State Hazard Mitigation Plan and all county hazard mitigation plans can be found on the website. In addition, there are links to the Alabama NFIP website, benefit-cost guidance, mitigation grant applications, and several other technical assistance documents.
    - As of the 2018 State Plan update, all documents are online, but no changes have been made regarding their readability.
- AEMA is using social media outlets, including Facebook and Twitter, to reach and educate the public on hazard mitigation measures.
- Continue the functions of the All Hazard Task Force among the Regional Planning Councils: The Task Force was formed as means to exchange mitigation planning information among the RPCs. The Task Forced remained active until 2010. As of the 2013 State Plan update, the All Hazard Task Force has dissolved and is no longer functional. Many of the RPCs are no longer completing mitigation plans, so there is less of a need for a formalized information-sharing network.
- Another important outreach tool is ADECA OWR's flood map viewer: https://alabamaflood.com/map This tool allows the public to determine what flood risk they are exposed to give their specified location. This web map hosts effective and preliminary flood hazard data as well as a suit of non-regulatory products that are being developed in various counties in Alabama.
- In 2011, DCNR's Coastal Section completed a preparedness guide titled, "Homeowner's Handbook to Prepare for Natural Hazards." The handbook was funded through a Sea Grant and was modeled off the University of Hawaii's version of a similar document. The purpose of the handbook is to reduce the risk of natural hazards on people and property. It provides homeowners with basic guidance on how to prepare for nearly any hazard event, including hurricanes, tsunamis, earthquake, and several other hazards. The Coastal Section worked directly with AEMA to include information from the Alabama Hazard Mitigation Plan into their handbook. The Coastal Section solicited involvement from other agencies, such as AFC, through the SHMT.

4.6 Integration into Other FEMA Mitigation Programs and Initiatives

4.6.1 Summary

AEMA administers and oversees Federal mitigation grant programs for the State of Alabama that are related to hazard mitigation, emergency management, and disaster relief, and serves as the lead agency for the State in disaster mitigation efforts. Due in part to the agency's dual roles, AEMA has the opportunity to integrate the dissemination of mitigation information with the FEMA grant application process for the programs listed in Section 4.3.2.

The Alabama Office of Water Resources (OWR) administers the NFIP within the State of Alabama, with responsibilities assigned to the State NFIP Coordinator and support staff. The primary responsibilities of the office of the State NFIP Coordinator include facilitating participation in the NFIP among Alabama communities, providing technical support and training to local administrators, and encouraging participation in the CRS Program.

4.6.2 List of Ongoing FEMA Mitigation Programs and Initiatives

FEMA Grant Programs (see Section 4.3.2 for an overview of all FEMA grant programs and initiatives):

HMA Grants provide funding for mitigation activities:

- HMGP – requires a disaster declaration;
- PDM; and
- FMA.

In addition, PA program money, received following a disaster declaration, can be used towards mitigation projects.

- NFIP:
  - State NFIP Coordination;
  - CRS;
- Risk MAP:
  - Risk MAP is focused towards the flood hazard and has several goals including addressing gaps in flood hazard data, public awareness/outreach, mitigation planning, enhanced digital platform, and alignment and synergies of risk analysis program to enhance decision-making capabilities. It is not a grant program though it does provide resources to the states to reach the aforementioned goals.

4.6.3 Integration Process and Potential Improvements

The SHMT first identified and reviewed State of Alabama laws, regulations, policies, and programs pertaining to mitigation and FEMA sponsored programs and supporting regulations in the 2007 version of this plan. They were reviewed and updated as necessary subsequent versions.

- FEMA Grant Programs:
  - The Alabama EMA administers all FEMA grant programs. It notifies communities and eligible applicants of the availability of program funds, provides applicant briefings and technical assistance, reviews applications for eligibility and compliance, and recommends funding to FEMA. AEMA serves as the grantee of FEMA grant awards and oversees the implementation of funded projects by subgrantees (communities and other eligible applicants). AEMA should continue to facilitate and monitor grant awards to eligible applicants.
    - AEMA continues to administer and monitor the grant process.
  - Consistency of project applications with local mitigation plans is required by AEMA to assure integration of local mitigation activities with the hazard mitigation planning process.
  - The grant award process can be improved by adhering to established prioritization criteria presented in the State plan.
    - The grant award process using the prioritization criteria is now adhered to as of the 2007 State Plan update.
  - Beginning with projects for disaster number 4052 (Severe Storms, Tornadoes, Straight-line Winds, and Flooding) which occurred on January 2012, project applications will be submitted online. In addition, money will be allocated to counties and they will be able to decide how to spend their grant money. Previously, applications were used for a variety of projects, but the Governor would decide how a majority of the money was spent.
- NFIP
  - The NFIP Coordinator should continue to maintain a five-year plan for its community assistance programs.
  - The State NFIP Coordinator and staff should continue to provide statewide support for local participation in the NFIP, facilitating NFIP membership, assisting with flood hazard prevention ordinance development and Federal compliance, providing training and technical support to local floodplain ordinance administrators, encouraging the floodplain management practices of the NFIP, and promoting flood insurance.
    - NFIP guidance and support continues throughout the state.
  - The NFIP staff should continue to regularly conduct CAVs among NFIP participating communities throughout the State. During these visits the staff should

not only check for program compliance but offer guidance and support for improved flood hazard mitigation practices.

- In addition to regular NFIP participation, the State office should encourage CRS program participation by NFIP communities and assist current CRS communities to continually seek higher CRS classifications.
- The NFIP Coordinator should continue working closely with the Alabama EMA to assure strong integration of local flood hazard mitigation practices into local and state hazard mitigation planning policies.
- The OWR should complete its statewide flood map modernization program for the State, including the development of FIRMs that will readily provide flood GIS data for local and statewide risk assessments for hazard mitigation planning.
- The State NFIP Coordinator should continue to conduct formalized training and distribute technical publications to local floodplain administrators, building officials, public works engineers, planners, and state and local officials involved in hazard mitigation.
- Continue to coordinate with Alabama Association of Floodplain Managers to build capacity across the state.

5 Mitigation Strategy

5.1 State Mitigation Strategy

44 CFR 201.4 (c) (3) requires the State Hazard Mitigation Plan to include a Mitigation Strategy. The Mitigation Strategy serves as the blueprint to reduce the State's risk of losses as identified in the Risk Assessment. The State Hazard Mitigation Team reaffirmed Alabama's overall hazard mitigation strategy at the third State Hazard Mitigation Team meeting in May 2018. The state's mitigation strategy is as follows:

> *Reduce vulnerability through collaborative actions and policies that limit the effects of natural hazards on the citizens of Alabama and physical assets.*

This section describes the State of Alabama's process for identifying, evaluating, and prioritizing the State's mitigation actions, based on the hazard mitigation goals presented in next section. Several State agencies provided recommendations for goals, objectives and actions to be included in the plan.

5.1.1 Mitigation Goals

When the first plan was drafted in 2004, the SHMT identified six goals supporting the State of Alabama's overall mitigation strategy. These goals are accompanied by objectives and actions that are designed to support the implementation of the goals. A multi-stage process was used to identify, evaluate, and prioritize the goals, objectives, and actions. This multi-stage process included the analysis of how local mitigation strategies are linked with the state mitigation strategy (Section 1.3.2.3). With each plan update, the State Plan Goals are revisited by the State Hazard Mitigation Team. The purpose of their review is to determine if the goals and associated objectives are still valid. Minor changes were made in the 2007, 2010, and 2013 updates.

For the 2018 plan update, several minor changes were made to the wording and arrangement of the goals and objectives to best reflect the state's intent and continuing update process. The changes were suggested and agreed upon through a process of discussion and voting led by the project consultant at the Mitigation Strategy meeting in May 2018. Several former objectives under Goal 1 were combined into the new Objective 1.1 Also, the former Goals 2 and 3 were combined into the new Goal 2 to strengthen the goal and reduce redundancy. These changes are also reflected in the mitigation action plan. The refined mitigation goals and objectives are as follows:

Goal 1: Enhance the comprehensive statewide hazard mitigation system.

Objective 1.1 Improve local and state capability to study natural hazards by providing direct technical assistance to local public officials and maintaining qualified state mitigation staff.

Objective 1.2 Improve the statewide availability of risk information, particularly in GIS format.

Objective 1.3 Ensure that State, county, and local officials have most current data regarding RL and SRL properties.

Objective 1.4 Develop hazard mitigation policies that also protect the environment.

Goal 2: Reduce the State of Alabama's vulnerability and increase resilience to hazards to protect people, property, and natural resources.

Objective 2.1 Strengthen state building codes to require the latest construction techniques and materials that reduce the effects of natural hazards on buildings and infrastructure.

Objective 2.2 Encourage local governments to adopt and enforce more stringent building and zoning codes, especially in hazardous areas.

Objective 2.3 Enforce a program that reduces the Statewide number of Repetitive Loss and Severe Repetitive Loss properties.

Objective 2.4 Improve the state's ability to prepare for and respond to a natural or man-made disaster.

Objective 2.5 Reduce the impact of hazard events on state departmental functions (i.e., loss of service).

Objective 2.6 Promote hazard mitigation policies that reduce risk to people and property and protect the environment.

Goal 3: Foster public awareness and understanding of their hazard risk and of mitigation opportunities.

Objective 3.1 Publicize and encourage the adoption of appropriate hazard mitigation actions.

Objective 3.2 Educate public about hazards identified in State Plan.

Goal 4: Expand and promote coordination and communication with other government agencies, local governments, other relevant organizations.

Objective 4.1 Establish and maintain lasting partnerships that progress hazard mitigation in the state.

Objective 4.2 Promote and integrate hazard mitigation into activities of other organizations, especially those that do not currently coordinate with AEMA.

Objective 4.3 Improve State and local government capability to administer pre- and post-disaster mitigation programs and long-term recovery programs.

The planning team also reviewed local plans to verify that goals and objectives identified within these plans were compatible with the goals and objectives identified at the State level. In turn, State goals and objectives were determined to be reflective of local goals, objectives, and actions. This local plan review is discussed in greater detail in Section 1.3 Coordination of Local Planning.

5.1.1.1 How Recent Events Have Influenced Mitigation Actions

Since the 2004 Plan was adopted, the State of Alabama was faced with a variety of natural hazard threats. To the misfortune of countless persons in the State, many of these threats transformed into actual disasters. Large-scale disasters play a significant role in shaping the hazard mitigation priorities within Alabama throughout the planning process. Each disaster reveals strengths and weaknesses within the hazard mitigation program, and the State of Alabama must adjust its subsequent mitigation actions to address these weaknesses and reduce the impacts of future disasters.

A complete list of the 68 federal disaster declarations in Alabama since 1961 can be found in Section 3: Risk Assessment. The following are past disasters that have had profound effects on the state's mitigation actions:

- Hurricane Ivan (2004) revealed a lack of sheltering capacity within the coastal counties of Baldwin and Mobile.
- Hurricane Katrina (2005) caused catastrophic damage to counties and parishes bordering the Gulf Coast. In Alabama, the coastline received the most damage as it was impacted by near record storm surges and high winds, however inland flooding and spreading high winds impacted the entire State. The second largest HMGP obligation was made to the state to address a very diverse group of mitigation projects, including a number of elevation, acquisition, and mitigation reconstruction projects.
- The April 2011 tornadoes had a profound effect on the state, highlighting the need for safe rooms that can withstand an EF-5 tornado event (250 mile per hour winds). Nearly $64 million (2011 dollars) was allocated by FEMA for HMGP funding to build 291 community safe rooms and over 4,000 individual safe rooms. (See Table 5.5 below for grant allocation details.)

Since the last plan update, severe storms in 2014 and 2016 caused tornado outbreaks as well as severe flooding across the state resulting in disaster declarations. Continuing the trend that began after the April 2011 tornadoes, the State used $8 million in HMGP money obligated by FEMA for the construction of 55 community and residential safe room projects.

Being proactive, the State of Alabama does not wish to "chase" the last disaster in terms of identifying and implementing mitigation actions. As such, when funding has allowed, the state has pursued a core group of mitigation actions that are directed at achieving the goals identified in the Plan. These types of projects include:

- Safe rooms;

- Elevation;
- Acquisition;
- Drainage improvements;
- Individual and community shelters;
- Siren program; and
- Improved identification of threat through floodplain mapping.

Specifically, priorities have included the City of Elba acquisition projects and the Jacksonville State University recovery projects.

5.1.2 Mitigation Action Plan

5.1.2.1 2018 Mitigation Action Plan Development

The structure of the Mitigation Action Plan is meant to serve as a guide to assist State and local officials and administrators in the determination of which mitigation actions could be implemented within the State of Alabama. Additionally, during the time following a natural disaster, this action plan can be a tool for the State in determining which projects should be pursued. With each plan update, the SHMT is tasked with evaluating the Mitigation Action Plan to determine its effectiveness in meeting the mitigation goals and objectives. This includes reviewing all mitigation actions and determining if there are additional mitigation actions needed.

The SHMT begins this process by reviewing mitigation actions from the previous plan to determine their status of completion and to ensure they remain environmentally sound. As described in Section 1: Planning Process, the SHMT team members were emailed the mitigation actions from the 2013 plan that were associated with their particular state agency. Team members provided feedback on each action, describing whether it was completed, ongoing, deferred, and/or deleted. Explanations of each action status are listed below:

- Completed: The action is fully implemented and can be removed from the new Action Plan.
- Ongoing: The action is in progress, including having funding and the appropriate staffing to complete the goals.
- Deferred: The action or project is infeasible, impractical, or undesirable to complete at this time.
- Deleted: The action was either previously completed or completed on the 2013 Action Plan or combined with another action to create a more concise action.

The status of the 2013 actions is summarized in Appendix 7.8. The table contains a column called 2018 Proposed Action Changes that tracks the changes made to the original action, whether it was reworded, revised, and/or combined with other actions.

For the 2018 Plan Update, new mitigation actions were created based on the following types of mitigation techniques:

- Local plans and regulations;
- Structural projects;
- Natural systems protection;
- Education programs; and
- Preparedness and response actions.

5.1.2.2 Using these categories as a framework, SHMT members were also asked to provide new actions where applicable and include all necessary supporting information about the actions for this plan update. All new actions were determined to be environmentally sound prior to being incorporated into the 2018 Mitigation Action Plan. These new actions have been incorporated into the 2018 Mitigation Action Plan and are presented in 2018 Mitigation Action Plan

Table 5.3. In addition to the new actions, this table includes the ongoing and deferred actions identified from the 2013 action plan, some of which have been rewritten or combined with other actions. Appendix H contains the record of changes to the 2013 Mitigation Action Plan.

5.1.2.3 Mitigation Action Prioritization

Each mitigation action was prioritized using the Mitigation Action Prioritization Criteria. This process for prioritization includes five criteria categories, and for each category, each mitigation action is given a score of 1, 2, or 3, where 1 is the lowest category for the score, and 3 is the highest category for the score. The definition and weighting of the categories is identified in Table 5.1**.** The total score is then used to determine the action's priority category high, medium, or low as outlined in Table 5.2**.**

Table 5.1 Mitigation Action Prioritization Criteria

Criteria	Weight	Definition
Action Effectiveness	30%	The degree to which the action contributes to mitigating Alabama's risk to natural and technological hazards.
Action Efficiency	30%	The degree to which the action is a wise use of time, cost, and general organizational efficiency.
Multi-Hazard Mitigation	10%	The degree to which the action addresses multiple hazards. 3 = Mitigates against 3+ hazards 2 = Mitigates against 2 hazards 1 = Mitigates against 1 hazard
Addresses Probable Hazard(s)	15%	The degree to which the action addresses the hazard(s) that Alabama is most exposed to. 3 = Highly Likely Probability 2 = Likely Probability 1 = Possible or Unlikely Probability

Criteria	Weight	Definition
Addresses Critical Communications/Critical Infrastructure	15%	The degree to which the action helps to keep Alabama service running after a hazard event by targeting critical functions.

Table 5.2 Prioritization Score Categorization

Category	Score
Low	0.00–2.00
Medium	2.01–2.70
High	2.71–3.00

5.1.2.4 Timeline for Action Implementation

The State's Mitigation Strategy also includes a timeline to implement the different mitigation actions. Since funding can often be one of the largest limiting factors, these criteria were used to evaluate the timeframe in which an action or project could be implemented. Three different temporal phases were used:

- **Near-term** is for projects that have the potential to be put into action within **zero to two years**.
- **Mid-term** actions could be implemented within **three to six years**.
- **Long-term** actions are those actions on the horizon for the state, looking forward a **minimum of seven years** for potential execution.

The process of assigning actions to one of the three timeframes should not be considered a final determination of the project's initiation or completion date. This process is a fluid process; and constraints used in the initial determination change, such as availability of funding and priorities of the current political climate. Actions can and should be re-evaluated and adjusted. Placement of an action in a mid- or long-term time frame does not preclude the State or local entities from implementing that action at an earlier time if conditions warrant. Projects can also be deferred from near- and mid-term time frames if the State so decides.

5.1.2.5 Action Feasibility

Any State government construction project – regardless of potential funding source – must be cost-effective, technically feasible, and meet all appropriate Federal, State, and local environmental laws and regulations before it is started. State government projects funded by Federal hazard mitigation grant programs administered by AEMA must meet specific criteria related to cost-effectiveness, environmental soundness and technical feasibility.

5.1.2.6 The cost of many of the actions outlined in this plan is staff time to review measures, provide technical assistance to local communities, or develop internal guidelines and plans. Actions documented in this plan try to encompass a variety of specific projects that could be pursued at the State and local levels. In the Projected Cost column of 2018 Mitigation Action Plan

Table 5.3, some actions include estimated dollar amounts while others include a general description of costs involved, especially where specific project costs cannot be determined until the project scope has been developed.

5.1.2.7 2018 Mitigation Action Plan

Table 5.3: 2018 Mitigation Action Plan

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
1	Establish a schedule to provide state and local offices with current information on past events (including damages).	1.1	Low	All	AEMA	State Funds	Near-Term	Staff Time	Updating state and local officials with current information will improve future decisions regarding mitigation.	Continuous updating efforts through planning at both the county and state level to identify those past damages that pose the most hazardous threats in the future.
2	Provide funding and technical assistance to state agencies, local government, and tribes to administer mitigation activities, including preparing hazard mitigation plans.	1.1	Medium	All	AEMA; FEMA (HMA)	HMA; State Funds	Mid-Term	Staff Time and Project costs TBD by Local/Tribal project scope.	Expanding the number of hazard mitigation initiatives will improve the State's resistance to hazards.	Continuing to provide assistance when requested.
3	Develop and update a comprehensive record of ADEM's assets and operations.	1.1	Low	All	ADEM	State Funds	Near-Term	Staff Time	Maintaining a comprehensive record of assets and operations will improve accessibility and expand their use.	Continuously reviewing and updating as needed.
4	Assist K-12 schools and state colleges and universities develop vulnerability assessments, mitigation plans and mitigation projects to improve safety in their most vulnerable buildings.	1.1	High	All	AEMA; AARC; Local Government	FEMA (HMA & PA), local	Long-Term	Staff Time and Project specific costs based on individual regulations.	Providing technical assistance to educational facilities encourages the use of mitigation and strengthens critical facilities.	Provide assistance as requested.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
5	Inventory and catalog natural hazards studies, maps, digital data and other information available from city, county, state, federal, university, private, and other sources.	1.2	Low	All	AEMA	FEMA (HMA & PA), local, CDBG, EMPG	Near-Term	Staff Time	Maintaining a comprehensive invoice/catalog will improve the use of the data by agencies.	Continuously gathering information and updating as required
6	Adopt a common Geographical Information System (GIS) data system throughout State, county and local government.	1.2	Low	All	AEMA	USGS & State Funds	Near-Term	TBD	Better risk information will improve understanding for decisions to protect lives and property.	Continuing to work with all interested partners to develop a statewide system. AEMA has begun to use WebEOC as its platform for all response activities and is working to increase the use of it for all aspects of Emergency Management and Statewide adoption.
7	Alabama State Building Commission and Alabama Residential Codes Board to review the state building codes against the most recent standards (eg., IBC for earthquake, wind loads, flood, fire) to identify where state codes require revisions and update accordingly.	2.1	High	All	State Building Commission; Alabama Residential Energy Code Board	Operating Budget	Near-Term	Staff Time	Expanding hazard mitigation initiatives will improve the State's resistance to hazards for the future.	Continuously gathering information and updating as required.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
8	Develop state regulations that require local governments to incorporate natural hazard mitigation measures into all new public construction projects.	2.1	High	All	State Building Commission; Local Government	Operating Budget	Long-Term	TBD by project scope	Incorporating natural hazard mitigation into new public construction reduces vulnerabilities and protects live and property.	Continuously working with the State Building Commission to emphasize the importance of mitigation.
9	Implement Legislation Title 11-19-1 through 24.	2.2	Medium	All	ADECA; AAR; ACCA	Operating Budget, State funds, local	Mid-Term	Staff Time	Land use management practices that address mitigation increase the probability that lives and property will be protected.	Continuously working to promote mitigation throughout the State.
10	Provide regular educational programs to local building and code enforcement officials about minimum standards for construction in hazardous areas (e.g., wind loads, floodplains, earthquake zones).	2.2	Medium	All	AACC; ALM; DCNR; Local Government	Bonding Funds, ACAMP-CZMA funds	Mid-Term	Staff Time	Improving building inspections will increase the integrity of structures and protect occupants during hazard events.	Continuously working with the State Building Commission to emphasize the importance of mitigation.
11	Administer training to local governments about integrating hazard reduction planning into land-use plans and development regulations.	2.2	Medium	All	AEMA; Local Government	Operating Budget, State funds	Long-Term	Staff Time	Coordinating plans ensures that mitigation efforts are addressed.	Continuously working with the State Building Commission to emphasize the importance of mitigation. Provide mitigation training at Division meetings.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
12	Promote, strengthen and coordinate emergency response plans to better identify and mitigate risk to natural and manmade disasters.	2.4	Medium	All	AEMA; ADEM	Operating Budget, State funds	Mid-Term	Staff Time	Coordinating plans ensures that mitigation efforts are addressed.	Continuously attend AEMA Division meetings, SERC meetings, and LEPC meetings to educate about mitigation.
13	Create a statewide training system to test local emergency managers in activating the Emergency Alert Systems.	2.4	Medium	All	AEMA; Local Government	EMPG	Mid-Term	Staff Time	Expanding the number of hazard mitigation initiatives, to include reverse 911 systems, will increase the community's resistance to hazards.	Currently implementing Alert FM throughout the state.
14	Update contact information in the Departmental Emergency Operation SOP on a regular basis and review and update biannually.	2.5	Low	All	AEMA; All State Agencies	EMPG, Operating Revenue, State funds	Near-Term	Staff Time	Improved and up-to-date information in the SOP will improve mitigation and other planning designed to reduce the impact of hazard events.	The plan is reviewed annually during AEMA Division meetings and updated as needed.
15	Develop and maintain Continuity of Operations plans for all State agencies including periodic review and updates.	2.5	Medium	All	All State Agencies	Operating Budget; State funds, ALDOT O&M	Near-Term, Mid-Term (per ALDOT)	Staff Time	Keeping state departmental functions operational during and following hazard events is important to serving clients.	Currently working to locate a COOP site and finalize the plan.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
16	Develop a plan to protect public records.	2.5	Medium	All	All State Agencies	Operating Revenue, State funds	Mid-Term	Staff Time	Protecting public records will ensure that this information is available for future uses.	Completed as of 2010. Continuously reviewing and updating as needed.
17	Develop a plan to protect data.	2.5	High	All	All State Agencies	Operating Budget; State funds	Mid-Term	Staff Time	Protecting data will ensure that this information is available for future uses.	Completed as of 2010. Continuously reviewing and updating as needed.
18	Update continuity of government plans to incorporate the most up to date hazard risk data.	2.5	Medium	All	All State Agencies	Operating Budget; State funds	Mid-Term	Staff Time	The planning process involved with the maintenance of continuity of government often reveals mitigation opportunities.	Complete annual update of THIRA and EOP. AEMA participates in Division meetings, SERC, and LEPC meetings to discuss any mid-year changes.
19	Establish security system within the Gordon Persons Building to ensure that critical functions are not interrupted due to terrorist activities.	2.5	High	All	ADHR; ADF; ALEA	Operating Budget	Long-Term	Project costs TBD by project scope.	Keeping state departmental functions operational during and following hazard events is important to serving the public.	Continuously working with the security team to ensure security measures are followed and updating as needed.
20	Advance provision for electrical generators through FEMA grant programs for critical facilities.	2.6	High	All	AEMA	HMGP	Near-Term	Staff Time	Reduces loss of function to critical facilities and operations following natural hazards.	Continuously promote the use of initiative funds through HMGP when available.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
21	Disseminate information about Section 106 of the NHP Act and its ramifications in a disaster.	2.6	Medium	All	AHC	Operating Budget	Mid-Term	Staff Time and production cost	Information will improve decisions to protect cultural resources.	AEMA continuously works with the State Historic Preservation Office to insure all projects meet requirements. AEMA also attends various meetings to emphasize the importance of historic preservation.
22	Create a communication action plan for informing all stakeholders of the natural and manmade risks identified in the SHMP.	3.2	Medium	All	AEMA; ADEM	FEMA HMA; Operating Budget	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	Ongoing communication through Division, SERC, and LEPC meetings.
23	Develop and conduct outreach campaigns to educate all stakeholders and the public about the hazards identified in the SHMP.	3.2	Medium	All	AEMA; Local Government; CUSEC	FEMA HMA	Mid-Term	Staff Time	Better trained local officials and communities will result in safer, more hazard resistant communities.	Ongoing communication methods used to emphasize the various hazards to the private and public sector. CUSEC funds have been used to communicate earthquake hazards in a brochure and books.
24	Facilitate the coordination of local, state, and federal emergency management activities.	4.1	Medium	All	AEMA; FEMA	AEMA, FEMA (HMA, PA, EMPG), Local	Near-Term	Staff Time	Coordination between emergency management activities will reduce the risk from hazards.	Continuous communication with all necessary parties and assistance will be available as needed.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
25	Create a diverse State Hazard Mitigation team that includes regional, state, and federal organizations.	4.1	Medium	All	AEMA	State and Federal Funds	Near-Term	Staff Time	Promoting hazard mitigation will reduce the impact of hazard events on the state.	Continuous communication with all organizations in order to maintain updated plans and provide current information.
26	Create a SHMP maintenance schedule that includes at least one progress report meeting halfway through the five-year cycle to assess the status of all mitigation actions.	4.1	Medium	All	AEMA	Operating Budget; FEMA HMA	Near-Term	Staff Time	Promoting hazard mitigation will reduce the impact of hazard events on the state.	Meetings were held throughout each year at Division, SERC, and LEPC meetings to make any necessary updates to plans and provide any changes to HMA. Meetings will continue to be held.
27	Provide the public and forest managers with information about the importance of implementing Best Management Practices on forest land.	4.2	Medium	All	AFC; OWR; Local Government; DCNR	ACAMP-CZMA funds, US Forest Service	Mid-Term	Staff Time	Informing the public on the warning system will increase understanding of what to do when the warning system is used.	Continuous messaging is provided to the public via print, radio, TV, and digital messaging.
28	Provide guidance on incorporating risk and vulnerability assessment findings into state economic and community planning efforts.	4.2	Medium	All	AARC; ALM; ADECA; AACC	EDA, local planning contracts	Mid-Term	Staff Time	Incorporate hazard mitigation initiatives will increase the community's resistance to hazards	Continuous communication with all necessary parties and assistance will be available as needed.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
29	Integrate mitigation projects into recovery processes (Public Assistance, Individual Assistance, and SBA program) through education of local communities and program applicants.	4.2	Medium	All	AEMA	AEMA, FEMA (HMA, PA, EMPG), Local	Mid-Term	Staff Time	Promote hazard mitigation inclusion and funding through other programs, including Public Assistance and SBA, so that more mitigation measures are implemented.	Joint applicant briefings are held with eligible applicants for every Presidentially declared disaster to educate about HMGP and PA. This joint effort will help to promote 406 and 404 mitigation.
30	Establish provisions to ensure that Family Assistance program designed for moving families from dependency to self-sufficiency continue after a natural or man-made disaster.	4.3	Low	All	ADHR	Operating Budget, local	Long-Term	Staff Time	Keeping state departmental functions operational during and following hazard events is important to serving the public.	Joint efforts between AEMA and volunteer services are a continuous effort. Meetings are held throughout the year to update plans and guidance.
31	Provide local economic and community planners with guidance on risk and vulnerability assessments that will impact their future development plans.	1.1	Medium	All	AARC; ALM; ADECA; AACC	EDA, local planning contracts	Mid-Term	Staff Time	Incorporate hazard mitigation initiatives will increase the community's resistance to hazards	New
32	Provide large employers and local counties with GIS files for hazard-prone areas and encourage them to assess any new planned development or renovations with hazard data to inform development.	1.2	High	All	AEMA; AGIO	State Funds	Near-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
33	Make hazard mapping tools available online for residents and design professionals to view and download.	1.2	Low	All	AEMA	State Funds	Near-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New
34	Construct 15 community saferooms within existing shelters along I-65, following the evacuation route from the coastal area.	2.4	Medium	All	AEMA	HMGP	Long-Term	Staff Time	Constructing safe rooms along major transportation routes will increase accessibility to the public and prevent loss of life to high wind events.	New
35	Purchase a back-up generator for the Alabama Emergency Operations Center.	2.4	High	All	AEMA	HMGP	Near-Term	Staff Time	A back-up power supply will allow for the Alabama EOC to remain fully operational during extended power outages.	New
36	Assess proposed new, or planned renovations in, state assets and critical infrastructure against identified hazard-prone areas using GIS assessment to inform development decisions.	2.5	High	All	AEMA; AGIO	State Funds	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
37	Create a program to educate local governments about different types of hazard mitigation measures/projects and other available funding sources.	3.1	Medium	All	AEMA	Operating Budget	Mid-Term	Staff Time	Building awareness of mitigation project types and funding will increase the number of projects that are implemented.	New
38	Work with communities to develop local resiliency plans to assess ability to react to stressors on the jurisdiction.	1.1	Medium	All	NOAA; Local Government; AFC	Operating Budget	Mid-Term	Staff Time and Project costs TBD by project scope.	The use of erosion control measures will protect farmland and watershed infrastructure from floods.	Deferred - due to funding
39	Review local and county mitigation plans following disasters or serious hazard occurrences to evaluate risk assessments and mitigation priorities.	1.2	Medium	All	AEMA; Local Government	Operating Budget	Mid-Term	Staff Time	Reviewing local and county mitigation plans will increase the community's resistance to hazards.	Deferred - due to funding
40	Increase state agency accessibility to critical power lines by identifying and prioritizing utility ROWs for tree and brush removal.	2.6	Medium	All	ALDOT	Operating Budget	Mid-Term	Construction costs TBD by project specifics.	Increasing accessibility to critical power lines will increase the opportunity of repair crews to restore power following a hazard event.	Deferred - due to funding
41	Develop an inventory of the number of radio repeater sites and dispatch centers currently without backup electricity	2.6	High	All	AFC	Operating Budget	Near-Term	Staff Time	Backup communication will keep the AL Forestry Commission operational during a hazard event	Deferred - due to funding

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
42	Create a state dam safety program that will reduce the overall number of unsafe dams.	2.4	Medium	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Long-Term	Staff Time and Construction costs TBD by project specifics.	Reducing the number of unsafe State dams will protect lives and property in the downstream floodplain.	Currently there are ongoing efforts to introduce legislation to implement a dam safety program in Alabama.
43	Develop a statewide geodatabase and map of all dams in the state, including a status of their condition.	1.2	Medium	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New
44	Develop and implement a process to continually update the geodatabase as new dams are constructed and as the condition of dams changes over time.	1.2	Low	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New
45	Develop Emergency Action Plans for all high hazard dams, including the development of inundation maps.	2.4	Low	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Long-Term	Staff Time	Prepares communities for an emergency, increasing awareness of hazard areas, and ultimately saving lives.	New
46	Educate dam owners on the importance of dam safety, especially with regards to public access to dams and dam maintenance.	3.1	Low	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Mid-Term	Staff Time	Better trained local officials will result in safer, more hazard resistant communities.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
47	Coordinate an education campaign to notify the public about dam inundation areas and explain to them their risk.	3.2	Medium	Dam Failure	ADECA-OWR	National Dam Safety Program Grants	Mid-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
48	Routinely collect, monitor, and evaluate selected climatic, water- supply and water-use data to identify at an early stage the onset of a drought or potential for drought, geographic extent of the affected area and changes in the drought levels.	1.1	Medium	Drought	ADECA-OWR	Operating Budget	Mid-Term	Staff Time	Obtaining comprehensive data pertaining to drought will improve local and state capabilities response to and mitigation measures against droughts.	Continuously work with ADECA to receive any updates. Information is used to update planning reports, the THIRA, and for mitigation actions.
49	Develop agreements for secondary water sources that may be used during drought conditions.	4.1	Low	Drought	ADEM	Operating Budget	Near-Term	Staff Time	Redundancy in water supply will prevent lapses in service during drought conditions.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
50	Partner with the Alabama Cooperative Extension System to educate stakeholders and the public about the resources available through http://drought.aces.edu/ regarding the risk of drought and how to prepare for and mitigate effects of drought.	3.1	Low	Drought	AEMA; ACES	State Funds	Mid-Term	Staff Time	Better trained local officials and communities will result in safer, more hazard resistant communities.	New
51	Maintain membership and participation in the Central United States Earthquake Consortium.	2.6	Low	Earthquake	AEMA; GSA	FEMA NEHRP, USGS	Near-Term	Approx.$500	Keeping state departmental functions operational during and following hazard events is important to protecting lives and property.	Membership in CUSEC is vital for earthquake planning. Participation in exercises and conferences affords us the opportunity to receive training and updated information that is used for all State emergency plans.
52	Perform research to understand the geologic conditions that cause earthquakes in Alabama.	2.6	Low	Earthquake	GSA	USGS, FEMA NEHRP, NSF	Mid-Term	Staff Time	Will enable prediction of areas where earthquakes might originate.	This is an ongoing mission of GSA. The information that is gathered is used for the THIRA and the SHMP.
53	Identify areas within Alabama that are most susceptible to earthquakes.	2.6	Low	Earthquake	GSA	USGS, FEMA NEHRP	Mid-Term	Staff Time	Close monitoring of smaller earthquakes may indicate areas likely to have larger earthquakes.	This is an ongoing mission of GSA. The information that is gathered is used for the THIRA and the SHMP.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
54	Develop standard code language that considers the effects of soil liquefaction in the design of new buildings and infrastructure such as bridges, embankment dams and retaining structures.	2.1	Medium	Earthquake	GSA; AEMA; ALDOT	USGS, FEMA NEHRP	Mid-Term	Staff Time	Stronger local building codes will reduce property and infrastructure damage after earthquakes.	New
55	Create a seismic safety committee to provide policy recommendations, evaluate and recommend changes in seismic safety standards, and give an annual assessment of local and statewide implementation of seismic safety improvements.	2.1	Medium	Earthquake	GSA; AEMA	USGS, FEMA NEHRP	Mid-Term	Unknown	A committee dedicated to earthquake safety will drive mitigation initiatives forward towards completion.	New
56	Facilitate outreach to communities in the northwestern part of the state to educate homeowners and homebuilders about methods to strengthen and retrofit non-reinforced masonry buildings and non-ductile concrete facilities that are particularly vulnerable to ground shaking.	3.1	Medium	Earthquake	AEMA; GSA; ACES	USGS, FEMA NEHRP	Mid-Term	Unknown	Stronger building methods prevent damage and losses during earthquakes.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
57	Upgrade the State's monitoring capabilities for earthquakes.	2.6	Medium	Earthquake	AEMA; GSA	USGS, FEMA NEHRP	Long-Term	Individual Project costs associated with Map Production and Seismic monitoring equipment	Resulting maps indicate areas of greatest risk. Such maps can lead to wiser use of land and substantial savings to the State and its citizens.	Deferred - due to funding
58	Establish a system of 6 short-band seismic stations within the state.	2.6	Low	Earthquake	AEMA; GSA	USGS, NSF	Long-Term	Individual project costs associated with each short-band seismic station.	Provides a system of 6 short-band seismic stations to monitor seismic activity within the State that may indicate areas at risk for larger quakes.	Deferred - due to funding
59	Develop an emergency preparedness and response plan about earthquakes, landslides and sinkholes/subsidence for the state's Boards of Education to use in each school system.	2.4	High	Earthquake; Landslide; Sinkholes/Subsidence	AEMA; GSA	USGS, EMPG and Other FEMA Grants	Long-Term	Staff Time and production costs TBD by scope for each school system	Prepares citizens for an emergency. Avoids panic and saves lives.	Deferred - due to funding
60	Develop an earthquake, landslide and sinkhole/subsidence education program for the state's Boards of Education to use in each school system.	4.2	Low	Earthquake; Landslide; Sinkholes/Subsidence	AEMA; GSA	USGS, FEMA	Mid-Term	Staff Time and production costs	Prepares citizens for an emergency. Avoids panic and saves lives.	Deferred - due to funding

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
61	Work with local communities to identify and establish new locations for state temporary relief centers for extreme temperature events.	2.4	Low	Extreme Temperature	AEMA	HMGP	Long-Term	Construction costs TBD by project specification s.	Creating centers in communities provides a place for the public to go for relief from extreme temperature events. Mitigates loss of life to events.	New
62	Create an education campaign to raise public awareness of the location of state relief centers for extreme temperature events.	3.2	Low	Extreme Temperature	AEMA	Operating Budget; State funds	Mid-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
63	Provide technical assistance (community assistance visits, contacts, workshops and/or publications) to local officials on proper implementation of the NFIP.	1.1	Medium	Flood	OWR	FEMA CAP and CTP Grants	Near-Term	Staff Time	Well trained local officials in the NFIP will result in safer communities.	The OWR is continuously monitoring flood prone areas and working with those communities to be more resilient. OWR has also provided assistance to AEMA for elevation and buyout projects under HMA.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
64	Evaluate community Flood Insurance Studies (FIS's) and FIRMs for accuracy in order to prioritize requests for funding from FEMA to update flood studies and maps, and create additional risk mapping products.	1.1	Medium	Flood	DCNR; OWR	FEMA CTP Grant	Near-Term	Staff Time	Lack of information on flood vulnerability can inhibit effective flood protection measures.	The OWR is continuously monitoring flood prone areas and working with those communities to be more resilient. OWR has also provided assistance to AEMA for elevation and buyout projects under HMA.
65	Perform outreach to communities to promote the development and maintenance of critical facilities spatial databases to use for hazard mapping and analysis.	1.1	Medium	Flood	OWR	FEMA PDM	Near-Term	Staff Time	Lack of maps that include critical facilities can inhibit effective flood protection of these structures.	OWR maintains updated FIRMs and works with communities to promote building outside of the flood zone and implementing measures to mitigation structures already in the flood zone.
66	Support communities in reviewing the preliminary Flood Insurance Studies and Flood Insurance Rate Maps for approval and adoption.	1.1	Low	Flood	OWR; Local Government	FEMA CTP Grant	Near-Term	Staff Time	Understanding vulnerability will help to frame discussions by decision makers on how to preserve and protect assets from hazard events.	The OWR is continuously monitoring flood prone areas and working with those communities to be more resilient.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
67	Obtain periodic updates of RL and SRL lists from FEMA/NFIP and ensure that appropriate officials have access to the data.	1.3	Low	Flood	AEMA; ADECA; FEMA	Operating Budget	Near-Term	Staff Time	Flooding (particularly repetitive losses) is the single most significant natural hazard in the State, in terms of monetary losses and disruptions. The overall State mitigation strategy is focused on reducing these damages by various means, including FEMA grant programs. These programs rely on sound information as the basis for prioritizing actions.	The OWR is continuously monitoring flood prone areas and working with those communities to be more resilient.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
68	Ensure that site-specific risk assessments are available to local officials, as the basis for identifying and prioritizing mitigation actions on a site-specific basis. This action may be accomplished in a number of ways, including AEMA performing risk assessments (either itself or using consultants/ contractors), or continuing to provide training and technical support.	1.3	Medium	Flood	AEMA	FEMA PDM; Operating budget	Near-Term	Staff time	Flooding is the most significant natural hazard in the State. This information is the basis for implementing numerous FEMA grant programs.	Maintained current plans such as the THIRA, EOP, and SHMP. Each plan is reviewed annually and updated as needed.
69	Develop model ordinance for Gulf-fronting communities that requires higher standards for setbacks from waterfront and freeboard.	2.2	High	Flood	AEMA; DCNR; SARPC; Local Government	ACAMP-CZMA funds	Mid-Term	Staff Time	Increased setbacks will reduce property damage from storm surge.	Continuously coordinate with the building commission and locals to encourage flood mitigation. Funds provided to local communities as requested and as available.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
70	Develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the State for 90-10 cost share under the FEMA SRL program	2.3	Medium	Flood	AEMA; OWR	Operating Budget	Near-Term	Existing Federal and State Resources	Part of the process to initiate SRL program; establishes priorities for State and local jurisdictions to begin	Due to funding and staffing resources, this action is still in the developmental stages. There is constant communication with OWR and the local governments to discuss the best flood mitigation actions and prevent future flooding issues.
71	Conduct community outreach, workshops, and training to increase NFIP participation	2.3	Low	Flood	AEMA, ADECA	FEMA CTP Grant, State and local funds	Near-Term	Existing State Resources	Allows residents the ability to receive flood insurance claims and maintains eligibility in the FMA program of which flood insurance is a requirement	The State provides technical assistance to local communities to promote flood mitigation actions.
72	Provide updated SRL and RL lists to communities in advance of grant application windows. Include FEMA calculated avoided damages for SRL properties and any State calculated avoided damages for RL properties	2.3	Medium	Flood	AEMA; OWR	Operating Budget	Near-Term	Existing State Resources	Retrofitting, elevating, or removing repetitive loss properties from known hazard areas protects property and lives as well as preserve personal, state, and federal financial resources	Updated lists are available to communities as needed and requested.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
73	Increase state and local agencies' ability to issue flood warnings. (Construct automated stream gauging stations with rainfall measurement devices equipped with telemetry systems) - Choctawhatchee Pea Yellow River Watershed Authority's Flood Warning system in place. Consider expanding the program.	2.4	Low	Flood	OWR	State funds	Long-Term	TBD based on individual project costs and other specific information.	Better information on rainfall data will provide the NWS and state and local agencies with the necessary data to issue flood warnings and protect lives and property.	AEMA has increased its Emergency Alert System by using HMGP funds for FM Alert.
74	Identify channels and ditches that must be improved to provide maximum drainage capacity.	2.6	Medium	Flood	AEMA; ADECA; DCNR	FEMA CTP Grant; ACAMP-CZMA funds	Mid-Term	Staff Time	Supporting existing efforts to mitigate flood risk will reduce the impact of hazard events.	Continuously working with local communities to improve drainage systems through HMGP and PA programs.
75	Develop regulations that preserve and rehabilitate natural systems to serve natural hazard mitigation functions (i.e., floodplains, wetlands, watersheds, and urban interface areas).	2.6	Medium	Flood	USDA; DCNR; USACE; AEMA	DCNR-EDRP, NOAA-CRP	Mid-Term	TBD by project scope	Preserving and rehabilitating natural systems will result in the production of natural hazard mitigation.	Ongoing efforts to work with Legislation to develop regulation.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
76	Create technical bulletin that educates local floodplain managers about the benefit of evaluating the hazard posed by the encroachment of non-native plant species into floodways.	3.1	Medium	Flood	OWR; AEMA	FEMA CTP Grant, State Funds	Long-Term	Staff Time	Informing local officials on invasive plant species will contribute to the effective management of wetlands.	Ongoing efforts have been hampered by the lack of funding. National bulletins have been used when needed.
77	Create technical bulletin that educates local floodplain managers to account for and incorporate wetland protection and mitigation sites into the planning process when preparing new studies for watercourses.	3.1	Medium	Flood	OWR; AEMA	FEMA CTP Grant, State Funds	Mid-Term	Staff Time	Incorporating wetlands into the planning process will result in effective wetland management.	Ongoing efforts have been hampered by the lack of funding. National bulletins have been used when needed.
78	Modernize and improve access to flood gates for levee systems.	2.6	Medium	Flood	OWR; USACE	State Funds	Long-Term	Construction costs TBD by project specifics.	The modernization of flood control systems, such as flood gates for levee systems, will reduce the flooding hazard to lives and property.	Constant monitoring is ongoing and updates are completed as needed.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
79	Reduce the flooding risk to communities by acquiring property located in the 100-year floodplain and return it to open space.	2.6	Medium	Flood	AEMA; OWR; Local Government	FEMA HMGP	Near-Term	Construction costs TBD by project specifics. (historically >$1 million)	Open space will significantly reduce the flooding risk to communities.	HMA programs have been used throughout the state to acquire residential properties for flood mitigation. Flood mitigation is continuously emphasized to all communities.
80	Provide information and guidance to local communities to ensure they utilize flood control measures including the use of retention/detention basins and other stormwater management practices to retard the flow of water and reduce downstream damage.	3.2	Medium	Flood	OWR; USACE; DCNR; Local Government	ACAMP-CZMA funds	Long-Term	Staff Time	The use of flood control measures will provide protection to properties from floods.	HMA programs have been used throughout the state to improve drainage systems and alleviate flooding. Current drainage projects are under construction in the Cities of Huntsville and Tarrant.
81	Create education programs that increase community awareness about the process of requesting updated floodplain mapping from FEMA.	3.2	Low	Flood	ADECA; (OWR)	FEMA CTP Grant	Near-Term	Staff Time, Outreach Materials	Lack of information on flood vulnerability can inhibit effective flood protection measures.	Continuing efforts by local floodplain managers to update mapping and to educate communities on flood risk vulnerability.
82	Educate homeowners and renters that live in flood prone areas to purchase flood insurance, especially through the NFIP.	3.2	Low	Flood	OWR	FEMA CTP Grant	Mid-Term	Staff Time and production costs for outreach	Purchase of flood insurance will increase the awareness of flood mitigation among homeowners.	Continuing efforts by local floodplain mangers to encourage the purchase of flood insurance.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
83	Increase the number of communities and tribes who participate in the Community Rating System through targeted education and outreach programs.	3.2	Low	Flood	OWR	FEMA CTP Grant	Near-Term	Staff Time	Increased CRS scores will result in lower insurance premiums for homeowners and will decrease the flood risk to the community.	Ongoing efforts with OWR to promote flood mitigation actions and to increase flood education and outreach programs.
84	Educate communities and tribes about methods to improve their CRS classification.	3.1	Low	Flood	OWR	FEMA CTP Grant	Mid-Term	Staff Time and production costs	Increased CRS scores will result in lower insurance premiums for homeowners and will decrease the flood risk to the community.	Ongoing efforts with OWR to encourage communities to develop flood mitigation plans by utilizing yearly FMA funding.
85	Coordinate activities between the state and local or regional water management authorities.	4.1	Low	Flood	OWR	Operating Budget	Near-Term	Staff Time	Effective coordination between water management agencies will reduce the risk from future flooding.	Ongoing coordination and participation between AEMA and AL Rural Water Association via exercises and conferences.
86	Create statewide minimum standards of 1-foot freeboard for new and substantially improved buildings.	2.2	Medium	Flood	AEMA; Alabama Building Commission	Operating Budget	Mid-Term	Staff Time	Adding one foot of freeboard, above the mapped base flood elevation, can lower insurance costs on the structure and can better protect it from future flood events.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
87	Identify erosion control projects to protect state assets and critical infrastructure from floods and implement as identified (e.g., reshape fields, reestablish terrace systems, stabilize active gullies and watercourses, removed sediment bars and debris in channels and stabilize channel banks.)	2.5	Medium	Flood	OWR; DCNR; Local Government	Operating Budget	Long-Term	Construction costs TBD by project specifics.	The use of erosion control measures will protect farmland and watershed infrastructure from floods.	Deferred - due to funding
88	Conduct an awareness campaign that educates the public about hail storms and methods to protect property from damages.	3.1	Low	Hail	AEMA	Operating Budget	Near-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
89	Plant soil-stabilizing vegetation on steep, publicly-owned slopes to prevent roadway damage and traffic disruptions from landslides.	2.5	Medium	Landslide	ALDOT; GSA	USGS, HMGP, PDM	Long-Term	Construction costs TBD by project specification s.	Planting soil-stabilizing plants on steep slopes will prevent, or lessen the severity of landslides, protecting public roadways and maintaining operations and accessibility.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
90	Retrofit existing state-owned facilities with surge protection systems to protect these facilities against damage from lightning.	2.5	Medium	Lightning	AEMA; Alabama Department of Economic and Community Affairs	FEMA HMGP	Near-Term	Approx. $5,000	Protecting state-owned facilities from lightning damage can prevent interruptions of critical services.	New
91	Create a state education program through the Alabama State Department of Education that teaches school children about the dangers of lightning and how to take safety precautions.	3.2	Low	Lightning	AEMA; ALSDE	FEMA HMGP	Mid-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
92	Develop a Transportation Resilience Plan for the Port of Mobile.	2.4	Medium	Sea Level Rise	AEMA; USACE; NWS	USDOT; NCHRP	Mid-Term	~$50,000	Understanding vulnerability will help to frame discussions by decision makers on how to preserve and protect assets from hazard events.	New
93	Perform a state-wide transportation vulnerability assessment.	2.4	Low	Sea Level Rise	AEMA; USACE; ALDOT; NWS	USDOT; NCHRP	Long-Term	~$250,000	Understanding vulnerability will help to frame discussions by decision makers on how to preserve and protect assets from hazard events.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
94	Identify areas at risk of subsidence by monitoring changes in groundwater levels.	1.2	Medium	Sinkholes/Subsidence	GSA; AEMA	Operating Budget, State Funds	Mid-Term	Staff Time	Risk awareness allows for better planning to prevent loss of life and property.	New
95	To prevent property loss, acquire and demolish or relocate buildings and infrastructure in high-risk areas.	2.3	Medium	Sinkholes/Subsidence	AEMA; GSA	FEMA PDM; FEMA HMGP; HUD CDGB-DR	Long-Term	Contingent on number of building and infrastructure projects.	Relocating at-risk properties outside of hazardous areas prevents future loss of life and property.	New
96	Educate farmers about groundwater withdrawal and water conservation practices.	3.1	Low	Sinkholes/Subsidence	AEMA; Alabama Cooperative Extension System (ACES); GSA	Operating Budget	Near-Term	Staff Time	Educating farmers about groundwater withdrawal conservation practices will diminish the rate of sinkhole formation.	New
97	Educate design professionals about where to locate information on subsidence rates and maps.	3.1	Low	Sinkholes/Subsidence	AEMA; GSA	Operating Budget	Near-Term	Staff Time	Better informed design professionals can build safer buildings and infrastructure.	New
98	Develop and maintain a statewide real-time or near real-time record or reporting system of sinkhole/subsidence, landslides and earthquake events throughout the state.	1.2	Medium	Sinkholes/Subsidence, Landslides and Earthquakes	AEMA; GSA	State Funds, Operating Budget	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New
99	Construct five safe houses for district offices and purchase one 5KW generator for each safe house.	2.5	Medium	Tornadoes	DCNR	FEMA HMA	Near-Term	Pending bids by contractors	Provides safe sheltering place	Deferred - due to funding

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
100	Develop an online GIS map that shows tsunami runup areas.	1.2	Low	Tsunami	Alabama Geographic Information Office (AGIO); GSA	State Funds	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New
101	Develop and deliver an education program that teaches residents about the risk of submarine landslide induced tsunamis.	3.2	Low	Tsunami	AEMA; GSA	Operating Budget	Mid-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
102	Identify communities at risk to wildfire in urban interface; complete a minimum of (1) Community Wildfire Plan in each county	1.1	Low	Wildfire	AFC	US Forest Service, HMGP & Other FEMA Funding	Near-Term	$167,500 ($2,500 per plan x 67 counties)	Engage new development residents and developers in designing wildfire resistant neighborhoods.	Ongoing efforts by the Urban Forestry Strike Team of AL Forestry Commission to identify at risk communities and to encourage Wildfire Plans
103	Coordinate with neighboring states to offer training courses on wildfire management, compatible with the National Wildfire Coordinating Ground Incident Command System.	1.1	Medium	Wildfire	AEMA; AFC	Operating Budget	Near-Term	Staff Time	Better trained local officials will result in safer, more hazard resistant communities.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
104	Develop standard zoning ordinance language that restricts development in wildland-urban interface zones.	2.2	Medium	Wildfire	AEMA; AFC	State Funds	Mid-Term	Staff Time	Limiting development in the wildland-urban interface zone reduces property damage and loss of life.	New
105	Educate homeowners about the resources available through the Alabama Forestry Commission website regarding protecting homes and forestland from wildfire. http://www.forestry.alabama.gov/homeowner_resources.aspx	3.2	Low	Wildfire	AEMA	Operating Budget	Near-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New
106	Implement a state fuels management program to reduce hazardous vegetative fuels on public lands, new essential infrastructure, or on private lands by working with landowners.	3.1	Medium	Wildfire	AEMA; AFC	US Forest Service, HMGP & Other FEMA Funding	Mid-Term	Unknown	Reducing hazardous vegetative fuels reduces the risk of wildfire, especially reducing the risk in the wildland-urban interface zone.	New
107	Encourage local governments to inventory their urban forests.	1.1	Medium	Wind	AFC	US Forest Service	Near-Term	Staff Time	Better asset information will improve understanding for decisions to protect lives and property.	Ongoing efforts by the UFST of AFC to inventory urban areas of the State. UFST has participated in Hurricane exercises with AEMA, identifying vulnerable urban forests in coastal communities.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
108	Maintain tornado safe room initiatives statewide.	2.6	Medium	Wind	AEMA; NOAA; Local Government	FEMA HMA	Near-Term	Staff Time	Continues efforts to reduce tornado risk to citizens Statewide. Tornadoes, included in the "High Wind" hazard, are identified as one of three most significant hazards in the State.	Communities across the State continue to construct individual and community safe rooms utilizing both HMGP and PDM funding initiatives.
109	Create a state rebate or grant program for retrofitting (or modifying) existing residential homes, community critical facilities, and infrastructure to reduce future wind damage.	2.6	High	Wind	AL Insurance Department	State funds	Near-Term	Staff Time and Production costs	Improving the structural integrity of vulnerable homes and securing contents will improve the safety of households that might not be able to afford repairs.	Ongoing project in Tuscaloosa at Druid City Hospital to retrofit windows to reduce future wind damage.
110	Encourage the use of software such as ITREE to both manage and predict tree damage.	2.6	Low	Wind	Department of Forestry	US Forest Service	Near-Term	Staff Time and Software costs	Promoting use of software will assist in risk identification.	AFC continues efforts to encourage the use of software by local officials to manage and predict tree damage.
111	Retrofit state owned public buildings and critical facilities to reduce future wind damage from tornados and hurricanes (per FEMA 361).	2.6	Medium	Wind	AEMA; Local Government	FEMA PDM; HMGP	Long-Term	Staff Time	Retrofitting structures can mitigate future damage from wind events.	Continuing efforts to encourage the use of HMGP and PDM funds to retrofit critical facilities.

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
112	Create a state program to promote the planting of indigenous trees that are more resilient to high wind events.	2.6	Medium	Wind	AFC	US Forest Service	Long-Term	TBD - Cost of trees in critical areas	Proper use of indigenous trees can serve to mitigate damage to structures by shielding from wind. Additionally, they are less likely to result in debris.	AFC and UFST continues to educate local communities on the planting indigenous trees that are more resilient.
113	Encourage the integration of Tree Emergency Plans into the risk assessment portion of all local mitigation plans.	2.6	Medium	Wind	AFC	US Forest Service, HMGP & Other FEMA Funding	Mid-Term	Staff Time	Increasing accessibility to new information/data such as Tree Emergency Plans strengthens mitigation planning as trees are a major source of damage during wind events.	Ongoing efforts by AFC and AEMA to encourage local emergency managers to include Tree Emergency Plans into their risk assessment portion of their county and region hazard mitigation plans.
114	Conduct ongoing outreach to communities to inform residents of state run shelter locations and evacuation routes.	3.2	Medium	Wind	AEMA	Operating Budget	Mid-Term	Staff Time	Educating the public about hazards in their area builds capacity to complete mitigation projects that increase community resilience.	New

Action #	Action	Obj.	Priority	Hazard(s) Addr.	Responsible Agency	Potential Funding Source	Projected Timeline	Projected Cost	How Action Contributes to Mitigation Strategy	2018 Status
115	Develop and incorporate a new standard in all state-wide building codes that requires a standard system be incorporated into window design and protection for all new construction.	2.1	High	Wind	AACC; ALM; AERC	Operating Budget	Long-Term	Staff Time	Improving building inspections will increase the integrity of structures and protect occupants during hazard events.	Deferred - due to funding
116	Create teams of Arborists to assist in performing damage assessments and recommend mitigation projects.	4.2	Low	Wind	Department of Forestry	US Forest Service	Mid-Term	Staff Time	Coordinating with specialists prior to a disaster will aid in the implementation of mitigation actions following a disaster.	Deferred - due to funding
117	Develop design criteria for marinas, piers and other coastal structures with respect to storm resistance.	2.1	Medium	Wind; Floods	Building Code Commission; OWR; Local Government	Operating Budget	Mid-Term	Staff Time	Developing design criteria will reduce the probability that these structures will be affected by hazards.	Deferred - due to funding
118	Establish capacity to purchase and utilize remotely sensed imagery as a tool to develop localized risk models to mitigate storm damaged forest hazards.	1.1	Medium	Wind; Storm Surge; Wildfire	AFC	US Forest Service, EMPG	Near-Term	$19,386 (ERDAS IMAGINE Pro 10 software license; 3-yr maintenance contract)	By implementing collaborative AFC and local agency strategies to mitigate potential damage, injuries, and costs related to storm damaged urban and interface trees and forests.	Deferred - due to funding

5.1.3 Strategy for Mitigating Repetitive Loss and Severe Repetitive Loss Properties

Mitigating risk to RL and SRL properties is a high priority for the State of Alabama. In conjunction with FEMA initiating the SRL program, the State is presently re-emphasizing its commitment to mitigating losses to flood prone properties through a range of actions, including:

1. Develop, adopt, and implement Repetitive Loss/Severe Repetitive Loss Mitigation appendix to the State Hazard Mitigation Plan.
2. Promulgate most current guidance and requirements to local municipalities. The guidance includes plan review criteria so that jurisdictions with RL and SRL properties clearly understand the importance of having an approved plan, regarding qualifying for FEMA mitigation grant program funding.
3. Perform detailed study of risks and costs of mitigating properties and identify the most at risk and most cost-effective properties to mitigate.
4. Re-emphasize the need for counties and local communities to include RL and SRL properties in their mitigation plans and provide guidance and technical assistance in methods to accomplish this.
5. Develop criteria related to RL and SRL properties in county and local mitigation plans.
6. Implement a mitigation project ranking methodology that gives higher priority to projects that mitigate risk to RL and SRL properties (by assigning higher scores to projects that do so).
7. In the State HMP, assign high priority to actions that mitigate SRL and RL properties.
8. Provide training and technical assistance to the jurisdictions with the greatest numbers of RL and SRL properties. This effort includes providing the same level of training to the top SRL/RL counties in the State that FEMA provided to Alabama when the Agency initiated the SRL program. The State will incorporate most current FEMA guidance and training when it delivers training and assistance.
9. Provide local and regional jurisdictions with annual updates to SRL and RL lists, FEMA actuarial calculations of the potential benefits of mitigation actions for SRL and RL properties, and to the extent possible, risk estimates for RL properties.

As part of implementing this RL/SRL Strategy, the State is establishing Mobile and Baldwin counties as priorities in its ongoing efforts to mitigate flood risks to such properties. However, there is a wide distribution of these properties across the state, so although these counties may be the State's priority areas, in many cases there may be highly cost-effective projects in other areas. The State will always consider mitigation projects on a case-by-case basis.

5.1.3.1 Strategy to Encourage Local Communities to Mitigate RL and SRL Properties

The State of Alabama has a well-established and effective system for supporting local communities in developing mitigation projects. AEMA intends to increase emphasis on mitigating SRL and RL properties at the local level through the following actions, many of which are already part of existing procedures:

1. Continue to support local communities with technical training related to mitigation, including risk assessment, benefit-cost analysis, and environmental compliance.
2. Provide communities with the most current lists of SRL and RL properties, including (when possible) preliminary risk calculations to allow communities to prioritize their actions.
3. Increase the emphasis on mitigating SRL and RL properties during applicant briefings.
4. Issue planning guidance to counties reiterating FEMA/State emphasis on RL/SRL.
5. Make communities aware that the State is implementing a project ranking procedure that emphasizes mitigating SRL and RL properties by assigning higher scores to projects that mitigate such risks.

5.1.3.2 Actions in the Mitigation Strategy that address RL and SRL Properties

The following actions specific to reducing the number of RL and SRL properties statewide were developed by AEMA, reviewed by the SHMT, and incorporated into the 2018 Plan Update. The goals, objectives and actions addressed in the Mitigation Strategy have been created to focus on the mitigation of RL and SRL properties.

Goal 1: Enhance the comprehensive statewide hazard mitigation system.

Objective 1.3: Ensure that State, county and local officials have most current data regarding RL and SRL properties.

Action	Obtain periodic updates of RL and SRL lists from FEMA/NFIP and ensure that appropriate officials have access to the data.
Priority	Low
Hazard(s) Addressed	Flood
Responsible Agency	AEMA; ADECA; FEMA
Funding Source	N/A
Projected Timeline	Ongoing
Projected Cost	Staff Time
How Action Contributes to Mitigation Strategy	Flooding (particularly repetitive losses) is the single most significant natural hazard in the State, in terms of monetary losses and disruptions. The overall State mitigation strategy is focused on reducing these

	damages by various means, including FEMA grant programs. These programs rely on sound information as the basis for prioritizing actions.
2018 Status	Ongoing

Goal 2: Reduce the State of Alabama's vulnerability and increase resilience to hazards to protect people, property, and natural resources.

Objective 2.3: Enforce a program that reduces the Statewide number of Repetitive Loss and Severe Repetitive Loss properties.

Action	Develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the State for 90-10 cost share under the FEMA SRL program
Priority	Medium
Hazard(s) Addressed	Flood
Responsible Agency	AEMA
Funding Source	N/A
Projected Timeline	Near-Term
Projected Cost	Existing Federal and State Resources
How Action Contributes to Mitigation Strategy	Part of the process to initiate SRL program; establishes priorities for State and local jurisdictions to begin
2018 Status	Ongoing

Action	Provide updated SRL and RL lists to communities in advance of grant application windows. Include FEMA calculated avoided damages for SRL properties and any State calculated avoided damages for RL properties
Priority	Medium
Hazard(s) Addressed	Flood
Responsible Agency	AEMA
Funding Source	N/A
Projected Timeline	Near-Term
Projected Cost	Existing State Resources
How Action Contributes to Mitigation Strategy	Retrofitting, elevating, or removing repetitive loss properties from known hazard areas protects property and lives as well as preserve personal, state, and federal financial resources
2018 Status	Ongoing

5.2 Prioritization of Funding

The prioritization of funding for mitigation projects in communities and local jurisdictions includes consideration of the following criteria that will be discussed in further detail in these sections:

- Jurisdictions with the highest risk
- Repetitive loss properties
- Development pressure
- Cost benefit review

Applicants must demonstrate that their risk is sufficient to merit grant funds, particularly when compared to the project cost, but there is often considerable uncertainty in risk determinations. For this and other reasons, the State considers a variety of factors in addition to risk and benefit-cost analysis (BCA) in determining its priorities for mitigation grants.

There was no official grant evaluation process in Alabama prior to 2005. In 2005, following the State's HMGP allocation after Hurricane Katrina (Federal Disaster Declaration 1605), AEMA developed a process to evaluate grants and prioritize funding. Relevant criteria such as jurisdictions with the highest risk and a benefit cost analysis were considered and the specific process can be found in previous versions of the plan. However, until the DR-1971 April Tornadoes event, the state had not been faced with a situation where the amount of money requested exceeded that received. As a result, the process was revised and is referred to as the Hazard Mitigation Grant Program Implementation Process. Details of this three-phase implementation process have been captured in Appendix 7.10.

For hazard mitigation plan development grants specifically, the current process is for AEMA to request and divide the funds among the counties who request it, thus serving as the grantee and sub-grantee. Those counties whose plan expires first are given the highest priority for funds.

5.2.1 Jurisdictions with Highest Risk

One of the primary purposes of this Plan is to identify the areas within Alabama with the highest risk of damage from natural hazards. Section 3.3 of this plan contains the Vulnerability Assessment and Loss Estimation for the three most significant hazards in Alabama. The estimated property damage loss results from each hazard's assessment were ranked from 1 to 67, where 1 is the county with the largest estimated losses. In addition, RL and SRL data was summarized by county, and the total claims payments were ranked as well, where 1 is the county with the largest total claims paid. The rankings for RL (where available), SRL (where available), flood, hurricane wind, tornado wind, and earthquake were combined into one table and an average ranking score was computed for each county. The results of this analysis are shown in Table 5.4 and suggest that a well-defined group of counties, mostly those with the greatest populations and those close to the Gulf coastline, are at the greatest risk to impacts from a variety of hazards. Those counties that ranked in the top ten in the table generally have populations close

to or greater than 100,000 and have some of the greatest loss potential. Mobile and Baldwin counties ranked highest for flood and hurricane wind loss, however their loss potential for an earthquake and historic reported tornados was significantly lower than other counties.

Although the State does not have a formal system established to evaluate and prioritize potential mitigation projects based on risk, this plan update is partly intended to identify those jurisdictions with the greatest risk. While the ranking methodology described above and shown below highlights areas with the greatest loss potential, it may not fully reflect the risk that is faced by some of the smaller, less populated counties in the state. In general, the State will continue to direct mitigation grant funds to the areas with the highest risk. However, in many cases, more localized risk assessments (often produced in the local mitigation planning process), as well as risk assessments and benefit cost analyses done in support of applications, could demonstrate many areas of high vulnerability outside the higher-risk counties identified in this plan.

This ranking should be considered only a general indication of risk statewide. As noted elsewhere in this plan, accurate risk assessments and information about the performance and costs of mitigation measures (including policy changes), are the primary basis of mitigation planning. To be truly accurate, risk assessments must be highly localized, often addressing a single asset or operation. Because of this, the state-level risk assessment should be considered only a guide that identifies where the most risk is at a county level.

Table 5.4 Average Ranking for Hazard Losses by County

County	Overall Rank	Average Rank	RL Total Payments	SRL Total Payments	Historic Tornado Damage ($ 2017)	Wind Property Damage (AAL)	1-Percent-Annual Flood	Earthquake Property Damage (AAL)	Population
Jefferson	1	3.0	3	4	2	5	3	1	659,521
Shelby	2	7.0	4	3	13	12	6	4	210,622
Tuscaloosa	3	7.2	11	N/A	1	14	7	3	206,102
Madison	4	8.0	12	8	4	20	2	2	356,967
Baldwin	5	13.2	1	1	38	2	1	36	208,563
Mobile	6	13.5	2	2	47	1	4	25	414,836
Limestone	7	17.2	10	15	3	41	23	11	92,753
Morgan	8	18.6	17	N/A	24	36	10	6	119,012
Calhoun	9	19.0	36	N/A	10	27	9	13	114,611
St. Clair	10	19.2	28	N/A	5	34	13	16	88,019
Montgomery	11	19.4	37	N/A	33	4	5	18	226,349
Coffee	12	20.5	6	12	6	8	37	54	51,226
Talladega	13	21.0	35	N/A	16	29	8	17	80,103
Autauga	14	21.7	8	7	37	19	24	35	55,416
Etowah	15	22.2	22	N/A	32	31	17	9	102,564
Marshall	16	23.8	25	9	22	45	32	10	95,157
Elmore	17	24.2	38	N/A	21	17	16	29	81,799
Colbert	18	24.5	14	5	43	56	22	7	54,216
Dallas	19	25.0	21	N/A	35	23	12	34	40,008
Walker	20	25.2	33	N/A	7	39	33	14	64,967
Lauderdale	21	25.3	16	13	56	48	14	5	92,318
Dale	22	25.8	7	6	20	9	58	55	49,226
Lee	23	26.0	34	N/A	30	15	25	26	158,991
Cullman	24	26.0	N/A	N/A	8	38	46	12	82,471
Escambia	25	26.4	5	N/A	54	3	18	52	37,728
Dekalb	26	27.0	N/A	N/A	25	54	21	8	70,900
Houston	27	27.2	13	N/A	45	6	27	45	104,056

County	Overall Rank	Average Rank	RL Total Payments	SRL Total Payments	Historic Tornado Damage ($ 2017)	Wind Property Damage (AAL)	1-Percent-Annual Flood	Earthquake Property Damage (AAL)	Population
Blount	28	28.2	15	N/A	26	44	35	21	57,704
Russell	29	28.3	N/A	N/A	23	26	20	44	58,172
Hale	30	28.6	26	N/A	11	43	26	37	14,952
Marion	31	29.4	29	N/A	9	58	31	20	29,998
Jackson	32	30.2	30	N/A	34	57	15	15	52,138
Tallapoosa	33	30.3	N/A	N/A	19	28	43	31	40,727
Cherokee	34	30.6	31	N/A	28	59	11	24	25,725
Lawrence	35	31.5	23	14	29	61	40	22	33,244
Pickens	36	31.8	20	N/A	15	53	39	32	20,324
Bibb	37	34.6	44	N/A	14	46	36	33	22,643
Chilton	38	34.8	N/A	N/A	39	32	41	27	43,941
Geneva	39	35.0	9	11	63	10	53	64	26,614
Marengo	40	35.0	N/A	N/A	36	35	28	41	19,673
Choctaw	41	35.4	32	N/A	46	30	19	50	12,993
Covington	42	36.8	24	N/A	48	7	49	56	37,458
Coosa	43	38.8	27	10	42	55	51	48	10,581
Franklin	44	39.3	N/A	N/A	27	66	45	19	31,628
Fayette	45	40.5	N/A	N/A	17	63	54	28	16,546
Greene	46	41.4	18	N/A	49	60	34	46	8,422
Perry	47	42.8	N/A	N/A	12	52	60	47	9,574
Sumter	48	42.8	45	N/A	41	47	38	43	13,040
Chambers	49	42.8	39	N/A	52	40	44	39	33,843
Monroe	50	43.2	43	N/A	44	13	59	57	21,530
Clarke	51	44.3	N/A	N/A	55	16	57	49	24,392
Clay	52	44.5	N/A	N/A	18	65	55	40	13,492
Washington	53	44.8	42	N/A	61	11	50	60	16,756
Randolph	54	46.5	N/A	N/A	51	50	47	38	22,652
Henry	55	46.5	N/A	N/A	31	25	63	67	17,164

County	Overall Rank	Average Rank	RL Total Payments	SRL Total Payments	Historic Tornado Damage ($ 2017)	Wind Property Damage (AAL)	1-Percent-Annual Flood	Earthquake Property Damage (AAL)	Population
Lamar	56	46.6	40	N/A	53	62	48	30	13,918
Pike	57	47.3	N/A	N/A	50	22	64	53	33,286
Winston	58	48.0	N/A	N/A	40	64	65	23	23,805
Wilcox	59	49.2	41	N/A	65	37	42	61	10,986
Cleburne	60	50.5	N/A	N/A	64	67	29	42	14,924
Butler	61	50.8	N/A	N/A	62	21	61	59	19,998
Lowndes	62	50.8	N/A	N/A	60	51	30	62	10,358
Barbour	63	51.5	N/A	N/A	59	33	56	58	25,965
Conecuh	64	51.8	N/A	N/A	57	18	67	65	12,395
Macon	65	52.8	N/A	N/A	66	42	52	51	18,963
Crenshaw	66	52.8	N/A	N/A	58	24	66	63	13,913
Bullock	67	61.0	N/A	N/A	67	49	62	66	10,362

5.2.2 Repetitive Loss Properties

Although the FMA program prioritizes funding towards the mitigation of repetitive loss properties, FEMA currently has no formal requirement that grants funded through the HMGP or PDM address repetitive losses. However, in response to the Federal emphasis on reducing the burden of repetitive losses on the NFIP, the State presently considers the repetitive loss status of properties in determining the grants it will support (i.e. forward to FEMA for consideration and funding). The FMA program mandates that grant funds be directed to NFIP insured repetitive loss properties, and the State will continue to comply with this requirement, as it has since the inception of the FMA program. AEMA has been awarded FMA grants in the past, and actively promotes the FMA grant program every year.

The National Flood Insurance Reform Act (NFIRA) of 2004 was signed into law by the President on June 30, 2004. NFIRA reforms the NFIP to create a disincentive for property owners to live in repetitively flooded areas. Rather than continue to rebuild, the program would provide repeatedly flooded homeowner's assistance in either elevating or moving their homes away from flood waters. The Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) required the NFIP to reduce subsidies provided to pre-Flood Insurance Rate Maps structures over time, further incentivizing the need to mitigation structures. Those who refuse mitigation assistance would incur the long-term losses associated with living in high risk areas.

The county ranking table in Section 5.2.1 summarizes the counties with the largest total payments towards RL and SRL properties. The two coastal counties, Mobile and Baldwin, have the largest total payments, followed by the inland counties of Birmingham and Shelby. These counties will be prioritized by the state for outreach to educate local officials on how to pursue funding for property mitigation.

5.2.3 Most Intense Development Pressure

Development pressure is clearly a potential factor in any risk determination, however, development undertaken in accordance with effective comprehensive planning and plan implementation tools, such as building codes, zoning ordinances, subdivision regulations, floodplain management ordinances, and capital improvements programming should in many cases be less risky than existing developed areas. The State recognizes that increased development does cause new population settlements, construction of new buildings, and expansion of infrastructure. These development pressures could increase exposure of population, buildings, and infrastructure to the risks of natural hazards. Although development and growth are in themselves not risks, local mitigation planning fully integrated into a community's comprehensive planning and regulatory program can reduce exposure of new development to natural hazards risks. A community's planning responses to manage growth and development is essential to effective local mitigation, and these factors are carefully considered by the State in its project review process.

5.2.4 Maximizing Benefits According to Benefit-Cost Review of Local Projects

The regulations that apply to all FEMA mitigation grant programs require all mitigation projects to be cost effective. Under some pre-established conditions, certain projects may be exempt from this regulation, but in most cases, projects are provided a benefit-cost analysis either prior to submission to AEMA and FEMA for funding consideration, or during the grant evaluation process. The PDM program further emphasizes the role of cost effectiveness by making the benefit-cost ratio the single most important criterion in project rating and evaluation.

For all HMA grant programs (HMGP, PDM, and FMA), the regulations require only that proposed mitigation projects are cost-effective, not that they are the most cost-effective of projects that the State or FEMA is considering. In most cases, grant applications are either accompanied by a BCA, or AEMA or FEMA perform one in accordance with FEMA and U.S. Office of Management and Budget OMB regulations. Projects that do not achieve the required 1.0 benefit cost ratio and are not exempt from BCA are rejected from funding consideration. This is the case for all FEMA mitigation grant programs.

5.3 Mitigation Successes

From 2004 to present, Alabama has successfully implemented mitigation projects throughout the state that address a variety of hazards. FEMA's Hazard Mitigation Grant Program has been a primary source of funding to complete these mitigation projects. To date, over $200 million has been obligated towards mitigation projects pursued by the State of Alabama using HMGP funds (Table 5.5). A little over half of these funds (~$111 million) have been used to fund 817 safe room projects (Table 5.6) across the state. In addition, Alabama has successfully secured several FEMA PDM grants to fund several hazard mitigation plan updates and flood mitigation projects (Table 5.7).

While all mitigation projects, big and small, have contributed to the effectiveness of Alabama's recovery and mitigation, several projects have been highlighted as Alabama "Success Stories" in the section below.

Table 5.5 Federal Funds Obligated for Alabama HMGP Projects from 2004- 2018

Disaster Number	Declaration Date	Event	Acquisition	Elevation	Feasibility, Engineering and Design Studies	Flood Control	Floodproofing	Generators	Hazard Mitigation Plan	Infrastructure Protective Measures	Mitigation Reconstruction	Relocation	Retrofitting	Safe Room	Stabilization	Stormwater Management	Utility Protective Measures	Warning Systems	Total
DR-1549	9/15/2004	Hurricane Ivan	$9,159,077	$553,375	$6,070,229	$0	$0	$2,318,670	$640,055	$69,041	$0	$0	$472,886	$8,320,773	$0	$1,340,107	$6,655,911	$2,280,423	**$37,880,547**
DR-1593	7/10/2005	Hurricane Dennis	$0	$58,526	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$888,750	$0	$0	**$947,276**
DR-1605	8/29/2005	Hurricane Katrina	$5,384,969	$1,038,386	$7,138,580	$0	$844,825	$4,035,864	$2,815,004	$205,258	$1,053,149	$17,650	$5,938,385	$22,082,257	$0	$5,144,372	$1,092,158	$3,858,847	**$60,649,704**
DR-1687	3/3/2007	Severe Storms And Tornadoes	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$690,000	$813,000	$0	$0	$0	$0	**$1,503,000**
DR-1789	9/10/2008	Hurricane Gustav	$0	$0	$0	$0	$0	$0	$152,277	$0	$0	$0	$0	$1,294,528	$0	$0	$0	$0	**$1,446,805**
DR-1797	9/26/2008	Severe Storms And Flooding Associated With Hurricane Ike	$0	$37,223	$0	$0	$0	$0	$63,750	$0	$0	$0	$0	$158,804	$0	$1,546,125	$0	$105,105	**$1,911,007**
DR-1835	4/28/2009	Severe Storms, Flooding, Tornadoes & Straight-Line Winds	$582,168	$271,819	$0	$0	$0	$290,001	$149,762	$33,410	$0	$0	$0	$1,478,829	$0	$0	$377,538	$867,375	**$4,050,902**
DR-1836	5/8/2009	Severe Storms, Flooding, Tornadoes, And Straight-Line Winds	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$550,269	$0	$0	$0	$74,164	**$624,433**
DR-1842	6/3/2009	Severe Storms, Tornadoes, Flooding, And Straight-Line Winds	$0	$0	$0	$554,347	$0	$0	$0	$0	$0	$0	$0	$187,588	$0	$690,143	$0	$0	**$1,432,078**
DR-1866	12/22/2009	Tropical Storm Ida	$0	$0	$0	$0	$0	$0	$47,090	$0	$0	$0	$0	$1,153,171	$0	$68,156	$21,269	$135,550	**$1,425,236**
DR-1870	12/31/2009	Severe Storms And Flooding	$543,366	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,067,298	$0	$0	$0	$93,300	**$1,703,964**
DR-1908	5/3/2010	Severe Storms, Tornadoes, Straight-Line Winds, And Flooding	$5,717,219	$0	$0	$60,672	$0	$669,803	$0	$0	$0	$0	$0	$1,145,350	$0	$0	$318,310	$58,236	**$7,969,590**
DR-1971	4/28/2011	Severe Storms, Tornadoes, Straight-Line Winds, And Flooding	$0	$216,318	$0	$0	$0	$3,325,580	$1,221,695	$0	$0	$0	$1,435,711	$64,218,827	$0	$0	$0	$3,153,834	**$73,571,965**
DR-4052	2/1/2012	Severe Storms, Tornadoes, Straight-Line Winds, And Flooding	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$146,221	$0	$0	$0	$0	**$146,221**
DR-4082	9/21/2012	Hurricane Isaac	$0	$0	$0	$0	$0	$23,099	$0	$0	$0	$0	$1,573,107	$1,018,297	$0	$22,500	$0	$43,300	**$2,680,303**
DR-4176	5/2/2014	Severe Storms, Tornadoes, Straight-Line Winds, And Flooding	$307,939	$67,726	$0	$0	$147,263	$73,427	$0	$0	$0	$0	$0	$6,313,781	$0	$53,624	$0	$802,500	**$7,766,260**
DR-4251	1/21/2016	Severe Storms, Tornadoes, Straight-Line Winds, And Flooding	$0	$0	$0	$0	$0	$1,295,830	$0	$0	$0	$0	$0	$1,698,084	$0	$0	$0	$227,700	**$3,221,614**
		Total:	**$21,694,738**	**$2,243,373**	**$13,208,809**	**$615,019**	**$992,088**	**$12,032,274**	**$5,089,633**	**$307,709**	**$1,053,149**	**$17,650**	**$10,110,089**	**$111,647,077**	**$0**	**$9,753,777**	**$8,465,186**	**$11,700,334**	**$208,930,905**

Table 5.6 Count of HMGP Projects by Disaster, 2004 - Present

Disaster Number	Acquisition	Advanced Assistance	Elevation	Feasibility, Engineering and Design Studies	Flood Control	Floodproofing	Generators	Hazard Mitigation Plan	Infrastructure Protective Measures	Mitigation Reconstruction	Relocation	Retrofitting	Safe Room	Stabilization	State Admin Costs	Stormwater Management	Utility Protective Measures	Warning Systems	Total Projects	Federal Share Obligated
1549	17		8	1			37	6	3			4	42		1	6	11	48	**184**	$39,661,678.00
1593			1									1				1			**3**	$947,276.00
1605	20		14	1		1	56	20	2	8	1	10	81		1	22	8	85	**330**	$63,138,573.00
1687												3	3						**6**	$1,503,000.00
1789								6					25		1	1			**33**	$1,486,158.00
1797			1					1					4		1	2		1	**10**	$1,990,734.00
1835	3		3				2	3	1				3		1		1	6	**23**	$5,066,771.00
1836					1								6		1			3	**11**	$688,694.00
1842					1								1		1	2		1	**6**	$1,495,005.00
1866								2					7		1	1	1	4	**16**	$1,505,845.00
1870	1						1						2		1			1	**6**	$1,703,964.00
1908	1				1		3						13		1		1	3	**23**	$7,979,621.00
1971			1				41	5				1	617		1			68	**734**	$74,189,344.00
4052													1						**1**	$146,221.00
4082							3					5	7		1	1		5	**22**	$2,723,359.00
4176	2	1	2			1	4						32		1	1		1	**45**	$7,856,448.00
4251							4						23		1			1	**29**	$3,347,358.00
Total	**112**	**1**	**45**	**12**	**9**	**2**	**151**	**59**	**14**	**8**	**4**	**26**	**871**	**3**	**19**	**67**	**25**	**259**	**1687**	**$260,379,842.00**

Table 5.7: Open Pre-Disaster Mitigation Grants by Project Type (as of first quarter of 2018)

Project Type	Total Project Amount	Count of Projects
Acquisition	$666,667.00	1
Community Safe Room	$927,635.00	3
Drainage	$7,882,343.00	4
Flood Reduction Project	$325,800.00	1
Local Hazard Mitigation Plan Update	$835,328.63	14
Plan Integration	$203,059.72	3
State Management Cost	$90,250.00	1
Total	$10,931,083.35	27

5.3.1 Mitigating RL and SRL Properties

Alabama has a successful record of implementing projects that mitigate damages to repetitive and severe repetitive loss properties. According to data provided by FEMA/NFIP, the State and federal governments have funded site-specific mitigation projects for 466 properties in 8 Alabama counties. These figures include mitigation actions for individual sites, including elevations, acquisitions, demolitions and relocations. According to the database, the NFIP had paid 3,133 flood insurance claims for damage to these properties; the claims totaled $140.5 million (historic value of claims, not inflated to present value). Project funds were provided through various FEMA mitigation grant programs (except the PDM and SRL, which had not funded any single-site mitigation projects, according to the database).

Over the past 10 years, the State of Alabama and FEMA have also funded numerous flood control projects statewide, and these presumably mitigate risk to repetitive and severe repetitive loss properties. However, neither FEMA nor the State maintain readily accessible or detailed records of specific RL or SRL properties that are protected by these projects. The State has consistently met FEMA requirements for proving the cost effectiveness of mitigation actions it funds, so presumably, many of the properties within the areas protected by these projects are in fact RL/SRL properties.

5.3.2 Success Stories

5.3.2.1 Poarch Creek Flume Redesign

Willow Creek, a housing subdivision in the Poarch Creek Indian Reservation near Atmore experienced frequent flooding events from a nearby drainage basin. This put the residents of Willow Creek, including 30 elderly or disabled citizens, and an adjacent utilities building, at

significant risk. Using accurate risk and mitigation studies, the Reservation identified an opportunity to rebuild an inadequately designed flume at the mouth of the basin. Using funds awarded from AEMA, Poarch Creek completed the project in 2002 for a total cost of $60,000, saving the Reservation from hundreds of thousands of dollars of potential damages in the years since.

5.3.2.2 Elba and Geneva Levee Rehabilitation Projects

The CPYRWMA and USACE spearheaded levee rehabilitation projects in Elba, Alabama and Geneva, Alabama. Elba is situated along the Pea River, while Geneva is situated by both the Pea and Choctawhatchee Rivers. Both had levees previously constructed in the early 1900's and then breached causing flooding damage. In 2002, the levee in Elba was rehabilitated by USACE for a total cost of $12.9 million, with a state cost share of $4.5 million and a federal cost share of $8.4 million. In 2004, the levee downstream in Geneva was rehabilitated by USACE for a total cost of $16.6 million, with a state cost share of $5.8 million and a federal cost share of $10.8 million. These projects have been successful in their efforts to mitigate flooding risk.

5.3.2.3 Middle Coosa Watershed Areas of Mitigation Interest

As part of the FY 2011 Middle Coosa Watershed project, 427 Areas of Mitigation Interest (AoMIs) were identified. The OWR identified the need to assist the watershed by providing a link between this data and FEMA's Mitigation Action Tracker. Therefore, the 427 AoMIs were screened using geospatial analysis and engineering judgement to arrive at a list of eight "Mitigation Opportunities" in high average annualized loss (AAL) locations. The following information was provided for each Mitigation Opportunity: 1) physical identification on a map and description of the opportunity, 2) loss value estimates to establish the cost of the problem, and 3) suggested mitigation action to address the problem.

The mitigation actions presented can be input directly into FEMA's Mitigation Action Tracker, and OWR can provide support to the communities to advance these opportunities. Additionally, the Mitigation Opportunities can be utilized to assist in mitigation planning in the form of grant applications for action advancement funding. OWR plans to produce a similar report for future watersheds as part of the Risk MAP program.

5.3.2.4 Dauphin Island

Several homes in the Town of Dauphin Island, situated in Mobile County between Mobile Bay and the Gulf of Mexico, were regularly inundated by the storm surges that frequently accompany hurricanes. After Hurricane Ivan in 2004, the Town partnered with AEMA to acquire three of these homes. For less than $525,000, most of which was funded by FEMA's HMGP, the Town removed the repetitive-loss structures and built community parks in their place. Today, these parks are enjoyed by the whole community, featuring playground equipment, benches, and a habitat for native birds.

Buyout programs like this provide a cost-effective and long-term solution for both the community and for property owners by replacing at-risk structures with flood-resistant projects like parks or natural spaces.

5.3.2.5 Risk MAP

Risk MAP is a FEMA program that builds on the flood maps and flood hazard data produced by the Flood Map Modernization Program. Risk MAP continues to provide flood data to communities but focuses on risk communication. Like Map Mod, the Alabama Department of Economic and Community Affairs –OWR is responsible for implementing the Risk MAP program within the State. There are five goals of the program including addressing flood hazard gaps, public awareness and outreach, hazard mitigation planning, enhanced digital platform, and alignment and synergies of risk analysis programs.

FEMA undertook a multi-year engineering analyses and mapping effort in cooperation with ADECA OWR to assess the risk of riverine and coastal flooding in Mobile and Baldwin Counties. Phase 1, Scoping, identified 33 riverine miles and 100 coastal miles in Mobile and 55 riverine miles and 111 coastal miles in Baldwin for new detailed engineering study. After the preliminary flood insurance study (FIS) and FIRMs were completed in Phase 2, Phase 3 was initiated with the distribution of the preliminary FIS and FIRMs in November 2017 for Mobile County and July 31, 2017 for Baldwin County. Effective products are anticipated in the summer and winter of 2019. Together, these new detailed flood studies will more accurately portray present day flood risk in the riverine and coastal communities of these counties and will aid decision makers and homeowners in making decisions about methods to mitigate risk and plan for the future.

Watershed studies are scheduled to occur throughout Alabama and some are underway. However, none are complete now. Watershed planning transcends political boundaries to study risk and vulnerability in the entire hazard area. Ultimately, Risk MAP will help local officials make more informed decisions with regards to mitigation using these enhanced products and risk communication.

5.3.2.6 Alabama Safe Rooms

Severe storms impacted Alabama between April 27 and 30, 2014 and again between January 20 and 21, 2016, in both instances causing widespread tornado outbreaks and resulting in disaster declarations. The 2014 severe weather outbreak also caused very severe flooding when 20-26” of rain fell in Baldwin County. As a result of these disasters, $8 million was obligated by FEMA through the HMGP to fund community and residential safe room projects in the state. The obligation of these funds is a mitigation success for Alabama because these safe rooms will help to reduce lives lost in future tornado events.

6 Plan Maintenance

6.1 Method for Monitoring, Evaluating and Updating the Plan

6.1.1 Background

As directed by Executive Order No. 19, AEMA is responsible for maintaining the State Hazard Mitigation Plan, including all monitoring, evaluation, and update activities.

As part of the 2018 plan update process, AEMA reviewed the strategy detailed in the previous plan versions for monitoring, evaluating, and updating the plan and compared it to the plan maintenance activities that occurred since plan adoption. It has been modified over the years to best meet the State and SHMT needs. Beginning in 2007, the plan update called for AEMA to conduct an annual review of the plan and provide a summary of this review to the SHMT indicating whether an update was warranted. For 2010 plan update, this process remained but was adjusted to only provide a summary of the review to the SHMT if a change is warranted. In addition, the SHMT will only be reconvened if an update to the state plan is warranted or after a major disaster. If an update is warranted, it will be AEMA's discretion to determine if it is necessary to reconvene the entire team. Further, AEMA is committed to tracking mitigation action progress for the next plan update. This section of the plan describes how plan maintenance activities will be accomplished.

6.1.2 Method for Monitoring the Plan

Regular plan monitoring will be led by AEMA to track mitigation actions with the SHMT. These activities are described in Sections 6.2 through 6.4 below.

6.1.3 System for Evaluating the Plan

AEMA will conduct an annual evaluation of the plan, generally in the month of April. The evaluation will consider several basic factors including:

1. Changes in the level of risk to the State and its citizens.
2. Changes in laws, policies, or regulations at the State or local levels.
3. Changes in State agencies or their procedures that will affect how mitigation programs or funds are administered.

4. Significant changes in funding sources or capabilities.
5. Changes in the composition of the State Hazard Mitigation Team.
6. Progress on mitigation actions (including project closeouts) and new mitigation actions that the State is considering.
7. Major changes to local or multi-jurisdictional hazard mitigation plans.

In regards to tracking mitigation actions, AEMA will email SHMT members each year, at a minimum, to determine if there are any changes in status for the mitigation actions. The SHMT will also be encouraged to submit new mitigation actions. If an agency reports changes or submits a new action, AEMA will be responsible for incorporating those changes into the state plan.

Additionally, as described separately in Appendix C, AEMA will contact the Regional Planning Councils and local Emergency Management Agency Directors (or other individuals and organizations as appropriate) to determine if updates have been made to certain elements of the local plans as part of the annual review process. The purpose of this effort is to ensure that local information about risk, goals, projects, and mitigation strategies included in the State Plan remains current. If any party indicates that an update is warranted, then AEMA, in conjunction with the SHMT, will initiate the plan update process.

To further involve the SMHT in the ongoing mitigation planning process, the SHMT will be invited to attend AEMA's applicant briefing following a disaster. The SHMT will also be informed about disaster events via email. AEMA continues to advise agencies on how to incorporate mitigation into their planning efforts. Further, AEMA maintains weekly contact with several members of the SHMT including ADECA-OWR, ADEM, and the state's NFIP administrators. This ongoing communication and relationship will facilitate information sharing between agencies regarding mitigation activities.

6.1.4 System for Updating the Plan

The plan will be updated and re-submitted to FEMA for re-approval every five years, as required by law. The plan may also be subject to interim updates if any of the following conditions apply:

1. At the request of the Governor;
2. When significant new risks or vulnerabilities are identified; or
3. If the findings of the annual / post-disaster review and evaluation warrant.

The two sections below describe the procedures for interim and five-year updates, respectively.

6.1.4.1 Updates Resulting from Interim Evaluations

The nature of plan updates will be determined by the evaluation process described above. In general, AEMA will notify the SHMT that the Agency is initiating an interim plan update and describe the circumstances that created the need for the update. AEMA will determine if the full SHMT should be consulted regarding the potential changes. If it is determined that the SHMT

should be involved, the nature of the involvement will be at the discretion of AEMA. When interim updates are completed, AEMA will advise all SHMT members that the plan has been updated and describe the nature of the update.

6.1.4.2 Updates Related to the Required Five-year Plan Review

As required by law, every five years the plan will be updated for re-submission and re-approval by FEMA. In those years, the evaluation process will be substantially more rigorous and will examine all aspects of the plan in detail. It is anticipated that several meetings of the SHMT will be required, and that the plan will be formally readopted by the State. Between 6 and 12 months prior to the update deadline, AEMA will initiate the plan update process by contacting SHMT members and other appropriate agencies and organizations to determine a schedule and process for updating the plan.

The update process will entail a detailed and structured re-examination of all aspects of the original plan, followed by recommended updates. The recommendations will be presented to the SHMT for consideration and approval. It is expected that the Director of AEMA will approve the plan and adopt it on behalf of the Governor.

6.2 System for Monitoring Mitigation Measures and Project Closeouts

As described in the HMGP Administrative Plan, AEMA uses the following system for monitoring mitigation measures and project closeouts. AEMA reviewed this system as part of the 2018 plan update and determined that it is still effective and was still the preferred method for monitoring mitigation measures and project closeouts. Therefore, no changes have been made to the system.

6.2.1 Monitoring Mitigation Measures

Mitigation projects are generally monitored as follows.

- Each mitigation project or activity (such as planning) has an established period of performance that AEMA and FEMA monitor throughout the development and execution of the activity.
- AEMA conducts kick-off meetings for newly approved grants in cases where the sub-grantee does not have much grant administration experience, or upon request, to discuss grant administration procedures and process to request reimbursement.
- AEMA regularly meets with representatives from FEMA Region IV to coordinate project monitoring activities.
- Every calendar quarter, AEMA sends letters to all sub-grantees with open projects (i.e. ones that have been funded but are not completed), requesting a project progress update.
- Each of the sub-grantees responds to AEMA request by preparing a standard report that details progress on individual mitigation projects and indicates percent complete.

- AEMA performs quarterly site visits on all open mitigation projects.
- AEMA compiles the sub-grantee progress reports, and produces a consolidated quarterly report that is sent to FEMA Region IV for review.

6.2.2 Monitoring Project Closeouts

Mitigation project closeouts occur in the following sequence. These procedures were established in accordance with FEMA HMGP guidelines as set out in the HMGP Desk Reference and the State of Alabama HMGP Administrative Plan.

- Sub-grantee indicates in a quarterly project progress report that a mitigation project is 100 percent complete.
- AEMA reconciles FEMA SmartLink account for the project (by disaster).
- AEMA initiates an internal financial audit of the project.
- AEMA resolves any issues discovered in the audit.
- AEMA sends FEMA Region IV a closeout letter that identifies the final eligible cost of the project and delineates any de-obligations that are required, as well as any monies that will be recovered from the sub-grantee.

6.3 System for Reviewing Progress on Achieving Goals

In order to track progress on achieving the goals identified in this plan, AEMA will ensure that both the annual and five-year plan evaluations include a review and analysis of the goals, and the various actions that are intended to achieve them. This process will be substantially more rigorous and detailed during the formal plan update process. Section 5 of the plan describes the four hazard mitigation goals and includes a detailed table that lists the actions that the State is undertaking to address the goals. This table includes a column indicating the status of the various actions and a general indication of progress.

The system for reviewing progress on achieving goals will remain the same as it has proved successful over the last five years.

6.4 System for Reviewing Progress on Activities and Projects in the State Mitigation Strategy

As part of the annual evaluation, AEMA will email the SHMT to determine if there are any changes to the mitigation actions listed in the mitigation strategy section. In addition, members of the SHMT will be encouraged submit new actions at this time.

As part of the five-year update to the plan, AEMA will initiate a more detailed review and evaluation of all activities and projects noted in the mitigation strategy. AEMA will report its findings to the SHMT at meetings held as part of the plan update process. The results of these findings will be included in the table of mitigation goals and actions included in Section 5. If requested by FEMA, AEMA will prepare a summary report describing the results of the review.

A. Approval and Implementation

The purpose of hazard mitigation is to implement actions that eliminate the risk from hazards, or reduce the severity of the effects of hazards on people and property. Mitigation actions are both short-term and long-term activities that reduce the cause or occurrence of hazards; reduce exposure to hazards; or reduce effects of hazards through various means to include preparedness, response and recovery measures.

This plan applies to all State agencies, boards, commissions, and departments assigned mitigation responsibilities, and to others as designated by the Governor or Director of the Alabama Emergency Management Agency.

The State of Alabama Hazard Mitigation Plan was prepared in compliance with Public Law 106390, Disaster Mitigation Act of 2000, as amended. This plan implements hazard mitigation measures intended to eliminate or reduce the effects of future disasters throughout Alabama, and was developed in a joint and cooperative venture by members of the State Hazard Mitigation Team and the agencies identified in Executive Order No. 19.

The State of Alabama will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 Code of Federal Regulations (CFR) 13.11c. The State of Alabama will amend its plan whenever necessary to reflect changes in State and/or Federal laws and statutes as required in 44 CFR, 13.11d. At a minimum, the State will review and if necessary, update the Plan every five years from the date of approval in accordance with 44 CFR, 201.3(c)(2) and (3) in order to continue program eligibility.

In accordance with the Alabama Emergency Management Act of 1955, dated March 1, 2002, as amended, and as the Director of the Alabama Emergency Management Agency, in order to protect the lives and property of the citizens of Alabama, I hereby adopt this plan in accordance to the powers delegated to me and accept this plan for implementation.

_____

Date

_____

Brian Hastings
Director
Alabama Emergency Management Agency

B. Glossary of Acronyms and Terms

Acronym	Term
AAFM	Alabama Association of State Floodplain Managers
AAL	Average Annualized Loss
AARC	Alabama Association of Regional Councils
ACAMP	Alabama Coastal Area Management Program
ADAPT	Alabama Drought Assessment and Planning Team
ADECA	Alabama Department of Economic and Community Affairs
ADECA-CEDP	ADECA Community and Economic Development Programs
ADECA-OWR	ADECA Office of Water Resources
ADEM	Alabama Department of Environmental Management
ADF	Alabama Department of Finance
ADHR	Alabama Department of Human Resources
ADPH	Alabama Department of Public Health
AEMA	Alabama Emergency Management Agency
AFC	Alabama Forestry Commission
AGI	Alabama Department of Agriculture & Industry
AHTF	All-Hazards Task Force
ALDOI	Alabama Department of Insurance
ALDOT	Alabama Department of Transportation
ALEA	Alabama Law Enforcement Agency
ALNG	Alabama National Guard
ALSDE	Alabama State Department of Eduction
AoMI	Areas of Mitigation Interest
API	Alabama Planning Institute
ASCE	American Society of Civil Engineers
ASDSO	Association of State Dam Safety Officials
ATC	Applied Technology Council
ATRC	Alabama-Tombigbee Regional Commission
BCA	Benefit-Cost Analysis
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012

Acronym	Term
CAP-SSSE	Community Assistance Program State Support Services Element
CARPDC	Central Alabama Regional Planning Development Commission
CAV	Community Assistance Visit
CCL	Construction Control Line
CDBG	Community Development Block Grants
CERI	University of Memphis Center for Earthquake Research and Information
CFM	Certified Floodplain Managers
CFR	Code of Federal Regulations
CIAP	Alabama Coastal Impact Assistance Program
CIKR	Critical Infrastructure and Key Resources
CMIP5	Coupled Model Intercomparison Project Phase 5
COG	Council of Governments
CPG	Comprehensive Preparedness Guide
CPYRWMA	Choctawhatchee, Pea, and Yellow Rivers Watershed Management Authority
CRS	Community Rating System
CUSEC	Central United States Earthquake Consortium
CZEP	Coastal Zone Enhancement Program
CZMP	Coastal Zone Management Program
DCNR	Alabama Department of Conservation & Natural Resources
DFIRM	Digital Flood Insurance Rate Map
DMA2K	Disaster Mitigation Act of 2000
DMP	Alabama Drought Management Plan
DORM	Alabama Division of Risk Management
DR	Disaster Recovery
DRI	Disaster Recovery Initiative
EAP	Emergency Action Plan
EARPDC	East Alabama Regional Planning and Development Commission
EDA	United States Economic Development Administration
EF	Enhanced Fujita
EMA	Emergency Management Agency
EMAP	Emergency Management Accreditation Program
EMC	Emergency Management Coordinator
EMPG	Emergency Management Performance Grant
EO 19	Executive Order 19
EOP	Emergency Operations Plan

Acronym	Term
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
GSA	Geological Survey of Alabama
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
HUD	United States Department of Housing and Urban Development
ICC	International Code Council
ISO	Insurance Services Office
LEPC	Local Emergency Planning Committee
LOMR	Letter of Map Revision
LRCOG	Lee-Russell Council of Governments
MMI	Modified Mercalli Intensity
NACOLG	Northwest Alabama Council of Local Governments
NARCOG	North-Central Alabama Regional Council of Governments
NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NHC	National Hurricane Center
NID	National Inventory of Dams
NIMS	National Incident Management System
NLCD	National Land Cover Database
NLDN	National Lightning Detection Network
NOAA	National Oceanic and Atmospheric Administration
NRP	National Response Plan
NVUE	New, Validated, or Updated
NWLON	National Water Level Observation Network
NWS	National Weather Service
OCRM	Ocean and Coastal Resource Management

Acronym	Term
OMB	United States Office of Management and Budget
PA	Public Assistance Grant Program
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
PGA	Peak Ground Acceleration
PNP	Private Non-Profit
PSC	Alabama Public Service Commission
RCP	Representative Concentration Pathways
RD	USDA Rural Development
RF	Risk Factor
RFC	Repetitive Flood Claims
Risk MAP	Risk Mapping, Assessment, and Planning
RL	Repetitive Loss
RLF	Revolving Loan Fund
RPC	Regional Planning Council
RPCGB	Regional Planning Commission of Greater Birmingham
RSL	Relative Sea Level
SARPC	South Alabama Regional Planning Commission
SCADC	South Central Alabama Development Commission
SEARPDC	Southeast Alabama Regional Planning and Development Commission
SEI	Structural Engineering Institute
SERCC	Southeast Regional Climate Center
SFHA	Special Flood Hazard Area
SGSF	Southern Group of State Foresters
SHMT	State Hazard Mitigation Team
SLD	State Lands Division
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
SOG	Standard Operating Guideline
SRL	Severe Repetitive Loss
SRP	StormReady Program
TAC	Technical Advisory Committee
TAG	Tennessee-Alabama-Georgia
TARCOG	Top of Alabama Regional Council of Governments
UCAR	University Corporation for Atmospheric Research
UCS	Union of Concerned Scientists

Acronym	Term
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDA-RMA	USDA Risk Management Agency
USFS	USDA Forest Service
USGS	United States Geological Survey
WARC	West Alabama Regional Commission
WFO	Weather Forecast Office

C. Coordination of Local Planning

CFR Requirements for Coordination of Local Mitigation Planning

44 CFR 201.4 (c) (4) requires the State Hazard Mitigation Plan to include a section on the coordination of local mitigation planning.[1] This includes information that describes the following:

- Funding and technical assistance the state has provided since the previous update to assist local jurisdictions with the development of local mitigation plans and how the state will continue to provide this funding and technical assistance;
- The process by which the state reviews, coordinates, and links local plans to the state HMP; and
- The state's approach for prioritizing local assistance, including:
  - Considerations for communities with the highest risk, repetitive loss properties, and most intense development pressures; and
  - A cost-benefit review of proposed mitigation projects and their associated costs.

Further, 44 CFR 201.4 (d) requires that the State Hazard Mitigation Plan be updated to reflect changing conditions in the state.[2] This means that the Plan Update should include the following:

- Changes in development;
- Progress in statewide mitigation efforts; and
- Changes in mitigation priorities.

This appendix describes how the 2018 Plan Update satisfies the first two requirements of 44 CFR 201.4 (c) (4). The third requirement is satisfied as described in Section 5.2 (Prioritization of Funding). The requirements outlined by 44 CFR 201.4 (d) are addressed in Section 1.1 (State Mitigation Strategy) and Section 2 (Current and Future Conditions).

[1] 44 CFR 201.4 – State Mitigation Plans. Retrieved at: https://www.law.cornell.edu/cfr/text/44/201.4
[2] Ibid.

Development and Update of Local Mitigation Plans

This section describes the ongoing state efforts to assist in the completion and update of local mitigation plans.

Development of Local Hazard Mitigation Plans

AEMA's involvement to assist counties with local plan development includes:

- Distributing federal funds to aid counties in the development of plans;
- Providing technical assistance;
- Coordinating with FEMA;
- Reviewing plans for state compliance; and
- Partnering with local EMAs.

Alabama's 12 Regional Planning Councils (RPCs) traditionally assumed the latter responsibility; this is not the case with the 2018 Plan Update as described below.

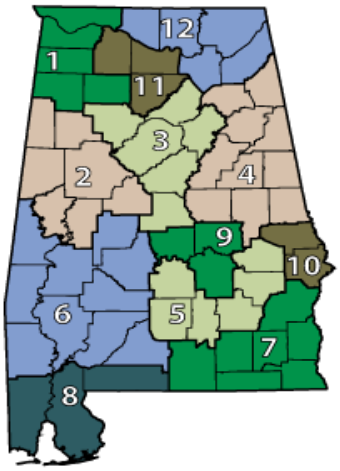

Figure C.1 RPCs

Regional Planning Councils

RPCs were originally chosen by the counties to assist in the initial local plan development process because of their established planning expertise, knowledge of local and regional issues within their jurisdictions, and their rapport with local county and city representatives and stakeholders. Due to lack of funding, most RPCs became less active in the plan development processes, however this trend is changing. The historical role of RPCs in coordinating the development of the State HMP as described further below.

The jurisdictions of the 12 RPCs cover all 67 counties within the State. Figure C.1 and **Error! Reference source not found. Error! Reference source not found.**identify the 12 regions covered by the RPCs.

Table C.1 Regional Planning Councils[3]

Region	Regional Planning Council
Region 1	Northwest Alabama Council of Local Governments (NACOLG)

[3] Alabama Association of Regional Councils. Retrieved at: http://alarc.org/the-councils/.

Region	Regional Planning Council
Region 2	West Alabama Regional Commission (WARC)
Region 3	Regional Planning Commission of Greater Birmingham (RPCGB)
Region 4	East Alabama Regional Planning and Development Commission (EARPDC)
Region 5	South Central Alabama Development Commission (SCADC)
Region 6	Alabama-Tombigbee Regional Commission (ATRC)
Region 7	Southeast Alabama Regional Planning and Development Council (SEARPDC)
Region 8	South Alabama Regional Planning Commission (SARPC)
Region 9	Central Alabama Regional Planning Development Commission (CARPDC)
Region 10	Lee-Russell Council of Governments (LRCOG)
Region 11	North-Central Alabama Regional Council of Governments (NARCOG)
Region 12	Top of Alabama Regional Council of Governments (TARCOG)

Historically, the RPCs were heavily involved in the initial local plan development as well as local plan updates (see **Error! Reference source not found.** below). For the development of the 2004 State Hazard Mitigation Plan, AEMA recruited assistance from the 12 RPCs within the State of Alabama, represented by the AARC. The RPCs had agreements in place with AEMA to develop local hazard mitigation plans for some counties within their jurisdictions. Since 2004, AEMA has provided considerable technical support and training to RPC planners to gain proficiency in hazard mitigation planning. Several of the RPCs have retained a mitigation planner on staff to provide ongoing planning services to all jurisdictions within their respective regions.

The RPCs completed 47 county-level plans from 2004 to 2005. In 2006, AEMA provided additional funding to seven of the twelve RPCs to update 34 plans across the State. As of the 2018 update, the RPCs continue to be involved in mitigation planning; but for the most recent updates, RPCs have contributed to only 22 of the 67 currently approved county-level plans. As noted in the 2013 Plan Update, this number has been decreasing, while an increasing number of counties are using consultants to complete the plan updates. This decline can be attributed to lack of funding. As indicated in **Error! Reference source not found.**, however, a recent trend has some RPCs developing regional HMPs on behalf of some or all the counties within that RPC. Examples of regional HMPs developed recently include those for the counties in NACOLG, ATRC, SEARPDC, and LRCOG.

RPCs have also traditionally been involved in other planning activities with local jurisdictions (counties, cities, and towns) and other local or regional interest groups, either by directly developing and updating or assisting with the development of local comprehensive plans. With a thorough knowledge of hazard mitigation planning and strong partnership with AEMA, the RPCs

work with the local agencies to integrate hazard mitigation planning into local and regional comprehensive planning initiatives. AEMA continues to improve and solidify this process.

The RPCs have often worked in conjunction with the Alabama Planning Institute (API) to provide regular training to local planning officials and planners throughout Alabama. The Alabama Planning Institute, housed within the University of North Alabama Center for Continuing Education, is sponsored by the Alabama Chapter of the American Planning Association. The Institute has a long-standing and successful record of achievement and its courses are always in high demand. Topics in hazard mitigation have been recently added to the API courses, and AEMA continues to work to expand these course offerings to emphasize the integration of hazard mitigation planning into local and regional comprehensive planning processes.

Local Plan Status

At the time that the initial State Plan was approved and adopted in 2004, no local hazard mitigation plans had been completed. For the 2018 plan update, all counties now have approved updates in place. For the latest round of local plan updates, most counties have elected to contract this work through consultants in lieu of working through RPCs. In only a few counties were local plan updates conducted entirely by in-house planners.

Error! Reference source not found. summarizes the status of each county plan update as of January 31, 2018, and indicates the entity (or entities) responsible for plan development in each county.

Table C.2 Plan Status and Responsible Entities by RPC, by County

County	Plan Status as of January 31, 2018	Updated Plan	Responsible Entity for Local Plan Development
Region 1: Northwest Alabama Council of Local Governments (NACOLG)			
Colbert	Approved Update - April 29, 2015	X	Local EMAs, NACOLG
Franklin	Approved Update - April 29, 2015	X	Local EMAs, NACOLG
Lauderdale	Approved Update - January 26, 2017	X	Local EMA, Local Planning Committee, FarmerMorgan LLC
Marion	Approved Update - April 29, 2015	X	Local EMAs, NACOLG
Winston	Approved Update - April 29, 2015	X	Local EMAs, NACOLG

County	Plan Status as of January 31, 2018	Updated Plan	Responsible Entity for Local Plan Development
Region 2: West Alabama Regional Commission (WARC)			
Bibb	Approved Update - October 08, 2015	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Fayette	Approved Update - October 07, 2015	X	Local EMA, Local HMPC, Lehe Planning
Greene	Approved Update - July 22, 2015	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Hale	Approved Update - August 24, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Lamar	Approved Update - August 18, 2016	X	Local EMA, Local HMPC
Pickens	Approved Update - April 23, 2015	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Tuscaloosa	Approved Update - October 13, 2015	X	Local EMA, Local HMPC, Lehe Planning
Region 3: Regional Planning Commission of Greater Birmingham (RPCGB)			
Blount	Approved Update - March 21, 2017	X	Local EMA, Local HMPC, Lehe Planning
Chilton	Approved Update - October 14, 2016	X	Local EMA, Local HMPC, Lee Helms Associates
Jefferson	Approved Update - February 01, 2016	X	Local EMA, Local HMPC
Shelby	Approved Update - December 15, 2016	X	Local Hazard Mitigation Committee, EM Assist
St. Clair	Approved Update - October 22, 2015	X	Local EMA, Local HMPC, Lee Helms Associates
Walker	Approved Update - November 19, 2015	X	Local Hazard Mitigation Planning Team
Region 4: East Alabama Regional Planning and Development Commission (EARPDC)			
Calhoun	Approved Update - February 04, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Chambers	Approved Update - June 06, 2017	X	Local EMA, Local HMPC, Lehe Planning
Cherokee	Approved Update - October 07, 2015	X	Local EMA, Local HMPC, Lee Helms Associates

County	Plan Status as of January 31, 2018	Updated Plan	Responsible Entity for Local Plan Development
Clay	Approved Update - March 03, 2017	X	Local EMA, Local HMPC, EARPDC
Cleburne	Approved Update - May 27, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Coosa	Approved Update - March 08, 2017	X	Local EMA, Local Planning Committee
Etowah	Approved Update - December 10, 2015	X	Local EMA
Randolph	Approved Update - October 19, 2015	X	Local EMA, Local HMPC, Lee Helms Associates
Talladega	Approved Update - September 12, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Tallapoosa	Approved Update - June 09, 2016	X	Local EMA, Local HMPC, Lee Helms Associates
Region 5: South Central Alabama Development Commission (SCADC)			
Bullock	Approved Update - July 01, 2014	X	Local HMPC, Local EMA, Lee Helms Associates
Butler	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Crenshaw	Approved Update - August 25, 2015	X	Local HMPC
Lowndes	Approved Update - June 28, 2016	X	Local EMA, LEPC, SCADC
Macon	Approved Update - August 31, 2016	X	Local EMA, Local HMPC, Lee Helms Associates
Pike	Approved Update - October 27, 2016	X	Local HMPC
Region 6: Alabama-Tombigbee Regional Commission (ATRC)			
Choctaw	Approved Update - November 05, 2014	X	Local EMA, Local HMPC, Unnamed Consultant
Clarke	Approved Update - August 11, 2015	X	Local EMA, Local Natural Hazards Steering Committee, ATRC
Conecuh	Approved Update - December 04, 2015	X	Local EMA, Local Natural Hazards Steering Committee, ATRC
Dallas	Approved Update - February 02, 2016	X	Local EMA, Local HMPC, ATRC

County	Plan Status as of January 31, 2018	Updated Plan	Responsible Entity for Local Plan Development
Marengo	Approved Update - March 16, 2016	X	Local EMA, Local HMPC, Unnamed Consultant
Monroe	Approved Update - April 11, 2017	X	Local EMA, Local HMPC, Unnamed Consultant
Perry	Approved Update - October 16, 2015	X	Local EMA, Local Natural Hazards Steering Committee, ATRC
Sumter	Approved Update - January 22, 2016	X	Local EMA, Local Natural Hazards Steering Committee, ATRC
Washington	Approved Update - August 31, 2016	X	Local EMA, Local Natural Hazards Steering Committee, ATRC
Wilcox	Approved Update - October 20, 2015	X	Local EMA, ATRC
Region 7: Southeast Alabama Regional Planning and Development Council (SEARPDC)			
Barbour	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMA
Coffee	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Covington	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Dale	Approved Update - October 10, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Geneva	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Henry	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Houston	Approved Update - September 03, 2015	X	AEMA Region B, SEARPDC, Local EMAs
Region 8: South Alabama Regional Planning Commission (SARPC)			
Baldwin	Approved Update - May 05, 2016	X	Local EMA, Local HMPC, Lehe Planning
Escambia	Approved Update - May 25, 2016	X	Local EMA, Local HMPC, Lee Helms Associates
Mobile	Approved Update - May 12, 2016	X	Local EMA, Lehe Planning
Region 9: Central Alabama Regional Planning Development Commission (CARPDC)			

County	Plan Status as of January 31, 2018	Updated Plan	Responsible Entity for Local Plan Development
Autauga	Approved Update - February 23, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Elmore	Approved Update - December 17, 2015	X	Local EMA
Montgomery	Approved Update - January 14, 2016	X	Local EMA, Local HMPC, LEPC, Lee Helms Associates
Region 10: Lee-Russell Council of Governments (LRCOG)			
Lee	Approved Update - October 07, 2015	X	LRCOG
Russell	Approved Update - June 10, 2015	X	LRCOG
Region 11: North-Central Alabama Regional Council of Governments (NARCOG)			
Cullman	Approved Update - October 08, 2015	X	Local EMA, Local HMPC, Lee Helms Associates
Lawrence	Approved Update - September 01, 2016	X	Local EMA, Local 9-1-1, FarmerMorgan LLC
Morgan	Approved Update	X	Local HMPC, Lee Helms Associates
Region 12: Top of Alabama Regional Council of Governments (TARCOG)			
DeKalb	Approved Update - February 19, 2016	X	Local EMA
Jackson	Approved Update - May 25, 2016	X	Local EMA
Limestone	Approved Update - June 13, 2016	X	Local EMA, Local HMPC, Lee Helms Associates
Madison	Approved Update - April 28, 2016	X	Local EMA, Local HMPC
Marshall	Approved Update - February 26, 2016	X	Local EMA, Local HMPC, Lehe Planning

Technical Assistance for Local Hazard Mitigation Plans

Throughout the development, review, and update process, AEMA serves as a liaison between FEMA and the local jurisdictions. AEMA involvement includes providing significant technical assistance to local plan preparers. For example, during the initial development of the local plans and the plan update process, the State conducts Hazard Mitigation Planning Workshops throughout the State of Alabama. These workshops are expected to continue in the future as needed for plan updates. The most recent of these took place in 2015 and was attended by approximately 25 people. FEMA Region IV planning personnel conducted this workshop.

AEMA representatives also provided technical assistance via telephone to RPC and local EMA staff to answer questions and provide assistance on the Disaster Mitigation Act of 2000 guidelines and the hazard mitigation planning process. In addition, the AEMA Recovery Plans Chief worked with RPCs and counties to develop regional hazard mitigation plans, including NACOLG, ATRC, SEARPDC, and LRCOG, as noted in **Error! Reference source not found.**. Two of these RPCs, SEARPDC and NACOLG, also provided funding for the development of regional HMPs, as described in Funding for Local Hazard Mitigation Projects and Planning, below.

AEMA also has a State review process and timeframe in place for local plan development. The State reviews each of the county plans for applicability to the CFR requirements prior to FEMA's formal review. The process and timeframe employed by the State for review is summarized in **Error! Reference source not found.**.

Table C.3 Process and Timeframe Used by the State for Review of Local HMPs

Step	Process
1	The initial draft of a local county plan is sent to the AEMA for review within a 30 day timeframe. If required, revisions are sent back to the county for corrections. If no revisions are required, the draft is submitted to FEMA for review and approval.
2	The county has a 30-day period to address AEMA review comments and submit a corrected draft to AEMA.
3	AEMA has 30 days to review the revisions. If required, revisions are sent back to the county. If all revisions are corrected, AEMA submits the plan to FEMA for review and approval.
4	FEMA completes its review within 45 days and forwards their comments to AEMA. AEMA immediately forwards AEMA and FEMA review comments to the county.
5	The county has a 30-day period to address any FEMA comments. The county submits the corrected final draft to the AEMA.
6	Within 30 days, the AEMA checks the corrected final draft and forwards it to FEMA for review of corrections.

Step	Process
7	FEMA completes its second review within 45 days and if all comments were satisfactorily addressed in the corrected final draft of the plan, a letter stating that the plan is adoptable is mailed to AEMA and the county. In the cases where comments have not been addressed satisfactorily, the county again addresses the comments and repeats the process, thereby delaying the timeframe for approval and adoption.
8	The Plan is then formally adopted by all participating jurisdictions within the county within a reasonable period that allows for local review, public participation, legal notices, public hearings, and governing body adoptions. The local adoption process should be completed within a 30 to 60-day timeframe.
9	The Plan is officially approved. The timeframe from the county's submission of the initial draft plan to adoption of the final approved plan can take over 210 days to complete.

In some previous planning cycles, the All-Hazards Task Force (AHTF) provided substantial technical assistance for completion of the initial local plans. However, the AHTF was dissolved in January 2010 following completion of the initial local planning efforts.

Funding for Local Hazard Mitigation Projects and Planning

The State provided funding assistance to most county EMAs for development and update of local hazard mitigation plans. AEMA provides this assistance by distributing funds from three federal funding programs: Pre-Disaster Mitigation (PDM) Grants, Hazard Mitigation Grant Program (HMGP), and Community Development Block Grants (CDBG). Since the 2013 State Plan Update, the breakdown of this funding for local hazard mitigation plan updates includes:

- 11 Plans funded through PDM Grants;
- 31 Plans funded exclusively through the HMGP;
- 11 Plans funded through a combination of the HMGP and local funds;
- 3 Plans funded through non-specified FEMA grants;
- 3 Plans funded exclusively through local funds; and
- 8 Plans did not specify how they were funded

Since the 2013 State Plan Update, HMGP funding was used for a majority of the plan updates, and AEMA continues to administer federal funding when available and works with counties to identify potential funding sources. However, the number of counties supporting updates to their hazard mitigation plans with grant monies has decreased significantly from the 2013 Plan Update, at which time 61 counties had used the HMGP to fund their updates. HMGP funding has been

used by 31 counties to support local hazard mitigation plan updates since 2013, and 11 used PDM grants. However, 14 counties have chosen to update their plan with at least some degree of local funding (eleven counties represented by the SEARPDC or NACOLG provided local funding in combination with HMGP funds awarded to the SEARPDC and NACOLG). This is in contrast to the 2013 Plan Update, which indicated that no counties used local funds. Eight counties did not specify the method of funding used for their most recent local hazard mitigation plan updates. The information above summarizes **Error! Reference source not found.**, which lists the source of funding used to support the latest plan update for each county.

Table C.4 Funding Sources by County for Local Mitigation Plan Updates Since 2013

County	Funding Source
Autauga	HMGP
Baldwin	PDM
Barbour	HMGP (DR-1971 through SEARPDC) and local funds
Bibb	HMGP
Blount	PDM
Bullock	Not specified
Butler	HMGP (DR-1971 through SEARPDC) and local funds
Calhoun	HMGP
Chambers	PDM
Cherokee	HMGP
Chilton	HMGP
Choctaw	HMGP
Clarke	HMGP
Clay	PDM
Cleburne	HMGP
Coffee	HMGP (DR-1971 through SEARPDC) and local funds
Colbert	HMGP (through NACOLG) and local funds
Conecuh	HMGP
Coosa	Not specified
Covington	HMGP (DR-1971 through SEARPDC) and local funds
Crenshaw	Locally funded
Cullman	HMGP
Dale	HMGP (DR-1971 through SEARPDC) and local funds
Dallas	HMGP
DeKalb	FEMA grant (not specified)

County	Funding Source
Elmore	Not specified
Escambia	HMGP
Etowah	Not specified
Fayette	HMGP
Franklin	HMGP (through NACOLG) and local funds
Geneva	HMGP (DR-1971 through SEARPDC) and local funds
Greene	HMGP
Hale	HMGP
Henry	HMGP (DR-1971 through SEARPDC) and local funds
Houston	HMGP (DR-1971 through SEARPDC) and local funds
Jackson	PDM
Jefferson	HMGP
Lamar	HMGP
Lauderdale	FEMA grant (not specified)
Lawrence	FEMA grant (not specified)
Lee	Not specified
Limestone	PDM
Lowndes	HMGP
Macon	HMGP
Madison	Locally funded
Marengo	HMGP
Marion	HMGP (through NACOLG) and local funds
Marshall	HMGP
Mobile	PDM
Monroe	PDM
Montgomery	HMGP
Morgan	Not specified
Perry	HMGP
Pickens	HMGP
Pike	PDM
Randolph	HMGP
Russell	Not specified
Shelby	Not specified
St. Clair	HMGP

County	Funding Source
Sumter	HMGP
Talladega	HMGP
Tallapoosa	PDM
Tuscaloosa	HMGP
Walker	Locally funded
Washington	PDM
Wilcox	HMGP
Winston	HMGP (through NACOLG) and local funds

Error! Reference source not found. indicates that eleven counties have been obligated PDM funds to support the most recent local plan updates. In most cases, these PDM grants are currently open as of the first quarter of 2018. Several other jurisdictions also have open PDM grants which they used to finance mitigation projects. However, as of the first quarter of 2018, nearly 50% of open PDM grants obligated to jurisdictions in Alabama are being used for the update of local hazard mitigation plans. **Error! Reference source not found.** summarizes the PDM grants by sub-grantee.

Table C.5 Open Pre-Disaster Mitigation Grants by Jurisdiction (as of first quarter of 2018)

Sub-Grantee	Updated Project Type	Period of Performance	Project Amount	Federal Share
Jackson County EMA	HMP Update	4/21/14 - 1/5/16	$39,186.17	$29,389.63
Limestone County EMA	HMP Update	4/21/14 - 1/4/16	$28,573.12	$21,429.84
Baldwin County EMA	HMP Update	4/21/14 - 3/1/16	$40,000.00	$30,000.00
City of Hartselle	HMP Update	5/24/16 - 9/30/17	$399,900.01	$299,900.01
Mobile County EMA	HMP Update	4/21/14 - 9/30/17	$40,000.00	$30,000.00
Tallapoosa County EMA	HMP Update	4/21/14 - 9/30/17	$25,268.00	$18,951.00
Town of Blountsville	HMP Update	7/19/13 - 1/9/17	$100,000.00	$75,000.00
Monroe County	HMP Update	5/29/15 - 10/30/18	$28,333.00	$21,250.00
Blount County	HMP Update	5/29/15 - 10/30/18	$28,333.00	$21,250.00

Sub-Grantee	Updated Project Type	Period of Performance	Project Amount	Federal Share
Chambers County	HMP Update	5/29/15 - 10/30/18	$28,333.00	$21,250.00
Clay County	HMP Update	5/29/15 - 10/30/18	$20,625.00	$15,468.75
Washington County	HMP Update	5/29/15 - 10/30/18	$28,333.33	$21,249.33
Pike County	HMP Update	5/29/15 - 10/30/18	$23,444.00	$17,583.00
Poarch Band of Creek Indians	HMP Update	6/13/17 - 8/30/19	$5,000.00	$3,750.00

Many counties in Alabama, as well as some cities and commissions, are the recipients of HMGP funds. As noted in **Error! Reference source not found.**, most of the local hazard mitigation plan update processes among counties in Alabama are supported by HMGP funds. **Error! Reference source not found.** summarizes total HMGP funds on record used for local HMP updates by sub-grantee.

Table C.6 HMGP Funds Supporting Local Hazard Mitigation Plan Updates by Sub-Grantee

Sub-Grantee	Sum of Federal Share Obligated	Count of Projects
Alabama Association of Regional Councils	$260,562.00	5
Alabama Department of Economic and Community Affairs	$10,000.00	1
Autauga Emergency Management Agency	$12,834.00	1
Baldwin (County)	$26,021.00	1
Barbour (County)	$14,845.00	1
Birmingham	$432,400.00	1
Blount (County)	$95,078.00	2
Chambers (County)	$55,283.00	2
Chilton (County)	$7,904.00	1
Choctaw County Emergency Management Agency	$32,136.00	2
Crenshaw (County)	$7,500.00	1
Cullman (County)	$12,220.00	1
Dale (County)	$45,000.00	2
Dallas (County)	$23,970.00	1
Dauphin Island	$20,000.00	1

Sub-Grantee	Sum of Federal Share Obligated	Count of Projects
Deatsville	$30,551.00	1
DeKalb (County)	$17,239.00	1
East Alabama Regional Planning and Development Commission	$930,139.00	3
Escambia (County)	$20,968.00	1
Gadsden	$1,750.00	1
Geneva (County)	$20,185.00	1
Jackson (County)	$28,684.00	1
Jacksonville	$59,762.00	1
Jefferson (County)	$646,031.00	3
Lauderdale (County)	$27,574.00	1
Lawrence (County)	$25,955.00	1
Limestone (County)	$23,829.00	1
Marengo (County)	$22,500.00	1
Marshall (County)	$81,898.00	1
Mobile County Emergency Management Agency	$657,870.00	1
Monroe (County)	$32,364.00	1
Montgomery (County)	$112,800.00	1
Morgan (County)	$45,140.00	1
New Hope	$0.00	1
Northwest Alabama Council Of Local Governments	$47,998.00	1
Pike County Emergency Management Agency	$19,970.00	1
Poarch Creek Reservation And Trust Land (Also FL)	$22,943.00	1
South Alabama Regional Planning Commission	$97,097.00	2
St. Clair (County)	$34,122.00	1
Statewide	$1,784,749.00	4
Union Springs	$14,726.00	1
Valley Head	$0.00	1
Walker (County)	$25,129.00	1
Grand Total	$5,887,726.00	59

Barriers to Updating, Adopting, and Implementing Local Hazard Mitigation Plans

Barriers

The development of local hazard mitigation plans is often beset by a number of barriers. In states with large rural areas, such as Alabama, there is frequently a lack of human capital in smaller jurisdictions. As discussed in the Capability Assessment (Section 4), the majority of local jurisdictions in Alabama are rural with small populations and low public revenue streams. As a result, many jurisdictions lack the human capital to effectively monitor hazards, collect and analyze the datasets, and build updated plans.

The Local Capability Table (see Table C.7), which is based on analysis of the most recent local hazard mitigation plan updates for all 67 of Alabama's counties, indicates that only 26 counties employ a full-time planner, or have a municipality within their bounds that employs a full-time planner. In some cases, the county engineer serves as the engineer for all municipalities within that county, and sometimes takes on additional roles such as planner or building inspector. It is difficult for a one- or two-person staff to take on a project with the scope and size of a hazard mitigation plan update.

In many cases, even if the manpower existed to support a plan update, smaller and more rural counties may also lack an adequate existing regulatory infrastructure within which mitigation actions may be implemented. For example, of the 526 counties, cities, towns, and tribal lands in Alabama represented by the 67 county hazard mitigation plan updates since 2013, only a little more than half (267) of the jurisdictions have a zoning ordinance in place. Even fewer jurisdictions have adopted building codes, subdivision regulations, or comprehensive plans.

Another barrier that jurisdictions sometimes encounter while building local mitigation plans is the scarcity of complete, high-quality data. This is often the case when researching the extent of or historical occurrences of certain hazards. For example, some hazards, such as Sea Level Rise, have only been recognized as a threat in the last two decades, and consequently have not been tracked for as long as other hazards. In the case of Sea Level Rise, as discussed in Section 3, there are only two sources of measurement of sea level along Alabama's coast with sufficient datasets for analysis. As discussed above, some counties simply do not have the manpower to monitor, record, and publish data for all hazards. In the extreme case, there simply is no relevant historic dataset for threats that occur extremely infrequently, such as a tsunami. Even in cases where an abundance of data exists, such as for flooding events or hurricanes, some data sources may offer incongruent, incomplete, or conflicting data regarding a particular event.

Approaches to Removing Barriers

AEMA recognizes that local hazard mitigation planning is often limited by the barriers discussed above and understands its role in helping jurisdictions overcome those barriers. As discussed above, AEMA provides technical assistance to jurisdictions through Hazard Mitigation Planning Workshops. These workshops provide the personnel responsible for local plan development access to AEMA's expertise on planning requirements as set forth by the CFR and can help local planners identify statewide mitigation programs into which local mitigation action may integrate. AEMA also reviews each of the county plans for applicability to the CFR requirements prior to FEMA's formal review. This review occurs according to a well-defined process and timeframe for local plan development, as outlined above in **Error! Reference source not found.**.

As documented in this plan, AEMA invites and welcomes local stakeholders into the State Hazard Mitigation Plan Update process as well, to better familiarize local planners with the State Plan Update. Appendix E of this plan identifies the local stakeholders present at the Risk Assessment Meeting, the Mitigation Strategy Meeting, and the Plan Review Meeting during the development of this document.

AEMA understands that regional collaboration can also be useful for many under-staffed jurisdictions. In the past, AEMA has conducted outreach to jurisdictions through the RPCs; some of these RPCs, such as the NACOLG and SEARPDC, build local hazard mitigation plan updates as a regional document. For this update, as discussed in Section 1.2.2.5, AEMA leveraged its internal geographic divisions to distribute information about the state planning process. For example, as described in the Outreach Strategy (Section 1.2.3.2), AEMA distributed a monthly mitigation newsletter to its local stakeholders through its geographic divisions. While these newsletters provided updates on the state planning process, they also profiled common hazards and innovative mitigation actions, with links and direction to relevant data and more information. This helps bridge the capability gap some counties encounter in accessing complete, high-quality data during their own plan development process.

Finally, as funding is often a limiting factor for local plan updates, AEMA channels grant funding from FEMA to some jurisdictions that leverage HMGP or PDM grants to support the update of the local planning process. The Mitigation Strategy (Section 5) describes the process through which AEMA directs these funding sources.

Local Capability Table

Table C.7 summarizes the local mitigation capabilities of each jurisdiction within each county in Alabama. This information is collected from the most recent update of the local hazard mitigation plan for each county. The table assesses capabilities across the following dimensions:

- **HMP:** Has the jurisdiction adopted a hazard mitigation plan that has been approved by FEMA?

- **NFIP:** Is the jurisdiction a regular member of the National Flood Insurance Program?
- **CRS:** Does the jurisdiction participate in the Community Rating System Program, and if so, what is its class?
- **ZON:** Does the jurisdiction administer a zoning ordinance?
- **SUB REG:** Does the jurisdiction administer subdivision regulations?
- **BLDG CODE:** Does the jurisdiction administer building codes?
- **BCEGS:** What is the ISO classification of the jurisdiction under the Building Code Effectiveness Grade Schedule?
- **PPC:** What is the ISO classification of the jurisdiction under the Property Protection Classification for fire protection?
- **COMP PLAN:** Does the jurisdiction have a comprehensive plan to guide the community's long-term (10- to 25-year) growth and development has been adopted within the last five years or its preparation or update is in progress?
- **CIP:** Does the jurisdiction program its annual capital expenditures on a multi-year capital improvements plan?
- **MIT PROJ EXP:** What is the jurisdiction's level of experience with mitigation projects funded through a FEMA grant program? (0 = no experience, 1 = limited experience, 2 = moderate experience, 3 = significant experience)
- **PLNR:** Does the jurisdiction have a full-time professional planner on staff?
- **ENGR:** Does the jurisdiction have a full-time professional engineer on staff?
- **CFM:** Does the jurisdiction have a Certified Floodplain Manager on staff to administer its floodplain management ordinance?
- **BLDG INSP:** Does the jurisdiction have a full-time building inspector on staff?
- **CAPAB RAT:** What is the community's overall capabilities to carry out mitigation activities, based on the above criteria? (1 = very limited capabilities, 2 = limited capabilities, 3 = moderate capabilities, 4 = substantial capabilities, 5 = very substantial capabilities)

Where information is available, most fields have been filled either with a **"Y"** in the case that the jurisdiction possesses that capability, or with an **"N"** in the case that the jurisdiction does not possess that capability. Other selected fields in Table C.7 are populated with the following abbreviations:

- **A:** Adopted, not implemented
- **AP**: Approvable pending adoption
- **E:** Exempt
- **NA:** Not applicable
- **NM:** Not mapped
- **R:** Rescinded
- **S:** Sanctioned

Table C.7 Local Capability Table by RPC, by County

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Region 1: Northwest Alabama Council of Local Governments																		
Colbert County																		
Unincorporated	County	1	Y	Y	NA	N	N	N				Y			Y			
Cherokee	City	1	Y	Y	NA	Y	N	Y				Y						
Leighton	Town	1	Y	Y	NA	N	N	N				Y						
Littleville	Town	1	Y	Y	NA	N	N	N				Y						
Muscle Shoals	City	1	Y	Y	NA	Y	Y	Y				Y		Y				
Sheffield	City	1	Y	Y	NA	Y	Y	Y				Y						
Tuscumbia	City	1	Y	Y	NA	Y	Y	Y				Y						
Franklin County																		
Unincorporated	County	1	Y	Y	NA	N	N	N				Y						
Hodges	Town	1	Y	Y	NA	N	N	N				Y						
Phil Campbell	Town	1	Y	Y	NA	N	N	N				Y						
Red Bay	City	1	Y	Y	NA	N	N	N				Y						
Russellville	City	1	Y	Y	NA	Y	Y	Y				Y						
Vina	Town	1	Y	Y	NA	N	N	N				Y						
Lauderdale County																		
Unincorporated	County	1	Y	Y	NA	N	Y	N			N			Y	Y			
Anderson	Town	1	Y	Y	NA	N	A	N			N			N	N			
Florence	City	1	Y	Y	NA	Y	Y	Y			Y			Y	Y		Y	
Killen	Town	1	Y	Y	NA	N	Y	Y			Y			N	N			
Lexington	Town	1	Y	Y	NA	N	N	N			A			N	N			
Rogersville	Town	1	Y	Y	NA	Y	N	N			N			N	N			
St. Florian	Town	1	Y	Y	NA	N	Y	Y			Y			Y	N			
Waterloo	Town	1	Y	Y	NA	N	Y	Y			N			N	N			
Marion County																		
Unincorporated	County	1	Y	Y	NA	N	N	N				Y						
Bear Creek	Town	1	Y	N	NA	N	N	N				Y						

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Brilliant	Town	1	Y	N	NA	N	N	N				Y						
Guin	City	1	Y	Y	NA	N	N	N				Y						
Gu-Win	Town	1	Y	N	NA	N	N	N				Y						
Hackleburg	Town	1	Y	N	NA	N	N	N				Y						
Hamilton	City	1	Y	Y	NA	Y	N	Y				Y						
Twin	Town	1	Y	Y	NA	N	N	N				Y						
Winfield	City	1	Y	Y	NA	Y	Y	N			Y	Y						
Winston County																		
Unincorporated	County	1	Y	Y	NA	N	N	N				Y						
Addison	Town	1	Y	Y	NA	N	N	N				Y						
Arley	Town	1	Y	N	NA	N	N	N				Y						
Double Springs	City	1	Y	N	NA	Y	N	N				Y						
Haleyville	City	1	Y	Y	NA	Y	Y	Y				Y						
Lynn	Town	1	Y	N	NA	N	N	N				Y						
Natural Bridge	Town	1	Y	N	NA	N	N	N				Y						
Region 2: West Alabama Regional Commission																		
Bibb County																		
Unincorporated	County	2	Y	Y	NA	N		Y			N	N			Y			
Brent	City	2	Y	Y	NA	Y		N			N	N						
Centreville	City	2	Y	Y	NA	Y		Y			N	N						
Vance	Town	2	Y	Y	NA	Y		Y			N	N						
West Blocton	Town	2	Y	Y	NA	Y		N			N	N						
Woodstock	Town	2	Y	Y	NA	N		Y			N	N					Y	
Fayette County																		
Unincorporated	County	2	Y	Y	NA	N	N	N			N				N		N	
Belk	Town	2	Y	Y	NA	N	N	N			N				N		N	
Berry	Town	2	Y	Y	NA	N	N	N			N				N		N	
Fayette	City	2	Y	Y	NA	Y	Y	Y			N				Y		Y	
Glen Allen	Town	2	Y	Y	NA	N	N	N			N				N		N	
Greene County																		

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Unincorporated	County	2	Y	Y	NA	N	N	N			Y	Y			Y			
Boligee	Town	2	Y	Y	NA	N	N	N			N	N						
Eutaw	City	2	Y	Y	NA	Y	N	Y			N	N						
Forkland	Town	2	Y	N	NA	N	N	N			N	N						
Union	Town	2	Y	N	NA	N	N	N			N	N						
Hale County																		
Unincorporated	County	2	Y	Y	NA	N	N	N			N	N			Y			
Akron	Town	2	Y	N	NA	N	N	Y			N	Y						
Greensboro	City	2	Y	Y	NA	Y	N	Y			N	N						
Moundville	City	2	Y	Y	NA	Y	N	Y			Y	N						
Newbern	Town	2	Y	N	NA	Y	N	N			N	N						
Lamar County																		
Unincorporated	County	2	Y	Y	NA	N	N	N			N	N			Y			
Beaverton	Town	2	Y	Y	NA	N	N	N			N	N						
Detroit	Town	2	Y	Y	NA	N	N	N			Y	N						
Kennedy	Town	2	Y	Y	NA	N	Y	Y			Y	N						
Millport	Town	2	Y	Y	NA	Y	Y	N			Y	Y						
Sulligent	City	2	Y	Y	NA	N	N	N			N	N						
Vernon	City	2	Y	Y	NA	Y	Y	Y			N	Y						
Pickens County																		
Unincorporated	County	2	Y	Y	NA	N	N	N			N	N			Y			
Aliceville	City	2	Y	Y	NA	Y	N	Y			Y	N						
Carrollton	Town	2	Y	Y	NA	Y	N	Y			N	N						
Ethelsville	Town	2	Y	N	NA	N	N	N			N	N						
Gordo	Town	2	Y	Y	NA	Y	N	Y			N	Y						
McMullen	Town	2	Y	N	NA	N	N	N			N	N						
Memphis	Town	2	Y	N	NA	N	N	N			N	N						
Pickensville	Town	2	Y	Y	NA	N	N	N			N	N						
Reform	Town	2	Y	Y	NA	Y	N	Y			N	N						
Tuscaloosa County																		

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Unincorporated	County	2	Y	Y	NA	N	Y	N			N	N		N	Y	Y	N	
Brookwood	Town	2	Y	Y	NA	Y	Y	Y			N	N		N	N	N	Y	
Coaling	Town	2	Y	Y	NA	Y	Y	Y			N	N		N	N	N	Y	
Coker	Town	2	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Lake View	Town	2	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Northport	City	2	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	N	Y	
Tuscaloosa	City	2	Y	Y	8	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Vance	Town	2	Y	Y	NA	Y	Y	Y			N	N		N	N	N	Y	
Region 3: Regional Planning Commission of Greater Birmingham																		
Blount County																		
Unincorporated	County	3	Y	Y	NA	N	Y	N			N	N		Y	Y	Y	N	
Allgood	Town	3	Y	NM	NA	N	N	N			N	N		N	N	Y	N	
Blountsville	Town	3	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Cleveland	Town	3	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Hayden	Town	3	Y	NM	NA	N	N	N			N	N		N	N	Y	N	
Highland Lake	Town	3	Y	Y	NA	Y	Y	Y			N	N		N	N	Y	Y	
Locust Fork	Town	3	Y	N	NA	N	Y	N			N	N		N	N	Y	N	
Nectar	Town	3	Y	N	NA	N	N	N			N	N		N	N	Y	N	
Oneonta	City	3	Y	Y	NA	Y	Y	Y			N	N		N	Y	Y	Y	
Rosa	Town	3	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Snead	Town	3	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Susan Moore	Town	3	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Chilton County																		
Unincorporated	County	3	Y	Y	NA	N	N	N			N	N		N	Y	Y	N	
Clanton	City	3	Y	Y	NA	Y	N	Y			Y	N		N	Y	Y	N	
Jemison	City	3	Y	Y	NA	Y	Y	Y			Y	N		N	Y	N	N	
Maplesville	Town	3	Y	Y	NA	N	N	N			N	N		N	Y	Y	N	
Thorsby	Town	3	Y	Y	NA	Y	Y	Y			Y	N		N	Y	Y	N	
Jefferson County																		
Unincorporated	County	3	Y	Y	NA												Y	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Adamsville	City	3	Y	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Bessemer	City	3	N	Y	NA	Y	Y	Y			Y	N		N	Y	Y	Y	
Birmingham	City	3	Y	Y	5	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Brighton	City	3	N	Y	NA													
Brookside	Town	3	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Center Point	City	3	Y	Y	NA	Y	Y	Y			Y	Y		N	N	N	Y	
Clay	City	3	N	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	
County Line	Town	3	Y	NM	NA	N	N	N			N	N		N	N	N	N	
Fairfield	City	3	Y	Y	NA	Y	N	N			N	Y		Y	N	N	Y	
Fultondale	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	N	Y	
Gardendale	City	3	N	Y	NA	Y	Y	Y			Y	Y		N	Y	N	Y	
Graysville	City	3	Y	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Homewood	City	3	Y	Y	9	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Hoover	City	3	Y	Y	9	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Hueytown	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Irondale	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Kimberly	Town	3	N	Y	NA	Y	Y	Y			N	N		N	N	N	N	
Leeds	City	3	N	Y	NA	Y	Y	Y			N	N		Y	N	Y	Y	
Lipscomb	City	3	N	Y	NA													
Midfield	City	3	Y	Y	NA	Y	Y	Y			N	Y		N	N	N	Y	
Morris	Town	3	N	Y	NA	Y	Y	Y			N	N		N	N	N	N	
Mountain Brook	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	N	N	Y	
Mulga	Town	3	N	Y	NA	Y	Y	Y			N	N		N	N	N	N	
Pinson	City	3	Y		NA	Y	Y	Y			Y	Y		N	N	N	N	
Pleasant Grove	City	3	Y	Y	NA	Y	Y	Y			Y	Y		N	Y	N	Y	
Sylvan Springs	Town	3	Y	S	NA	Y	Y	Y			N	N		N	N	N	N	
Tarrant	City	3			NA													
Trafford	Town	3	N	Y	NA	Y	N	Y			Y	Y		N	N	N	N	
Trussville	City	3	Y	Y	NA	Y	Y	Y			Y	N		N	Y	Y	Y	
Vestavia Hills	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Warrior	City	3	Y	Y	NA	Y	Y	Y			Y	N		N	Y	N	Y	
West Jefferson	Town	3	N	S	NA	Y	N	Y			N	Y		N	N	N	N	
Shelby County																		
Unincorporated	County	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Alabaster	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Calera	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Chelsea	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Columbiana	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Harpersville	Town	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Helena	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Indian Springs Village	Town	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Montevallo	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Pelham	City	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Vincent	Town	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Westover	Town	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Wilsonville	Town	3	Y	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Wilton	Town	3	Y	N	NA	Y	Y	Y			N	Y		Y	Y	Y	Y	
St. Clair County																		
Unincorporated	County	3	Y	Y	NA	N	N	N			Y	N		Y	Y	Y	N	
Argo	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Ashville	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Margaret	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	N	Y	
Moody	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Odenville	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Pell City	City	3	Y	Y	8	Y	Y	N			Y	N		N	Y	Y	Y	
Ragland	Town	3	Y	Y	NA	Y	N	N			Y	N		N	N	N	N	
Riverside	City	3	Y	Y	NA	Y	Y	N			Y	N		N	N	Y	N	
Springville	City	3	Y	Y	NA	Y	Y	Y			Y	Y		N	N	N	Y	
Steele	Town	3	Y	Y	NA	Y	N	N			Y	N		N	N	N	N	
Walker County																		

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Unincorporated	County	3	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	
Carbon Hill	City	3		Y	NA	N	N	N			N	N		N	Y	N	N	
Cordova	City	3		Y	NA	N	N	N			N	N		N	Y	N	N	
Dora	City	3		Y	NA	N	N	N			N	N		N	N	N	Y	
Eldridge	Town	3		Y	NA	N	N	N			N	N		N	N	N	N	
Jasper	City	3		Y	NA	N	N	N			N	N		Y	N	N	N	
Kansas	Town	3		Y	NA	N	N	N			N	N		N	N	N	N	
Nauvoo	Town	3		Y	NA	N	N	N			N	N		N	N	N	N	
Oakman	Town	3		Y	NA	N	N	N			N	N		N	Y	N	N	
Parrish	Town	3		Y	NA	N	N	N			N	N		N	N	N	N	
Sipsey	Town	3		Y	NA	N	N	N			N	N		N	N	N	N	
Sumiton	City	3		Y	NA	N	N	N			N	N		N	N	N	N	
Region 4: East Alabama Regional Planning and Development Commission																		
Calhoun County																		
Unincorporated	County	4	Y	Y	NA	N	N	N			Y	N		Y	Y	N	N	
Anniston	City	4	Y	Y	NA	Y	N	Y			Y	Y		N	N	Y	N	
Hobston City	Town	4	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Jacksonville	City	4	Y	Y	NA	Y	N	Y			N	N		Y	N	N	N	
Ohatchee	Town	4	Y	Y	NA	Y	N	N			N	N		N	N	N	N	
Oxford	City	4	Y	Y	NA	Y	N	Y			Y	N		Y	Y	Y	N	
Piedmont	City	4	Y	Y	NA	Y	N	Y			N	N		N	N	N	Y	
Weaver	City	4	Y	Y	NA	Y	N	Y			N	N		N	N	N	Y	
Chambers County																		
Unincorporated	County	4	Y	Y	NA	N	Y	N			N	N		Y	Y	Y	N	
Cusseta	Town	4		NM	NA	N	N	N			N	N		Y	N	N	N	
Five Points		4		S	NA	N	N	N			N	N		Y	N	Y	N	
Fredonia	Town	4		NM	NA	N	N	N			N	N		Y	N	N	N	
LaFayette	City	4		Y	NA	Y	N	Y			N	N		Y	N	Y	Y	
Lanett	City	4		Y	NA	Y	N	Y			N	N		Y	N	Y	Y	
Valley	City	4		Y	NA	Y	N	Y			Y	N		Y	N	Y	Y	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Waverly	Town	4		NM	NA	N	Y	N			N	N		Y	N	N	N	
Cherokee County																		
Unincorporated	County	4	Y	Y	NA	N	N	N			N	N		N	Y	N	N	
Cedar Bluff	Town	4	Y	Y	NA	Y	N	Y			N	N		N	N	N	N	
Centre	City	4	Y	Y	NA	Y	N	Y			N	N		N	N	N	N	
Gaylesville	Town	4	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Leesburg	Town	4	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Sand Rock	Town	4	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Clay County																		
Unincorporated	County	4	Y	NM	NA	N	N	N			N	N		N	Y	N	N	
Ashland		4	Y	NM	NA	Y	Y	N			N	N		N	N	N	N	
Lineville		4	Y	NM	NA	Y	Y	N			N	N		N	N	N	N	
Cleburne County																		
Unincorporated	County	4	Y	N	NA	N	N	N			N	N		N	Y	N	N	
Edwardsville	Town	4	Y	N	NA	N	N	N			N	N		N	N	N	N	
Fruithurst	Town	4	Y	N	NA	N	N	N			N	N		N	N	N	N	
Heflin	City	4	Y	Y	NA	Y	N	Y			Y	Y		N	Y	N	N	
Ranburne	Town	4	Y	N	NA	N	N	N			N	N		N	N	N	N	
Coosa County																		
Unincorporated	County	4	Y	Y	NA	N	N	N			N	N		N	Y	N	N	
Goodwater		4		Y	NA	N	N	N			Y	N		N	N	N	N	
Kellyton		4		NM	NA	N	N	N			N	N		N	N	N	N	
Rockford		4		N	NA	N	N	N			N	N		N	N	N	N	
Etowah County																		
Unincorporated	County	4	Y	Y	NA									Y	Y			
Altoona	Town	4		Y	NA													
Attalla	City	4		Y	NA										Y			
Boaz	City	4	Y	Y	NA	Y	Y	Y			N	N		N	N	N	N	
Gadsden	City	4		Y	NA													
Glencoe	City	4		Y	NA												Y	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Hokes Buff	City	4		Y	NA													
Rainbow City	City	4		Y	NA										Y			
Reece City	Town	4		Y	NA													
Ridgeville	Town	4		E	NA													
Southside	City	4		Y	NA													
Walnut Grove	Town	4		Y	NA													
Randolph County																		
Unincorporated	County	4	Y	Y	NA	N	N	N			Y	Y		N	Y	N	N	
Roanoke	City	4	Y	Y	NA	N	N	N			Y	Y		N	N	N	N	
Wadley	Town	4	Y	Y	NA	N	N	N			Y	Y		N	N	N	N	
Wedowee	Town	4	Y	Y	NA	N	N	N			Y	Y		N	N	N	N	
Woodland	Town	4	Y	N	NA	N	N	N			Y	Y		N	N	N	N	
Talladega County																		
Unincorporated	County	4	Y	Y	NA	N	N	N			N	N		Y	Y	Y	N	
Talladega	City	4	Y	Y	NA	Y	N	Y			N	Y		N	N	Y	N	
Childersburg	City	4	Y	Y	NA	Y	N	Y			Y	N		N	N	Y	N	
Sylacauga	City	4	Y	Y	NA	Y	N	Y			Y	Y		N	N	Y	N	
Lincoln	City	4	Y	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Munford		4	Y	Y	NA	Y	N	N			N	N		N	N	N	N	
Oak Grove	Town	4	Y	N	NA	Y	N	Y			Y	N		N	N	N	N	
Tallapoosa County																		
Unincorporated	County	4	Y	Y	NA	N	N	Y			Y	Y		N	Y	Y	N	
Alexander City	City	4	N	Y	NA	Y	N	Y			N	N		N	N	Y	N	
Camp Hill	Town	4	N	Y	NA	Y	N	Y			N	N		N	N	Y	N	
Dadeville	Town	4	N	Y	NA	Y	N	Y			N	N		N	N	Y	N	
Goldville	Town	4	N	Y	NA	N	N	N			N	N		N	N	N	N	
Jackson's Gap	Town	4	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
New Site	Town	4	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Tallassee	City	4	N	Y	NA	Y	N	Y			N	N		N	N	N	N	

Region 5: South Central Alabama Development Commission

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Bullock County																		
Unincorporated	County	5	Y	Y	NA	N	N	N			Y	Y		Y	Y	N	Y	
Union Springs	City	5	Y	Y	NA	Y	N	Y			Y	Y		Y	Y	N	Y	
Midway	Town	5	Y	Y	NA	N	N	N			Y	Y		Y	Y	N	Y	
Bulter County																		
Unincorporated	County	5	Y	Y	NA	N	Y	N			N	N		N	Y	N	N	
Georgiana	City	5	Y	Y	NA	Y	N	Y			N	N		N	N	N	Y	
Greenville	City	5	Y	Y	NA	Y	N	N			N	N		N	N	N	N	
McKenzie	Town	5	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Crenshaw County																		
Unincorporated	County	5		Y	NA	N	N	N			N	N		N	Y	N	N	
Luverne	City	5		Y	NA	Y	N	Y			N	N		N	Y	N	N	
Brantley	Town	5		Y	NA	Y	N	N			N	N		N	N	N	N	
Rutledge	Town	5		N	NA	Y	N	N			N	N		N	N	N	N	
Dozier	Town	5		Y	NA	N	N	N			N	N		N	N	N	N	
Glenwood	Town	5		Y	NA	N	N	N			N	N		N	N	N	N	
Petrey	Town	5		N	NA	N	N	N			N	N		N	N	N	N	
Lowndes County																		
Unincorporated	County	5		Y	NA	NA	Y	N			N	N		NA	Y	Y	Y	
Benton	Town	5		Y	NA	N	N	N			N	N		N	N	N	N	
Fort Deposit	Town	5		Y	NA	Y	Y	Y			N	N		Y	N	N	N	
Gordonville	Town	5		N	NA	N	N	N			N	N		N	N	N	N	
Hayneville	Town	5		Y	NA	Y	Y	N			Y	N		N	N	N	N	
Lowndesboro	Town	5			NA	Y	Y	N			Y	N		Y	N	N	N	
Mosses	Town	5		Y	NA	Y	Y	N			Y	N		Y	N	N	N	
White Hall	Town	5		Y	NA	N	N	N			N	N		N	N	N	N	
Macon County																		
Unincorporated	County	5	Y	Y	NA	Y	N	N			Y	N		N	Y	Y	N	
Franklin	Town	5	Y	N	NA	N	N	N			N	N		N	N	Y	N	
Notasulga	Town	5	Y	Y	NA	Y	N	N			Y	N		N	N	Y	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Shorter	Town	5	Y	Y	NA	Y	N	N			Y	N		N	N	Y	N	
Tuskegee	City	5	Y	Y	NA	Y	N	N			Y	N		N	N	Y	N	
Pike County																		
Unincorporated	County	5		Y	NA	N	N	N			N	N		N	Y	N	N	
Banks	Town	5		N	NA	N	N	N			N	N		N	N	N	N	
Brundidge	City	5		Y	NA	N	N	N			N	N		N	N	N	N	
Goshen	Town	5		Y	NA	N	N	N			N	N		N	N	N	N	
Troy	City	5		Y	NA	Y	N	N			N	N		N	N	N	N	
Region 6: Alabama-Tombigbee Regional Commission																		
Choctaw County																		
Unincorporated	County	6	Y	Y	NA	N		N			N				Y		N	
Butler	Town	6	Y	Y	NA	N		N			N						N	
Gilbertown	Town	6	Y	Y	NA	N		N			N						N	
Lisman	Town	6	Y	E	NA	N		N			N						N	
Needham	Town	6	Y	E	NA	N		N			N						N	
Pennington	Town	6	Y	Y	NA	N		N			N						N	
Silas	Town	6	Y	E	NA	N		N			N						N	
Toxey	Town	6	Y	E	NA	N		N			N						N	
Clarke County																		
Unincorporated	County	6	Y	Y	NA	N	N	N			N				Y			
Coffeeville	Town	6	Y	Y	NA	N	N	N			N				N			
Fulton	Town	6	Y	Y	NA	N	N	N			N				N			
Grove Hill	Town	6	Y	Y	NA	Y	Y	Y			Y				N			
Jackson	City	6	Y	Y	NA	Y	Y	Y			Y				N			
Thomasville	City	6	Y	Y	NA	Y	Y	Y			Y				N		Y	
Conecuh County																		
Unincorporated	County	6	Y	Y	NA	N	N	N			N				Y			
Castleberry	Town	6	Y	Y	NA	N	Y	Y			N				N			
Evergreen	City	6	Y	Y	NA	Y	N	Y			Y				N			
Repton	Town	6	Y	Y	NA	N	N	Y			N				N			

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Dallas County																		
Unincorporated	County	6	Y	Y	NA	N	N	Y			N			N	Y			
Orrville	Town	6	Y	Y	NA	Y	N	N			N			N	N			
Selma	City	6	Y	Y	NA	Y	Y	N			Y			Y	Y			
Valley Grande	City	6	Y	Y	NA	N	Y	Y			N			N	N			
Marengo County																		
Unincorporated	County	6	Y	Y	NA	N	N	N			N				Y		N	
Dayton	Town	6	Y	E	NA	N	N	N			N						N	
Demopolis	City	6	Y	Y	NA	N	N	N			N						N	
Faunsdale	Town	6	Y	E	NA	N	N	N			N						N	
Linden	City	6	Y	Y	NA	N	N	N			N						N	
Myrtlewood	Town	6	Y	E	NA	N	N	N			N						N	
Providence	Town	6		Y	NA	N	N	N			N						N	
Sweetwater	Town	6	Y	E	NA	N	N	N			N						N	
Thomaston	Town	6	Y	E	NA	N	N	N			N						N	
Monroe County																		
Unincorporated	County	6	Y	Y	NA	N	N	N			N						N	
Beatrice	Town	6	Y	N	NA	N	N	N			N						N	
Excel	Town	6	Y	N	NA	N	N	N			N						N	
Frisco City	Town	6	Y	N	NA	N	N	N			N						N	
Monroeville	City	6	Y	Y	NA	N	N	N			Y						N	
Vrdenburgh	Town	6		N	NA	N	N	N			N						N	
Perry County																		
Unincorporated	County	6	Y	N	NA	N	N	N			N				Y			
Marion	City	6	Y	Y	NA	Y	Y	Y			N							
Uniontown	City	6	Y	N	NA	Y	N	Y			N							
Sumter County																		
Unincorporated	County	6		Y	NA	N	N	N			Y				Y			
Cuba	Town	6		Y	NA	Y	N	Y			Y							
Emelle	Town	6		NM	NA	N	N	N			N							

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Epes	Town	6		Y	NA	N	N	N			N							
Gainesville	Town	6		N	NA	N	N	N			N							
Geiger	Town	6		Y	NA	N	N	N			N							
Livingston	City	6		Y	NA	Y	N	Y			Y							
York	City	6		Y	NA	Y	N	Y			Y							
Washington County																		
Unincorporated	County	6	Y	Y	NA	N	N	Y			N				Y			
Chatom	Town	6	Y	Y	NA	Y	Y	N			N				N			
McIntosh	Town	6	Y	N	NA	Y	N	N			N				N			
Millry	Town	6	Y	Y	NA	N	N	N			N				N			
Wilcox County																		
Unincorporated	County	6	Y	Y	NA	N	N	N			Y				Y			
Camden	City	6	Y	Y	NA	Y	N	Y			Y							
Oak Hill	Town	6	Y	Y	NA	N	N	N			N							
Pine Apple	Town	6	Y	Y	NA	N	N	N			N							
Pine Hill	Town	6	Y	Y	NA	Y	N	N			Y							
Yellow Bluff	Town	6	Y	Y	NA	N	N	N			N							
Region 7: Southeast Alabama Regional Planning and Development Council																		
Barbour County																		
Unincorporated	County	7	N	Y	NA	N	Y	N			N	N		N	Y	N	N	
Baker	Town	7	N	N	NA	Y	N	N			N	N		N	N	N	N	
Blue Springs	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Clayton	City	7	N	Y	NA	Y	N	N			N	N		N	N	N	N	
Clio	City	7	N	Y	NA	Y	N	N			N	N		N	N	N	N	
Eufaula	City	7	N	Y	NA	Y	N	N			Y	N		N	N	N	N	
Louisville	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Coffee County																		
Unincorporated	County	7	N	Y	NA	N	N	N			N	N		N	Y	N	N	
Elba	City	7	N	Y	NA	Y	N	N			N	N		N	Y	Y	N	
Enterprise	City	7	N	Y	NA	Y	Y	Y			Y	N		N	Y	Y	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Kinston	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
New Brockton	Town	7	N	Y	NA	Y	N	N			N	N		N	N	N	N	
Covington County																		
Unincorporated	County	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Andalusia	City	7	N	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Babbie	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Carolina	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Florala	City	7	N	Y	NA	Y	N	N			Y	N		N	N	N	N	
Gantt	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Heath	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Horn Hill	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Libertyville	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Lockhart	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Onycha	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Opp	City	7	N	Y	NA	Y	N	N			Y	N		Y	N	N	N	
Red Level	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
River Falls	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Sanford	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Dale County																		
Unincorporated	County	7	N	Y	NA	N	N	N			N	N		N	Y	N	N	
Ariton	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Clayhatchee	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Daleville	City	7	N	Y	NA	Y	Y	N			N	N		N	N	N	N	
Grimes	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Level Plains	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Midland City	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Napier Field	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Newton	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Ozark	City	7	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	Y	
Pinckard	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Geneva County																		
Unincorporated	County	7	N	Y	NA	N	Y	N			N	N		N	Y	N	N	
Black	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Coffee Springs	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Geneva	City	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Hartford	City	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Malvern	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Samson	City	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Slocomb	City	7	N	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Henry County																		
Unincorporated	County	7	N	Y	NA	N	N	N			N	N		N	Y	N	N	
Abbeville	City	7	N	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Haleburg	Town	7	N	N	NA	N	N	N			N	N		N	N	N	N	
Headland	City	7	N	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Newville	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Houston County																		
Unincorporated	County	7	N	Y	NA	N	Y	N			N	N		N	Y	N	N	
Ashford	City	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Avon	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Columbia	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Cottonwood	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Cowarts	Town	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Dothan	City	7	N	Y	NA	Y	N	Y			Y	N		N	N	N	N	
Gordon	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Kinsey	City	7	N	Y	NA	Y	N	N			N	N		N	N	N	N	
Madrid	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Rehobeth	Town	7	N	Y	NA	Y	N	Y			N	N		N	N	N	N	
Taylor	City	7	N	Y	NA	N	N	N			N	N		N	N	N	N	
Webb	Town	7	N	Y	NA	N	N	N			N	N		N	N	N	N	

Region 8: South Alabama Regional Planning Commission

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Baldwin County																		
Unincorporated	County	8	N	Y	7	Y	Y	Y			Y	N		Y	Y	Y	Y	
Minette	City	8	N	Y	NA	Y	N	Y			N	Y		N	N	N	Y	
Daphne	City	8	N	Y	NA	Y	Y	Y			N	N		Y	Y	Y	Y	
Elberta	Town	8	N	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	
Fairhope	City	8	N	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Foley	City	8	N	Y	8	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Gulf Shores	Town	8	N	Y	8	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Loxley	Town	8	N	Y	NA	Y	N	Y			Y	N		N	N	N	Y	
Magnolia Springs	Town	8	N	Y	NA	Y	Y	Y			Y	N		Y	Y	N	Y	
Orange Beach	City	8	N	Y	7	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Perdido Beach	Town	8	N	Y	NA	Y	Y	Y			Y	N		Y	Y	Y	Y	
Robertsdale	City	8	N	Y	NA	Y	Y	Y			Y	N		N	Y	Y	Y	
Silverhill	Town	8	N	Y	NA	Y	N	Y			N	N		N	N	N	Y	
Spanish Fort	City	8	N	Y	NA	Y	Y	Y			Y	N		Y	Y	Y	Y	
Summerdale	Town	8	N	Y	NA	Y	Y	Y			N	N		Y	N	N	Y	
Escambia County																		
Unincorporated	County	8	Y	Y	NA	N	N	N			Y	Y						
Atmore	City	8	Y	Y	9	Y	N	Y			Y	N					Y	
Brewton	City	8	Y	Y	NA	Y	N	Y			Y	N					Y	
East Brewton	City	8	Y	Y	NA	Y	N	Y			N	N						
Flomaton	Town	8	Y	Y	NA	N	N	N			N	N						
Pollard	Town	8	Y	Y	NA	N	N	N			N	N						
Riverview	Town	8	Y	Y	NA	N	N	N			N	N						
Poarch Band of Creek Indians	Tribe	8	Y	Y	NA	N	N	N			Y	N						
Mobile County																		
Unincorporated	County	8	Y	Y	NA	N	Y	Y			N	N		N	Y	Y	Y	
Bayou La Batre	Town	8	Y	Y	NA	Y	Y	Y			N	N		N	N	Y	Y	
Chickasaw	Town	8	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Citronelle	Town	8	Y	Y	NA	Y	Y	Y			N	N		N	N	N	Y	
Creola	Town	8	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	
Dauphin Island	Town	8	Y	Y	8	Y	Y	Y			N	N		N	N	N	Y	
Mobile	City	8	Y	Y	10 (R)	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Mt. Vernon	Town	8	Y	Y	NA	Y	Y	Y			Y	Y		N	N	N	Y	
Prichard	Town	8	Y	Y	NA	Y	Y	Y			N	Y		N	N	N	Y	
Saraland	Town	8	Y	Y	NA	Y	Y	Y			N	Y		N	N	N	Y	
Satsuma	Town	8	Y	Y	NA	Y	Y	Y			N	Y		N	N	N	Y	
Semmes	Town	8	Y	N	NA	N	Y	Y			Y	Y		N	N	N	Y	
Region 9: Central Alabama Regional Planning Development Commission																		
Autauga County																		
Unincorporated	County	9	Y	Y	NA	N	Y	N			N	N		N	N	N	N	
Autaugaville	Town	9	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Billingsley	City	9	Y	Y	NA	N	N	N			N	N		N	N	N	N	
Prattville	City	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Elmore County																		
Unincorporated	County	9	Y	Y	NA	N	Y	N			N	N		N	Y	N	N	
Coosada	Town	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Deatsville	Town	9	Y	N	NA	N	Y	N			N	N		N	N	N	N	
Eclectic	Town	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Elmore	Town	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Millbrook	City	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Prattville	City	9	Y	Y	8	Y	Y	Y			Y	N		N	N	N	N	
Tallassee	City	9	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Wetumpka	City	9	Y	Y	9	Y	Y	Y			N	N		N	N	N	N	
Montgomery County																		
Unincorporated	County	9	N	Y	NA	Y	N	Y			Y	Y		N	Y	N	N	
Montgomery	City	9	N	Y	NA	Y	N	Y			Y	Y		N	N	N	N	
Pike Road	Town	9	N	Y	NA	Y	N	Y			Y	Y		N	N	N	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Region 10: Lee-Russell Council of Governments																		
Lee County																		
Unincorporated	County	10	Y	Y	NA	Y	Y	N			Y	N		N	Y	N	Y	
Auburn	City	10	Y	Y	7	Y	Y	N			Y	N		N	N	N	N	
Opelika	City	10	Y	Y	NA	Y	Y	N			Y	N		N	Y	N	Y	
Smiths Station	City	10	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Loachapoka	Town	10	Y	N	NA	N	N	N			N	N		N	N	N	N	
Russell County																		
Unincorporated	County	10	Y	Y	NA	Y	Y	Y			Y	N		Y	Y	Y	Y	
Hurtsboro	Town	10	Y	Y	NA	N	N	N			N	N		N	N	Y	N	
Phenix City	City	10	Y	Y	NA	Y	Y	Y			Y	N		Y	Y	Y	Y	
Region 11: North-Central Alabama Regional Council of Governments																		
Cullman County																		
Unincorporated	County	11	N	Y	NA	Y	Y	Y			Y	Y		N	Y	N	N	
Baileyton	Town	11	N	N	NA	Y	Y	Y			Y	Y		N	N	N	N	
Colony	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Cullman	City	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Dodge City	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Fairview	Town	11	N	N	NA	Y	Y	Y			Y	Y		N	N	N	N	
Garden City	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Good Hope	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Hanceville	City	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Holly Pond	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
South Vinemont	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
West Point	Town	11	N	Y	NA	Y	Y	Y			Y	Y		N	N	N	N	
Lawrence County																		
Unincorporated	County	11	Y	Y	NA	N	Y	N			N	N			Y			
Courtland	Town	11	Y	Y	NA		Y	Y			Y	N			N			
Hillsboro	Town	11	Y	Y	NA		A	N			Y	N			N			

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Moulton	City	11	Y	Y	NA	Y	Y	Y			N	N		Y	Y		Y	
North Courtland	Town	11	Y	Y	NA		N	Y			Y	N			N			
Town Creek	Town	11	Y	Y	NA		Y	Y			N	N		Y	N			
Morgan County																		
Unincorporated	County	11	AP	N	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Decatur	City	11	AP	Y	10 (R)	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Eva	Town	11	AP	N	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Falkville	Town	11	AP	Y	NA	Y	Y	Y			Y	Y		Y	Y	N	Y	
Hartselle	City	11	AP	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Priceville	Town	11	AP	N	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Somerville	Town	11	AP	N	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Trinity	Town	11	AP	Y	NA	Y	Y	Y			Y	Y		Y	Y	Y	Y	
Region 12: Top of Alabama Regional Council of Governments																		
Dekalb County																		
Unincorporated	County	12	Y	Y	NA	N	N	N			N	N		N	Y	N	Y	
Collinsville	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Crossville	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Fort Payne	City	12		Y	NA	N	Y	N			N	N		N	N	N	N	
Fyffe	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Geraldine	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Hammondville	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Hengar	City	12		Y	NA	N	N	N			N	N		N	N	N	N	
Ider	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Lakeview	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Mentone	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Pine Ridge	Town	12		S	NA	N	N	N			N	N		N	N	N	N	
Powell	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Rainsville	City	12		Y	NA	N	N	N			N	N		N	N	N	N	
Shiloh	Town	12		S	NA	N	N	N			N	N		N	N	N	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Sylvania	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Valley Head	Town	12		Y	NA	N	N	N			N	N		N	N	N	N	
Jackson County																		
Unincorporated	County	12	Y	Y	NA	N	Y	N			Y	N		Y	Y	Y	N	
Bridgeport	City	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Dutton	Town	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Hollywood	Town	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Hytop	Town	12	Y	N/A	NA	N	N	N			Y	N		N	N	N	N	
Langston	Town	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Paint Rock	Town	12	Y	SU	NA	N	N	N			Y	N		N	N	N	N	
Pisgah	Town	12	Y	S	NA	N	N	N			Y	N		N	N	N	N	
Pleasant Groves	Town	12	Y	N/A	NA	N	N	N			Y	N		N	N	N	N	
Scottsboro	City	12	Y	Y	NA	Y	N	Y			Y	N		N	Y	Y	N	
Section	Town	12	Y	S	NA	N	N	N			Y	N		N	N	N	N	
Skyline	Town	12	Y	N/A	NA	N	N	N			Y	N		N	N	N	N	
Stevenson	City	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Woodville	Town	12	Y	Y	NA	N	N	N			Y	N		N	N	N	N	
Limestone County																		
Unincorporated	County	12	Y	Y	NA	Y	Y	N			Y	N			Y			
Ardmore	Town	12	Y	Y	NA	N	N	N			N	N						
Athens	City	12	Y	Y	10 (R)	Y	Y	Y			N	Y						
Elkmont	Town	12	Y	N	NA	N	N	N			N	N						
Lester	Town	12	Y	N	NA	N	N	N			N	N						
Mooresville	Town	12	Y	Y	NA	N	N	N			N	N						
Madison County																		
Unincorporated	County	12	N	Y	9	Y	N	Y			N	N		N	N	Y	N	
Huntsville	City	12	N	Y	8	Y	N	Y			Y	Y		Y	Y	Y	N	
Madison	City	12	N	Y	NA	Y	N	Y			Y	Y		N	N	Y	N	
New Hope	Town	12	N	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Gurley	Town	12	N	Y	NA	Y	N	Y			Y	Y		Y	N	N	N	

Jurisdiction	Type	REG	HMP	NFIP	CRS	ZON	SUB REG	BLDG CODE	BCEGS	PPC	COMP PLAN	CIP	MIT PROJ EXP	PLNR	ENGR	CFM	BLDG INSP	CAPAB RAT
Owens Cross Roads	City	12	N	Y	NA	N	N	Y			N	N		N	N	N	N	
Triana	Town	12	N	Y	NA	N	N	Y			N	N		N	N	N	N	
Marshall County																		
Unincorporated	County	12	Y	Y	NA	N	Y	N			N	N		N	Y	N	N	
Albertville	City	12	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Arab	City	12	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	N	
Boaz	City	12	Y	Y	NA	Y	Y	Y			N	N		N	N	N	N	
Douglas	Town	12	Y	N	NA	N	Y	N			Y	N		N	N	N	N	
Grant	Town	12	Y	Y	NA	Y	Y	N			Y	N		N	N	N	N	
Guntersville	City	12	Y	Y	NA	Y	Y	Y			Y	N		N	N	N	Y	
Union Grove	Town	12	Y	Y	NA	N	Y	N			N	N		N	N	N	N	

D. Comments Received from SHMT and FEMA

As described in Section 1.2.1.3.5, AEMA distributed the initial draft of this Plan Update to the SHMT and all county stakeholders on June 1, 2018, for comment. Additionally, the draft was made available to the public through AEMA's Hazard Mitigation Web Page. In addition to soliciting comments at the Plan Review Meeting on June 12, 2018, the SHMT and county stakeholders were also invited to provide comments up through July 2, 2018.

AEMA submitted this Plan Update to FEMA for review and approval on July 18, 2018. After review, FEMA returned the draft to AEMA [PLACEHOLDER: WITH/WITHOUT] comments.

Table D.1 records the comments received during the SHMT and county stakeholder review process, as well as the comments received from FEMA. The table indicates the location referenced and the corrective action taken by AEMA.

Table D.1 Comments Received from SHMT and FEMA

Commenter	Comment	Location within Plan	Date Received	Corrective Action
ADEM	Replace ADEM with ADECA-OWR as responsible agency for mitigation actions related to dam failure (Mitigation Actions #42-47).	Table 5.3	June 12, 2018	Replaced ADEM with ADECA-OWR as responsible agency for Mitigation Actions #42-47.
ADECA-OWR	The size of the bodies of water in Alabama contained by dams which ADECA inventories is incorrect. The size should be greater than 50 acre-feet, not 50,000 acre-feet.	Section 3.2.1.2	June 7, 2018	Corrected size of bodies of water in Alabama contained by dams as indicated.

Commenter	Comment	Location within Plan	Date Received	Corrective Action
ADHR	Add Alabama Department of Finance (ADF) and ALEA as additional responsible agencies for Mitigation Action #19 (Mitigation Action #4.1.3 in the 2013 Plan Update)	Table 5.3; Appendix H	June 5, 2018	Added ADF and ALEA as responsible agencies for Mitigation Action #19.
ADHR	Ensure that Alabama Department of Human Resources acronym is corrected to ADHR throughout.	All sections	June 5, 2018	Corrected acronym as indicated.
AERC	Provided clarification of the State Building Commission.	Section 4.2.1	June 28, 2018	Clarified the role of the State Building Commission and corrected the Commission's name throughout the document
AERC	Remove reference to Southern Building Code.	Section 4.2.1	June 28, 2018	Removed reference to Southern Building Code
AERC	Update the International Building Code information for the State: the Building Commission adopted the 2015 International Building Code in 2016.	Section 4.2.1	June 28, 2018	Updated reference as indicated.
AERC	Add reference to the Alabama Energy and Residential Codes Board.	Section 4.2.1; Section 4.5.1.3; Section 5.1.2.5	June 28, 2018	Added reference as indicated.

Commenter	Comment	Location within Plan	Date Received	Corrective Action
AERC	Correct reference for building codes for Mobile and Baldwin Counties.	Section 4.2.3.3	June 28, 2018	Corrected building code reference for Mobile and Baldwin Counties to note the adoption of the 2012 International Building Code and International Residential Code.
AERC	Reference Property Insurance and Energy Reduction Act of Alabama.	Section 4.2.4	June 28, 2018	Referenced as indicated
AERC	Replace “many” with “most” to be more representative of statement.	Section 4.4.2	June 28, 2018	Changed wording as indicated.
CPYRWMA	Include information about the Elba and Geneva Levee Rehabilitation Projects with other mitigation successes.	Section 5.3.2.2	June 12, 2018	Narrative provided, including state and federal cost shares.
FEMA Region IV	Include statement on the evaluation of mitigation actions that are environmentally sound.	Section 5.1.2.1	June 11, 2018	Statement on the evaluation of mitigation actions based on their environmental effect included.
FEMA Region IV	Include statement on the connection of mitigation strategy's of local and tribal plans to the state plan	Section 5.1.1	June 11, 2018	Statement directing readers to Section 1.3.2.3 where the local plan analysis was completed was added.
FEMA Region IV	Include specific sources of funding for all mitigation actions.	Section 5.1.2.5	June 11, 2018	Include potential funding sources for all mitigation actions in the 2018 Mitigation Action Plan.

Commenter	Comment	Location within Plan	Date Received	Corrective Action
FEMA Region IV	Include specific FEMA funding sources for all mitigation actions (e.g. HMGP Funding etc.)	Section 5.1.2.5	June 11, 2018	Include specific FEMA funding sources when appropriate in the 2018 Mitigation Action Plan.
FEMA Region IV	Include a narrative description of mitigation project updates for ongoing projects that are funded and staffed.	Section 5.1.2.5	June 11, 2018	Provide a narrative description of mitigation project updates for ongoing projects that are funded and staffed.
GSA	Number of requests received for information on sinkholes is now over 203.	Section 3.2.11.3	June 6, 2018	Corrected number as indicated.
GSA	Reference to “4,000 human-induced sinkholes” requires citation.	Section 3.2.11.2	June 25, 2018	Provided citation.
NWS-Birmingham	Correct “Tennessee Valley and Ridge” to “Alabama Valley and Ridge” in both text and maps.	Figure 2.2; Section 2.1.3.1.1	June 12, 2018	Corrected name as indicated.

E. Planning Process Documents

This appendix includes the materials, records of attendance, and notes from all of the meetings held during the planning process, including:

- Project Planning Conference Call
- Kickoff Meeting
  - Agenda
  - Slide Deck
  - Meeting Notes
  - Attendance
- Risk Assessment Methodology and Outreach Strategy Meeting
  - Agenda
  - Slide Deck
  - Meeting Notes
  - Attendance
- Risk Assessment Meeting
  - Agenda
  - Slide Deck
  - Meeting Notes
  - Attendance
- Mitigation Strategy Meeting
  - Agenda
  - Slide Deck
  - Meeting Notes
  - Attendance
- Plan Review Meeting
  - Agenda
  - Slide Deck
  - Meeting Notes
  - Attendance

[This appendix will be included as a separate document because of its large size.]

F. Record of Changes

Change Number	Date of Change	Initials and Date Entered

G. Hazard Mitigation Grant Program Implementation Process

Specific details of the three phase Hazard Mitigation Grant Program Implementation Process and items considered in the review are presented below.

Phase I: HMGP Funds Allocation/Application Submittal

- Disaster Declaration
- Perform HMGP briefings in conjunction with PA applicant briefings to announce availability of HMGP - general program overview
- 30 day:
  - Initial Estimate for HMGP received
  - State establishes initial procedure for funds allocation
- 90 day:
  - FEMA issues 90-day lock-in for HMGP funding amount (can increase/decrease)
  - State finalizes the funding projections and issues NOFA to County EMA Office, with instructions to convene Local Hazard Mitigation Planning Committee to complete LOI by established deadline
  - LOI deadline set for 30 days from NOFA receipt
    - Must be coordinated and prioritized through local mitigation planning committee and signed by County EMA Director and all affected applicants
  - State schedules application workshops
- 180 day:
  - Full application deadline

Phase II – Project Reviews and Submittals

- Applications completed by the requesting jurisdiction (city, county, agency) are sent to the county EMA
- County EMA keeps a copy and sends original to AEMA by deadline
- AEMA planners will review and address any correspondence to the listed POC (and copy the county EMA director and AEMA field coordinator)
- In the event of lack of communication with the applicant, planner will speak with the county EMA director

During Phase II, the state reviews projects for a variety of factors. This includes jurisdictions with highest risk, repetitive loss properties and development pressures.

Phase III – Project Approval/Implementation Procedures

- Upon FEMA approval, an approval package will be mailed to sub-grantee
- State-Subgrantee Agreement executed and returned to State
- Kick-off meeting held with AEMA, Sub-grantee, and County to discuss implementation and close-out procedures

H. Updates to the 2013 Mitigation Action Plan

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.1.2	Inventory and catalog natural hazards studies, maps, digital data and other information available from city, county, state, federal, university, private, and other sources.	1.1	All	AEMA	Unknown	Near-Term	Staff Time	Maintaining a comprehensive invoice/catalog will improve the use of the data by agencies.	Ongoing	Moderate	
1.1.3	Establish a schedule to provide state and local offices with current information on past events (including damages).	1.1	All	AEMA	Unknown	Near-Term	Staff Time	Updating state and local officials with current information will improve future decisions regarding mitigation.	Ongoing	Low	
1.1.4	Develop a comprehensive record of ADEM's assets and operations.	1.1	All	ADEM	State Funds	Near-Term	Staff Time	Maintaining a comprehensive record of assets and operations will improve accessibility and expand their use.	Ongoing	High	Develop and update a comprehensive record of ADEM's assets and operations.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.1.6	Routinely collect, monitor, and evaluate selected climatic, water-supply and water-use data to identify at an early stage the onset of a drought or potential for drought, geographic extent of the affected area and changes in the drought levels.	1.1	Drought	ADECA; (OWR)	Multiple funding sources	Mid-Term	Staff Time	Obtaining comprehensive data pertaining to drought will improve local and state capabilities response to and mitigation measures against droughts.	Ongoing	Moderate	
1.1.7	Encourage local governments to inventory their urban forests.	1.1	Wind	AFC	US Forest Service	Near-Term	Staff Time	Better asset information will improve understanding for decisions to protect lives and property.	Ongoing	Moderate	
1.2.1	Adopt a common Geographical Information System (GIS) data system throughout State, county and local government.	1.2	All	AEMA	Unknown	Near-Term	TBD	Better risk information will improve understanding for decisions to protect lives and property.	Ongoing	Moderate	
1.2.3	Utilize GIS to evaluate the vulnerability of critical facilities, large employers / public assembly areas and lifelines by comparing them with hazard-prone areas.	1.2	All	AEMA; AGIC	Unknown	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	New	Low	Assess proposed new, or planned renovations in, state assets and critical infrastructure against identified hazard-prone

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
											areas using GIS assessment to inform development decisions.
1.2.3									New		Provide large employers and local counties GIS files containing hazard-prone areas and encourage them to assess any new planned development or renovations with hazard data to inform development.
1.2.4	Provide a prioritized list of the natural risks to all Departmental facilities and remote monitoring sites.	1.2	All	AEMA; ADEM	Multiple funding sources	Mid-Term	Staff Time	Better risk information will improve understanding for decisions to protect lives and property.	Ongoing	High	**COMBINE with 3.2.3: Create a communication action plan for informing all stakeholders of the natural and manmade risks identified in the SHMP.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.2.5	Review local and county mitigation plans following disasters or serious hazard occurrences in order to evaluate risk assessments and mitigation priorities.	1.2	All	AEMA; Local Govt	Multiple funding sources	Mid-Term	Staff Time	Reviewing local and county mitigation plans will increase the community's resistance to hazards.	Deferred - due to funding	High	
1.3.1	Update contact information in the Departmental Emergency Operation SOP on a regular basis and review and update biannually.	1.3	All	AEMA; All State Agencies	EMPG, Operating Revenue, State funds	Near-Term	Staff Time	Improved and up-to-date information in the SOP will improve mitigation and other planning designed to reduce the impact of hazard events.	Ongoing	High, Moderate by ADCNR	
1.3.2 (Actions 4.2.3 and 1.3.6 were combined with this action in 2010)	Develop and maintain a Continuity of Operations plan for all State agencies including periodic review and updates.	1.3	All	All State Agencies	Multiple funding sources, Operating Revenue, State funds, ALDOT O&M	Near-Term, Mid-Term (per ALDOT)	Staff Time	Keeping state departmental functions operational during and following hazard events is important to serving clients.	Ongoing	High, Moderate by ADCNR	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.3.3	Develop a plan to protect public records.	1.3	All	All State Agencies	Operating Revenue; State funds	Mid-Term	Staff Time	Protecting public records will ensure that this information is available for future uses.	Ongoing	High, Moderate by ADCNR	
1.3.4	Develop a plan to protect data.	1.3	All	All State Agencies	Operating Revenue; State funds	Mid-Term	Staff Time	Protecting data will ensure that this information is available for future uses.	Ongoing	High, Moderate by ADCNR	
1.3.5	Develop and maintain COG.	1.3	All	All State Agencies	Multiple funding sources; State funds	Mid-Term	Staff Time	The planning process involved with the maintenance of continuity of government often reveals mitigation opportunities.	Ongoing	High, Moderate by ADCNR	Update continuity of government plans to incorporate the most up to date hazard risk data.
1.3.7	Construct five safe houses for district offices and purchase one 5KW generator for each safe house.		Tornadoes	ADCNR	FEMA HMA	Near-Term	Pending bids by contractors	Provides safe sheltering place	Deferred - due to funding	High	
1.4.1	Identify channel and ditches that must be improved to provide maximum drainage capacity.	1.4	Flood	AEMA; ADECA; ADCNR	FEMA CTP Grant; ACAMP-CZMA funds	Mid-Term	Staff Time	Supporting existing efforts to mitigate flood risk will reduce the impact of hazard events.	Ongoing	Moderate	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.4.10	Ensure local communities utilize flood control measures including the use of retention / detention basin and other storm water management practices to retard the flow of water and reduce downstream damage.	1.4	Flood	OWR; USACE; ADCNR; Local Govt	ACAMP-CZMA funds	Long-Term	Staff Time	The use of flood control measures will provide protection to properties from floods.	Ongoing	Low	Provide information and guidance to local communities to ensure they utilize flood control measures including the use of retention/detention basins and other stormwater management practices to retard the flow of water and reduce downstream damage.
1.4.11	Implement the use of erosion control measures to protect infrastructure from floods. (Reshape fields, reestablish terrace systems, stabilize active gullies and watercourses, removed sediment bars and debris in channels and stabilize channel banks.)	1.4	Flood	OWR; ADCNR; Local Govt	None	Long-Term	Construction costs TBD by project specifics.	The use of erosion control measures will protect farmland and watershed infrastructure from floods.	Deferred - due to funding	Moderate	Identify erosion control projects to protect state assets and critical infrastructure from floods and implement as identified (e.g., reshape fields, reestablish terrace systems, stabilize active gullies and watercourses, removed sediment bars and debris in

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
											channels and stabilize channel banks.)
1.4.12	Modernize and improve access to flood gates for levee systems.	1.4	Flood	OWR; USACE	No info provided	Long-Term	Construction costs TBD by project specifics.	The modernization of flood control systems, such as flood gates for levee systems, will reduce the flooding hazard to lives and property.	Ongoing	No info provided	
1.4.14	Reduce the number of unsafe State dams.	1.4	Dam Failure	ADECA	No info provided	Long-Term	Staff Time and Construction costs TBD by project specifics.	Reducing the number of unsafe State dams will protect lives and property in the downstream floodplain.	Ongoing	Low/ Moderate	Create a state dam safety program that will reduce the overall number of unsafe dams.
1.4.15	Reduce the flooding risk to communities by acquiring property located in the 100-year floodplain and return it to open space.	1.4	Flood	AEMA; OWR; Local Govt	HMA, HMGP grants	Near-Term	Construction costs TBD by project specifics. (historically >$1 million)	Open space will significantly reduce the flooding risk to communities.	Ongoing	High	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.4.2	Increase community awareness about the need and process for requesting floodplain mapping.	1.4	Flood	ADECA; (OWR)	FEMA CTP Grant	Near-Term	Staff Time, Outreach Materials	Lack of information on flood vulnerability can inhibit effective flood protection measures.	Ongoing	High	Create education programs that increase community awareness about the process of requesting floodplain mapping.
1.4.3	Request funding from FEMA to update state floodplain maps.	1.4	Flood	ADCNR; OWR	N/A	Near-Term	Staff Time	Lack of information on flood vulnerability can inhibit effective flood protection measures.	Ongoing	High	**COMBINE with 1.4.4: Evaluate community Flood Insurance Studies (FIS's) and Flood Insurance Rate Maps (FIRMs) for accuracy in order to priotize requests for funding from FEMA to update flood studies and maps, and create additional risk mapping products.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.4.4	Evaluate community flood studies and FIRMS for accuracy.	1.4	Flood	OWR	FEMA CTP Grant	Near-Term	Staff Time	Understanding vulnerability will help to frame discussions by decision makers on how to preserve and protect assets from hazard events.	Ongoing	High	**REMOVE; combine with 1.4.3
1.4.6	Increase state and local agencies' ability to issue flood warnings. (Construct automated stream gauging stations with rainfall measurement devices equipped with telemetry systems) - Choctawhatchee Pea Yellow River Watershed Authority's Flood Warning system in place. Consider expanding the program.	1.4	Flood	OWR	No info provided	Long-Term	TBD based on individual project costs and other specific information.	Better information on rainfall data will provide the NWS and state and local agencies with the necessary data to issue flood warnings and protect lives and property.	Ongoing	Low	
1.4.7	Encourage each community to include critical facilities such as hospitals, nursing homes, schools, police stations, fire stations and emergency operations centers	1.4	Flood	OWR	No info provided	Near-Term	Staff Time	Lack of maps that include critical facilities can inhibit effective flood protection of these structures.	Ongoing	Low	Perform outreach to communities to promote the development and maintainance of critical facilities spatial databases to use for hazard

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
	indicated on each floodplain map.										mapping and analysis.
1.4.8	Coordinate activities between the state and local or regional water management authorities.	1.4	Flood	OWR	No info provided	Near-Term	Staff Time	Effective coordination between water management agencies will reduce the risk from future flooding.	Ongoing	No info provided	
1.5.1	Review coastal NFIP maps for potential updates.	1.5	Flood	OWR; Local Govt	FEMA CTP Grant	Near-Term	Staff Time	Understanding vulnerability will help to frame discussions by decision makers on how to preserve and protect assets from hazard events.	Ongoing	High	Support communities in reviewing the preliminary Coastal Flood Insurance Rate Maps for approval and adoption.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.6.1	Maintain membership and participation in the Central United States Earthquake Consortium.	1.6	Earthquake	AEMA; GSA	Federal, USGS	Near-Term	Approx.$500	Keeping state departmental functions operational during and following hazard events is important to protecting lives and property.	Ongoing	High/ Moderate	
1.6.2	Upgrade the State's monitoring capabilities for earthquakes.	1.6	Earthquake	AEMA; GSA	USGS, NEHRP/ FEMA	Long-Term	Individual Project costs associated with Map Production and Seismic monitoring equipment	Resulting maps indicate areas of greatest risk. Such maps can lead to wiser use of land and substantial savings to the State and its citizens.	Deferred - due to funding	Low	
1.6.4	Perform research to understand the geologic conditions that cause earthquakes in Alabama.	1.6	Earthquake	GSA	USGS, NEHRP/ FEMA, NSF	Mid-Term	Staff Time	Will enable prediction of areas where earthquakes might originate.	Ongoing	Moderate	
1.6.5	Identify areas within Alabama that are most susceptible to earthquakes.	1.6	Earthquake	GSA	USGS, NEHRP/ FEMA	Mid-Term	Staff Time	Close monitoring of smaller earthquakes may indicate areas likely to have larger earthquakes.	Ongoing	Moderate	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.6.6	Establish a system of 6 short-band seismic stations within the state.	1.6	Earthquake	AEMA; GSA	USGS, NSF	Long-Term		Provides a system of 6 short-band seismic stations to monitor seismic activity within the State that may indicate areas at risk for larger quakes.	Deferred - due to funding	Low	
1.9.1	Obtain periodic updates of RL and SRL lists from FEMA/NFIP and ensure that appropriate officials have access to the data.	1.9	Flood	AEMA; ADECA; FEMA	N/A	Ongoing	Staff Time	Flooding (particularly repetitive losses) is the single most significant natural hazard in the State, in terms of monetary losses and disruptions. The overall State mitigation strategy is focused on reducing these damages by various means, including FEMA grant programs. These programs rely on sound information as the basis for prioritizing actions.	Ongoing	High	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
1.9.2	Ensure that site-specific risk assessments are available to local officials, as the basis for identifying and prioritizing mitigation actions on a site-specific basis. This action may be accomplished in a number of ways, including AEMA performing risk assessments (either itself or using consultants/ contractors), or continuing to provide training and technical support.	1.9	Flood	AEMA	Existing State staff; potential outside resources to be determine d	Ongoi ng	Staff time	Flooding is the most significant natural hazard in the State. This information is the basis for implementing numerous FEMA grant programs.	Ongoing	Moderate	
2.1.1	Implement Legislation Title 11-19-1 through 24.	2.1	All	ADECA; AAR; ACCA	FEMA, local	Mid-Term	Staff Time	Land use management practices that address mitigation increase the probability that lives and property will be protected.	Ongoing	Low/ Moderate	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.1.13	Encourage the integration of Tree Emergency Plans into the risk assessment portion of all local mitigation plans.	2.1	Wind	AFC	US Forest Service, FEMA	Mid-Term	Staff Time	Increasing accessibility to new information/data such as Tree Emergency Plans strengthens mitigation planning as trees are a major source of damage during wind events.	Ongoing	Moderate	
2.1.2	Ensure all states codes and standards ensure the protection of life.	2.1	All	BLDG. CODE COMMISSION	Operating Budget	Near-Term	Staff Time	Expanding hazard mitigation initiatives will improve the State's resistance to hazards for the future.	Ongoing	High	Alabama State Building Commission to review the state building codes against the most recent standards (eg., IBC for earthquake, wind loads, flood, fire) to identify where state codes require revisions and update accordingly.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.1.3	Ensure all structures in the state meet minimum standards for life safety.	2.1	All	AACC; ALM	Bonding Funds	Mid-Term	Staff Time	Improving building inspections will increase the integrity of structures and protect occupants during hazard events.	Ongoing	High	**COMBINE with 3.2.6: Provide regular educational programs to local building and code enforcement officials about minimum standards for construction in hazardous areas (e.g., wind loads, floodplains, earthquake zones).
2.1.5	Maintain tornado safe room initiatives statewide.	2.1	Wind	AEMA; NOAA; Local Govt	HMA	Near-Term	Staff Time	Continues efforts to reduce tornado risk to citizens Statewide. Tornadoes are identified as one of three most significant hazards in the State.	Ongoing	High	
2.1.6	Expand the number of local governments that include hazard reduction planning into their land-use plans and development regulations.	2.1	All	AEMA; Local Govt	Multiple funding sources	Long-Term	Staff Time	Coordinating plans ensures that mitigation efforts are addressed.	Ongoing	Moderate	Administer training to local governments about integrating hazard reduction planning into land-use plans and

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
											development regulations.
2.1.7	Assist K-12 schools and state colleges and universities develop vulnerability assessments, mitigation plans and mitigation projects to improve safety in their most vulnerable buildings.	2.1	All	AEMA; AARC; Local Govt	FEMA, local	Long-Term	Staff Time and Project specific costs based on individual regulations.	Providing technical assistance to educational facilities encourages the use of mitigation and strengthens critical facilities.	Ongoing	High	
2.1.9	Promote, strengthen and coordinate emergency response plans.	2.1	All	AEMA; ADEM	Multiple funding sources; State funds	Mid-Term	Staff Time	Coordinating plans ensures that mitigation efforts are addressed.	Ongoing	High	Promote, strengthen and coordinate emergency response plans in order to better identify and mitigate risk to natural and manmade disasters.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.2.1	Increase state agency accessibility to critical power lines.	2.2	All	ALDOT	No info provided	Mid-Term	Construction costs TBD by project specifics.	Increasing accessibility to critical power lines will increase the opportunity of repair crews to restore power following a hazard event.	Deferred - due to funding	Low	**COMBINE with 2.2.2: Increase state agency accessibility to critical power lines by identifying and prioritizing utility ROW's for tree and brush removal.
2.2.10	Develop and inventory of the number of radio repeater sites and dispatch centers currently without backup electricity	2.2	All	AFC	No info provided	Near-Term	Staff Time	Backup communication will keep the AL Forestry Commission operational during a hazard event	Deferred - due to funding	High	
2.2.12	Develop model ordinance for Gulf-fronting communities requiring additional setbacks for Gulf-fronting properties.	2.2	Floods	AEMA; ADCNR; SARPC; Local Govt	ACAMP-CZMA funds	Mid-Term	Staff Time	Increased setbacks will reduce property damage from storm surge.	Ongoing	Moderate	Develop model ordinance for Gulf-fronting communities that requires higher standards for setbacks from waterfront and freeboard.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.2.2	Identify and prioritize utility ROWs for tree and brush removal.	2.2	All	ALDOT	No info provided	Near-Term	Staff Time	Increasing accessibility to critical power lines will increase the opportunity of repair crews to restore power following a hazard event.	Deferred - due to funding	Low	**REMOVE; combine with 2.2.1
2.2.4	Encourage applicable local governments (insert county names) to retrofit critical facilities so that they will sustain natural disasters.	2.2	Wind	AL Insurance Department	State funds	Near-Term	Staff Time and Production costs	Improving the structural integrity of vulnerable homes and securing contents will improve the safety of households that might not be able to afford repairs.	Ongoing	High	**COMBINE with 2.2.8 and 2.2.9: Create a state rebate or grant program for retrofitting (or modifying) existing residential homes, community critical facilities, and infrastructure to reduce future wind damage.
2.2.5	Advance provision for electrical generators through FEMA grant programs.	2.2	All	AEMA	HMA	Near-Term	Staff Time	Reduces loss of function to critical facilities and operations following natural hazards.	Ongoing	Moderate	Advance provision for electrical generators thorugh FEMA grant programs for critical facilities.

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.2.7	Strengthen all state building codes and enforcement.	2.2	All	BC; AACC; ALM; Local Govt	Operating budget	Mid-Term	Staff Time	Reduces vulnerability of buildings to hazards.	Ongoing	High	**REMOVE; combine with 2.1.2
2.2.8	Encourage homeowners to retrofit their homes for category F-0 to F-2 tornadoes by providing information materials (handouts, booklets and videos).	2.2	Wind	AEMA; FEMA	Multiple funding sources	Mid-Term	Staff Time and Material Production costs	A well informed general public will result in a safer and less hazard prone community.	Ongoing	Moderate	**REMOVE; combine with 2.2.4
2.2.9	Encourage homeowners to retrofit their homes for category 1-3 hurricane winds.	2.2	Wind	AEMA; FEMA	Multiple funding sources	Mid-Term	Staff Time and Material Production costs	Retrofitting homes will protect lives and property from hurricane hazards.	Ongoing	Moderate	**REMOVE; combine with 2.2.4
2.3.1	Develop hazard mitigation policies to protect the environment.	2.3	All	ADCNR	ACAMP-CZMA funds	Mid-Term	Staff Time	Promoting mitigation measures that have an environmental benefit increase the overall benefits of the mitigation action.	Deferred - due to funding	High	**REMOVE; new Objective 1.4

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2.3.2	Preserve and rehabilitate natural systems to serve natural hazard mitigation functions (i.e., floodplains, wetlands, watersheds and urban interface areas).	2.3	Floods	USDA; ADCNR; USACE; AEMA	ADCNR-EDRP, NOAA-CRP	Mid-Term	TBD by project scope	Preserving and rehabilitating natural systems will result in the production of natural hazard mitigation.	Ongoing	High	Develop regulations that preserve and rehabilitate natural systems to serve natural hazard mitigation functions (i.e., floodplains, wetlands, watersheds, and urban interface areas).
2.3.4	Encourage local floodplain managers to evaluate the increased hazard posed by the encroachment of non-native plant species into floodways.	2.3	Floods	OWR; AEMA	Unknown	Long-Term	Staff Time	Informing local officials on invasive plant species will contribute to the effective management of wetlands.	Ongoing	Low	Create technical bulletin that educates local floodplain managers about the benefit of evaluating the hazard posed by the encroachment of non-native plant species into floodways.

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2.3.5	Encourage local floodplain managers to continue to account for and incorporate wetlands protection and mitigation sites into the planning process when preparing new studies for watercourses.	2.3	Floods	OWR; AEMA	Unknown	Mid-Term	Staff Time	Incorporating wetlands into the planning process will result in effective wetland management.	Ongoing	Low	Create technical bulletin that educates local floodplain managers to account for and incorporate wetland protection and mitigation sites into the planning process when preparing new studies for watercourses.
2.3.6	Encourage the use of software such as ITREE to both manage and predict tree damage.	2.3	Wind	DOF	US Forest Service	Near-Term	Staff Time and Software costs	Promoting use of software will assist in risk identification.	Ongoing	Moderate	
2.4.1	Develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the State for 90-10 cost share under the FEMA SRL program	2.4	Flood	AEMA	N/A	Near-Term	Existing Federal and State Resources	Part of the process to initiate SRL program; establishes priorities for State and local jurisdictions to begin	Ongoing	High	

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
2.4.2	Conduct community outreach, workshops, and training to increase NFIP participation	2.4	Flood	AEMA, ADECA	N/A	Near-Term	Existing State Resources	Allows residents the ability to receive flood insurance claims and maintains eligibility in the FMA program of which flood insurance is a requirement	Ongoing	High	
2.4.3	Provide updated SRL and RL lists to communities in advance of grant application windows. Include FEMA calculated avoided damages for SRL properties and any State calculated avoided damages for RL properties	2.4	Flood	AEMA	N/A	Near-Term	Existing State Resources	Retrofitting, elevating, or removing repetitive loss properties from known hazard areas protects property and lives as well as preserve personal, state, and federal financial resources	Ongoing	High	
3.1.10	Identify communities at risk to wildfire in urban interface; complete a minimum of (1) Community Wildfire Plan in each county	3.1	Wildfire	AFC	US Forest Service, FEMA	Near-Term	$167,500 ($2,500 per plan x 67 counties)	Engage new development residents and developers in designing wildfire resistant neighborhoods.	Ongoing	Moderate	

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3.1.2	Require the incorporation of natural hazard mitigation measures in all new public construction.	3.1	All	Bldg. Code Commission; Local Govt	Operating Budget	Long-Term	TBD by project scope	Incorporating natural hazard mitigation into new public construction reduces vulnerabilities and protects live and property.	Ongoing	High	Develop state regulations that require local governments to incorporate natural hazard mitigation measures into all new public construction projects.
3.1.3	Promote enforcement of applicable building codes in hazardous areas.	3.1	All	AACC; Local Govt	N/A	Mid-Term	Staff Time	Improving building inspections will improve the integrity of structures and protect occupants during hazard events.	Ongoing	N/A	**REMOVE; combine with 2.1.3
3.1.4	Ensure local building codes require the latest construction techniques and materials designed to reduce the effects of natural hazards on residential and commercial structures.	3.1	All	AACC; ALM	N/A	Mid-Term	Staff Time	Improving building inspections will increase the integrity of structures and protect occupants during hazard events.	Deferred - due to funding	N/A	**REMOVE; combine with 2.1.2

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3.1.6	Develop design criteria for marinas, piers and other coastal structures with respect to storm resistance.	3.1	Wind; Floods	Building Code Commission; OWR; Local Govt	Operating Budget	Mid-Term	Staff Time	Developing design criteria will reduce the probability that these structures will be affected by hazards.	Deferred - due to funding	Low	
3.1.7	Review new development proposal prior to issuance of floodplain development permits.	3.1	Floods	NOAA; Local Govt; AFC	No info provided	Mid-Term	Staff Time	Reviewing development proposals will improve the integrity of structures and protect occupants during flooding events.	Deferred - due to funding	No info provided	**REMOVE, combine with second 2018 action proposed in 1.2.3
3.1.8	Develop coastal community resiliency plans to react to stressors on the jurisdiction (i.e. natural hazards).	3.1	All	NOAA; Local Govt; AFC	No info provided	Mid-Term	Staff Time and Project costs TBD by project scope.	The use of erosion control measures will protect farmland and watershed infrastructure from floods.	Deferred - due to funding	No info provided	Work with communities to develop local resiliency plans to assess ability to react to stressors on the jurisdiction.

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3.1.9	Establish capacity to purchase and utilize remotely sensed imagery as a tool to develop localized risk models to mitigate storm damaged forest hazards	3.1	Wind; Storm Surge; Wildfire	AFC	US Forest Service, FEMA	Near-Term	$19,386 (ERDAS IMAGINE Pro 10 software license; 3-yr maintenance contract)	By implementing collaborative AFC and local agency strategies to mitigate potential damage, injuries, and costs related to storm damaged urban and interface trees and forests.	Deferred - due to funding	Moderate	
3.2.3	Inform land and resource managers, including those engaged in planning and zoning, about potential hazards in their jurisdictions.	3.2	All	AEMA; ADEM	Multiple funding sources; State funds	Near-Term	Staff Time	Ensuring the continued involvement of stakeholders will increase the awareness of the impact of hazard events.	Ongoing	Moderate / Low	**REMOVE; combine with 1.2.4
3.2.4	Develop and incorporate a new standard in all state-wide building codes that requires a standard system be incorporated into window design and protection for all new construction.	3.2	Wind	AACC; ALM	N/A	Long-Term	Staff Time	Improving building inspections will increase the integrity of structures and protect occupants during hazard events.	Deferred - due to funding	N/A	**REMOVE; combine with 2.1.2.

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3.2.6	Ensure that building inspectors are trained in the enforcement of the adopted codes.	3.2	All	AACC; ALM; ADCNR; Local Govt	ACAMP-CZMA funds	Long-Term	Staff Time	Better-trained inspectors result in safer, better-protected neighborhoods.	Deferred - due to funding	Moderate	**REMOVE; combine with 2.1.3
3.2.7	Disseminate information about Section 106 of the NHP Act and its ramifications in a disaster.	3.2	All	AHC	N/A	Mid-Term	Staff Time and production cost	Information will improve decisions to protect cultural resources.	Ongoing	High	
3.2.8	Encourage Retrofit.	3.2	Wind	AEMA; Local Govt	Multiple funding sources	Long-Term	Staff Time	Retrofitting structures can mitigate future damage from wind events.	Ongoing	Moderate	Retrofit state owned public buildings and critical facilities to reduce future wind damage.
3.2.9	Look at critical facilities to determine which can be brought to FEMA 361 retrofit which can support.	3.2	Wind	AEMA; All Agencies	Multiple funding sources; Bond funds; FEMA	Mid-Term	Staff Time and Project costs TBD by project scope.	Retrofitting critical facilities mitigates/reduces future damages and helps ensure continuity of operations.	Deferred - due to funding	Moderate	**REMOVE; combine with 3.2.8

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4.1.1	Provide funding and technical assistance to state agencies and local and tribal governments to prepare hazard mitigation plans.	2.5	All	AEMA; FEMA	HMA	Mid-Term	Staff Time and Project costs TBD by Local/Tribal project scope.	Expanding the number of hazard mitigation initiatives will improve the State's resistance to hazards.	Ongoing	High	**COMBINE with 4.2.4: Provide funding and technical assistance to state agencies and local and government tribes to administer mitigation activities, including preparing hazard mitigation plans.
4.1.2	Improve the state's capability to administer pre- and post-disaster mitigation programs.	4.5	All	AEMA	HMA	Mid-Term	Staff Time	Expanding the number of hazard mitigation initiatives will improve the State's resistance to hazards.	Ongoing	High	**REMOVE; new Objective 4.3

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4.1.3	Establish security system within the Gordon Persons Building to ensure that critical functions are not interrupted due to terrorist activities.	2.5	All	ADHR	Existing operating budget	Long-Term	Project costs TBD by project scope.	Keeping state departmental functions operational during and following hazard events is important to serving the public.	Ongoing	High	Add ADF and ALEA as responsible agencies as managing agencies for the Gordon Persons Building.
4.1.5	Implement proper use of trees to reduce amount of damage and protect structures.	2.5	Wind	AFC	US Forest Service	Long-Term	TBD - Cost of trees in critical areas	Proper use of indigenous trees can serve to mitigate damage to structures by shielding from wind. Additionally they are less likely to result in debris.	Ongoing	Moderate	Create a state program to promote the planting of indigenous trees that are more resilient to high wind events.
4.1.6	Encourage the use of storm resistant trees to reduce both the wind hazards as well as the amount of debris.	2.5	Wind	AFC	US Forest Service	Long-Term	TBD - Cost of trees in critical areas	Proper use of indigenous trees can serve to mitigate damage to structures by shielding from wind. Additionally they are less likely to result in debris.	Ongoing	Moderate	**REMOVE; combine with 4.1.5

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4.2.1	Initiate a system to test the ability of local emergency manager to activates the Emergency Alert System.	2.6	All	AEMA; Local Govt	EMPG	Mid-Term	Staff Time	Expanding the number of hazard mitigation initiatives, to include reverse 911 systems, will increase the community's resistance to hazards.	Ongoing	High	Create statewide training system to test local emergency managers in activating the Emergecy Alert Systems.
4.2.2	Establish provisions to ensure that Family Assistance program designed for moving families from dependency to self-sufficiency continue after a natural or man-made disaster.	2.6	All	ADHR	Existing operating budget	Long-Term	Staff Time	Keeping state departmental functions operational during and following hazard events is important to serving the public.	Ongoing	High	
4.2.4	Provide training for local officials in mitigation activities.	2.6	All	Local Govt; AEMA	HMA	Mid-Term	Staff Time	Better trained local officials will result in safer, better protected communities.	Ongoing	Moderate	**REMOVE; combine with 4.1.1
5.1.1	Develop a public outreach and awareness campaign to educate stakeholders on the hazards identified in the state's hazard mitigation plan.	5.1	All	AEMA; AARC; AFC	Multiple funding sources, AFC	Near-Term	Staff Time and production costs	Informing the public on hazards within Alabama prepares citizens to understand and undertake their own mitigation actions.	Ongoing	Moderate / High	**REMOVE; combine with 5.2.6

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5.1.2	As part of the public outreach plan, ensure the public and forest managers are informed about the importance of implementing Best Management Practices on forest land.	5.1	All	AFC; OWR; Local Govt; ADCNR	ACAMP-CZMA funds, US Forest Service	Mid-Term	Staff Time	Informing the public on the warning system will increase understanding of what to do when the warning system is used.	Ongoing	Moderate	Provide the public and forest managers with information about the importance of implementing Best Management Practices on forest land.
5.1.3	Develop an earthquake, landslide and sinkhole education program for the state's Boards of Education to use in each school system.	5.1	Earthquakes; Landslides; Sinkholes	AEMA; GSA	USGS, FEMA	Mid-Term	Staff Time and production costs	Prepares citizens for an emergency. Avoids panic and saves lives.	Deferred - due to funding	Low/ Moderate	
5.2.2	Develop an emergency preparedness and response plan about earthquakes, landslides and sinkholes for the state's Boards of Education to use in each school system.	5.2	Earthquake; Landslides; Sinkholes	AEMA; GSA	USGS, FEMA	Long-Term	Staff Time and production costs TBD by scope for each school system	Prepares citizens for an emergency. Avoids panic and saves lives.	Deferred - due to funding	Moderate	

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5.2.3	Increase the number of homeowners and renters living in flood prone areas that have flood insurance through NFIP.	5.2	Floods	OWR	No info provided	Mid-Term	Staff Time and production costs for outreach	Purchase of flood insurance will increase the awareness of flood mitigation among homeowners.	Ongoing	High	Educate homeowners and renters that live in floodprone areas to purchase flood insurance, especially through the NFIP.
5.2.4	Increase the number of communities who participate in the Community Rating System program.	5.2	Floods	OWR	No info provided	Near-Term	Staff Time	Increased CRS scores will result in lower insurance premiums for homeowners and will decrease the flood risk to the community.	Ongoing	Moderate	Increase the number of communities and tribes who participate in the Community Rating System through targeted education and outreach programs.
5.2.5	Educate local communities about how to improve the CRS classification of other cities and Indian communities within their jurisdictions.	5.2	Floods	OWR	No info provided	Mid-Term	Staff Time and production costs	Increased CRS scores will result in lower insurance premiums for homeowners and will decrease the flood risk to the community.	Ongoing	Low	Educate communities and tribes about methods to improve their CRS classification.

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5.2.6	Conduct hazard mitigation education and awareness workshops for local government officials and the private sector.	5.2	All	AEMA; Local Govt	HMA	Mid-Term	Staff Time	Better trained local officials will result in safer, more hazard resistant communities.	Ongoing	Moderate	**COMBINE with 5.1.1: Develop and conduct outreach campaigns to educate all stakeholders and the public about the hazards identified in the SHMP.
5.2.7	Provide technical assistance (community assistance visits, contacts, workshops and/or publications) to local officials on proper implementation of the NFIP.	5.2	Floods	OWR	FEMA CAP and CTP Grants	Near-Term	Staff Time	Well trained local officials in the NFIP will result in safer communities.	Ongoing	High	
6.1.1	Facilitate the coordination of all state and federal emergency management activities.	6.1	All	AEMA; FEMA	Multiple funding sources	Near-Term	Staff Time	Coordination between emergency management activities will reduce the risk from hazards.	Ongoing	Moderate	Facilitate the coordination of local, state, and federal emergency management activities.

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6.1.2	Facilitate the coordination of state and local emergency management activities.	6.1	All	AEMA; Local EMAs	Multiple funding sources	Near-Term	Staff Time	Coordinating agencies will increase the community's resistance to hazards.	Ongoing	High	**REMOVE; combine with 6.1.1
6.1.3	Ensure hazard mitigation programs are included in all state and local economic development and community planning.	6.1	All	AARC; ALM; ADECA; AACC	EDA, local planning contracts	Mid-Term	Staff Time	Incorporate hazard mitigation initiatives will increase the community's resistance to hazards	Ongoing	Moderate / High	Provide guidance on incorporating risk and vulnerability assessment findings into state economic and community planning efforts.
6.1.4	Expand the use of the State Hazard Mitigation team by adding representatives from other state, regional and federal organizations.	6.1	All	AEMA	Multiple funding sources	Near-Term	Staff Time	Promoting hazard mitigation will reduce the impact of hazard events on the state.	Ongoing	Moderate	Create a diverse State Hazard Mitigation team that includes regional, state, and federal organizations.

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6.1.5	Establish a schedule to update the SHMT on existing and upcoming hazard mitigation activities throughout the state.	6.1	All	AEMA	Multiple funding sources	Near-Term	Staff Time	Promoting hazard mitigation will reduce the impact of hazard events on the state.	Ongoing	Moderate	Create a SHMP maintenance schedule that includes at least one progress report meeting halfway through the five year cycle to asses the status of all mitigation actions.
6.2.1	Integrate mitigation projects into recovery process through Public Assistance, Individual Assistance and SBA programs.	6.2	All	AEMA	Multiple funding sources	Mid-Term	Staff Time	Promote hazard mitigation inclusion and funding through other programs, including Public Assistance and SBA, so that more mitigation measures are implemented.	Ongoing	Moderate	Integrate mitigation projects into recovery processes (Public Assistance, Individual Assistance, and SBA program) through education of local communities and program applicants.

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6.2.2	Integrate mitigation projects through education of local community and Public Assistance applicants.	6.2	All	AEMA; Local Govt	Multiple funding sources	Mid-Term	Staff Time	Promote hazard mitigation inclusion and funding through other programs, including Public Assistance and SBA, so that more mitigation measures are implemented.	Ongoing	Moderate	**REMOVE; combine with 6.2.1
6.2.3	Encourage/ create teams of Arborists to assist in performing damage assessments and recommend mitigation projects.	6.2	Wind	Departm ent of Forestry	US Forest Service	Mid-Term	Staff Time	Coordinating with specialists prior to a disaster will aid in the implementation of mitigation actions following a disaster.	Deferred - due to funding	Moderate	Create teams of Arborists to assist in performing damage assessments and recommend mitigation projects.

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New				AEMA					New		Create a program to educate local governments about different types of hazard mitigation measures/projects and other available funding sources.
New			All	AARC; ALM; ADECA; AACC	EDA, local planning contracts	Mid-Term	Staff Time	Incorporate hazard mitigation initiatives will increase the community's resistance to hazards	New	Moderate / High	Provide local economic and community planners guidance on risk and vulnerability assessments that will impact their future development plans.
New	Make hazard mapping tools available online for residents and design professionals to view and download.		All hazards	AEMA					New		

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New	Construct 15 community saferooms within existing shelters along I-65, following the evacuation route from the coastal area.		All hazards	AEMA					New		
New	Purchase a back-up generator for the Alabama Emergency Operations Center.		All hazards	AEMA					New		
New	Develop a statewide geodatabase and map of all dams in the state, including a status of their condition.		Dam Failure	ADEM					New		
New	Develop and implement a process to continually update the geodatabase as new dams are constructed and as the condition of dams changes over time.		Dam Failure	ADEM					New		
New	Develop Emergency Action Plans for all high hazard dams, including the development of inundation maps.		Dam Failure	AEMA; ADEM					New		

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New	Coordinate an education campaign to notify the public about dam inundation areas and explain to them their risk.		Dam Failure	AEMA; ADEM					New		
New	Educate dam owners on the importance of dam safety, especially with regards to public access to dams and dam maintenance.		Dam Failure	AEMA; ADEM					New		
New	Develop agreements for secondary water sources that may be used during drought conditions.		Drought	ADEM					New		
New	Partner with the Alabama Cooperative Extension System to educate stakeholders and the public about the resources available through http://drought.aces.edu/ regarding the risk of drought and how to prepare for and mitigate effects of drought.		Drought	AEMA; ACES					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
New	Develop standard ordinance language that considers the effects of soil liquefaction in the design of new buildings and infrastructure such as bridges, embankment dams and retaining structures.		Earthquake	AL USGS; AEMA					New		
New	Create a seismic safety committee to provide policy recommendations, evaluate and recommend changes in seismic safety standards, and give an annual assessment of local and statewide implementation of seismic safety improvements.		Earthquake	AL USGS; AEMA					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
New	Facilitate outreach to communities in the northwestern part of the state to educate homeowners and homebuilders about methods to strengthen and retrofit non-reinforced masonry buildings and non-ductile concrete facilities that are particularly vulnerable to ground shaking.		Earthquake	AEMA; AL USGS; ACES					New		
New	Identify new locations for state temporary relief centers from extreme temperature events, especially extreme cold, and educate residents of the location of these centers.		Extreme Cold	AEMA					New		
New	Create statewide minimum standards of 1 foot freeboard for new and substantially improved buildings.		Flood	AEMA; Alabama Building Commission					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
New	Plant soil-stabilizing vegetation on steep, publicly-owned slopes to prevent roadway damage and traffic disruptions from landslides.		Landslide	ALDOT					New		
New	Retrofit existing state-owned facilities with surge protection systems to protect these facilities against damage from lightning.		Lightning	AEMA; ADECA					New		
New	Create a state education program through the Alabama State Department of Education that teaches school children about the dangers of lightning and how to take safety precautions.		Lightning	AEMA; ALSDE					New		
New	Develop a Transportation Resilience Plan for the Port of Mobile.		Sea Level Rise	AEMA; USACE; NWS (NOAA)					New		
New	Perform a state-wide transportation vulnerability assessment.		Sea Level Rise	AEMA; NOAA; USACE					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
New	To prevent property loss, acquire and demolish or relocate buildings and infrastructure in high-risk areas		Sinkholes	AEMA					New		
New	Educate farmers about groundwater withdrawal and water conservation practices.		Sinkholes	AEMA; Alabama Cooperative Extension System (ACES)					New		
New	Educate design professionals about where to locate information on subsidence rates and maps.		Sinkholes	AEMA					New		
New	Develop and maintain a statewide real-time or near real-time record or reporting system of sinkhole, land subsidence, and earthquake events throughout the state.		Sinkholes	AEMA; AL USGS					New		
New	Monitoring areas at risk to subsidence by remaining aware of changes in groundwater levels.		Sinkholes	AL USGS, AEMA					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
New	Develop an online GIS map that shows tsunami runup areas.		Tsunami	Alabama Geographic Information Office (AGIO)					New		
New	Develop and deliver an education program that teaches residents about the risk of submarine landslide induced tsunamis.		Tsunami	AEMA					New		
New	Educate homeowners about the resources available through the Alabama Forestry Commission website regarding protecting homes and forestland from wildfire. http://www.forestry.alabama.gov/homeowner_resources.aspx		Wildfire	AEMA					New		
New	Conduct ongoing outreach to communities to inform residents of state run shelter locations and evacuation routes.		Wind	AEMA					New		
New	Develop standard zoning ordinance language that restricts development in		Wildfire	AEMA; Alabama Forestry Commission					New		

2013 Action #	Action	2013 Obj(s) Adr	Hazard(s) Adr	Resp. Agency	Funding Source	Time-line	Cost	How Action Contributes to Mitigation Strategy	2018 Status (AEMA)	Priority	2018 Proposed Action Changes
	wildland-urban interface zones.										
New	Implement a state fuels management program to reduce hazardous vegetative fuels on public lands, new essential infrastructure, or on private lands by working with landowners.		Wildfire	AEMA; Alabama Forestry Commission					New		
New	Coordinate with neighboring states to offer training courses compatible with the National Wildfire Coordinating Ground Incident Command System.		Wildfire	AEMA; Alabama Forestry Commission					New		
New	Retrofit at least 3 regional shelters to withstand Category 4 wind loads that are located along the I-65 evacuation route from coastal areas.		Wind	AEMA					New		

I. State of Alabama Office of Water Resources Risk MAP Program Business Plan

When describing the Alabama Floodplain Management Program in Section 4.2.4.1, the 2018 Plan Update references the FY17 Risk MAP Program Business Plan developed by ADECA-OWR. This Business Plan outlines the OWR's floodplain management capabilities and accomplishments, and describes how the state plans to restudy various watersheds and build capabilities related to flood risk analysis.

Persons wishing to reference the Business Plan may do so by visiting the following web page: http://www.adeca.alabama.gov/Divisions/owr/floodplain/Documents/State%20of%20Alabama%20Business%20Plan_2017.docx.