

CITY OF AUSTIN HAZARD MITIGATION ACTION PLAN



UPDATE 2021

Maintaining a Safe, Secure, and Sustainable Community



U.S. Department of Homeland Security
FEMA Region 6
800 N. Loop 288
Denton, TX 76209



FEMA

September 15, 2021

Jasper Cooke, Hazard Mitigation Section Chief
Texas Division of Emergency Management
P.O. Box 15467
Austin, TX 78761

RE: Approval of the Austin, Texas Multi-Jurisdiction Hazard Mitigation Plan

Dear Mr. Cooke:

This office has concluded its review of the referenced plan and we are pleased to provide our approval of this plan in meeting the criteria set forth by 44 CFR § 201.6. By receiving this approval, eligibility for the Hazard Mitigation Assistance Grants will be ensured for five years from the date of this letter, expiring on September 14, 2026.

This approval does not demonstrate approval of projects contained in the plan. This office has provided the enclosed Local Hazard Mitigation Planning Tool with reviewer's comments, to further assist the community in refining the plan going forward. Please advise the referenced community of this approval.

If you have any questions, please contact David Freeborn, HM Community Planner, at (940) 898-5323.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald C. Wanhanen".

Ronald C. Wanhanen
Chief, Risk Analysis Branch

Enclosures: Approved Participants

Approved Participants

Attached is the list of approved participating governments included in the September 15, 2021 review of the referenced Hazard Mitigation plan.

Community Name

- 1) Austin city

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BACKGROUND

The City of Austin is the Capital of the State of Texas. It is a vibrant community known for the arts, culture, education, and live music. Austinites share a sense of community pride and a determination towards Austin’s vision, to become the most livable city in the country. Austin residents rate the City of Austin’s services high, especially when compared to other large cities – these high rankings reflect a City government that keeps its vision in the forefront while planning for the future.¹

The City of Austin is the county seat for Travis County and is located on the Colorado River and Interstate Highway 35. It is at the eastern edge of the Hill Country and the Edwards Plateau.

Texas is prone to extremely heavy rains and flooding, holding half of the world-record rainfall rates (48 hours or less).² While flooding is a well-known risk, the City of Austin is susceptible to a wide range of natural hazards, including but not limited to: extreme heat, tornadoes, hail, and wildfires. These life-threatening hazards can destroy property, disrupt the economy, and lower the overall quality of life for individuals.

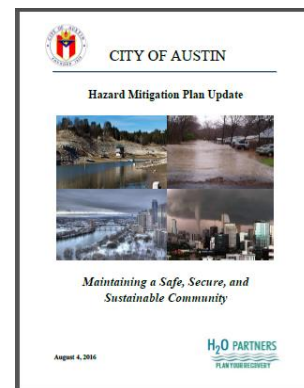
While it is impossible to prevent an event from occurring, the effects from many hazards to people and property can be lessened. This concept is known as hazard mitigation, which is defined by the Federal Emergency Management Agency (FEMA) as *sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects*.³ Communities participate in hazard mitigation by developing hazard mitigation plans. The Texas Division of Emergency Management (TDEM) is required to review the plan before the plan is sent to FEMA for review and final approval in accordance with the Disaster Mitigation Act of 2000.

In 2003, the City of Austin developed its initial Hazard Mitigation Action Plan (HMAP) titled, “Disaster Ready Austin: Building a Safe, Secure and Sustainable Community.” This plan was developed by the City and the Lower Colorado River Authority (LCRA) and was one of the first hazard mitigation plans approved by FEMA in 2004 for the State of Texas. Then in 2008, the City was awarded grant funds to write and develop the HMAP Update. This plan update was approved by FEMA in November 2010. In 2016, the HMAP Update was again updated, and included the City of Austin and the Austin Independent School District (AISD) as participants.

¹ <http://www.austintexas.gov/department/vision-and-values>
² http://floodsafety.com/texas/regional_info/regional_info/austin_zone.htm
³ <http://www.fema.gov/hazard-mitigation-planning-resources>

SECTION 1: INTRODUCTION

The Disaster Mitigation Act requires that hazard mitigation plans be reviewed and revised every 5 years to maintain eligibility for Hazard Mitigation Assistance (HMA) grant funding. Since FEMA originally approved the City of Austin HMAP in 2004, and then approved updates in 2010 and 2016, the City began the process of developing an HMP Update in order to maintain eligibility for grant funding within the 5-year window. The City of Austin selected the consultant team of H2O Partners, Inc. to write and develop the HMAP Update for 2021; hereinafter titled: “City of Austin Hazard Mitigation Plan Update 2021: Maintaining a Safe, Secure, and Sustainable Community” (Plan or Plan Update). The HMAP Update planning process provided an opportunity for the City of Austin to evaluate successful mitigation actions and explore opportunities to avoid future disaster loss.



Hazard mitigation activities are an investment in a community’s safety and sustainability. It is widely accepted that the most effective hazard mitigation measures are implemented at the local government level, where decisions on the regulation and control of development are ultimately made. A comprehensive update to a hazard mitigation plan addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, it is essential that a plan identifies projected patterns of how future development will increase or decrease a community’s overall hazard vulnerability.

The Office of Homeland Security and Emergency Management (HSEM) is responsible for overseeing the development of the Plan Update for the City of Austin. The Vision of HSEM is a disaster-prepared and resilient community; the Mission of HSEM is to serve as the coordinating focal point for preparedness, response, recovery, and education in any emergency or disaster that disrupts the community.⁴

SCOPE AND PARTICIPATION

The City of Austin’s 2021 Plan Update is a single jurisdictional plan. Previously, the plan included the Austin Independent School District (AISD) along with the City, however, AISD did not participate in this update. Therefore, the City of Austin is the single jurisdiction within this Plan Update.

The focus of the 2021 Plan Update is to identify activities to mitigate hazards classified as “high” or “moderate” risk, as determined through a detailed hazard risk assessment conducted for the City of Austin. The hazard classification enables the City to prioritize mitigation actions based on hazards which can present the greatest risk to lives and property in the geographic scope (i.e. planning area).

PURPOSE

The 2021 Plan Update was prepared by the City of Austin and H2O Partners, Inc. The purpose of the Plan Update is to protect people and structures, and to minimize the costs of disaster response and recovery. The goal of the Plan Update is to minimize or eliminate long-term risks to human life and property from known hazards, by identifying and implementing cost-effective

⁴ <http://www.austintexas.gov/department/about-hsem>

SECTION 1: INTRODUCTION

hazard mitigation actions. The planning process is an opportunity for the City of Austin, stakeholders, and the general public to evaluate and develop successful hazard mitigation actions, reducing the future risk of fatalities and property damage resulting from a disaster in the Austin planning area.

The Mission Statement of the Plan Update is: *“Maintaining a secure and sustainable future through the revision and development of targeted hazard mitigation actions to protect life and property.”*

The City of Austin and planning participants identified 12 natural hazards and 6 human-caused hazards to be addressed by the Plan Update. The specific goals of the Plan Update are to:

- Provide a comprehensive update to the 2016 HMAP;
- Minimize disruption to the City of Austin following a disaster;
- Streamline disaster recovery by articulating actions to be taken before a disaster strikes in order to reduce or eliminate future damage;
- Demonstrate a firm local commitment to hazard mitigation principles;
- Serve as a basis for future funding that may become available through grant and technical assistance programs offered by the State or Federal government. The Plan Update will enable the City of Austin to take advantage of rapidly developing mitigation grant opportunities as they arise; and
- Ensure that the City of Austin maintain eligibility for the full range of future Federal disaster relief.

AUTHORITY



The Plan Update is tailored specifically for the City of Austin, and plan participants including Planning Team members, stakeholders, and the general public who participated in the Plan Update development process. The Plan Update complies with all requirements promulgated by the Texas Division of Emergency Management (TDEM), all applicable provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390), and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108-264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). Additionally, the Plan complies with the Interim Final Rules for the Hazard Mitigation Planning and Hazard Mitigation Grant Program (44 CFR, Part 201), which specify the criteria for approval of mitigation plans required in Section 322 of the DMA 2000 and standards found in FEMA’s “Local Mitigation Plan Review Guide” (October 2011) and the “Local Mitigation Planning Handbook” (March 2013). Additionally, the Plan is developed in accordance with FEMA’s Community Rating System (CRS) Floodplain Management Plan standards and policies.

SUMMARY OF SECTIONS

Sections 1 and 2 of the Plan Update outline the Plan’s purpose and development, including how Planning Team members, stakeholders, and members of the general public were involved in the planning process. Section 3 profiles the planning area’s population and economy.

SECTION 1: INTRODUCTION

Sections 4 through 22 present a hazard overview and information on individual natural hazards in the planning area. The hazards generally appear in order of priority based on potential losses to life and property and other community concerns. For each hazard, the Plan Update presents a description of the hazard, a list of historical hazard events, and the results of the vulnerability and risk assessment process.

Section 23 presents hazard mitigation goals and objectives. Section 24 gives an analysis for the previous actions and Section 25 presents hazard mitigation actions for the City of Austin. Section 26 identifies Plan maintenance mechanisms.

A list of Planning Team members is located in Appendix A. Public survey results are analyzed and presented in Appendix B. Appendix C contains a detailed list of critical facilities for the planning area, and Appendix D provides a list of dam locations. Appendix E contains information regarding workshops, including meeting documentation. The Capability Assessment for the City of Austin is located in Appendix F. The Watershed Protection Department's 5-Year Project list is located in Appendix G, and Appendix H contains the Climate Resilience Action Plan.⁵

⁵ Information contained in some of these appendices are exempt from public release under the Freedom of Information Act (FOIA).

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PLAN PREPARATION AND DEVELOPMENT

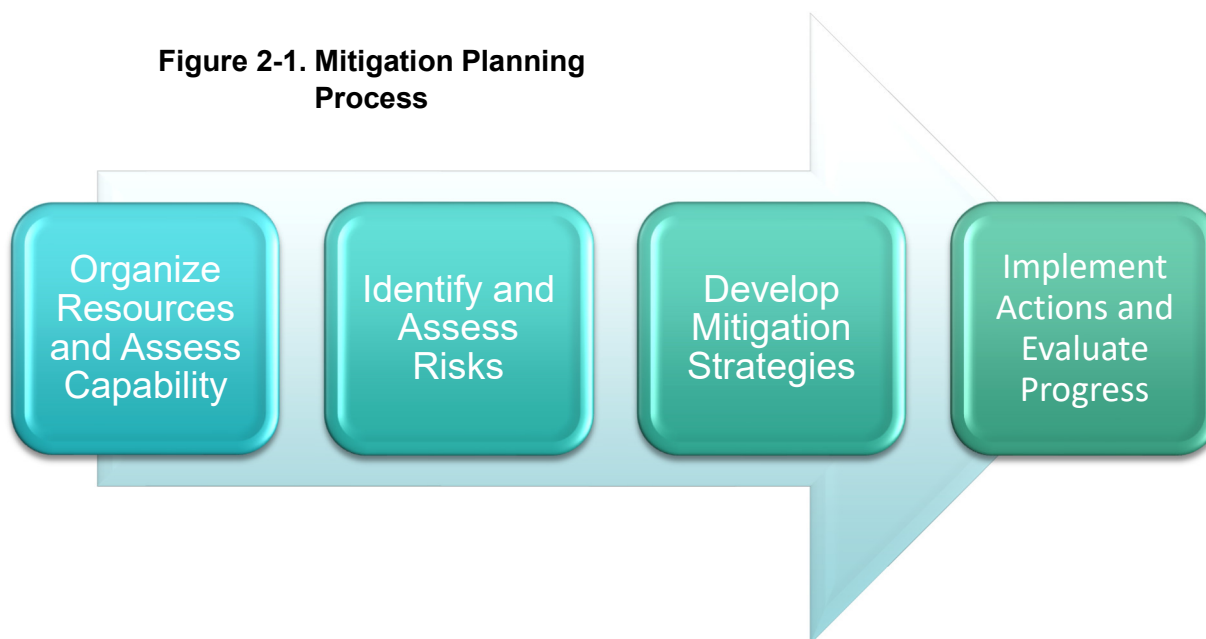
Hazard mitigation planning involves coordination with various constituents and stakeholders to develop a more disaster-resistant community. Section 2 provides an overview of the planning process, including the identification of key steps and a detailed description of how stakeholders and the public were involved.

OVERVIEW OF THE PLAN

The City of Austin hired H2O Partners, Inc. (Consultant Team), to provide technical support and oversee the development of the 2021 Plan Update. The Consultant Team used the Federal Emergency Management Agency’s (FEMA) “Local Mitigation Plan Review Guide” (October 1, 2011) and the “Local Mitigation Planning Handbook” (March 2013) to develop the Plan. The overall planning process is shown in Figure 2-1 below.

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Figure 2-1. Mitigation Planning Process



The City of Austin and the Consultant Team met in January 2020 to begin organizing resources, identifying Planning Team members, and conducting a Capability Assessment.

PLANNING TEAM

Key members of H2O Partners, Inc. developed the Plan Update in conjunction with the Planning Team. The Planning Team was established using a direct representation model. Some of the responsibilities of the Planning Team included: completing Capability Assessment surveys, providing input regarding the identification of hazards, identifying mitigation goals, and developing mitigation strategies. As shown in Table 2-1, an Executive Planning Team consisting of key personnel from the Office of Homeland Security and Emergency Management to coordinate planning efforts and request input and participation in the planning process. Table 2-2 reflects the Advisory Planning Team, consisting of additional representatives from city departments that participated throughout the planning process.

Table 2-1. Executive Planning Team

DEPARTMENT	TITLE
Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
Office of Homeland Security & Emergency Management	Director
Office of Homeland Security & Emergency Management	Program Manager
Office of Homeland Security & Emergency Management	Assistant Director

SECTION 2: PLANNING PROCESS

DEPARTMENT	TITLE
Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
Office of Homeland Security & Emergency Management	Accountant
Office of Homeland Security & Emergency Management	Public Information & Marketing Program Manager
Office of Homeland Security & Emergency Management	Community Preparedness Program Coordinator

Table 2-2. Advisory Planning Team

DEPARTMENT	TITLE
Austin Code Department	Assistant Director
Austin Fire Department	Fire Chief
Austin Fire Department	Fire Chief
Austin Police Department	Police Chief
Austin Police Department	Senior Police Officer Emergency Management Unit
Austin Police Department	Emergency Plans Officer
Austin Police Department	Emergency Plans Officer
Austin / Travis County Emergency Medical Services	Division Chief – Emergency Management
Austin / Travis County Health & Human Services Department	Chief Epidemiologist
Austin / Travis County Health & Human Services Department	Program Manager Epidemiology
Austin Water	Emergency Manager
Austin Water	Utility Emergency Management Coordinator
Communications & Technology Management	Chief Information Security Officer
Communications & Technology Management	Chief Information Officer
Communications & Technology Management	Chief of IT Operations

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DEPARTMENT	TITLE
Communications & Technology Management	Information Security Architect
Emergency Medical Services	Division Chief
Equity Office	Chief Equity Officer
Equity Office	Business Process Specialist
Fleet Services	Assistant Director
Fleet Services	Division Manager
Office of Sustainability	Environmental Conservation Program Manager
Travis County Office of Emergency Management	Chief Emergency Management Coordinator
Watershed Protection Department	Floodplain Coordinator

Additionally, a Stakeholder Group was invited to participate in the planning process via e-mail. The Consultant Team, Planning Team, and Stakeholder Group coordinated to identify mitigation goals and develop mitigation strategies and actions for the Plan Update. Appendix A provides a complete listing of all participating Planning Team members and stakeholders by organization and title.

Based on results of the completed Capability Assessment, the City of Austin described methods for achieving future hazard mitigation measures by expanding existing capabilities. For example, the City of Austin may consider developing a Community Wildfire Protection Plan (CWPP). Other options for improving capabilities include the following:

- Establishing Planning Team members with the authority to monitor the Plan Update and identify grant funding opportunities for expanding staff.
- Identifying opportunities for cross-training or increasing the technical expertise of staff by attending free training available through FEMA and the Texas Division of Emergency Management (TDEM), and by monitoring classes and availability through preparingtexas.org.
- Reviewing current floodplain ordinances for opportunities to increase resiliency, (above current standards) such as modifying permitting or building codes.
- Developing ordinances that will require all new developments to conform to the higher mitigation standards, exceeding current requirements.

Sample hazard mitigation actions developed with similar hazard risk were shared at the meetings. These important discussions resulted in development of multiple mitigation actions that are included in the Plan Update to further mitigate risk from natural hazards in the future.

SECTION 2: PLANNING PROCESS

The Planning Team developed hazard mitigation actions for mitigating risk from potential flooding and wildfire; these actions include upgrading storm drainage systems and restricting future development in high risk areas. The Plan Update also includes an action to provide back-up generators to all grant funded critical facilities to ensure continuity of operations after a hazard event.

PLANNING PROCESS

The process used to prepare the 2021 Plan Update followed the four major steps included in Figure 2-1. After the Planning Team was organized, a capability assessment was developed and distributed at the Kick-Off Workshop. Hazards were identified and assessed, and results associated with each of the hazards were provided at the Risk Assessment Workshop. Based on the City of Austin's identified vulnerabilities, specific mitigation strategies were discussed and developed at the Mitigation Strategy Workshop. Finally, Plan maintenance and implementation procedures were developed and are included in Section 26. Participation of Planning Team members, stakeholders, and the public at each of the workshops is documented in Appendix E.

At the Plan Update development workshops held throughout the planning process described herein, the following factors were taken into consideration:

- The nature and magnitude of risks currently affecting the community;
- Hazard mitigation goals to address current and expected conditions;
- Whether current resources will be sufficient for implementing the Plan Update;
- Implementation problems, such as technical, political, legal, and coordination issues that may hinder development;
- Anticipated outcomes; and
- How the City of Austin, agencies, and partners will participate in implementing the Plan Update.

KICKOFF WORKSHOP

The Kickoff Workshop was held at the Combined Transportation, Emergency & Communications Center on January 29, 2020. The initial workshop informed City officials and key department personnel about how the planning process pertained to their distinct roles and responsibilities, and engaged stakeholder groups such as neighboring counties' EMCs, local community college and universities, local hospitals, and the Red Cross. In addition to the kickoff presentation, participants received the following information:

- Project overview regarding the planning process;
- Public survey access information;
- Hazard Ranking form; and
- Capability Assessment survey for completion.

A risk ranking exercise was conducted at the Kickoff Workshop to get input from the Planning Team and stakeholders pertaining to various risks from a list of natural hazards affecting the planning area. Participants ranked hazards from high to low in terms of perceived level of risk, frequency of occurrence, and potential impact.

SECTION 2: PLANNING PROCESS

HAZARD IDENTIFICATION

At the Kickoff Workshop and through e-mail and phone correspondence, the Planning Team conducted preliminary hazard identification. In coordination with the Consultant Team, the Planning Team reviewed and considered a full range of natural hazards. Once identified, the teams narrowed the list to significant hazards by reviewing hazards affecting the area as a whole, the 2018 State of Texas Hazard Mitigation Plan Update, and initial study results from reputable sources such as federal and state agencies. Based on this initial analysis, the teams identified a total of 12 natural hazards and 6 human-caused hazards which pose a significant threat to the planning area.

RISK ASSESSMENT

An initial risk assessment for the City of Austin was completed in June 2020 and results were presented to Planning Team members at the Risk Assessment Workshop webinar held on June 29, 2020. At the workshop, the characteristics and consequences of each hazard were evaluated to determine the extent to which the planning area would be affected in terms of potential danger to property and citizens.

Potential dollar losses from each hazard were estimated using NOAA's National Centers for Environmental Information (NCEI). The damages given are for property and crop damage. The resulting risk assessment profiled hazard events, provided information on previous occurrences, estimated probability of future events, and detailed the spatial extent and magnitude of impact on people and property. Each participant at the Risk Assessment Workshop was provided a risk ranking sheet that asked participants to rank hazards in terms of the probability or frequency of occurrence, extent of spatial impact, and the magnitude of impact. The results of the ranking sheets identified unique perspectives on varied risks throughout the planning area.

The assessments were also used to set priorities for hazard mitigation actions based on potential loss of life and dollar losses. A hazard profile and vulnerability analysis for each of the hazards can be found in Sections 4 through 22.

MITIGATION REVIEW AND DEVELOPMENT

Developing the Mitigation Strategy for the Plan Update involved identifying mitigation goals and new mitigation actions. A Mitigation Workshop webinar was held on June 29, 2020, in conjunction with the Risk Assessment Workshop webinar. In addition to the Planning Team, stakeholder groups were invited to attend the workshop. Regarding hazard mitigation actions, Workshop participants emphasized the desire for actions that addressed flood and wildfire hazards. Additionally, the City was proactive in identifying mitigation actions to lessen the risk of all the identified hazards included in the Plan Update.

An inclusive and structured process was used to develop and prioritize new hazard mitigation actions for the 2021 Plan Update. The prioritization method was based on FEMA's STAPLE(E) criteria and included social, technical, administrative, political, legal, economic, and environmental considerations. As a result, each Planning Team Member assigned an overall priority to each hazard mitigation action. The overall priority of each action is reflected in the hazard mitigation actions found in Section 25.

Planning Team Members then developed action plans identifying proposed actions, costs and benefits, the responsible organization(s), effects on new and existing buildings, implementation schedules, priorities, and potential funding sources.

SECTION 2: PLANNING PROCESS

Specifically the process involved:

- Listing optional hazard mitigation actions based on information collected from previous plan reviews, studies, and interviews with federal, state, and local officials. Workshop participants reviewed the optional mitigation actions and selected actions that were most applicable to their area of responsibility, cost-effective in reducing risk, easily implemented, and likely to receive institutional and community support.
- Workshop participants inventoried federal and state funding sources that could assist in implementing the proposed hazard mitigation actions. Information was collected, including the program name, authority, purpose of the program, types of assistance and eligible projects, conditions on funding, types of hazards covered, match requirements, application deadlines, and a point of contact.
- Planning Team Members considered the benefits that would result from implementing the hazard mitigation actions compared to the cost of those projects. Although detailed cost-benefit analyses were beyond the scope of the Plan Update, Planning Team Members utilized economic evaluation as a determining factor between hazard mitigation actions.
- Planning Team Members then selected and prioritized mitigation actions.

Hazard mitigation actions identified in the process were made available to the Planning Team for review. The draft 2021 Plan Update was posted on the City of Austin's website.

REVIEW AND INCORPORATION OF EXISTING PLANS

REVIEW

Background information utilized during the planning process included various studies, plans, reports, and technical information from sources such as FEMA, the United States Army Corps of Engineers (USACE), the U.S. Fire Administration, National Oceanic and Atmospheric Administration (NOAA), the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), the Texas State Data Center, Texas A&M Forest Service, the Texas Division of Emergency Management (TDEM), and local hazard assessments and plans. Section 4 and the hazard-specific sections of the Plan (Sections 5-22) summarize the relevant background information.

Specific background documents, including those from FEMA, provided information on hazard risk, hazard mitigation actions currently being implemented, and potential mitigation actions. Previous hazard events, occurrences, and descriptions were identified through NOAA's National Centers for Environmental Information (NCEI). Results of past hazard events were found through searching the NCEI. The USACE studies were reviewed for their assessment of risk and potential projects in the region. State Data Center documents were used to obtain population projections. The State Demographer webpages were reviewed for population and other projections included in Section 3 of the Plan Update. Information from the Texas A&M Forest Service was used to appropriately rank the wildfire hazard and to help identify potential grant opportunities. Materials from FEMA and TDEM were reviewed for guidance on Plan Update development requirements.

INCORPORATION OF EXISTING PLANS INTO THE HMAP PROCESS

A Capability Assessment was completed by key City of Austin's departments and provided information pertaining to existing plans, policies, ordinances, and regulations to be integrated into

SECTION 2: PLANNING PROCESS

the goals and objectives of the Plan Update. The relevant information was included in a master Capability Assessment, Appendix F.

Existing projects and studies were utilized as a starting point for discussing hazard mitigation actions among Planning and Consultant Team members. For example, the City of Austin's Watershed Protection Department has included projects from their five-year Capital Improvement Program to address flooding and associated water quality and erosion issues. Other plans were reviewed, such as the Climate Resilience Action Plan, which provides an overview of climate projects for Austin, an assessment of potential extreme weather impacts to City-owned assets and operations, and strategies to mitigate those impacts. This plan has been included in Appendix H and actions have been included in Section 25. Finally, the 2018 State of Texas Mitigation Plan Update, developed by TDEM, was discussed in the initial planning meeting in order to develop a specific group of hazards to address in the planning effort. The 2018 State Plan Update was also used as a guidance document along with FEMA materials in the development of the City of Austin Plan Update.

INCORPORATION OF THE HMAP INTO OTHER PLANNING MECHANISMS

Planning Team members will integrate implementation of the Plan Update with other planning mechanisms for the City of Austin, such as the Emergency Management Plan. Existing plans for the City of Austin will be reviewed and incorporated into the Plan Update as appropriate. This section discusses how the Plan Update will be implemented by the City of Austin. It also addresses how the Plan Update will be evaluated and improved over time, and how the public will continue to be involved in the hazard mitigation planning process.

The City of Austin will be responsible for implementing hazard mitigation actions contained in Section 25. Each hazard mitigation action has been assigned to a specific City department that is responsible for tracking and implementing the action.

A funding source has been listed for each identified hazard mitigation action and may be utilized to implement the action. An implementation time period has also been assigned to each hazard mitigation action as an incentive and to determine whether actions are implemented on a timely basis.

The City of Austin will integrate hazard mitigation actions contained in the Plan Update with existing planning mechanisms such as floodplain ordinances, Emergency Operation Plans, Evacuation Plans, and other local and area planning efforts. The City of Austin will work closely with area organizations to coordinate implementation of hazard mitigation actions that benefit the planning area financially and economically.

Upon formal adoption of the 2021 Plan Update, Planning Team members from the City of Austin will review existing plans along with building codes to guide development and ensure that hazard mitigation actions are implemented. Each of the departments will be responsible for coordinating periodic review of the Plan Update with members of the Planning Team to ensure integration of hazard mitigation strategies into these planning mechanisms and codes. The Planning Team will also conduct periodic reviews of various existing planning mechanisms and analyze the need for any amendments or updates in light of the approved Plan Update. The City of Austin will ensure that future long-term planning objectives will contribute to the goals of the Plan Update to reduce the long-term risk to life and property from moderate and high risk hazards. Within one year of

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formal adoption of the Plan Update, existing planning mechanisms will be reviewed and analyzed as they pertain to the Plan Update.

Planning Team members will review and revise, as necessary, the long-range goals and objectives in its strategic plan and budgets to ensure that they are consistent with the Plan Update.

Furthermore, the City of Austin will work with neighboring jurisdictions to advance the goals of the Plan Update as it applies to ongoing, long-range planning goals and actions for mitigating risk from natural hazards throughout the planning area.

Table 2-3 identifies types of planning mechanisms and examples of methods for incorporating the Plan Update into other planning efforts.

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Table 2-3. Examples of Methods of Incorporation

Planning Mechanism	Incorporation of Plan
Grant Applications	The Plan Update will be evaluated by the City of Austin when grant funding is sought for mitigation projects. If a project is not in the Plan Update, an amendment may be necessary to include the action in the Plan Update.
Annual Budget Review	Various departments and key personnel that participated in the planning process for the City of Austin will review the Plan Update and mitigation actions therein when conducting their annual budget review. Allowances will be made in accordance with grant applications sought and mitigation actions that will be undertaken per the implementation schedule of the specific action.
Regulatory Plans	Currently, the City of Austin has regulatory plans in place, such as Emergency Management Plans, Continuity of Operations Plans, Land Use Plans, and Evacuation Plans. The Plan Update will be consulted when City departments review or revise their current regulatory planning mechanisms or in the development of regulatory plans that are not currently in place.
Capital Improvement Plan	The City of Austin has a Capital Improvement Plan (CIP) in place. Prior to any revisions to the CIP, City departments will review the risk assessment and mitigation strategy sections of the HMAP, as limiting public spending in hazardous zones is one of the most effective long-term mitigation actions available to local governments.
Floodplain Management Plan	Floodplain management plans include preventative and corrective actions to address the flood hazard. Therefore, the actions for flooding and information found in Section 5 of this Plan Update discussing the people and property at risk to flood will be reviewed and revised when the City of Austin updates their management plans or develops new plans.

Appendix F provides an overview of Planning Team members' existing planning and regulatory capabilities to support implementation of mitigation strategy objectives. Appendix F also provides further analysis of how each jurisdiction intends to incorporate hazard mitigation actions into existing plans, policies, and the annual budget review as it pertains to prioritizing grant applications for funding and implementation of identified hazard mitigation projects.

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It should be noted for the purposes of the plan update that the 2016 HMAP has been used as a reference when reviewing and updating all plans and ordinances for the City of Austin. The Emergency Management Plan, which provides strategic guidance for city departments, is updated every 5 years and incorporates goals, objectives and actions identified in the current 2016 mitigation plan.

PLAN REVIEW AND PLAN UPDATE

For the development of the Plan Update, the City of Austin will oversee the review and update process for relevance and to make necessary adjustments. At the beginning of each fiscal year, Planning Team Members will meet to evaluate the Plan Update and review other planning mechanisms to ensure consistency with long-range planning efforts. In addition, planning participants will also meet twice a year by conference call or presentation to re-evaluate prioritization of the hazard mitigation actions and the hazard assessment.

TIMELINE FOR IMPLEMENTING MITIGATION ACTIONS

The Executive Planning Team (Table A-1, Appendix A) will engage in discussions regarding a timeframe for how and when to implement each hazard mitigation action. Considerations include when the action will be started, how existing planning mechanisms' timelines affect implementation, and when the action should be fully implemented. Timeframes may be general and there will be short, medium, and long term goals for implementation; these goals will be based on prioritization of each action as identified on individual Hazard Mitigation Action worksheets included in the Plan Update for the City of Austin.

The Executive Planning Team will evaluate and prioritize the most suitable hazard mitigation actions for the community to implement. The timeline for implementation of actions will partially be directed by the City of Austin's comprehensive planning process, budgetary constraints, and community needs. The City committed to addressing and implementing hazard mitigation actions that may be aligned with and integrated into the Plan Update.

Overall, the Planning Team is in agreement that the goals and actions of the Plan Update shall be aligned with the timeframe for implementation of hazard mitigation actions, with respect to annual review and updates of existing plans and policies.

PUBLIC AND STAKEHOLDER INVOLVEMENT

An important component of hazard mitigation planning is public participation and stakeholder involvement. Input from individual citizens and the community as a whole provides the Planning Team with a greater understanding of local concerns and increases the likelihood of successfully implemented hazard mitigation actions. If citizens and stakeholders such as local businesses, non-profits, hospitals, and schools are involved, they are more likely to gain a greater appreciation of the risks that hazards may present in their community and take steps to reduce or mitigate their impact.

The public was involved in the development of the City of Austin's 2021 Plan Update at different stages prior to official Plan Update approval and adoption. Public input was sought using three methods: (1) open public meetings; (2) survey instruments; and (3) making the draft Plan Update available for public review at the City of Austin's website.

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The draft 2021 Plan Update was made available to the general public for review and comment on the City of Austin website. The public was notified at the public meetings that the draft Plan Update would be available for review online. Feedback was collected via email. Feedback was received from the public survey and all relevant information was incorporated into the Plan Update. Information that was obtained from the survey assisted in determining the community’s concern about risk which drove the focus of the plan on areas of concern and assisted in the development of mitigation actions.

The 2021 Plan Update will be advertised and posted on the City of Austin’s website upon approval from FEMA and a copy will be kept in the Office of Homeland Security and Emergency Management.

STAKEHOLDER INVOLVEMENT

Stakeholder involvement is essential to hazard mitigation planning since a wide range of stakeholders can provide input on specific topics and input from various points of view. Throughout the planning process, members of community groups, local businesses, neighboring jurisdictions, schools, and hospitals were invited to participate in the development of the 2021 Plan Update. The Stakeholder Group (Appendix A, Table A-3, and Table 2-4, below), included a broad range of representatives from both the public and private sector and served as a key component in the City of Austin’s outreach efforts for development of the Plan Update. Documentation of stakeholder meetings is found in Appendix E. A list of organizations invited to attend via e-mail is found in Table 2-4.

Table 2-4. Stakeholder Working Group

AGENCY	TITLE	PARTICIPATED
Ascension Seton Hospital	Project Coordinator, Emergency Disaster Preparedness	
Austin Area Legislators (Senators and Representatives)	Intergovernmental Relations Officer	
Austin Area Legislators	Intergovernmental Relations Deputy Officer	
Austin Community College (ACC)	Emergency Management, Department Chair	
Austin Community College (ACC)	District Police Chief	
Austin Independent School District (AISD)	Superintendent	
Capital Area Council of Governments (CAPCOG)	Director, Homeland Security	
Capital Area Council of Governments (CAPCOG)	Homeland Security Planning Coordinator	
Capital Area Metropolitan Planning Organization (CAMPO)	Planner	
Capital Area Metropolitan Planning Organization (CAMPO)	Executive Director	

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AGENCY	TITLE	PARTICIPATED
Capital Area Trauma Regional Advisory Council (CATRAC)	Executive Director	
Capital Metro	Chief Operations Officer	
Capital Metro	VP Risk Management and Safety	
Hays County EMC	Interim Director Emergency Services	
Integral Care (Austin/Travis County)	Practice Administrator, Crisis	
Integral Care (Austin/Travis County)	Facilities Director	
Integral Care (Austin/Travis County)	Facilities Manager	
Red Cross	Disaster Services Manager	
Red Cross	Red Cross Disaster Program Specialist	
St. Edward's University	Emergency Management, Department Chair	
TDEM	Planner	X
Travis County EMC	Chief Emergency Management Coordinator	
Travis County Medical Society	Chief Operations Officer	
University of Texas	Director, Office of Emergency Preparedness	
Williamson County EMC	Director / Emergency Management Coordinator	

Stakeholders and participants from neighboring communities that attended the Planning Team and public meetings played a key role in the planning process. For example, flooding and extreme heat were major concerns to the stakeholders, so the City of Austin included mitigation actions, such as constructing flood control and access improvements to protect and provide access to the Sand Hill Energy Center and the South Austin Regional Wastewater Treatment Plan and providing weather safety training to City of Austin staff, especially staff working outside.

PUBLIC MEETINGS

A series of public meetings were held throughout the planning area to collect public and stakeholder input. Topics of discussion included the purpose of hazard mitigation, discussion of the planning process, and types of natural hazards. Representatives from area neighborhood associations and area residents were invited to participate. Additionally, the City of Austin utilized social media sources including Facebook, Twitter, and the local media to increase public

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participation in the Plan Update development process. Documentation on the public meetings can be found in Appendix E.

Public meetings were held on the following dates and locations:

- July 21, 2020 – Adobe Connect Webinar
- July 23, 2020 – Adobe Connect Webinar
- July 28, 2020 – Adobe Connect Webinar
- July 31, 2020 – Adobe Connect Webinar

PUBLIC PARTICIPATION SURVEY

In addition to public meetings, the Planning and Consultant Teams developed a public survey designed to solicit public input during the planning process from citizens and stakeholders, and to obtain data regarding the identification of any potential hazard mitigation actions or problem areas. The survey was promoted by local officials and a link to the survey was posted on the City of Austin's website. A total of 18 surveys were completed online and the results are analyzed in Appendix B. The City of Austin reviewed the input from the surveys and decided which information to incorporate into the Plan Update as hazard mitigation actions. For example, many citizens discussed community engagement and the City being proactive in getting information out to everyone. In response to public input, several actions were included to enhance existing websites, such as the website for low water crossing closure information and low water crossing cameras.

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OVERVIEW

The City of Austin was founded in 1839 and is the capital of Texas and the county seat for Travis County. In 1839, Waterloo was chosen to be the capital of the new Republic of Texas. A new city was built quickly in the wilderness, and was named after Stephen F. Austin, “the father of Texas”. Judge Edwin Waller, who was later to become the City’s first mayor, surveyed the site and laid out a street plan that has survived largely intact to this day. In October 1839, the entire government of the Republic arrived from Houston in oxcarts. By the next January, the town’s population had grown to 856 people.

The new town plan included a hilltop site for a capitol building looking down toward the Colorado River from the head of a broad Congress Avenue. For over 150 years, “The Avenue” and Pecan Street (now 6th Street) have remained Austin’s principal business streets. After Texas was annexed by the United States in 1845, it took two statewide elections to keep Austin the capital city of Texas. In the 1850’s the City of Austin began to grow with the construction of the permanent capitol building and Governor’s Mansion, along with the arrival of the Houston and Texas Central Railway in 1871. After a fire destroyed the original building, the current Capitol building was completed in 1888.



In 1924, the City of Austin adopted a council-manager government, focusing on City planning and beautification. After the development of the City Plan in 1928, the City of Austin passed a bond that provided for the funding of streets, sewers, libraries, hospitals, and multiple parks. The development of parks, pools and recreational areas, combined with the development of the first municipal airport in 1930, attracted many people to the area. By 1936, the student population for the University of Texas had increased, and the City had funded more municipal projects than any other city in Texas.

The City of Austin is located primarily in Travis County, although part of the City’s border extends into Williamson and Hays Counties. The City of Austin is situated on the Colorado River and is located at the eastern edge of the Hill Country and Edwards Plateau, about 236 miles from the Mexican Border. The western portion of the City is made up of scenic rolling hills and limestone rock, whereas the eastern portion is more flat. Interstate 35 runs through the City of Austin, which

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occupies a total land area of 301.86 square miles in the Central Texas Hill Country. The City of Austin is known for its parks and green space, including greenbelts and lakes – there are three man-made lakes within the City’s limits: Lady Bird Lake, Lake Austin, and Lake Walter E. Long. Additionally, the foot of Lake Travis, including Mansfield Dam, is located within the City’s limits.

Figure 3-1 shows the general location of the City of Austin relative to other area communities within and adjacent to Travis County.

Figure 3-1. Location of City of Austin Planning Area

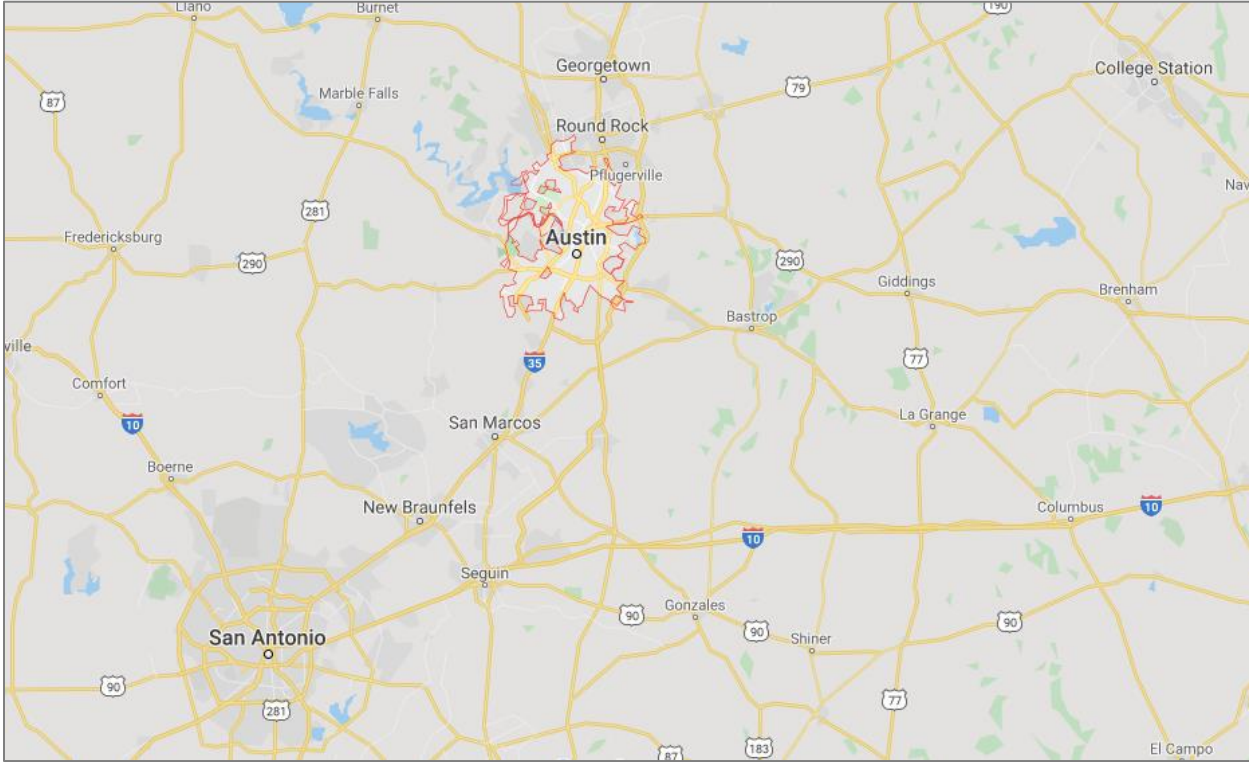
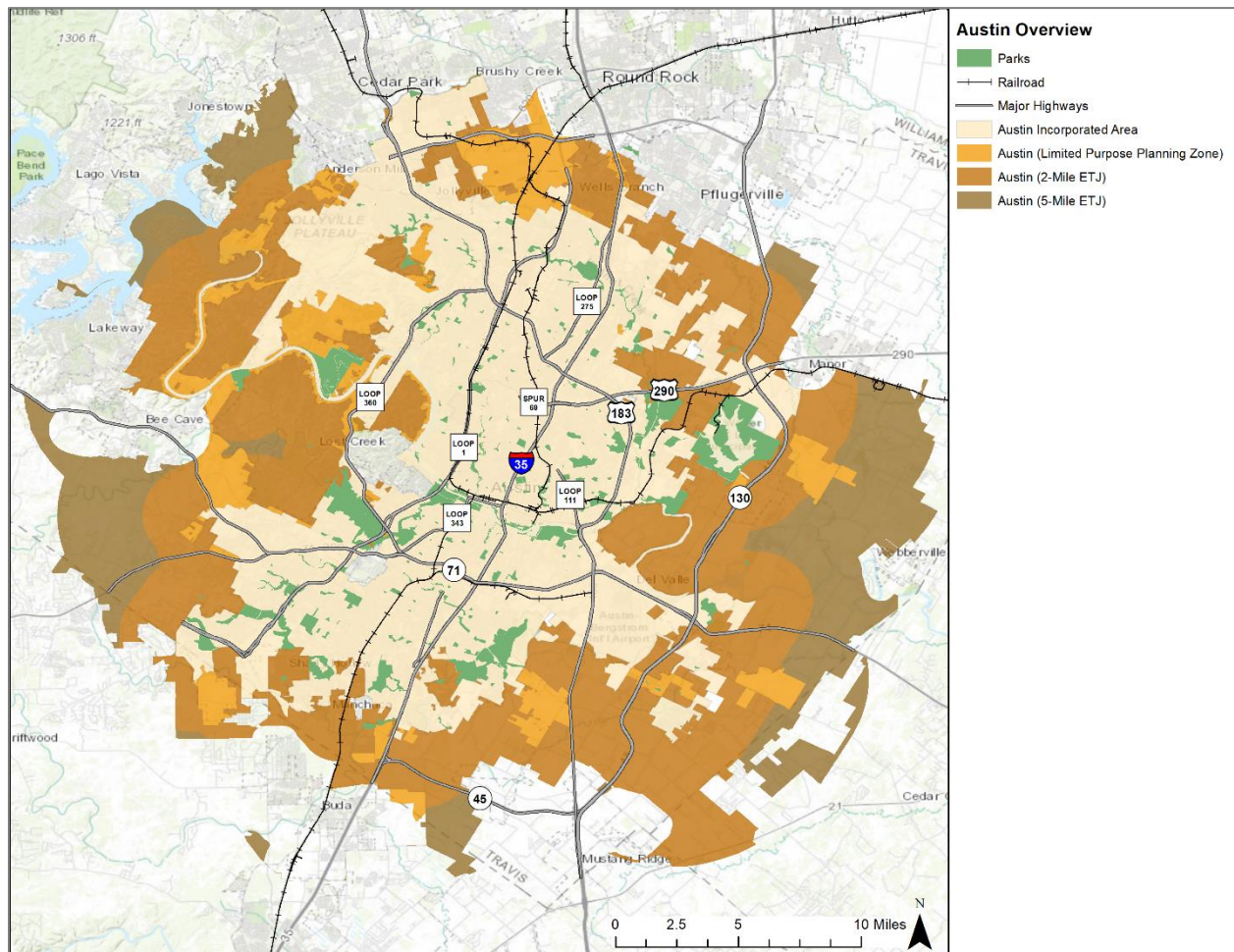


Figure 3-2 shows the city limits of the City of Austin, which makes up the planning area. The planning area for the Plan Update includes all areas within the City of Austin and its Extraterritorial Jurisdictions (ETJ) as displayed in Figure 3-2 below. The ETJ is the unincorporated land within five miles of the City of Austin’s boundary that is not within the City limits or ETJ of another city. It is the territory where the City of Austin alone is authorized to annex land. The ETJ enables the City of Austin to extend regulations to adjacent land where development can affect quality of life within the City.

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Figure 3-2. City of Austin Planning Area



POPULATION AND DEMOGRAPHICS

In the official Census population count, as of April 1, 2010, Austin had a population of 790,390 residents. By 2018, the number was estimated at 935,755. Table 3-1 highlights the vulnerable or sensitive populations in the City of Austin.¹

Between official U.S. Census population counts, the estimate uses a formula based on new residential building permits and household size. It is simply an estimate and there are many variables involved in achieving an accurate estimation of people living in a given area at a given time.

¹ Source: <https://www.census.gov/quickfacts/fact/table/austincitytexas/PST120218> and <https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2018/>

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Table 3-1. Population Distribution for the City of Austin

TOTAL 2010 POPULATION	2018 POPULATION ESTIMATE	ESTIMATED VULNERABLE OR SENSITIVE POPULATIONS ²		
		Youth (Under 5)	Elderly (Over 65)	Below Poverty Level
790,390	935,755	62,257	81,322	135,684

POPULATION GROWTH

The official 2010 Austin population is 790,390. Overall, Austin experienced an increase in population between 1980 and 2010 by 128.51 percent, or an increase by 444,500 people. The City continued to have population growth between 2000 and 2010 by 20.38 percent, or 133,828 people. Table 3-2 provides historic growth rates in the City of Austin. Population growth since the last plan was considered when updating this plan. A larger population means an increase in vulnerability and a growth in vulnerable populations, as well.

Table 3-2. Population for the City of Austin, 1980-2010

1980	1990	2000	2010	POP CHANGE 1980-2010	PERCENT OF CHANGE	POP CHANGE 2000-2010	PERCENT OF CHANGE
345,890	465,622	656,562	790,390	444,500	128.51%	133,828	20.38%

FUTURE DEVELOPMENT

To better understand how future growth and development in the City might affect hazard vulnerability, it is useful to consider population growth, occupied and vacant land, the potential for future development in hazard areas, and current planning and growth management efforts. This section includes an analysis of the projected population change and economic impacts.

Population projections from 2010 to 2040 are listed in Table 3-3, as provided by the Office of the State Demographer, Texas State Data Center, and the Institute for Demographic and Socioeconomic Research. Population projections are based on a 0.5 scenario growth rate, which is 50 percent of the population growth rate that occurred during 2000-2010. This information is only available at the County level; however, the population projection shows an increase in population density for the County, which would mean overall growth for the City of Austin.

² The Estimated Vulnerable or Sensitive Populations are based off of the 2018 American Community Survey.

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Table 3-3. Travis County Population Projections

County	LAND AREA (SQ MI)	2010		2020		2030		2040	
		Population							
		Total Number	Density (Land Area, SQ MI)	Total Number	Density (Land Area, SQ MI)	Total Number	Density (Land Area, SQ MI)	Total Number	Density (Land Area, SQ MI)
Travis	990.2	1,024,266	1,034.40	1,198,485	1,210.35	1,342,829	1,356.12	1,474,822	1,489.42

ECONOMIC IMPACT

The City of Austin has established itself as a world leader in technology, innovation, energy, workforce development, music and creativity that has led to significant business expansion and overall growth. The City strives to serve citizens by influencing and increasing economic development. The Economic Development Department supports and recruits business to Austin through all their divisions: Cultural Arts, Global Business Expansion, Heritage Tourism, Music & Entertainment, Redevelopment, and Small Business. Their mission is to promote a competitive, sustainable and equitable economy for all.

The City of Austin also offers incentive programs such as tax abatements, enterprise zone exemptions, public utility incentives, and financing programs for new and existing companies.

The Austin region is recognized across the country as a top destination for corporate headquarters and supporting facilities. The quality of life, deep talent pool, and strong regional infrastructure help the diverse economy grow every day.

- The region is home to technologies that are innovating the manufacturing sector.
- Austin is leading the clean technology revolution. The city is home to industry-leading wind turbine manufactures, system integrators, and solar companies.
- The Austin region is recognized around the country as a select location for corporate headquarters and supporting facilities.
- The Austin region has become the premier destination for creative and digital media technology.
- A growing data management cluster is at the heart of the region’s high-tech economy.
- Recent economic success stories such as Dimensional Fund Advisors, Charles Schwab, and PIMCO have enhanced and strengthened Austin’s financial services industry cluster.
- Austin’s growing cluster of innovative life sciences companies embraces the area’s technology infrastructure; and
- The Austin region is positioned to offer fertile ground for space-based enterprises to grow.³

³ Source: <https://www.austinchamber.com/economic-development/key-industries>

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EXISTING AND FUTURE LAND USE AND DEVELOPMENT TRENDS

The purpose of the Planning and Zoning Department is to provide planning, preservation and design services to make Austin the most livable city in the country. The City of Austin is committed to improving the experience of residents, small businesses, developers and other stakeholders needing these services.

The *Imagine Austin Comprehensive Plan* provides the roadmap of shaping the Austin of the 21st century by energetically leveraging strengths as the City grows, while turning around the negatives. The distinctive benefit of a comprehensive plan is that it confronts big issues in a big-picture way. Other City of Austin plans are more focused and deal with topics such as parks, solid waste, transportation, water, or smaller geographic areas. But only a comprehensive plan fully considers how the whole community's values, needs, people, and places are interrelated and interdependent. In creating this plan, the defining issues that are central to Austin's future success were identified:

- Preserving the City's Livability
- Expanding Transportation Choices
- Tackling the Ethnic Divide
- Protecting Natural Resources
- Promoting Prosperity for All
- Collaborating Regionally

The vision statement sets forth guidance for the city's growth and development for the next 30 years. The growth concept is illustrated by a series of maps. The Growth Concept Map applies the vision statement to show how the city should evolve over the next several decades. It is informed by existing development patterns, planned projects, and small-area plans, as well as environmental features, and existing and planned transportation networks. The Growth Concept Map illustrated the desired manner to accommodate new residents, jobs, open space, and transportation infrastructure over the next 30 years.⁴

⁴ Source: <http://www.austintexas.gov/department/imagine-austin>

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HAZARD DESCRIPTION

Section 4 is the first phase of the Risk Assessment and provides background information for the hazard identification process and descriptions for the hazards identified. The Risk Assessment continues with Sections 5 through 22, which include hazard descriptions and vulnerability assessments.

Upon a review of the full range of natural hazards suggested under the Federal Emergency Management Agency (FEMA) planning guidance, the City of Austin identified 11 natural hazards, 1 technical hazard, and 6 human-caused hazards that are addressed in the 2021 Hazard Mitigation Plan Update. Of the hazards identified, 11 natural hazards and 1 quasi-technological hazard (dam failure) were identified as significant, as shown in Table 4-1. The hazards were identified through input from Planning Team members and a review of the current 2018 State of Texas Hazard Mitigation Plan Update (State Plan Update). Readily available online information from reputable sources, such as federal and state agencies, were also evaluated and utilized to supplement information as needed.

In general, there are 3 main categories of hazards including: atmospheric, hydrologic, and technological. Atmospheric hazards are events or incidents associated with weather generated phenomenon. Atmospheric hazards that have been identified as significant for the City of Austin Planning area include: extreme heat, hail, hurricane wind, lightning, thunderstorm wind, tornado, and winter storm (Table 4-1).

Hydrologic hazards are events or incidents associated with water related damage and account for over 75 percent of Federal disaster declarations in the United States. Hydrologic hazards identified as significant for the planning area include drought and flood.

For the Risk Assessment, the wildfire and expansive soils hazards are considered “other,” since a wildfire may be natural or human-caused and is not considered atmospheric or hydrologic.

Technological hazards refers to the origins of incidents that can arise from human activities, such as the construction and maintenance of dams. Technological hazards are distinct from natural hazards primarily because they originate from human activity. Whereas the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced. Therefore, dam failure is classified as a quasi-technological hazard, and referred to as “technological” in Table 4-1 for purposes of description.

The human-caused hazards include: cyber attack, hazardous materials, infectious disease, pipeline failure, technological disruption, and terrorism.

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Table 4-1. Descriptions

HAZARD	DESCRIPTION
ATMOSPHERIC	
Extreme Heat	Extreme heat is the condition whereby temperatures hover 10 degrees or more above the average high temperature in a region for an extended period of time.
Hail	Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and subsequent cooling of the air mass.
Hurricane Wind	A hurricane is an intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 mph or higher.
Lightning	Lightning is a sudden electrostatic discharge that occurs during an electrical storm. This discharge occurs between electrically charged regions of a cloud, between two clouds, or between a cloud and the ground.
Thunderstorm Wind	A thunderstorm occurs when an observer hears thunder. Radar observers use the intensity of the radar echo to distinguish between rain showers and thunderstorms. Lightning detection networks routinely track cloud-to-ground flashes, and therefore thunderstorms.
Tornado	A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. The destruction caused by tornadoes ranges from light to catastrophic, depending on the location, intensity, size, and duration of the storm.
Winter Storm	Severe winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Blizzards, the most dangerous of all winter storms, combine low temperatures, heavy snowfall, and winds of at least 35 miles per hour, reducing visibility to only a few yards. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads, and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries to human life.

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HAZARD	DESCRIPTION
HYDROLOGIC	
Drought	A prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality.
Flood	The accumulation of water within a body of water, which results in the overflow of excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding. Most floods fall into the following three categories: riverine flooding, coastal flooding, and shallow flooding.
OTHER	
Expansive Soils	Expansive soils are soils and soft rock that tend to swell or shrink due to changes in moisture content. Changes in soil volume present a hazard primarily to structures built on top of expansive soils.
Wildfire	A wildfire is an uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase the risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors.
TECHNOLOGICAL	
Dam Failure	Dam failure is the collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam.
HUMAN-CAUSED	
Cyber Attack	A cyber attack is any type of offensive maneuver employed by individuals or whole organizations that targets computer information systems, infrastructures, computer networks, and/or personal computer devices by various means of malicious acts usually originating from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system.
Hazardous Materials (Transportation & Fixed-Site)	A hazardous material (solid, liquid, or gaseous contaminants) of flammable or poisonous material that would be a danger to life or to the environment if released without precaution.

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HAZARD	DESCRIPTION
Infectious Disease	A clinically evident disease resulting from the presence of pathogenic microbial agents. These infecting agents may be transmitted through liquids, food, bodily fluids, contaminated objects, airborne inhalation, or through vector-borne dissemination.
Pipeline Failure	Fuel pipeline breach or pipeline failure addresses the rare, but serious hazard of an oil or natural gas pipeline that, when breached, has the potential to cause extensive property damage and loss of life.
Technological Disruption	Technological disruptions can be caused by solar flares, geomagnetic storms, and power disruptions. Solar flares are a sudden, rapid, and intense flash of brightness observed over the sun's surface and they occur when magnetic energy that has built up in the solar atmosphere is suddenly released.
Terrorism	Incidents involving the application of one or more modes of harmful force to the built environment. These modes may include contamination (chemical, biological, radiological, or nuclear), energy (explosives, arson, electromagnetic waves), or denial of service (sabotage, infrastructure breakdown, and transportation service disruption). Terrorism is categorized as either domestic or international.

Hazards that were not considered significant and were not included in the Plan are located in Table 4-2, along with the evaluation process used for determining the significance of each of these hazards. Hazards not identified for inclusion at this time may be addressed during future evaluations and updates.

Table 4-2. Hazard Identification Process

HAZARD CONSIDERED	REASON FOR DETERMINATION
Coastal Erosion	The planning area is not located on the coast, therefore coastal erosion does not pose a risk.
Earthquakes	According to the State Plan, an earthquake occurrence for the planning area is considered exceedingly rare. Earthquake events are not considered to pose a risk to the planning area. There is no history of impact to critical structures, systems, populations or other community assets or vital services as a result of earthquakes and impact is not expected in the future.
Land Subsidence	There are no historical occurrences of land subsidence for the planning area and it is located in an area where occurrences are considered rare. There is no history of impact to critical structures, systems, populations, or other community assets or vital services as a result of land subsidence and impact is not expected in the future.

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NATURAL HAZARDS AND CLIMATE CHANGE

Climate change is defined as a long-term hazard which can increase or decrease the risk of other weather hazards. It directly endangers property and biological organisms due to sea level rise and habitat destruction.

Global climate change is expected to exacerbate the risks of certain types of natural hazards impacted by rising sea levels, warmer ocean temperatures, higher humidity, the possibility of stronger storms, and an increase in wind and flood damages due to storm surges. While sea level rise is a natural phenomenon and has been occurring for several thousand years, the general scientific consensus is that the rate has increased in the past 200 years, from 0.5 millimeters per year to 2 millimeters per year.

Texas is considered one of the more vulnerable states in the U.S. to both abrupt climate changes and to the impact of gradual climate changes to the natural and built environments. Climate impacts which have required tens of millions of dollars to address recovery efforts locally include:

- The summer of 2011, the City of Austin had 90 days with temperatures of at least 100 degrees Fahrenheit.
- Multiple wildfires destroyed over 1,500 homes and 32,000 acres of forest surrounding the nearby City of Bastrop in 2011.
- The Halloween flood of 2013 resulted in loss of life, caused extensive damage to homes and businesses around Onion Creek, and displaced many people from their homes. In addition, the loss of vegetation from intense precipitation combined with prolonged drought conditions may increase flooding severity in the future.

Mega-droughts can trigger abrupt changes to regional ecosystems and the water cycle, drastically increase extreme summer temperature and fire risk, and reduce availability of water resources, as Texas experienced during 2011-2012.

Paleoclimate records also show that the climate over Texas had large changes between periods of frequent mega-droughts and the periods of mild droughts that Texas is currently experiencing. While the cause of these fluctuations is unclear, it would be wise to anticipate that such changes could occur again, and may even be occurring now.

Climate change in Texas is consistent with larger-scale trends observed across the U.S. and the world. Based on the data collected at the Camp Mabry weather station in the City of Austin, projected climate changes include:

- Increases in annual and seasonal average temperatures,
- More frequent high temperature extremes,
- Little change in annual average precipitation,
- More frequent extreme precipitation,
- Slight increase in the number of dry days per year, and
- More frequent drought conditions in summer due to hotter weather.¹

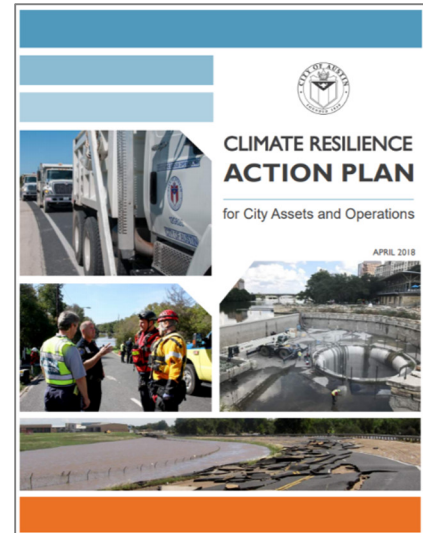
¹ https://austintexas.gov/sites/default/files/files/Sustainability/Climate/Toward_a_Climate_Resilient_Austin.pdf

SECTION 4: RISK OVERVIEW

CLIMATE RESILIENCE ACTION PLAN

Climate resilience is the ability to effectively manage both immediate shocks and long-term stressors related to climate change and weather extremes. Prepared and responsive city systems are the fundamental components of resilience for Austin’s overall community. While immediate response is required in the event of a catastrophe or natural disaster, ongoing adaptation through long-range planning and strengthening City assets and operations will ensure that the City of Austin is always prepared for changing climate conditions.

The Climate Resilience Action Plan, April 2018, provides an overview of climate projections for the City of Austin, an assessment of potential extreme weather impacts to City-owned assets and operations, and strategies to mitigate those impacts. City-owned assets and operations that are critical for overall resilience include (1) Utility infrastructure needed to deliver energy, water, wastewater, and telecommunications utility services to the community; (2) Transportation infrastructure, such as critical arterial roadways, that support the transportation and mobility of citizens; and (3) Community facilities, including recreation and activity centers, libraries, and neighborhood centers, that may be utilized as relief and assistance centers in the event of a disaster.



Climate projects for the City of Austin suggest that there will be an increase in average annual temperatures, with high temperature extremes becoming more common, Precipitation patterns are expected to become more variable, leading to longer periods of drought interspersed with heavy rainfall events.

The Climate Resilience Action Plan builds on current departmental efforts to increase resilience. Initiatives like Water Forward, Austin Water’s 100-year plan to ensure a diversified, sustainable, and resilient water future, demonstrate the City of Austin’s commitment to addressing the impacts of climate change in the community.² The Climate Resilience Action Plan can be found in Appendix H.

OVERVIEW OF HAZARD ANALYSIS

The methodologies utilized to develop the Risk Assessment are a historical analysis and a statistical approach. Both methodologies provide an estimate of potential impact by using a common, systematic framework for evaluation.

Records retrieved from the National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA) were reported for the City of Austin Planning Area. Remaining records identifying the occurrence of hazard events in the planning area and the maximum recorded magnitude of each event were also evaluated.

The use of geographic information system (GIS) technology to identify and assess risks for the City of Austin planning area and evaluate community assets and their vulnerability to the hazards.

² https://austintexas.gov/sites/default/files/files/Sustainability/Climate_Resilience_Action_Plan.compressed.pdf

SECTION 4: RISK OVERVIEW

The four general parameters that are described for each hazard in the Risk Assessment include frequency of return, approximate annualized losses, a description of general vulnerability, and a statement of the hazard's impact.

Frequency of return was calculated by dividing the number of events in the recorded time period for each hazard by the overall time period that the resource database was recording events. Frequency of return statements are defined in Table 4-3, and impact statements are defined in Table 4-4 below.

Table 4-3. Frequency of Return Statements

PROBABILITY	DESCRIPTION
Highly Likely	Event is probable in the next year.
Likely	Event is probable in the next three years.
Occasional	Event is probable in the next five years.
Unlikely	Event is probable in the next ten years.

Table 4-4. Impact Statements

POTENTIAL SEVERITY	DESCRIPTION
Substantial	Multiple deaths. Complete shutdown of facilities for 30 days or more. More than 50 percent of property destroyed or with major damage.
Major	Injuries and illnesses resulting in permanent disability. Complete shutdown of critical facilities for at least 2 weeks. More than 25 percent of property destroyed or with major damage.
Minor	Injuries and illnesses do not result in permanent disability. Complete shutdown of critical facilities for more than 1 week. More than 10 percent of property destroyed or with major damage.
Limited	Injuries and illnesses are treatable with first aid. Shutdown of critical facilities and services for 24 hours or less. Less than 10 percent of property destroyed or with major damage.

Each of the hazard profiles includes a description of a general Vulnerability Assessment. Vulnerability is the total of assets that are subject to damages from a hazard, based on historic recorded damages. Assets in the region were inventoried and defined in hazard zones where appropriate. The total amount of damages, including property and crop damages, for each hazard is divided by the total number of assets (building value totals) in that community to determine the percentage of damage that each hazard can cause to the community.

To better understand how future growth and development in the City might affect hazard vulnerability, it is useful to consider population growth, occupied and vacant land, the potential for future development in hazard areas, and current planning and growth management efforts.

SECTION 4: RISK OVERVIEW

Hazard vulnerability for the City of Austin was reviewed based on recent development changes that occurred throughout the planning area. The City of Austin grew by around 20 percent between 2010 and 2018 according to the U.S. Census Bureau, therefore the vulnerability to the population, infrastructure, and buildings has increased for hazards that do not have a geographical boundary. The City of Austin has participated in multiple activities to reduce flood losses and protect citizens and property. The City participates in the National Flood Insurance Program and regulations apply for buildings in the 25 year and 100 year floodplains. Therefore, vulnerability has not increased for flood.

Once loss estimates and vulnerability were known, an impact statement was applied to relate the potential impact of the hazard on the assets within the area of impact.

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- Location 1
- Extent 5
- Historical Occurrences 8
 - Significant Events 10
- Probability of Future Events 11
- Vulnerability and Impact 11
 - Assessment of Impacts 12
- National Flood Insurance Program (NFIP) Participation 14
- NFIP Compliance and Maintenance 15
- Repetitive Loss 16

HAZARD DESCRIPTION

Floods generally result from excessive precipitation. The severity of a flood event is determined by a combination of several major factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. Typically, floods are long-term events that may last for several days.

The primary types of general flooding are inland and coastal flooding. Inland or riverine flooding is a result of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Inland or riverine flooding is overbank flooding of rivers and streams, typically resulting from large-scale weather systems that generate prolonged rainfall over a wide geographic area, thus it is a naturally occurring and inevitable event. Some river floods occur seasonally when winter or spring rainfalls fill river basins with too much water, too quickly. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

LOCATION

The Flood Insurance Rate Map (FIRM) data provided by FEMA for the City of Austin shows the following flood hazard areas:

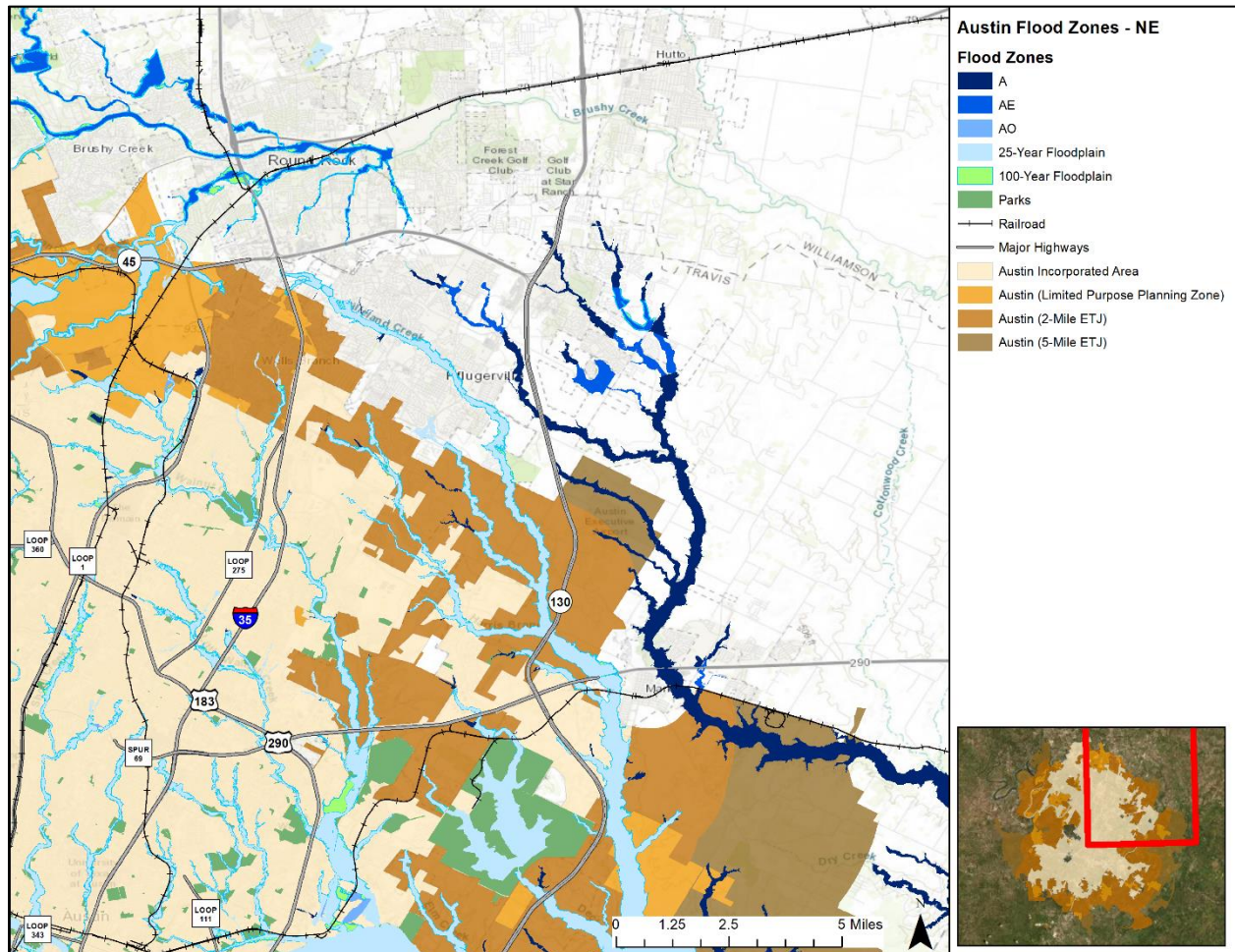
- Zone A: Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance requirements and floodplain management standards apply.
- Zone AE: Areas subject to inundation by 1-percent-annual-chance shallow flooding. It is the base floodplain where BFEs are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
- Zone X: Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-

SECTION 5: FLOOD

percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones.

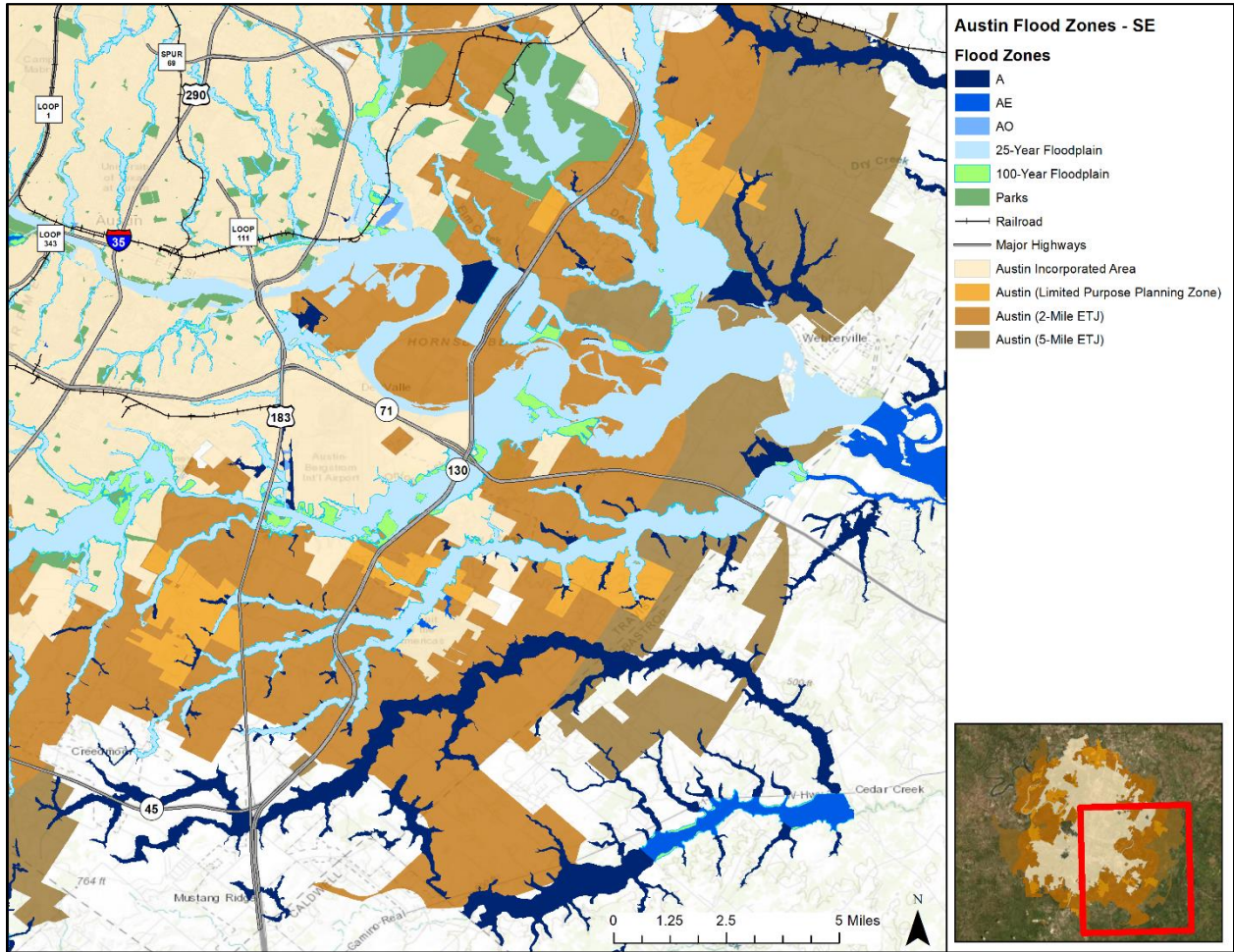
Locations of flood zones in the City of Austin are based on the Digital Flood Insurance Rate Map (DFIRM) from FEMA are detailed below (Figure 5-1 through 5-4).

Figure 5-1. Estimated Flood Zones in Northeast Austin



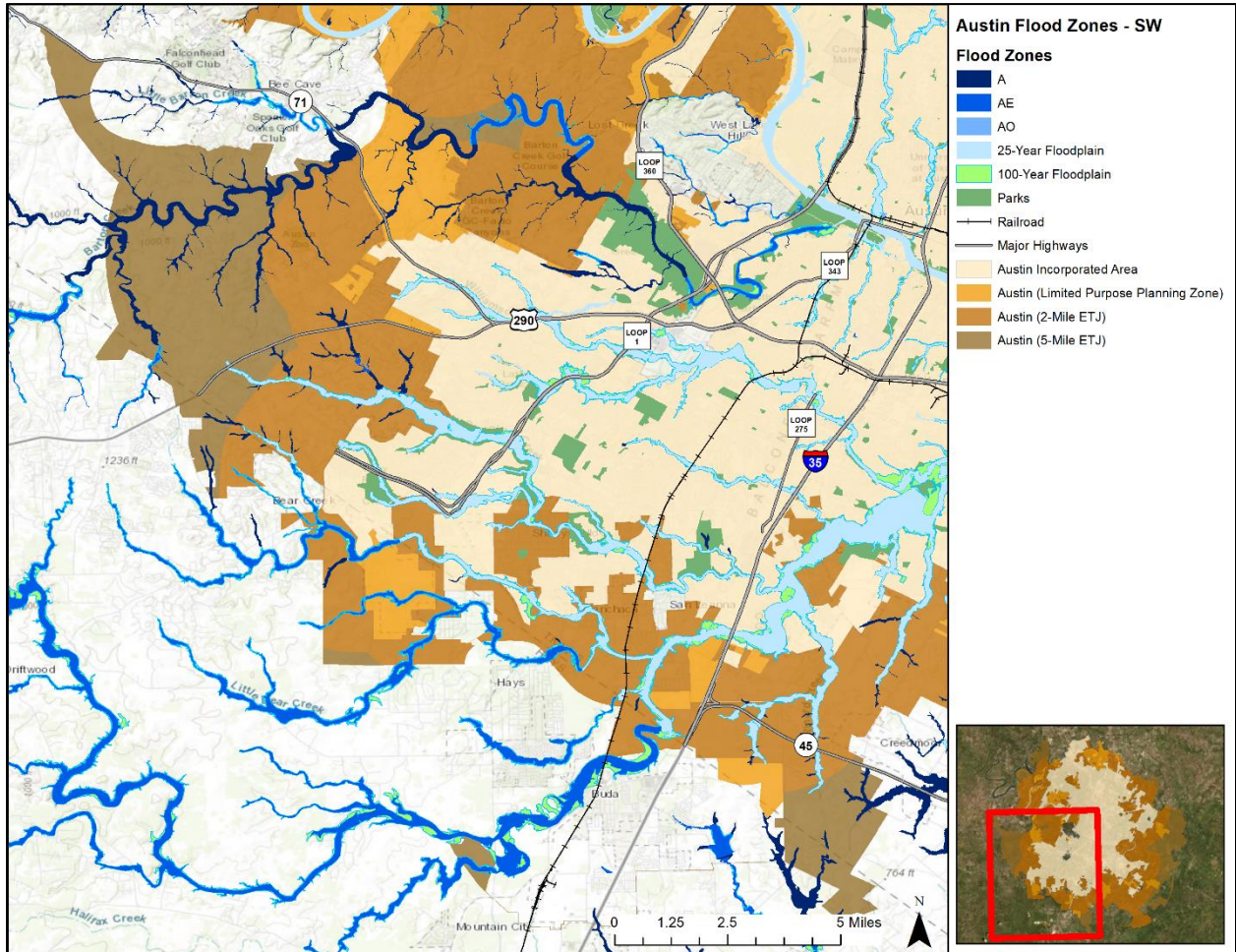
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Figure 5-2. Estimated Flood Zones in Southeast Austin



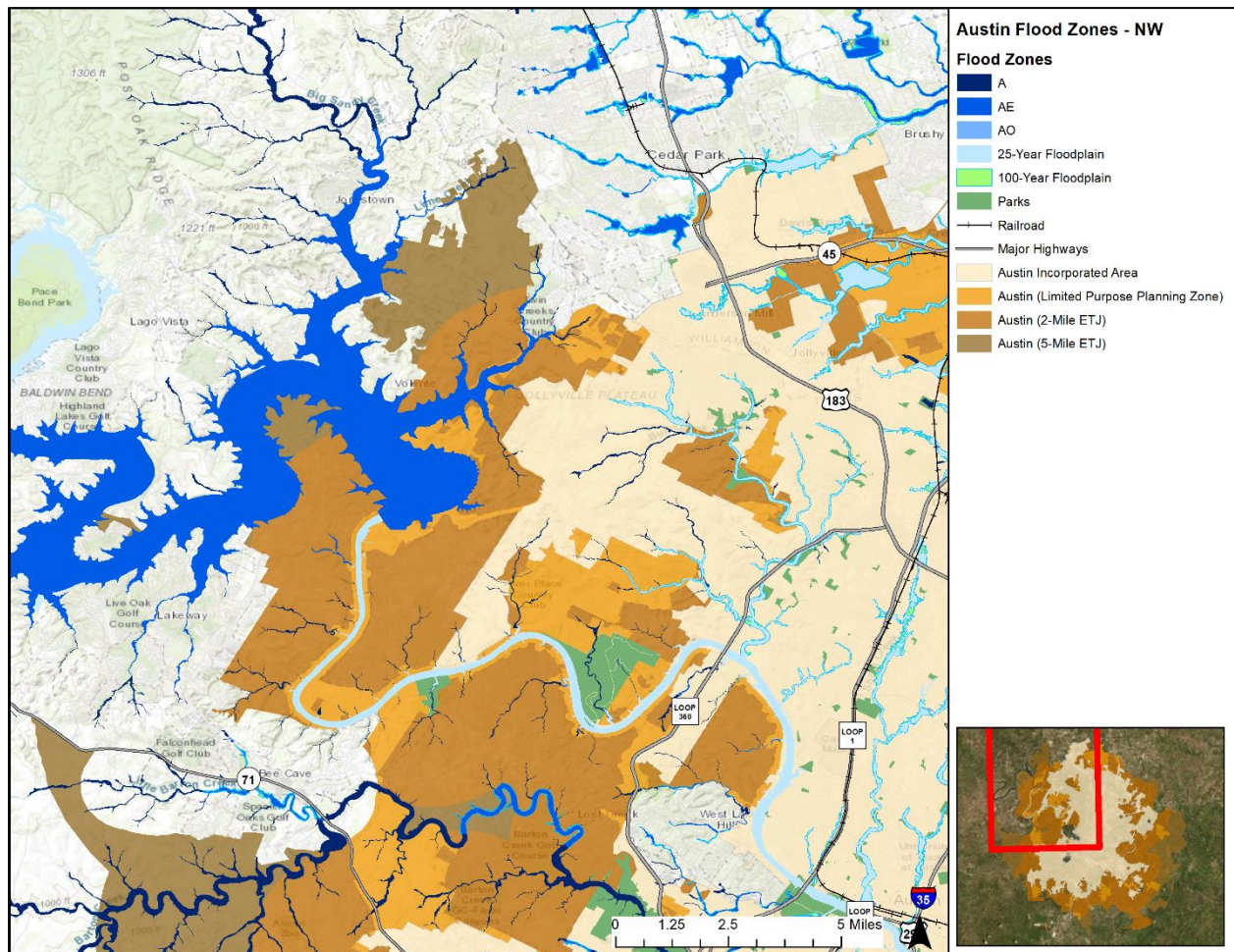
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Figure 5-3. Estimated Flood Zones in Southwest Austin



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Figure 5-4. Estimated Flood Zones in Northwest Austin



EXTENT

The severity of a flood event is determined by a combination of several factors including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Typically, floods are long-term events that may last for several days.

Determining the intensity and magnitude of a flood event is dependent upon the flood zone and location of the flood hazard area in addition to depths of flood waters. Extent of flood damages can be expected to be more damaging in the areas that will convey a base flood. FEMA categorizes areas on the terrain according to how the area will convey flood water. Flood zones are the categories that are mapped on Flood Insurance Rate Maps. Table 5-1 provides a description of FEMA flood zones and the flood impact in terms of severity or potential harm. Flood Zones A, AE and X are the only hazard areas mapped in the region. Figures 5-1 through 5-4 should be read in conjunction with the extent for flooding in Tables 5-1 and 5-2 to determine the intensity of a potential flood event.

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Table 5-1. Flood Zones

INTENSITY	ZONE	DESCRIPTION
HIGH	ZONE A	Areas with a one percent annual chance of flooding and a 26 percent chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
	ZONE A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a Base Flood Elevation (BFE) (old format).
	ZONE AE	The base floodplain where base flood elevations are provided. AE Zones are now used on the new format FIRMs instead of A1-A30 Zones.
	ZONE AO	River or stream flood hazard areas and areas with a one percent or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from one to three feet. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
	ZONE AH	Areas with a one percent annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from one to three feet. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
	ZONE A99	Areas with a one percent annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
	ZONE AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
HIGH COASTAL	ZONE VE, V1-30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.

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INTENSITY	ZONE	DESCRIPTION
MODERATE to LOW	ZONE X 500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than one foot or with drainage areas less than one square mile; or an area protected by levees from 100-year flooding.

Zone A is interchangeably referred to as the 100-year flood, the one percent-annual chance flood, the Special Flood Hazard Area (SFHA), or more commonly, the base flood. This is the area that will convey the base flood and constitutes a threat to the planning area. The impact from a flood event can be more damaging in areas that will convey a base flood.

Structures built in the SFHA are subject to damage by rising waters and floating debris. Moving flood water exerts pressure on everything in its path and causes erosion of soil and solid objects. Utility systems, such as heating, ventilation, air conditioning, fuel, electrical systems, sewage maintenance systems and water systems, if not elevated above base flood elevation, may also be damaged.

The intensity and magnitude of a flood event is also determined by the depth of flood waters. Table 5-2 describes the stream gauge data provided by the United States Geological Survey (USGS).

Table 5-2. Extent for City of Austin¹

JURISDICTION ²	PEAK FLOOD EVENT
City of Austin	Colorado River in Austin had floodwaters reach 273 feet in December 1913 and 46 feet in July 1869.
City of Austin	Bull Creek at Loop 360 near Austin, Texas reached an overflow elevation of 14.9 feet in September of 2010. The average peak flow for the Bull Creek is 14.97 feet at this site.
City of Austin	Shoal Creek at Silverway Drive in Austin, Texas reached an overflow elevation of 10.7 feet in May of 2015. The average peak flow for the Shoal Creek is 8.6 feet at this site.
City of Austin	Little Walnut Creek at Georgian Drive in Austin, Texas reached an overflow elevation of 13.3 feet in May of 1987. The average peak flow for the Little Walnut Creek is 8.6 feet at this site.
City of Austin	Onion Creek at US Highway 183 in Austin, Texas reached an overflow elevation of 40.1 feet in October of 2013. The average peak flow for the Onion Creek is 19.4 feet at this site.

¹ Severity estimated by averaging floods at certain stage level over the history of flood events. Severity and peak events are based on U.S. Geological Survey data.

² Severity is provided for jurisdictions where peak data was provided.

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JURISDICTION ²	PEAK FLOOD EVENT
City of Austin	Walker Creek at Red River Street in Austin, Texas reached an overflow elevation of 8.03 feet in October of 2015. The average peak flow for the Walker Creek is 5.5 feet at this site.
City of Austin	Shoal Creek at W 12 th Street in Austin, Texas reached an overflow elevation of 23.2 feet in May of 1981. The average peak flow for the Shoal Creek is 13.13 feet at this site.

The range of flood intensity that the planning area can experience is high, or Zone A. Based on historical occurrences, the planning area could expect to experience up to 4.1 inches of rainfall within a 3.5-hour period, resulting in flash flooding.

The data described in Tables 5-1 and 5-2, together with Figures 5-1 through 5-4, and historical occurrences for the area, provides an estimated potential magnitude and severity for the planning area. For example, the Northeast section of Austin, as shown in Figure 5-1, has areas designated as Zone A. Reading this figure in conjunction with Table 5-1 means the area is an area of high risk for flood.

HISTORICAL OCCURRENCES

Historical evidence indicates that areas within the planning area are susceptible to flooding, especially in the form of flash flooding. It is important to note that only flood events that have been reported have been factored into this risk assessment, therefore it is likely that additional flood occurrences have gone unreported before and during the recording period. Table 5-3 identifies historical flood events within the City of Austin planning area. Table 5-4 provides the historical flood event summary totals for the planning area. Historical data is provided by the Storm Prediction Center (NOAA), NCEI database for the City of Austin.

Table 5-3. Historical Flood Events, 1996-2019³

JURISDICTION	DATE	TIME	DEATHS	INJURIES	PROPERTY DAMAGE ⁴	CROP DAMAGE
City of Austin	8/24/1996	10:30 AM	0	0	\$16,400	\$0
City of Austin	8/24/1996	11:30 AM	0	0	\$49,200	\$0
Countywide	4/4/1997	6:30 AM	0	0	\$6,423	\$0
Countywide	4/25/1997	2:30 PM	0	0	\$2,141	\$0
Countywide	4/26/1997	4:30 AM	0	0	\$2,141	\$0

³ Only recorded events with fatalities, injuries, and/or damages are listed, values are in 2020 dollars. Historic events are reported from January 1996 through November 2019.

⁴ Countywide damages have been adjusted to reflect only a percentage (26.59%) of the damages attributed to the City of Austin.

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JURISDICTION	DATE	TIME	DEATHS	INJURIES	PROPERTY DAMAGE ⁴	CROP DAMAGE
Countywide	5/23/1997	5:00 PM	0	0	\$21,422	\$0
City of Austin	5/27/1997	4:00 PM	1	0	\$8,057	\$0
Countywide	6/6/1997	4:00 PM	0	0	\$6,419	\$0
Countywide	6/8/1997	11:30 PM	1	10	\$42,791	\$0
City of Austin	6/17/1997	4:30 AM	0	0	\$16,093	\$0
Countywide	6/22/1997	1:00 PM	0	0	\$427,913	\$21,396
City of Austin	7/30/1997	6:00 PM	0	0	\$80,365	\$0
Countywide	12/20/1997	8:45 PM	1	0	\$21,263	\$0
Countywide	2/21/1998	6:00 PM	0	0	\$4,237	\$0
Countywide	10/17/1998	8:30 AM	1	50	\$627,389	\$41,826
Countywide	6/21/1999	2:00 PM	0	0	\$4,127	\$0
Countywide	11/2/2000	3:50 PM	0	0	\$7,880	\$0
Countywide	11/3/2000	10:30 AM	0	0	\$7,880	\$0
Countywide	5/20/2001	8:30 PM	0	5	\$23,161	\$0
Countywide	8/26/2001	7:15 PM	0	0	\$11,594	\$0
City of Austin	8/31/2001	9:00 PM	0	0	\$29,067	\$0
Countywide	11/15/2001	10:00 AM	2	50	\$193,333	\$0
Countywide	9/8/2002	9:15 AM	0	2	\$11,369	\$0
Countywide	11/4/2002	1:15 PM	0	0	\$3,783	\$0
Countywide	2/20/2003	8:30 AM	0	0	\$5,620	\$0
Countywide	1/16/2004	6:00 PM	0	0	\$3,704	\$0
City of Austin	6/11/2009	9:00 PM	0	0	\$2,392,020	\$0
City of Austin	9/7/2010	11:00 PM	1	0	\$0	\$0
City of Austin	10/16/2018	12:00 PM	0	0	\$10,201,119	\$0
City of Austin	5/8/2019	12:00 PM	1	0	\$0	\$0
TOTALS			8	117	\$14,226,911	\$63,221

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Table 5-4. Summary of Historical Flood Events, January 1996-2019

JURISDICTION	NUMBER OF EVENTS	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin ⁵	80	8	117	\$14,226,911	\$63,221

Based on the list of historical flood events for the City of Austin planning area (listed above) 14 of the events have occurred since the 2016 Plan.

SIGNIFICANT EVENTS

Flash Flood on May 8, 2019 – City of Austin

Thunderstorms in the area produced heavy rain that led to flash flooding. A 58-year old male was swept away in Shoal Creek near 9th St. in downtown Austin. The deceased body was later recovered in Lady Bird Lake. An LCRA stream gauge on Shoal Creek at 12th St. reported less than 1000 CFS at the time of the incident. It is believed that the deceased was a transient.

Flood on October 28, 2018- City of Austin

After 5-10 inches of rain fell in the Llano River basin flood waters moved into the Colorado River basin. Lake Travis rose into its flood pool (681 feet MSL) on the 16th and eventually rose to 704.3 feet MSL on the 19th. This flood water overwhelmed Austin's water treatment facilities and the city issued a boil water notice on the 22nd. The city distributed bottled water to residents. The Lower Colorado River Authority conducted flood operations opening as many as eight floodgates on Mansfield Dam to reduce the level of the lake. By the 28th the level was sufficiently low to allow the water treatment facilities to operate normally and the boil water notice was lifted. In and around the Lake Travis area there were reportedly nearly 100 homes that experienced Major damage, 76 with Minor damage, and over 200 homes that were impacted. Damage estimates and insured losses were estimated to top 10 million dollars. The monetary loss to businesses in Austin with regards to the boil water notice were unknown.

Flash Flood on October 31, 2013 – City of Austin

Prolonged flow from the Gulf of Mexico produced a deep moist layer at the surface with perceptible water values at two standard deviations above the mean on area surroundings. An upper level trough of low pressure moved out of northern New Mexico and across the Texas Panhandle providing lift to produce showers and thunderstorms. A surface trough was the focus of training storms which produced heavy rainfall that led to major flooding across the Onion Creek and Blanco/San Marcos River watersheds.

Heavy rains in excess of 14 inches upstream of the City of Austin in the Onion Creek Watershed near Wimberly caused a flash flood that hit portions of South Austin in the early morning hours. Water started to rise and flood portions of the Onion Creek area near Interstate 35 by 4-5 a.m. on the morning of October 31, 2013, and water continued to rise into the early morning hours. USGS gauges were overtopped near Twin Creek Road and this record flood water continued to move along Onion Creek, passing under I-35 and inundating several neighborhoods between I-35 and US Highway 183.

⁵ Includes the percentage of countywide damages attributed to the City of Austin.

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Flood waters rose so quickly that most residents sheltered in place and were rescued by truck and helicopter later that morning. Those that tried to escape the flood waters via their vehicles got caught in the rising waters and this led to several fatalities. A mother and infant son died when their SUV vehicle was swept off the Onion Creek Bridge on Bluff Springs Road in the predawn hours around 4:30 a.m. Another resident in a neighborhood along Onion Creek was also found drowned as his vehicle got swept off the road and was recovered near Pleasant Valley Drive and William Cannon. Almost 2 weeks later the body of a homeless man was found in Williamson Creek near South First Street and Heartwood. He was presumed a flood fatality from this event. Manual readings were performed by USGS at the Onion Creek/Highway 183 gauge site ATIT2. Onion Creek crested just over 40 feet at 9:30 a.m. on the morning of October 31, 2013. This was a new record height for this location and translated to about 135,000 cubic feet per second. Across Travis County and the City of Austin over 700 homes were damaged by flooding, of which over 100 were destroyed. Most of the affected homes did not have insurance and were within the 100-year floodplain of Onion Creek. Flood recovery efforts lasted for several weeks including debris removal. Damage estimates were still being calculated when reported, but damages across Travis County and City of Austin were estimated to exceed \$100 million.

Flash Flood on June 11, 2009 – City of Austin

A mesoscale convective system developed along a dryline in Central Texas and moved southeastward through the northwestern part of South Central Texas. Thunderstorms within this system produced severe winds and large hail. The bridge at 12th Street and Red River Street in the City of Austin was washed out. The flash flood caused \$2 million in damages.

Flash Flood and Flood on October 17, 1998 – City of Austin

Shoal Creek at West 12th Street in the City of Austin crested at 15.4 feet. Several businesses downstream flooded up to two feet, and nearly a foot of water flooded over Shoal Creek Boulevard just above West 12th Street. Flood water discharge reached the Lamar Street Bridge, and was close to flooding many businesses near West 6th Street. Williamson Creek at Oak Hill on Highway 290 West, crested at 6.8 feet at 11 a.m. on October 17th, flooding businesses in the shopping mall. Onion Creek crested at 24.9 feet, with flood stage at 7 feet. This produced 19 feet of flood water discharge over the FM 150 bridge near Driftwood and put two feet of water into several mobile homes. The William Cannon Drive bridge floor had near 20 feet of flood water discharge over it. At Highway 183, Onion Creek crested at 32.0 feet, where flood stage is 20 feet. Walnut Creek crested just above 25 feet, causing minor flooding.

PROBABILITY OF FUTURE EVENTS

Based on recorded historical occurrences and extent within the City of Austin planning area, flooding is highly likely, and an event will likely occur within the next year.

VULNERABILITY AND IMPACT

A property's vulnerability to a flood depends on its location and proximity to the floodplain. Structures that lie along banks of a waterway are the most vulnerable and are often repetitive loss structures. The City of Austin encourages development outside of the floodplain, and the impact for flood for the entire planning area is limited as facilities and services would be shut down for 24 hours or less, depending on the scale of the storm.

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Table 5-5 includes the critical facilities identified in Appendix C that were determined to be located within the SFHA by DFIRM mapping.

Table 5-5. Critical Facilities in the Floodplain by Jurisdiction

JURISDICTION	CRITICAL FACILITIES
City of Austin	1 Fire Station, and 2 EMS Stations

Historic loss estimates due to flood are presented in Table 5-6 below. Considering 80 flood events over a 24-year period, frequency is approximately three to four events per year.

Table 5-6. City of Austin Potential Annualized Losses

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$14,290,132	\$595,422

The City of Austin planning area has experienced high growth (29.8% growth since 2010, according to the Austin Chamber), resulting in greater flood losses due to extensive development in this area. In addition, due to the generally flat terrain of this Central Texas County, homes and businesses in the floodplain remain at risk of flash flooding. During periods of heavy rainfall, homes and businesses located in some areas of the City experience rapid runoff and are vulnerable to flooding from the many major and minor waterways.

Although the City has encouraged development outside of the floodplain, impact for flood for the City of Austin planning area is “Substantial” as it could result in fatalities, depending on the scale of the storm. Table 5-7 depicts the level of impact for the City of Austin.

Table 5-7. City of Austin Impact

JURISDICTION	IMPACT	DESCRIPTION
City of Austin	Substantial	It is anticipated that the City of Austin could anticipate an impact of “minor” with critical facilities would be shut down for 24 hours or less and less than 10 percent of property would be destroyed or damaged. However, the historical deaths resulting from flood indicate a “substantial” impact.

ASSESSMENT OF IMPACTS

Flooding is the deadliest natural disaster that occurs in the U.S. each year, and it poses a constant and significant threat to the health and safety of the people in the City of Austin planning area. Impacts to the planning area can include:

- Flood-related rescues may be necessary at swift and low water crossings or in flooded neighborhoods where roads have become impassable, placing first responders in harm’s way.

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- Evacuations may be required for entire neighborhoods because of rising floodwaters, further taxing limited response capabilities and increasing sheltering needs for displaced residents.
- Health risks and threats to residents are elevated after the flood waters have receded due to contaminated flood waters (untreated sewage and hazardous chemicals) and mold growth typical in flooded buildings and homes.
- Significant flood events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- Floods can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.
- First responders are exposed to downed power lines, contaminated and potentially unstable debris, hazardous materials, and generally unsafe conditions, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.
- Emergency operations and services may be significantly impacted due to damaged facilities.
- Significant flooding can result in the inability of emergency response vehicles to access areas of the community.
- Critical staff may suffer personal losses or otherwise impacted by a flood event and unable to report for duty, limiting response capabilities.
- City or county departments may be flooded, delaying response and recovery efforts for the entire community.
- Private sector entities that the jurisdiction and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Damage to infrastructure may slow economic recovery since repairs may be extensive and lengthy.
- Some businesses not directly damaged by the flood may be negatively impacted while utilities are being restored or water recedes, further slowing economic recovery.
- When the community is affected by significant property damage it is anticipated that funding would be required for infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, and normal day-to-day operating expenses.
- Displaced residents may not be able to immediately return to work, further slowing economic recovery.
- Residential structures substantially damaged by a flood may not be rebuilt for years and uninsured or underinsured residential structures may never be rebuilt, reducing the tax base for the community.
- Large floods may result in a dramatic population fluctuation, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area.
- Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community and a potential increase in the unemployment rate.

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- Flooding may cause significant disruptions of clean water and sewer services, elevating health risks and delaying recovery efforts.
- The psycho-social effects on flood victims and their families can traumatize them for long periods of time, creating long term increases in medical treatment and services.
- Extensive or repetitive flooding can lead to decreases in property value for the affected community.
- Flood poses a potential catastrophic risk to annual and perennial crop production and overall crop quality leading to higher food costs.
- Flood related declines in production may lead to an increase in unemployment.
- Large floods may result in loss of livestock, potential increased livestock mortality due to stress and water borne disease, and increased cost for feed.

The overall extent of damages caused by floods is dependent on the extent, depth and duration of flooding, and the velocities of flows in the flooded areas. The level of preparedness and pre-event planning done by government, businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of a flood event.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) PARTICIPATION

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the flood hazard. The City of Austin is currently participating in the NFIP and is in good standing. In addition, the City of Austin is currently participating in the Community Rating System (CRS) with a current CRS class of 6. The City of Austin participates in the CRS program to provide flood insurance incentives and expand the community's current NFIP policy base and reduce risk through the adoption of higher regulatory standards. The City of Austin has previously acquired and continues to acquire numerous structures that have experienced one or more floods resulting in substantial damage, in an effort to protect open space adjacent to floodplains.

The Legislature of the State of Texas has, in Section 16.315, Texas Water Code, delegates the responsibility to local government units to adopt regulations designed to minimize flood losses. The City of Austin has adopted ordinances to regulate the floodplain, or any land area susceptible to being inundated by water from any source. The City of Austin's floodplain ordinances go above and beyond the requirement of the NFIP.

The flood hazard areas throughout the planning area are subject to periodic inundation, which may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, of which adversely affect public safety.

These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, flood-proofed or otherwise protected from flood damage. Mitigation actions are included to address flood maintenance issues as well, including routinely clearing debris from drainage systems and bridges and expanding drainage culverts and storm water structures to more adequately convey flood waters.

SECTION 5: FLOOD

It is the purpose of the City of Austin to continue to promote the public health, safety and general welfare by minimizing public and private losses due to flood conditions in specific areas. The NFIP participating jurisdiction in the Plan is guided by their local Flood Damage Prevention Ordinance. This community will continue to comply with NFIP requirements through their local permitting, inspection, and record-keeping requirements for new and substantially developed construction. Further, the NFIP program promotes sound development in floodplain areas and includes provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, and bridges located in floodplains;
- Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
- Ensure that potential buyers are notified that property is in a flood area.

In order to accomplish these tasks, City of Austin seek to follow these guidelines to achieve flood mitigation by:

- Restrict or prohibit uses that are dangerous to health, safety, or property in times of flood, such as filling or dumping, that may cause excessive increases in flood heights and/or velocities;
- Require that uses vulnerable to floods, including facilities, which serve such uses, be protected against flood damage at the time of initial construction as a method of reducing flood losses;
- Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;
- Control filling, grading, dredging, and other development, which may increase flood damage; and
- Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

NFIP COMPLIANCE AND MAINTENANCE

As mentioned, the City of Austin has developed mitigation actions that relate to either NFIP maintenance or compliance. Compliance and maintenance actions can be found in Section 25.

Flooding was identified by the planning team as a high-risk hazard during hazard ranking activities at the Risk Assessment Workshop. As such, many of the mitigation actions were developed with flood mitigation in mind. A majority of these flood actions address compliance with the NFIP and implementing flood awareness programs. The City of Austin recognizes the need and are working towards maintaining and improving the community's CRS class as well as implementing additional public flood awareness activities. This includes promoting the availability of flood insurance.

SECTION 5: FLOOD

The City of Austin has a designated floodplain administrator. The floodplain administrator in the planning area will continue to maintain compliance with the NFIP including continued floodplain administration, zoning ordinances, and development regulation. The floodplain ordinance adopted by the jurisdiction outlines the minimum requirements for development in special flood hazard areas.

REPETITIVE LOSS

The Severe Repetitive Loss (SRL) Grant Program under FEMA provides federal funding to assist states and communities in implementing mitigation measures to reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential structures insured under the NFIP. The Texas Water Development Board (TWDB) administers the SRL grant program for the State of Texas. One of the goals of the FMA program is to reduce the burden of repetitive loss and severe repetitive loss properties on the NFIP through mitigation activities that significantly reduce or eliminate the threat of future flood damages.

Repetitive Loss properties are defined as structures that are:

- Any insurable building for which 2 or more claims of more than \$1,000 each, paid by the National Flood Insurance Program (NFIP) within any 10-year period, since 1978;
- May or may not be currently insured under the NFIP.

Severe Repetitive Loss properties are defined as residential properties that are:

- Covered under the NFIP and have at least four flood related damage claim payments (building and contents) over \$5,000.00 each, and the cumulative amount of such claim payments exceed \$20,000; or
- At least two separate claim payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

In either scenario, at least two of the referenced claims must have occurred within any ten-year period and must be greater than 10 days apart.⁶ Table 5-8 shows repetitive loss and severe repetitive loss properties for the City of Austin planning area.

⁶ Source: Texas Water Development Board

SECTION 5: FLOOD

Table 5-8. Repetitive Loss and Severe Repetitive Loss Properties

JURISDICTION	BUILDING TYPE	NUMBER OF STRUCTURES	NUMBER OF LOSSES
City of Austin	2-4 Family	2	4
	Assumed Condo	5	13
	Non-Residential	21	69
	Other Residential	3	7
	Single Family	87	218

SECTION 6: DROUGHT

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HAZARD DESCRIPTION

Drought is a period of time without substantial rainfall that persists from one year to the next. Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of anticipated natural precipitation reduction over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 6-1 presents definitions for these different types of drought.



Droughts are one of the most complex of all natural hazards as it is difficult to determine their precise beginning or end. In addition, droughts can lead to other hazards such as extreme heat and wildfires. Their impact on wildlife and area farming is enormous, often killing crops, grazing land, edible plants, and even in severe cases, trees. A secondary hazard to drought is wildfire because dying vegetation serves as a prime ignition source. Therefore, a heat wave combined with a drought is a very dangerous situation.

Table 6-1. Drought Classification Definitions¹

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

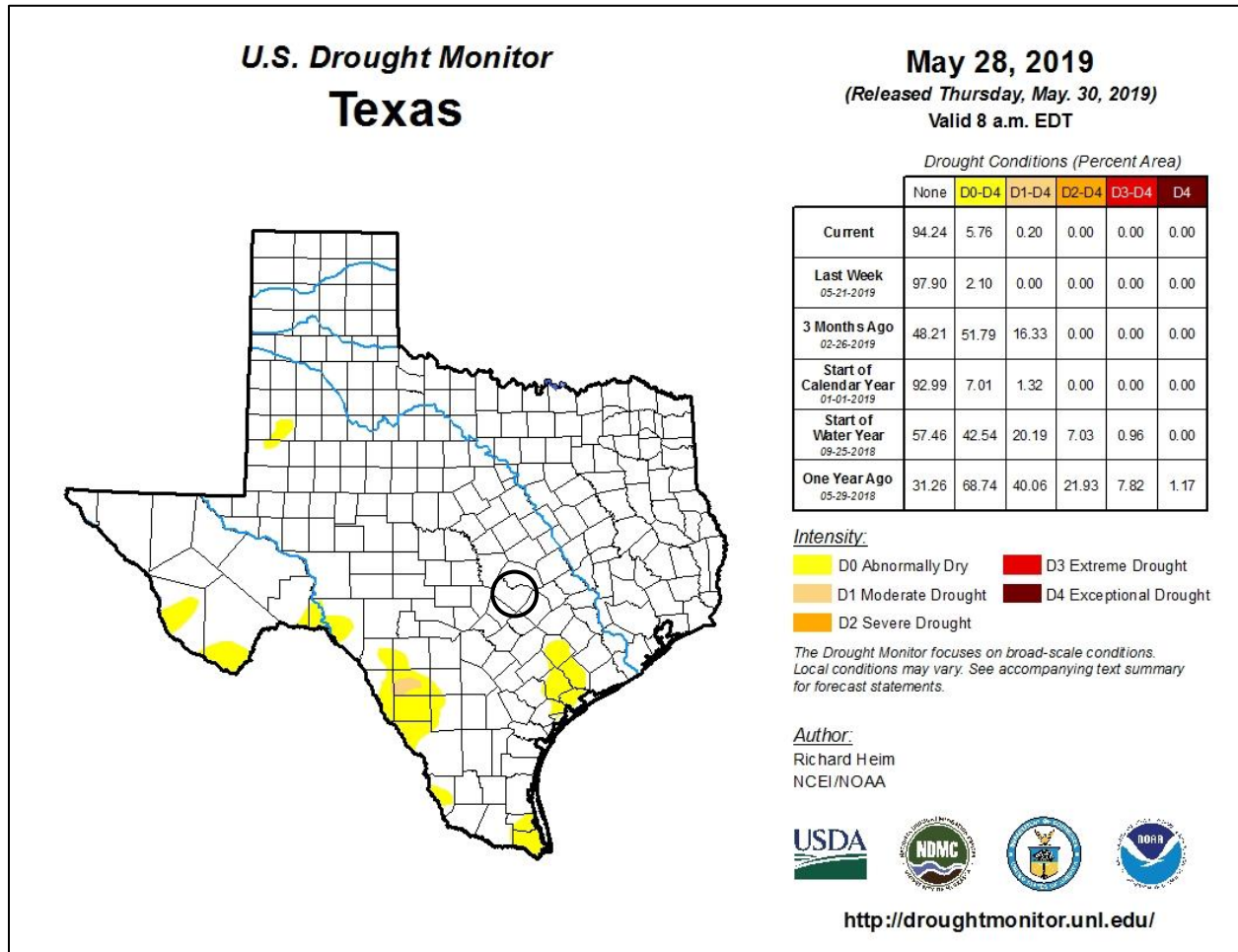
¹ Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

SECTION 6: DROUGHT

LOCATION

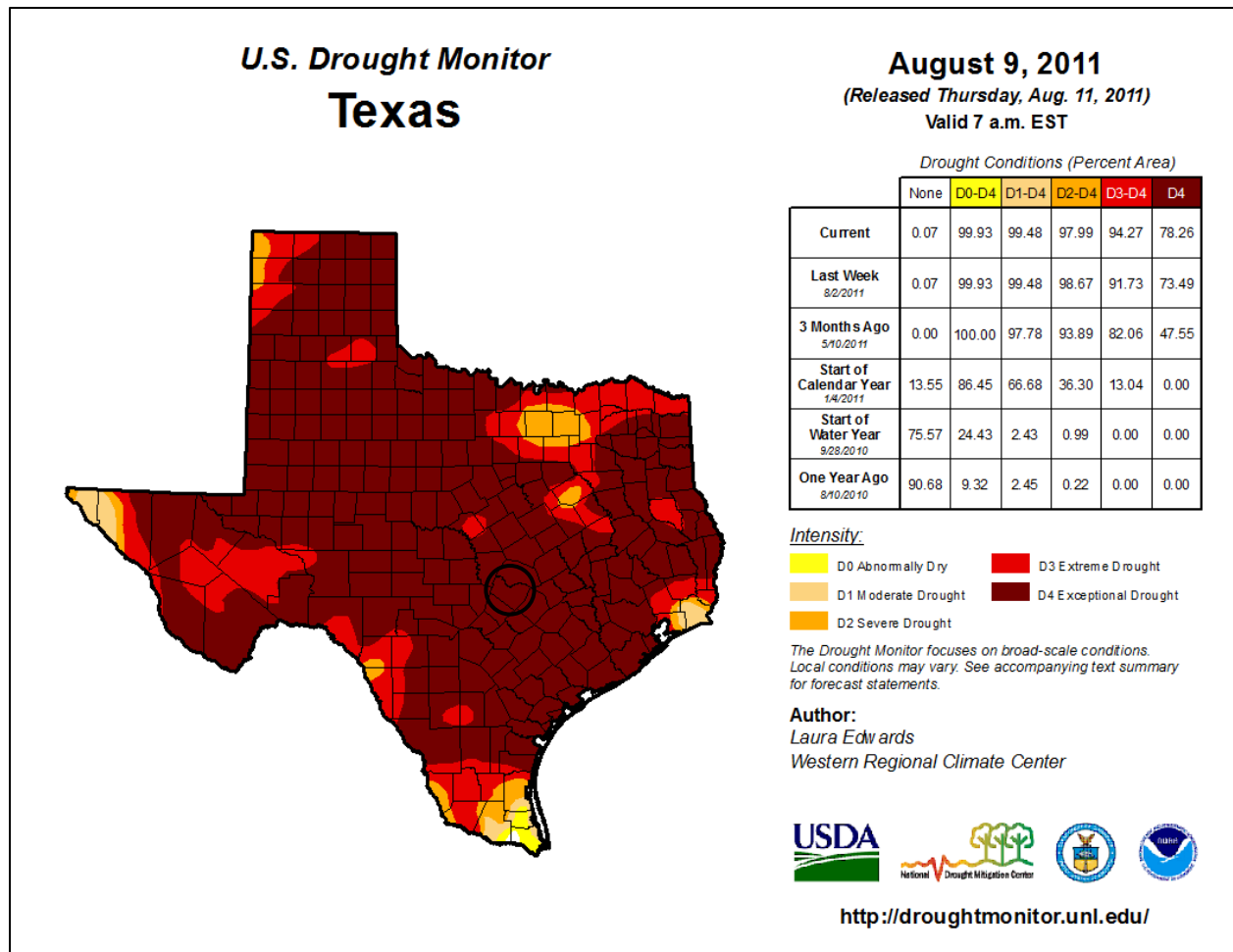
Droughts occur regularly throughout Texas and the City of Austin planning area and are a normal condition. However, they can vary greatly in their intensity and duration. The Drought Monitor shows the planning area is currently experiencing normal conditions throughout the county (Figure 6-1). However, the planning area has experienced abnormally dry to exceptional drought conditions over the last ten years (Figure 6-2). There is no distinct geographic boundary to drought; therefore, it can occur throughout the City of Austin planning area equally.

Figure 6-1. U.S. Drought Monitor, May 2019



SECTION 6: DROUGHT

Figure 6-2. U.S. Drought Monitor, August 2011



EXTENT

The Palmer Drought Index is used to measure the extent of drought by measuring the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, with the intensity of drought during the current month dependent upon the current weather patterns plus the cumulative patterns of previous months. The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop. Table 6-2 depicts magnitude of drought, while Table 6-3 describes the classification descriptions.

SECTION 6: DROUGHT

Table 6-2. Palmer Drought Index

DROUGHT INDEX	DROUGHT CONDITION CLASSIFICATIONS						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
Z Index	-2.75 and below	-2.00 to -2.74	-1.25 to -1.99	-1.24 to +.99	+1.00 to +2.49	+2.50 to +3.49	n/a
Meteorological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above
Hydrological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

Table 6-3. Palmer Drought Category Descriptions²

CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT INDEX
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. 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; fire risk high; 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; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	-5.0 or less

Drought is monitored nationwide by the National Drought Mitigation Center (NDMC). Indicators are used to describe broad scale drought conditions across the U.S. and correspond to the intensity of drought.

² Source: National Drought Mitigation Center

SECTION 6: DROUGHT

Based on the historical occurrences for drought and the location of the City of Austin planning area the area can anticipate a range of drought from abnormally dry to exceptional, or D0 to D4, based on the Palmer Drought Category. The entire planning area has experienced exceptional drought conditions. This is the most extreme drought conditions the planning area can anticipate in the future.

HISTORICAL OCCURRENCES

The City of Austin planning area may typically experience a severe drought. Table 6-4 and 6-5 list historical events that have occurred in the City of Austin planning area as reported in the National Centers for Environmental Information (NCEI). Historical drought information shows drought activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. Historical drought data for the City of Austin Planning Area are provided on a county-wide basis per the NCEI database.

Table 6-4. Historical Drought Years, 1996-2019³

DROUGHT YEAR
1996
2000
2011-2012
2012
2012
2013
2013
2014
2019
9 unique events

Table 6-5. Historical Drought Events, 1996-2019

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	4/1/1996	0	0	\$0	\$0
Travis County	5/1/1996	0	0	\$0	\$0
Travis County	6/1/1996	0	0	\$0	\$0

³ Historic events are reported from January 1996 through November 2019.

SECTION 6: DROUGHT

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	7/1/1996	0	0	\$0	\$0
Travis County	8/1/1996	0	0	\$0	\$0
Travis County	7/1/2000	0	0	\$0	\$0
Travis County	8/1/2000	0	0	\$0	\$0
Travis County	9/1/2000	0	0	\$0	\$0
Travis County	10/1/2000	0	0	\$0	\$0
Travis County	5/1/2011	0	0	\$0	\$0
Travis County	6/1/2011	0	0	\$0	\$0
Travis County	7/1/2011	0	0	\$0	\$0
Travis County	8/1/2011	0	0	\$0	\$0
Travis County	9/1/2011	0	0	\$0	\$0
Travis County	10/1/2011	0	0	\$0	\$0
Travis County	11/1/2011	0	0	\$0	\$0
Travis County	12/1/2011	0	0	\$0	\$0
Travis County	1/1/2012	0	0	\$0	\$0
Travis County	2/1/2012	0	0	\$0	\$0
Travis County	6/1/2012	0	0	\$0	\$0
Travis County	12/1/2012	0	0	\$0	\$0
Travis County	2/1/2013	0	0	\$0	\$0
Travis County	3/1/2013	0	0	\$0	\$0
Travis County	4/1/2013	0	0	\$0	\$0
Travis County	6/1/2013	0	0	\$0	\$0
Travis County	7/1/2013	0	0	\$0	\$0
Travis County	8/1/2013	0	0	\$0	\$0
Travis County	8/1/2014	0	0	\$0	\$0
Travis County	9/1/2019	0	0	\$0	\$0
Travis County	10/1/2019	0	0	\$0	\$0

SECTION 6: DROUGHT

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	11/1/2019	0	0	\$0	\$0
TOTALS		0	0	\$0	\$0

Based on the list of historical drought events for the City of Austin planning area (listed above) one of the unique events has occurred since the 2016 Plan.

SIGNIFICANT EVENTS

September 2019- November 2019

Most of South-Central Texas received less than 50% of normal precipitation during July, August, and September, and a large part of the region had less than 25%. This resulted in drought conditions setting in. Travis County went into Severe (D2) drought. Stage 1 restrictions were in place in Travis County. Burn bans were in place throughout the region. Texas A&M Agrilife reported rangelands were dry with very short soil moisture levels. Livestock were in fair condition and supplemental feeding continued. Throughout September and October Travis County remained in Severe (D2) drought.

December 2005 – September 2006

Without any significant precipitation for several months, drought conditions continued to increase during the month of December and continued until September. The area experienced severe to extreme (D2-D3) drought conditions, with conditions worsening to the highest category, exceptional (D4) in August. The dry, hot conditions maintained an increased level in wildfire potential across the area. The lack of water caused some communities to implement water restrictions. The agriculture community continued to be hit hard with a lack of pasture land and hay for livestock. Farm ponds also continued to dry up across the area, causing some ranchers to sell part or all of their herds. Recreation activities on area lakes were affected by the drought conditions. The lack of water caused many lakes to lose shorelines causing many boat ramps and docks to become dry. The low water levels affected boaters as well due to debris on the lake bottom being closer to the surface leading to boating accidents. During the middle of September, heavy rains caused conditions to improve and continued throughout the month.

February 2011 – May 2015

Several months of below normal precipitation caused drought conditions for the area beginning in February 2011 and continued until May 2015. The area experienced severe to exceptional (D2-D4) drought conditions. Although there were a few rainfall events throughout the drought, it wasn't enough to affect the ongoing conditions due to the severity of the drought. Crops, hay forages, and alfalfa were hit hard by the lack of any significant precipitation. The shortage of hay caused farmers to sell the majority of their cattle, with some selling their entire herd. Farm pond water levels decreased, or dried up altogether, which added insult to injury for area livestock. The extent of the damage was still undetermined monetary, but it was beginning to look like a total loss for many Texas farmers. With record rainfall throughout the month of May 2015, the drought was completely eradicated throughout western north Texas.

SECTION 6: DROUGHT

PROBABILITY OF FUTURE EVENTS

Based on available records of historic events, there have been nine extended time periods of drought (ranging in length from approximately 30 days to over 300 days) within a 24-year reporting period, which provides a probability of one event every two to three years. This frequency supports a likely probability of future events for the City of Austin.

VULNERABILITY AND IMPACT

Loss estimates were based on 24 years of statistical data from the NCEI. A drought event frequency-impact was then developed to determine an impact profile on agriculture products and estimate potential losses due to drought in the area. Table 6-6 shows annualized exposure.

Table 6-6. Potential Annualized Losses for City of Austin

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$0	\$0

Drought impacts large areas and crosses jurisdictional boundaries. All existing and future buildings, facilities, and populations are exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced in water shortages and crop/livestock losses on agricultural lands and typically have no impact on buildings.

In terms of vulnerability, population, agriculture, property, socioeconomics and environment are all vulnerable to drought in the City of Austin planning area. Typical demand can deplete water resources during extreme drought conditions. As resources are depleted, potable water is in short supply and overall water quality can suffer, elevating health concerns for all residents but especially vulnerable populations – typically children, the elderly, the ill, and those living below the poverty level. In addition, potable water is used for drinking, sanitation, patient care, sterilization, equipment, heating and cooling systems, and many other essential functions in medical facilities.

The average person will survive only a few days without potable water, and this timeframe can be drastically shortened for those people with more fragile health – typically children, the elderly, and the ill. Population over 65 in the City of Austin planning area is estimated at 8.7% of the total population, and children under the age of 5 are estimated at 6.7% or an estimated total of 138,295⁴ potentially vulnerable residents in the planning area based on age. In addition, an estimated 14.5% of the planning area population live below the poverty level (Table 6-7) which may contribute to overall health impacts of a drought.

Table 6-7. Populations at Greater Risk by Jurisdiction

JURISDICTION	POPULATION 65 AND OLDER	POPULATION UNDER 5	POPULATION BELOW POVERTY LEVEL
City of Austin ⁵	81,322	62,257	135,684

⁴ US Census Bureau 2018 data for City of Austin

⁵ County totals includes all incorporated jurisdictions and unincorporated areas.

SECTION 6: DROUGHT

The economic impact of droughts can be significant as they produce a complex web of impacts that spans many sectors of the economy and reach well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. If droughts extend over a number of years, the direct and indirect economic impact can be significant.

Habitat damage is a vulnerability of the environment during periods of drought for both aquatic and terrestrial species. The environment also becomes vulnerable during periods of extreme or prolonged drought due to severe erosion and land degradation.

Impact of droughts experienced in the City of Austin planning area has resulted in no injuries or fatalities supporting a “Limited” severity of impact meaning injuries and/or illnesses are treatable with first aid, shutdown of facilities and services for 24 hours or less, and less than 10% of property is destroyed or with major damage. Annualized loss over the 24-year reporting period in the City of Austin is considered negligible.

ASSESSMENT OF IMPACTS

The Drought Impact Reporter was developed in 2005 by the University of Nebraska-Lincoln to provide a national database of drought impacts. Droughts can have an impact on: the agriculture; business and industry; energy; fire; plants and wildlife; relief, response, and restrictions; society and public health; tourism and recreation; and water supply and quality. The reports are submitted from individuals from Federal, State, and local agencies, as well as the general public. Table 6-8 lists the drought impacts to City of Austin from 2005 to 2019 based on reports received by the Drought Impact Reporter.

Table 6-8. Drought Impacts, 2005-2019

DROUGHT IMPACTS 2005-2019	
Agriculture	4
Business & Industry	4
Energy	1
Fire	8
Plants & Wildlife	16
Relief, Response & Restrictions	20
Society & Public Health	14
Tourism & Recreation	2
Water Supply & Quality	22

Drought has the potential to impact people in the City of Austin planning area. While it is rare that drought, in and of itself, leads to a direct risk to the health and safety of people in the U.S., severe water shortages could result in inadequate supply for human needs. Drought also is frequently associated with a variety of impacts, including:

SECTION 6: DROUGHT

- The number of health-related low-flow issues (e.g., diminished sewage flows, increased pollution concentrations, reduced firefighting capacity, and cross-connection contamination) will increase as the drought intensifies.
- Public safety from forest/range/wildfires will increase as water availability and/or pressure decreases.
- Respiratory ailments may increase as the air quality decreases.
- There may be an increase in disease due to wildlife concentrations (e.g., rabies, Rocky Mountain spotted fever, Lyme disease).
- Jurisdictions and residents may disagree over water use/water rights, creating conflict.
- Political conflicts may increase between municipalities, counties, states, and regions.
- Water management conflicts may arise between competing interests.
- Increased law enforcement activities may be required to enforce water restrictions.
- Severe water shortages could result in inadequate supply for human needs as well as lower quality of water for consumption.
- Firefighters may have limited water resources to aid in firefighting and suppression activities, increasing risk to lives and property.
- During drought there is an increased risk for wildfires and dust storms.
- The community may need increased operational costs to enforce water restriction or rationing.
- Prolonged drought can lead to increases in illness and disease related to drought.
- Utility providers can see decreases in revenue as water supplies diminish.
- Utilities providers may cut back energy generation and service to their customers to prioritize critical service needs.
- Hydroelectric power generation facilities and infrastructure would have significantly diminished generation capability. Dams simply cannot produce as much electricity from low water levels as they can from high water levels.
- Fish and wildlife food and habitat will be reduced or degraded over time during a drought and disease will increase, especially for aquatic life.
- Wildlife will move to more sustainable locations creating higher concentrations of wildlife in smaller areas, increasing vulnerability and further depleting limited natural resources.
- Severe and prolonged drought can result in the reduction of a species or cause the extinction of a species altogether.
- Plant life will suffer from long-term drought. Wind and erosion will also pose a threat to plant life as soil quality will decline.
- Dry and dead vegetation will increase the risk of wildfire.
- Drought poses a significant risk to annual and perennial crop production and overall crop quality leading to higher food costs.
- Drought related declines in production may lead to an increase in unemployment.
- Drought may limit livestock grazing resulting in decreased livestock weight, potential increased livestock mortality, and increased cost for feed.

SECTION 6: DROUGHT

- Negatively impacted water suppliers may face increased costs resulting from the transport water or develop supplemental water resources.
- Long term drought may negatively impact future economic development.

The overall extent of damages caused by periods of drought is dependent on its extent and duration. The level of preparedness and pre-event planning done by government, businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of a drought event.

SECTION 7: WILDFIRE

- Hazard Description 1
- Location 1
- Extent 2
- Historical Occurrences 5
 - Significant Events 7
- Probability of Future Events 7
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HAZARD DESCRIPTION

A wildfire event can rapidly spread out of control and occurs most often in the summer when the brush is dry and flames can move unchecked through a highly vegetative area. Wildfires can start as a slow burning fire along the forest floor, killing and damaging trees. The fires often spread more rapidly as they reach the tops of trees with wind carrying the flames from tree to tree. Usually, dense smoke is the first indication of a wildfire.

A wildfire event often begins unnoticed and spreads quickly, lighting brush, trees, and homes on fire. For example, a wildfire may be started by a campfire that was not doused properly, a tossed cigarette, burning debris, or arson.

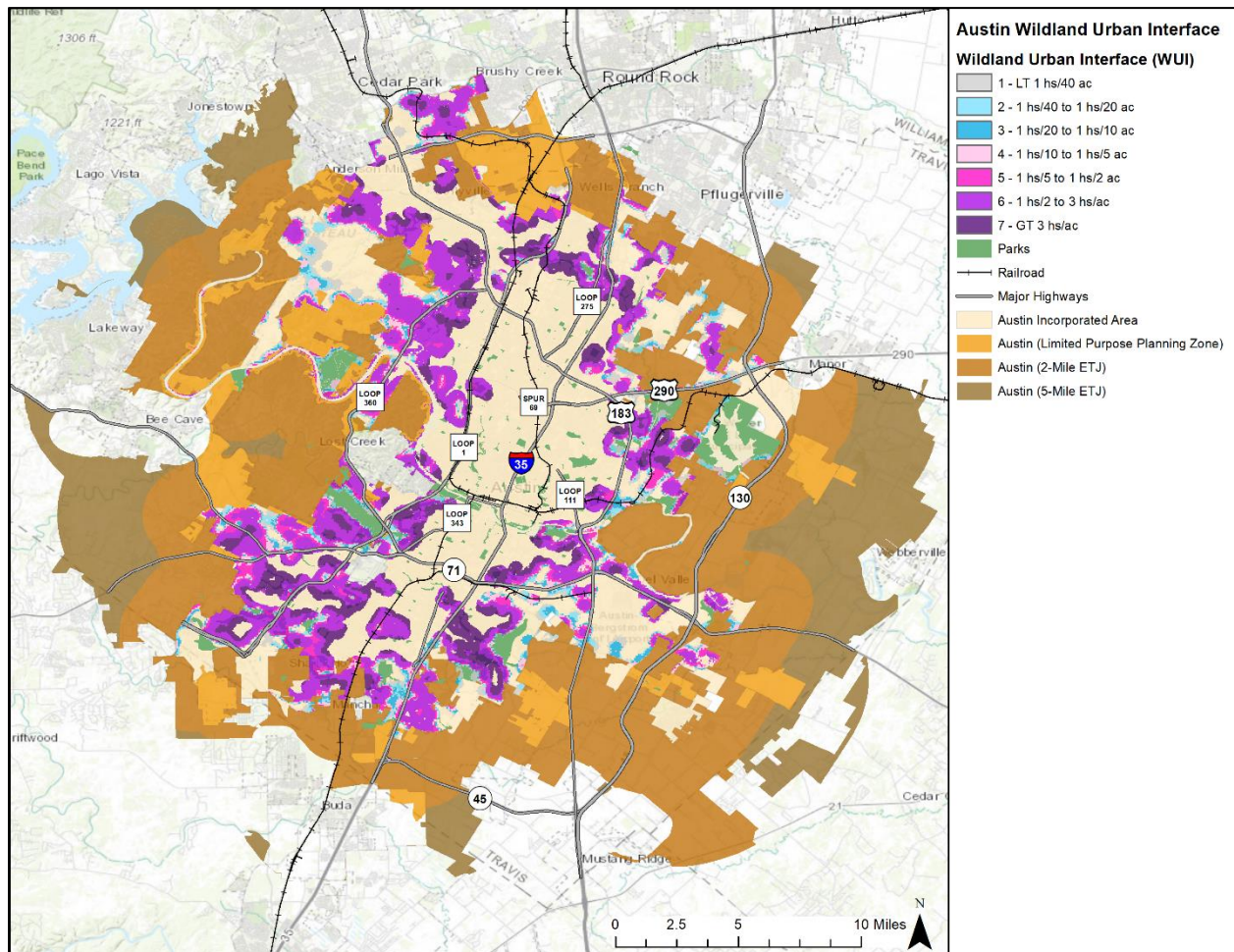
Texas has seen a significant increase in the number of wildfires in the past 30 years, which included wildland, interface, or intermix fires. Wildland fires are fueled almost exclusively by natural vegetation, while interface or intermix fires are urban/wildland fires in which vegetation and the built environment provide the fuel.

LOCATION

A wildfire event can be a potentially damaging consequence of drought. Wildfires can vary greatly in terms of size, location, intensity, and duration. While wildfires are not confined to any specific geographic location, they are most likely to occur in open grasslands. The threat to people and property from a wildfire event is greater in the fringe areas where developed areas meet open grass lands, such as the WUI. (Figure 7-1). It is estimated that 34.5 percent of the total population in the City of Austin live within the WUI. However, the entire City of Austin planning area is at risk for wildfires.

SECTION 7: WILDFIRE

Figure 7-1. Wildland Urban Interface Map – City of Austin



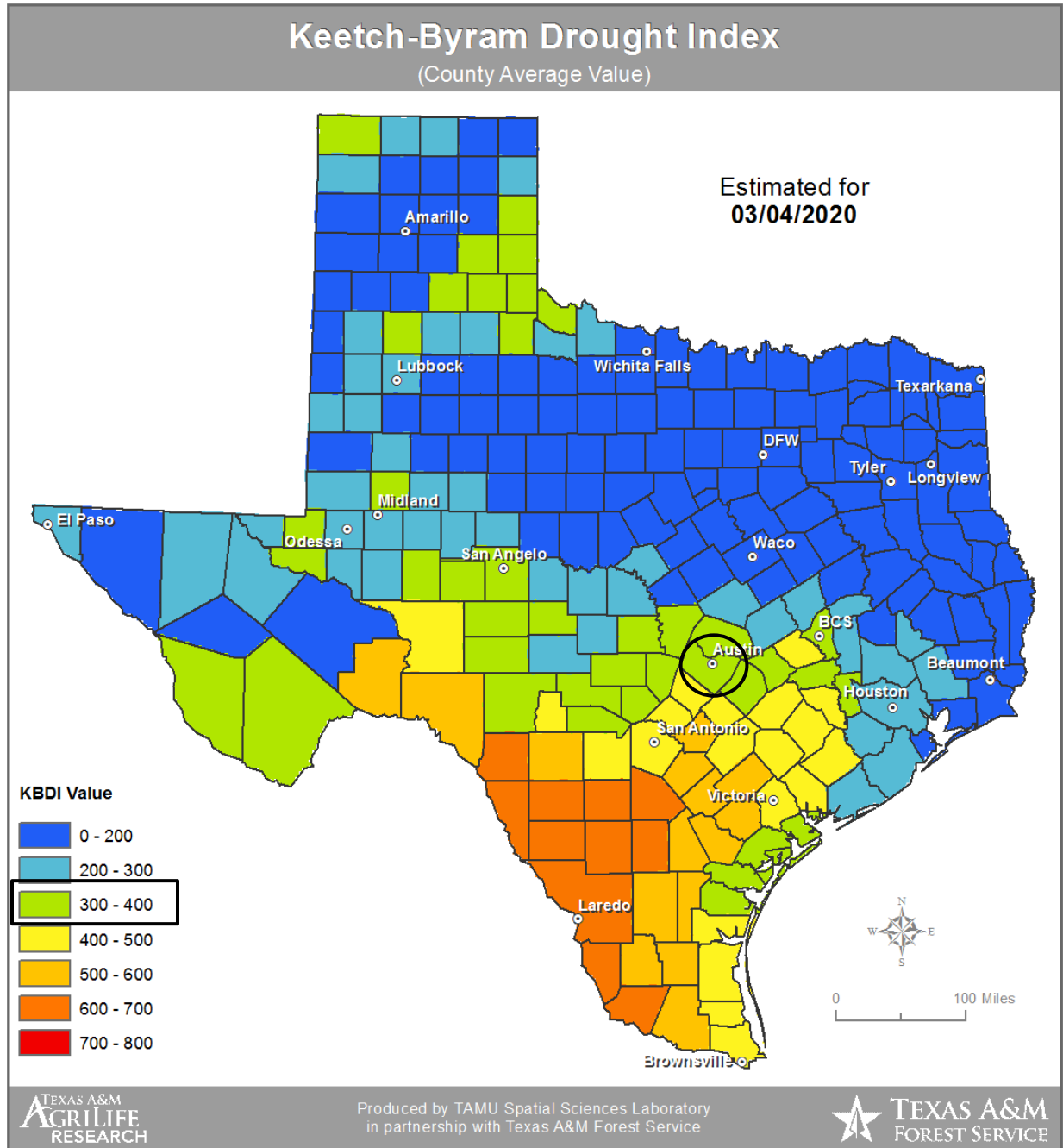
EXTENT



Risk for a wildfire event is measured in terms of magnitude and intensity using the Keetch Byram Drought Index (KBDI), a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. The KBDI determines forest fire potential based on a daily water balance, derived by balancing a drought factor with precipitation and soil moisture (assumed to have a maximum storage capacity of eight inches), and is expressed in hundredths of an inch of soil moisture depletion.

SECTION 7: WILDFIRE

Figure 7-2. Keetch-Byram Drought Index (KBDI) for the State of Texas, 2020¹



¹ City of Austin is located within the black circle.

SECTION 7: WILDFIRE

Fire behavior can be categorized at four distinct levels on the KBDI:

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

The KBDI is a good measure of the readiness of fuels for a wildfire event. It should be referenced as the area experiences changes in precipitation and soil moisture, while caution should be exercised in dryer, hotter conditions.

The range of intensity for the City of Austin planning area in a wildfire event is within 314 to 744. The average extent to be mitigated for the City of Austin planning area is a KBDI of 358. At this level fires more readily burn and will carry across an area with no gaps. Heavier fuels will not readily ignite and burn. The worst the planning area can anticipate based on historical occurrences and readily available fuel is 600 to 800 as 744 falls within this range. At this level fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.

The Texas Forest Service's Fire Intensity Scale identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on weighted average of four percentile weather categories. The City of Austin is between a potential limited to low wildfire intensities. Figure 7-3 identifies the wildfire intensity for the City of Austin planning area.

SECTION 7: WILDFIRE

Figure 7-4. Location and Historic Wildfire Events for City of Austin Planning Area

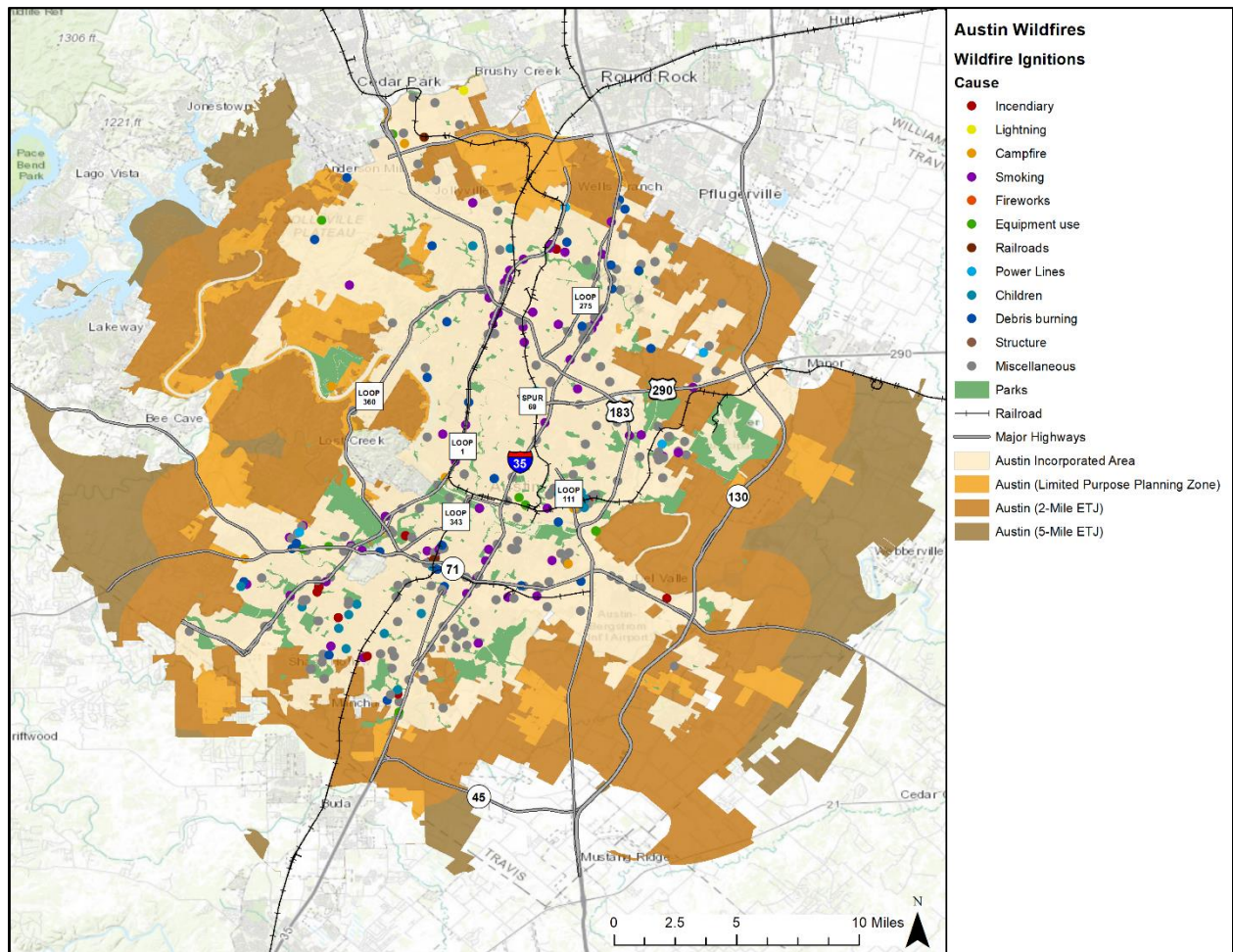


Table 7-1. Historical Wildfire Events Summary

JURISDICTION	NUMBER OF EVENTS	ACRES BURNED
City of Austin	335	684

Table 7-2. Acreage of Suppressed Wildfire by Year

JURISDICTION	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
City of Austin	32	129	52	249	24	1	144	8	42	2	1

Based on the list of historical wildfire events for the City of Austin planning area 40 of the events have occurred since the 2016 Plan.

SECTION 7: WILDFIRE

SIGNIFICANT EVENTS

September 4-6, 2011- City of Austin

The Steiner Ranch Wildfire started on September 4 behind Tropical Storm Lee and a cold front that brought strong northerly winds. The peak wind at Austin Bergstrom International Airport was 36 mph. The fire burned 125 acres, destroyed 24 homes, and damaged 30 others.

PROBABILITY OF FUTURE EVENTS

Wildfires can occur at any time of the year. As the jurisdictions within the county move into wildland, the potential area of occurrence of wildfire increases. With 355 events in an 11-year period, an event within the City of Austin is highly likely, meaning an event is probable within the next year.

VULNERABILITY AND IMPACT

Periods of drought, dry conditions, high temperatures, and low humidity are factors that contribute to the occurrence of a wildfire event. Areas along railroads and people whose homes are in woodland settings have an increased risk of being affected by wildfire.

The heavily populated, urban areas of the City of Austin are not likely to experience large, sweeping fires. Areas on the outer boundaries of the City of Austin are vulnerable, including areas around Lake Walter E Long as well as along the Colorado River in various locations, and the borders of the unincorporated Travis County areas. Unoccupied buildings and open spaces that have not been maintained have the greatest vulnerability to wildfire. The overall level of concern for wildfires is located mostly along the perimeter of the study area where wildland and urban areas interface. Figure 7-1 illustrates the areas that are the most vulnerable to wildfire within the planning area.

Areas along railroads and people with homes in wooded, rural areas have an increased risk of wildfire. Seton Southwest Hospital has a moderate risk to wildfire. The fire and EMS stations that have a low risk to wildfire are: 5309 E. Riverside Dr., 1330 E. Rundberg Ln., 517 S. Pleasant Valley Rd., 11612 Four Irons Dr., 5811 Nuckols Crossing Rd., 5500 Burleson Rd., 6702 Wentworth Dr., 9421 Spectrum Dr., 3704 Deer Ln., 9409 Bluegrass Dr., 4201 Spicewood Springs Rd., 2434 Cardinal Loop, 11205 Harris Branch Pkwy, 7701 River Place Blvd., 2307-A Foster Ave., 5905 Nuckols Crossing Rd., and 2454 Cardinal Loop. The Travis County State Jail has a low risk to wildfire.

Five fire and EMS stations in the City of Austin have a moderate risk to wildfire: 8700 W SH 71, 7701 River Place Blvd., 4200 City Park Rd., 11401 Escarpment Blvd, and 3625 Davis Ln. The schools with a moderate risk are: Austin Montessori School, Bowie High, Bridge Point Elementary, Cedar Creek Elementary, Clayton Elementary, Four Points Middle, Gorzycki Middle, Grandview Hills Elementary, Kiker Elementary, Oak Hill Elementary, River Place Elementary, Vandegriff High, Baldwin Elementary, and Regents School of Austin.

The following critical facilities are located in the WUI and are more susceptible to wildfire in the City of Austin Planning Area:

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Table 7-3. City of Austin Critical Facilities Located in WUI

JURISDICTION	CRITICAL FACILITIES
City of Austin	15 Fire Stations, 1 Hospital, 10 EMS Stations, and 42 School Facilities

Within the City of Austin, a total of 355 fire events were reported from 2005 to 2015. All of these events were suspected wildfires. Historic loss and annualized estimates due to wildfires are presented in Table 7-4 below. The frequency is approximately 32 events every year.

Table 7-4. Potential Annualized Losses for the City of Austin Planning Area³

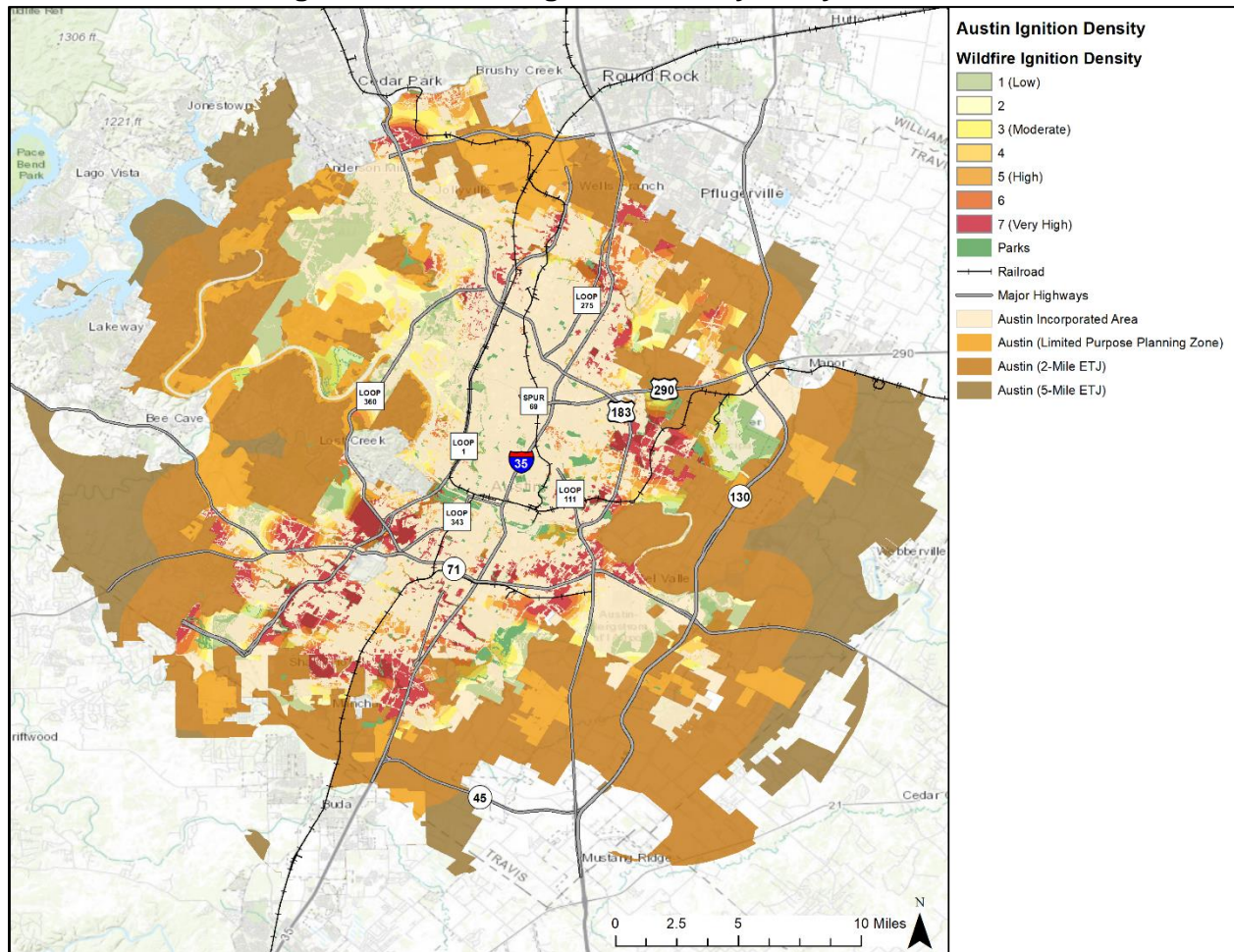
JURISDICTION	ACRES BURNED	ANNUAL ACRE LOSSES
City of Austin	684	62

Figure 7-5 show City of Austin and the threat of wildfire to the planning area.

³ Events divided by 11 years of data.

SECTION 7: WILDFIRE

Figure 7-5. Wildfire Ignition Density – City of Austin



Diminished air quality is an environmental impact that can result from a wildfire event and pose a potential health risk. The smoke plumes from wildfires can contain potentially inhalable carcinogenic matter. Fine particles of invisible soot and ash that are too small for the respiratory system to filter can cause immediate and possibly long-term health effects. The elderly or those individuals with compromised respiratory systems may be more vulnerable to the effects of diminished air quality after a wildfire event.

Climatic conditions such as severe freezes and drought can significantly increase the intensity of wildfires since these conditions kill vegetation, creating a prime fuel source for wildfires. The intensity and rate at which wildfires spread are directly related to wind speed, temperature, and relative humidity.

A wildfire event poses a potentially significant risk to public health and safety, particularly if the wildfire is initially unnoticed and spreads quickly. The risk for injury or death from the variety of threats during a wildfire are present to persons in the area at the time of the fire, with the foremost threats being burns to the human body and smoke inhalation.

Response personnel face the same potential impacts as the general public. Due to the nature of their responsibilities that may bring them closer to the hazard, response personnel can also be at

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increased risk of physical injury. Prolonged exposure to smoke, chemicals, and heat may result in more long-term impacts for response personnel. Heart disease, respiratory problems, and related illnesses can develop in response personnel after repeated and concentrated exposure.

Depending on the characteristics and location of the wildfire event, it is possible that operations and service delivery could be impacted by a wildfire. Roadways in or near the WUI could also be impacted by wildfire. Damage may occur from the wildfire, or closures could result from limited visibility due to heavy smoke in the area.

Damage from a wildfire can have an impact on utility infrastructure. This could result in a temporary loss of function for businesses in the City of Austin planning area that rely on utilities for operation, even if those businesses were not directly impacted by the fire. Additionally, businesses can suffer interruption from closed or blocked roadways. For example, firefighters may need to close a roadway in the event that a wildfire grows out of control or shifts unexpectedly. This could negatively impact other businesses in the area that were not otherwise damaged.

Wildfires are often a natural phenomenon and part of the normal cycle of the natural environment. In fire-dependent ecosystems, many plants and animals cannot survive without the cycles of fire to which they are adapted. If all fire is suppressed, fuel may build up, making hotter, more destructive fires inevitable which can result in significant deforestation, wildlife death, and cause water and air pollution. Environmental damage caused by a wildfire event may take decades, or longer, to become fully restored.

Wildfire also performs a variety of environmentally beneficial functions to the burned area if they are low in intensity and do not grow out of control. Fire removes low-growing underbrush, opens the area to sunlight, and nourishes the soil. Reducing the competition for nutrients allows established trees to grow stronger and healthier. Through the clearing of heavy brush, new grasses, herbs, and regenerated shrubs are able to grow, providing food and habitat for many wildlife species. Small seed-eating mammals and birds are attracted to the area, which in turn attracts predators like foxes, hawks, and weasels. Cavity nesting birds, such as flickers, chickadees, and woodpeckers, thrive on the insects that inhabit fire-killed trees.

The City of Austin planning area is home to a large number of cultural and historic resources. Many of the historic neighborhoods may be at risk from a wildfire event because they are of a construction type and material that is more vulnerable to fire. Historic homes are often constructed close together and are generally exempt from modern building code requirements, which may require fire suppression equipment in the structure. Additionally, the City's historic and cultural resources are a significant draw for tourists and visitors to the area and help to generate revenue through taxes and fees. This revenue in turn pays services and programs, which benefit residents and the community.

The financial and economic impacts associated with a wildfire event may be significant. A major fire, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community. These consequences will depend on what is damaged, the extent of the damage, and the services the damaged structures provided to the community.

The severity of impact from major wildfire events can be substantial. Such events can cause multiple deaths, shut down facilities for 30 days or more, and cause more than 50 percent of

SECTION 7: WILDFIRE

affected properties to be destroyed or suffer major damage. Severity of impact is gauged by acreage burned, homes and structures lost, and the number of resulting injuries and fatalities.

For the City of Austin planning area, the impact from a wildfire event can be considered “Limited,” meaning injuries and/or illnesses are treatable with first aid, shutdown of facilities and services for 24 hours or less, and less than 10 percent of property is destroyed or with major damage. Severity of impact is gauged by acreage burned, homes and structures lost, injuries and fatalities. Based on this, impact for the planning area is listed below in Table 7-5.

Table 7-5. Impact by Jurisdiction

JURISDICTION	IMPACT	DESCRIPTION
City of Austin	Limited	The City of Austin has an estimated 280,716 people or 34.5 percent of the total population that live within the Wildland Urban Interface (WUI). City of Austin may suffer minor injuries that can be treated with first aid. Critical facilities could be shut down for 24 hours or less, and less than 10 percent of total property could be damaged.

ASSESSMENT OF IMPACTS

A Wildfire event poses a potentially significant risk to public health and safety, particularly if the wildfire is initially unnoticed and spreads quickly. The impacts associated with a wildfire are not limited to the direct damages. Potential impacts for the planning area include:

- Persons in the area at the time of the fire are at risk for injury or death from burns and/or smoke inhalation.
- First responders are at greater risk of physical injury since they are in close proximity to the hazard while extinguishing flames, protecting property or evacuating residents in the area.
- First responders can experience heart disease, respiratory problems, and other long-term related illnesses from prolonged exposure to smoke, chemicals, and heat.
- Emergency services may be disrupted during a wildfire if facilities are impacted, roadways are inaccessible, or personnel are unable to report for duty.
- Critical city and/or county departments may not be able to function and provide necessary services depending on the location of the fire and the structures or personnel impacted.
- Non-critical businesses may be directly damaged, suffer loss of utility services, or be otherwise inaccessible, delaying normal operations and slowing the recovery process.
- Displaced residents may not be able to immediately return to work, further slowing economic recovery.
- Roadways in or near the WUI could be damaged or closed due to smoke and limited visibility.
- Older homes are generally exempt from modern building code requirements, which may require fire suppression equipment in the structure.
- Some high-density neighborhoods feature small lots with structures close together, increasing the potential for fire to spread rapidly.
- Air pollution from smoke may exacerbate respiratory problems of vulnerable residents.

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- Charred ground after a wildfire cannot easily absorb rainwater, increasing the risk of flooding and potential mudflows.
- Wildlife may be displaced or destroyed.
- Historical or cultural resources may be damaged or destroyed.
- Tourism can be significantly disrupted, further delaying economic recovery for the area.
- Vegetated dunes can be stripped, significantly damaging the function of the dunes to protect inland areas from the destructive forces of wind and waves.
- Economic disruption negatively impacts the programs and services provided by the community due to short- and long-term loss in revenue.
- Fire suppression costs can be substantial, exhausting the financial resources of the community.
- Residential structures lost in a wildfire may not be rebuilt for years, reducing the tax base for the community.
- Area lakes such as Lake Travis, Lake Walter E. Long and Lady Bird Lake, recreation and tourism can be unappealing for years following a large wildfire, devastating directly related businesses.
- Direct impacts to municipal water supply may occur through contamination of ash and debris during the fire, destruction of aboveground delivery lines, and soil erosion or debris deposits into waterways after the fire.

The economic and financial impacts of a wildfire event on local government will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by government, businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of a wildfire event.

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HAZARD DESCRIPTION

Extreme heat is a prolonged period of excessively high temperatures and exceptionally humid conditions. Extreme heat during the summer months is a common occurrence throughout the State of Texas, and the City of Austin is no exception. The entire planning area typically experiences extended heat waves. A heat wave is an extended period of extreme heat and is often accompanied by high humidity.



Although heat can damage buildings and facilities, it presents a more significant threat to the safety and welfare of citizens. The major human risks associated with severe summer heat include: heat cramps; sunburn; dehydration; fatigue; heat exhaustion; and even heat stroke. The most vulnerable population to heat casualties are children and the elderly or infirmed who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being.

LOCATION

Though a death from extreme heat has not been recorded at a specific location in the County, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur anywhere within the City of Austin planning area.

EXTENT

The magnitude or intensity of an extreme heat event is measured according to temperature in relation to the percentage of humidity. According to the National Oceanic Atmospheric Administration (NOAA), this relationship is referred to as the “Heat Index” and is depicted in Figure 8-1. This index measures how hot it feels outside when humidity is combined with high temperatures.

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Figure 8-1. Extent Scale for Extreme Summer Heat¹

Temperatures (°F)		Temperatures (°F)		Temperatures (°F)		Temperatures (°F)	
40	80 - 88: CAUTION	40	90 - 96: EXTREME CAUTION	40	98 - 106: DANGER	40	108 - 110: EXTREME DANGER
45	80 - 88: CAUTION	45	90 - 94: EXTREME CAUTION	45	96 - 104: DANGER	45	106 - 110: EXTREME DANGER
50	80 - 86: CAUTION	50	88 - 94: EXTREME CAUTION	50	96 - 102: DANGER	50	104 - 110: EXTREME DANGER
55	80 - 86: CAUTION	55	88 - 92: EXTREME CAUTION	55	94 - 100: DANGER	55	102 - 110: EXTREME DANGER
60	80 - 84: CAUTION	60	86 - 90: EXTREME CAUTION	60	92 - 98: DANGER	60	100 - 110: EXTREME DANGER
65	80 - 84: CAUTION	65	86 - 90: EXTREME CAUTION	65	92 - 96: DANGER	65	98 - 110: EXTREME DANGER
70	80 - 84: CAUTION	70	86 - 88: EXTREME CAUTION	70	90 - 94: DANGER	70	96 - 110: EXTREME DANGER
75	80 - 82: CAUTION	75	84 - 88: EXTREME CAUTION	75	90 - 94: DANGER	75	96 - 110: EXTREME DANGER
80	80 - 82: CAUTION	80	84 - 86: EXTREME CAUTION	80	88 - 92: DANGER	80	94 - 110: EXTREME DANGER
85	80 - 82: CAUTION	85	84 - 86: EXTREME CAUTION	85	88 - 90: DANGER	85	92 - 110: EXTREME DANGER
90	80: CAUTION	90	82 - 84: EXTREME CAUTION	90	86 - 90: DANGER	90	92 - 110: EXTREME DANGER
95	80: CAUTION	95	82 - 84: EXTREME CAUTION	95	86 - 88: DANGER	95	90 - 110: EXTREME DANGER
100	80: CAUTION	100	82 - 84: EXTREME CAUTION	100	86 - 88: DANGER	100	90 - 110: EXTREME DANGER

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

The Extent Scale in Figure 8-1 displays varying categories of caution depending on the relative humidity combined with the temperature. For example, when the temperature is at 90 degrees Fahrenheit (°F) or lower, caution should be exercised if the humidity level is at or above 40 percent.

The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. “Caution” is the first category of intensity, and it indicates when fatigue due to heat exposure is possible. “Extreme Caution” indicates that sunstroke, muscle cramps, or heat exhaustion are possible, and a “Danger” level means that these symptoms are likely. “Extreme Danger” indicates that heat stroke is likely. The National Weather Service (NWS) initiates alerts based on the Heat Index as shown in Table 8-1.

Table 8-1. Heat Index and Warnings

CATEGORY	HEAT INDEX	POSSIBLE HEAT DISORDERS	WARNING TYPE
Extreme Danger	125°F and higher	Heat stroke or sun stroke likely.	
Danger	103 – 124°F	Sunstroke, muscle cramps, and/or heat exhaustion are likely. Heatstroke possible with prolonged exposure and/or physical activity.	A heat advisory will be issued to warn that the Heat Index may exceed 105°F.
Extreme Caution	90 – 103°F	Sunstroke, muscle cramps, and/or heat exhaustion possible	An Excessive Heat Warning is issued if the Heat Index

¹ Source: NOAA

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CATEGORY	HEAT INDEX	POSSIBLE HEAT DISORDERS	WARNING TYPE
		with prolonged exposure and/or physical activity.	rises above 105°F at least 3 hours during the day or above 80°F at night.
Caution	80 – 90°F	Fatigue is possible with prolonged exposure and/or physical activity.	

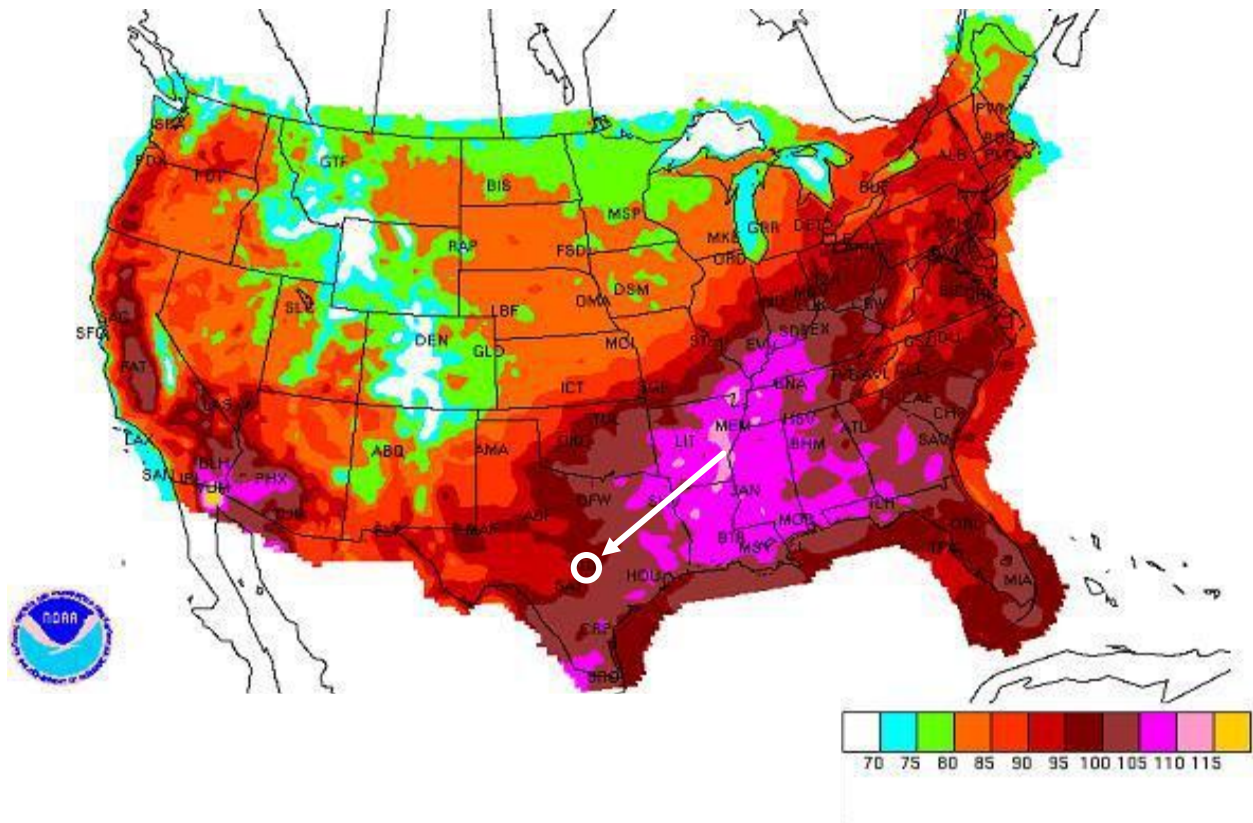
Due to its location, and its urban makeup, the City of Austin can expect an extreme heat event each summer. The City of Austin created an Emergency Operations Heat Plan in 2011 after the Heat Wave of 2009. The Heat Plan is triggered when the National Weather Service issues advisories or warnings for excessive heat above 105° F for more than three hours per day, and two days in a row. Emergency visits and calls due to heat-related illness is monitored by the Austin/Travis County Health and Human Services Department and reported to the City of Austin.

Citizens, especially children and the elderly, should exercise caution by staying out of the heat for prolonged periods when a heat advisory or excessive heat warning is issued. Also at risk are those working or remaining outdoors for prolonged periods of time. Due to the abundance of concrete and metal infrastructure, the effects of an extreme heat event can be intensified. Concrete and metal absorb heat energy and emit that energy at night, thereby trapping heat, and causing the temperature to feel as much as 10 degrees higher than surrounding areas. This is known as the “heat island” effect.

Figure 8-2 displays the daily maximum heat index as derived from NOAA based on data compiled from 1838 to 2015. The white circle shows the City of Austin planning area. The dark red color indicates a daily maximum heat index of 95° to 100°F. The City of Austin could experience extreme heat from 90° to 100°F in the future. The record high temperature for the City of Austin planning area was 110°F in July 2018. This is the highest temperature (danger category) the planning area can expect.

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Figure 8-2. Average Daily Maximum Heat Index Days²



HISTORICAL OCCURRENCES

Every summer, the hazard of heat-related illness becomes a significant public health issue throughout much of the US. Mortality from all causes increases during heat waves, and excessive heat is an important contributing factor to deaths from other causes, particularly among the elderly. Table 8-2 depicts historical occurrences of mortality from heat from 1994 to 2004 from the Texas Department of State Health Services and 2005 to 2019 from the NCEI database.

Table 8-2. Extreme Heat Related Deaths in Texas

YEAR	DEATHS
1994	1
1995	12
1996	10
1997	2
1998	66

² Source: NRDC and the white circle indicates the City of Austin planning area.

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YEAR	DEATHS
1999	22
2000	71
2001	20
2002	1
2003	0
2004	3
2005	49
2006	2
2007	2
2008	7
2009	120
2010	4
2011	46
2012	3
2013	2
2014	0
2015	5
2016	6
2017	3
2018	2
2019	7

Because the Texas Department of State Health Services reports on total events statewide, previous occurrences for extreme heat are derived from the NCEI database. According to heat related incidents located solely within Travis County, there is 14 heat waves on record for Travis County, including the City of Austin planning area (Table 8-3). Historical extreme heat information, as provided by the NCEI, shows extreme heat activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. Historical extreme heat data for the City of Austin are provided on a County-wide basis per the NCEI database. Only extreme heat events that have been reported have been factored into this Risk Assessment. It is highly likely additional extreme heat occurrences have gone unreported before and during the

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recording period. Due to the limited number of reported events, average high temperatures have been analyzed in order to determine the probability of future events.

Table 8-3. Historical Extreme Heat Events, 1996-2019³

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	7/29/1999	1	0	\$0	\$0
Travis County	8/14/1999	1	0	\$0	\$0
Travis County	8/16/1999	1	0	\$0	\$0
Travis County	7/4/2000	1	0	\$0	\$0
Travis County	7/5/2000	1	0	\$0	\$0
Travis County	7/18/2000	1	0	\$0	\$0
Travis County	7/23/2000	1	0	\$0	\$0
Travis County	7/23/2000	1	0	\$0	\$0
Travis County	7/15/2009	0	0	\$0	\$0
Travis County	5/25/2011	0	0	\$0	\$0
Travis County	8/9/2011	1	0	\$0	\$0
Travis County	7/22/2015	0	0	\$0	\$0
Travis County	8/6/2015	0	0	\$0	\$0
Travis County	7/19/2018	0	0	\$0	\$0
TOTALS		9	0	\$0	\$0

SIGNIFICANT EVENTS

July 19-23, 2018

Strong high pressure settled over South Central Texas and temperatures soared to record levels. The heat wave started on the 19th with high temperatures reaching 105 and higher. The hot temperatures spread across the region reaching its greatest extent on the 23rd. During this time Austin Bergstrom International Airport had record highs each day from the 20th through the 23rd, Austin Camp Mabry 21-23, and San Antonio 22-23. Both Austin sites set the all-time record high for the month on the 23rd, Bergstrom 109 and Camp Mabry 110. The extreme heat broke on the 24th when highs dropped down closer to 100.

³ Historical events are reported from January 1996 through November 2019.

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June 15, 2009

A heat related death occurred in Austin. A water well drilling construction worker was found unresponsive in his vehicle in South Austin in the late afternoon. He had been working outside for several days during the heat wave. He died from heat exhaustion.⁴

Summer of 2011

The summer of 2011 marked a period of extreme heat for the City. Temperatures across South Central Texas rose in advance of a cold front in May. The high in Austin was 100 degrees F. A one-year old girl was found unresponsive in a parked vehicle in northwest Austin and was taken to a hospital where she was pronounced dead. Again in August, persistent high pressure over Austin led to record high temperatures during a heat wave. A man died along County Line Road in Elgin due to hyperthermia. The high temperature at Austin Bergstrom International Airport reached 103 degrees and the heat index topped out at 109. This was the 11th consecutive day the temperature reached 100 degrees.

June 5, 2012

An Austin highway construction worker died due to heat stress.

July 8 & July 14, 2014

Austin/Travis County Health & Human Services Department reported two deaths due to hyperthermia.

PROBABILITY OF FUTURE EVENTS

Historical extreme heat events along with average high temperatures for the planning area through the summer months indicate a probability of one event or more every year. This frequency supports a highly likely probability of future events.

VULNERABILITY AND IMPACT

There is no defined geographic boundary for extreme heat events. While the entire City of Austin planning area is exposed to extreme temperatures, existing buildings, infrastructure, and critical facilities are not likely to sustain significant damage from extreme heat events. Therefore, any estimated property losses associated with the extreme heat hazard are anticipated to be minimal across the area.

Extreme temperatures do however present a significant threat to life and safety for the population of the County as a whole. Heat casualties for example are typically caused by a lack of adequate air-conditioning or heat exhaustion. The most vulnerable population to heat casualties are the elderly or infirmed who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being. In addition, populations living below the poverty level are unable to run air-conditioning on a regular basis and are limited in their ability to seek medical treatment. Another segment of the population at risk are those whose jobs consist of strenuous labor outdoors. Additionally, livestock and crops can become stressed, decreasing in quality or in production, during times of extreme heat.

⁴ https://www.osha.gov/SLTC/heatillness/map_text.html

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The population over 65 in the City of Austin planning area is estimated at 8.7% of the total population and children under the age of 5 are estimated at 6.7%, or an estimated total of 138,295⁵ potentially vulnerable residents in the planning area based on age. In addition, an estimated 14.5% of the planning area population live below the poverty level (Table 8-4).

Table 8-4. Populations at Greater Risk by Jurisdiction

JURISDICTION	POPULATION 65 AND OLDER	POPULATION UNDER 5	POPULATION BELOW POVERTY LEVEL
City of Austin	81,322	62,257	135,684

Extreme high temperatures can have significant secondary impacts, leading to droughts, water shortages, increased fire danger, and prompt excessive demands for energy. The possibility of rolling blackouts increases with unseasonably high temperatures in what is a normally mild month with low power demands.

In terms of vulnerability to structures, the impact from extreme heat would be negligible. It is possible that critical facilities and infrastructure could be shut down for 24 hours if cooling units are running constantly, leading to a temporary power outage. Less than ten percent of residential and commercial property could be damaged if extreme heat events lead to structure fires. However, the potential impact of excessive summer heat is considered “Substantial” due to the historic deaths reported in the planning area.

ASSESSMENT OF IMPACTS

The greatest risk from extreme heat is to public health and safety. Potential impacts the community may include:

- Vulnerable populations, particularly the elderly and children under 5, can face serious or life-threatening health problems from exposure to extreme heat including hyperthermia, heat cramps, heat exhaustion, and heat stroke (or sunstroke).
- Response personnel, including utility workers, public works personnel, and any other professions where individuals are required to work outside, are more subject to extreme heat related illnesses since their exposure would typically be greater.
- High energy demand periods can outpace the supply of energy, potentially creating the need for rolling brownouts which would elevate the risk of illness to vulnerable residents.
- Highways and roads may be damaged by excessive heat causing asphalt roads to soften and concrete roads to shift or buckle.
- Vehicles engines and cooling systems typically run harder during extreme heat events resulting in increases in mechanical failures.
- Extreme heat events during times of drought can exacerbate the environmental impacts associated with drought, decreasing water and air quality and further degrading wildlife habitat.
- Extreme heat increases ground-level ozone (smog), increasing the risk of respiratory illnesses.

⁵ U.S. Census Bureau 2018 data for City of Austin

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- Food suppliers can anticipate an increase in food costs due to increases in production costs and crop and livestock losses.
- Fisheries may be negatively impacted by extreme heat, suffering damage to fish habitats (either natural or man-made) and a loss of fish and/or other aquatic organisms due to decreased water flows or availability.
- Negatively impacted water suppliers may face increased costs resulting from the transport of water resources or development of supplemental water resources.
- Outdoor activities such as fishing, boating, and camping activities at Lake Travis, Lake Walter E. Long and Lady Bird Lake may see an increase in injury or illness during extreme heat events.

The economic and financial impacts of extreme heat on the community will depend on the duration of the event, demand for energy, drought associated with extreme heat, and many other factors. The level of preparedness and the amount of planning done by the jurisdiction, local businesses, and citizens will impact the overall economic and financial conditions before, during, and after an extreme heat event.

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HAZARD DESCRIPTION

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

According to FEMA, an average of 300 people are injured and 80 people are killed in the United States each year by lightning. Direct lightning strikes also have the ability to cause significant damage to buildings, critical facilities, and infrastructure. Lightning is also responsible for igniting wildfires that can result in widespread damages to property before firefighters have the ability to contain and suppress the resultant fire.

LOCATION

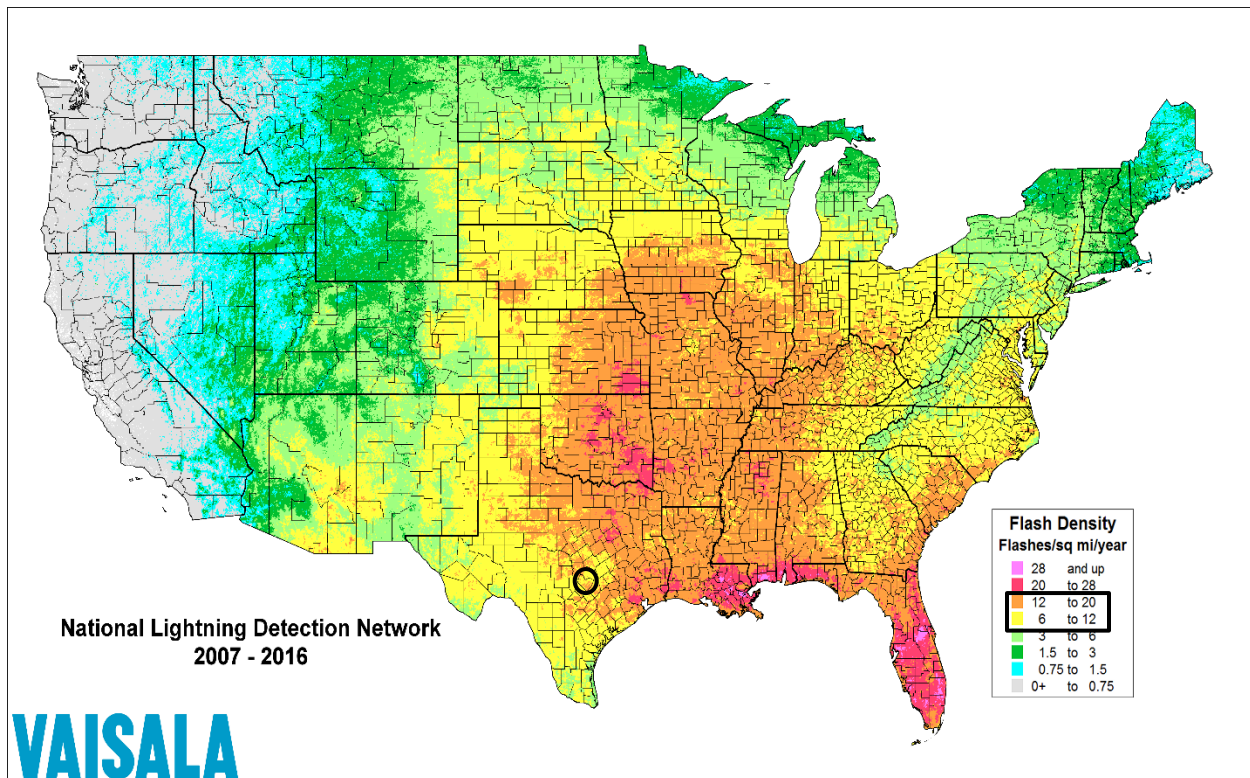
Lightning can strike in any geographic location and is considered a common occurrence in Texas. The City of Austin planning area is located in a region of the country that is moderately susceptible to a lightning strike. Therefore, lightning could occur at any location within the entire planning area. It is assumed that the entire City of Austin planning area is uniformly exposed to the threat of lightning.

EXTENT

According to the NOAA, the average number of cloud-to-ground flashes for the State of Texas between 2007 and 2016 was 11.3 flashes per square mile. Vaisala’s U.S. National Lightning Detection Network lightning flash density map (Figure 9-1) shows a range of six to twenty cloud-to-ground lightning flashes per square mile per year for the entire City of Austin planning area. This rate equates to approximately 1,632 to 5,440 flashes per year for the entire planning area.

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Figure 9-1. Lightning Flash Density, 2007-2016



The extent for lightning can be expressed in terms of the number of strikes in an interval. NOAA utilizes lightning activity levels (LALs) on a scale from 1-6. LAL rankings reflect the frequency of cloud-to-ground lightning either forecast or observed (Table 9-1).

Table 9-1. NOAA Lightning Activity Levels (LAL)

LAL	CLOUD & STORM DEVELOPMENT	LIGHTNING STRIKES/ 15 MIN
1	No thunderstorms.	-
2	Cumulus clouds are common but only a few reach the towering cumulus stage. A single thunderstorm must be confirmed in the observation area. The clouds produce mainly virga, but light rain will occasionally reach the ground. Lightning is very infrequent.	1-8
3	Towering cumulus covers less than two-tenths of the sky. Thunderstorms are few, but two to three must occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	9-15
4	Towering cumulus covers two to three-tenths of the sky. Thunderstorms are scattered and more than three must occur within the observation area. Moderate rain is common and lightning is frequent.	16-25

SECTION 9: LIGHTNING

LAL	CLOUD & STORM DEVELOPMENT	LIGHTNING STRIKES/ 15 MIN
5	Towering cumulus and thunderstorms are numerous. They cover more than three-tenths and occasionally obscure the sky. Rain is moderate to heavy and lightning is frequent and intense.	>25
6	Similar to LAL 3 except thunderstorms are dry.	

The NCEI does not include the LAL for historical lightning events, therefore in order to determine the extent of lightning strikes, the yearly average range of estimated number of lightning strikes within the planning area (1,632 to 5,440 flashes) and a cloud-to-ground flash density of six to twenty per square mile were divided by the number¹ of thunderstorm events that occur annually in the planning area. The City of Austin, should expect an average range of two to six lightning strikes within 15 minutes at any given time during a lightning or combined lightning and thunderstorm event, indicating lightning strikes have an average LAL range of 1 to 2. The highest being a 2 on the LAL for the City of Austin planning area.

HISTORICAL OCCURRENCES

Since January 1996, there has been seven recorded events for the City of Austin planning area. It is highly likely multiple lightning occurrences have gone unreported before and during the recording period. The NCEI is a national data source organized under the National Oceanic and Atmospheric Administration and considered a reliable resource for hazards. However, the flash density for the planning area along with input from local team members indicates regular lightning occurrences that simply have not been reported.

Table 9-2 Historical Lightning Events, 1996- 2018

JURISDICTION	DATE	INJURIES	FATALITIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	4/5/1996	0	1	\$0	\$0
City of Austin	8/16/1998	2	0	\$0	\$0
City of Austin	7/16/2000	1	0	\$0	\$0
City of Austin	4/27/2008	0	0	\$36,026	\$0
City of Austin	10/7/2008	0	0	\$595,575	\$0
City of Austin	6/9/2010	0	0	\$710,126	\$0
City of Austin	5/28/2017	0	0	\$126,491	\$0
TOTALS		3	1	\$1,468,218	\$0

¹ Analysis includes the highest number of events recorded in a given year during the reporting period in order to account for typical under reporting of thunderstorm and lightning events.

SECTION 9: LIGHTNING

Based on the list of historical lightning events for the City of Austin planning area (listed above), one of the reported events occurred since the 2016 Plan.

SIGNIFICANT EVENTS

May 28, 2017 – City of Austin

A thunderstorm produced lightning that caused a house fire in Austin.

April 5, 1996 – City of Austin

Lightning struck a 51-year old visitor from Scotland as he was playing golf in the southeast part of Austin. He was in critical condition for nearly 2 weeks after the strike, and died on April 13th.

PROBABILITY OF FUTURE EVENTS

Based on historical records and input from the planning team the probability of occurrence for future lightning events in the City of Austin planning area is considered highly likely, or an event probable in the next year. The planning team stated that lightning occurs regularly in the area. According to NOAA, the City of Austin planning area is located in an area of the country that experiences six to twenty lightning flashes per square mile per year (approximately 1,632 to 5,440 flashes per year). Given this estimated probability of events, it can be expected that future lightning events will continue to threaten life and cause minor property damages throughout the planning area.

VULNERABILITY AND IMPACT

Vulnerability is difficult to evaluate since lightning events can occur at different strength levels, in random locations, and can create a broad range of damages depending on the strike location. Due to the randomness of these events, all existing and future structures and facilities in the City of Austin planning area could potentially be impacted and remain vulnerable to possible injury and property loss from lightning strikes. The City of Austin planning area has only seven reported lightning events per the NCEI, however the entire planning area is vulnerable and could be impacted by lightning.

The direct and indirect losses associated with these events include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources. The entire population of the City of Austin is considered exposed to the lightning hazard. The peak lightning season in the State of Texas is from June to August; however, the most fatalities occur in July. Fatalities occur most often when people are outdoors and/or participating in some form of recreation. Population located outdoors is considered at risk and more vulnerable to a lightning strike compared to being inside a structure. Moving to a lower risk location will decrease a person's vulnerability.

The entire general building stock and all infrastructure of the City of Austin planning area, are considered exposed to the lightning hazard. Lightning can be responsible for damages to buildings, cause electrical, forest and/or wildfires, and damage infrastructure such as power transmission lines and communication towers. Agricultural losses can be extensive due to lightning and resulting fires.

The following critical facilities would be vulnerable to lightning events in each participating jurisdiction:

SECTION 9: LIGHTNING

Table 9-3. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

The impact of lightning events experienced in the City of Austin planning area are considered “Limited,” meaning shutdown of critical facilities and services for 24-hours or less and less than 10 percent of property destroyed or with major damage. However, historical events include three injuries and one fatality, indicating a “substantial” impact is possible. Overall, the average loss estimate of property and crops (in 2020 dollars) is \$1,468,218, having an approximate annual loss estimate of \$61,176.

Table 9-4. Potential Annualized Losses by Jurisdiction²

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATE
City of Austin	\$1,468,218	\$61,176

ASSESSMENT OF IMPACTS

Lightning events have the potential to pose a significant risk to people and can create dangerous and difficult situations for public health and safety officials. Impacts to the planning area can include:

- Individuals exposed to the storm can be directly struck, posing significant health risks and potential death.
- Structures can be damaged or crushed by falling trees damaged by lightning, which can result in physical harm to the occupants.
- Lightning strikes can result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage often results in an increase in structure fires and carbon monoxide poisoning as individuals attempt to cook or heat their homes with alternate, unsafe cooking or heating devices, such as grills.
- Lightning strikes can be associated with structure fires and wildfires, creating additional risk to residents and first responders.
- Emergency operations and services may be significantly impacted due to power outages and/or loss of communications.
- City or county departments may be damaged, delaying response and recovery efforts for the entire community.
- Economic disruption due to power outages and fires negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Some businesses not directly damaged by lightning events may be negatively impacted while utilities are being restored, further slowing economic recovery.

² Damage values are in 2019 dollars.

SECTION 9: LIGHTNING

- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.

The economic and financial impacts of lightning on the area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by the county, communities, local businesses, and citizens will also contribute to the overall economic and financial conditions in the aftermath of any lightning event.

SECTION 10: THUNDERSTORM WIND

- Hazard Description 1
- Location 1
- Extent 2
- Historical Occurrences 3
 - Significant Events 6
- Probability of Future Events 7
- Vulnerability and Impact..... 7
 - Assessment of Impacts..... 8

HAZARD DESCRIPTION

Thunderstorms create extreme wind events which includes straight line winds. Wind is the horizontal motion of the air past a given point, beginning with differences in air pressures. Pressure that is higher at one place than another sets up a force pushing from the high toward the low pressure; the greater the difference in pressures, the stronger the force. The distance between the area of high pressure and the area of low pressure also determines how fast the moving air is accelerated.

Thunderstorms are created when heat and moisture near the Earth's surface are transported to the upper levels of the atmosphere. By-products of this process are the clouds, precipitation, and wind that become the thunderstorm.



According to the National Weather Service (NWS), a thunderstorm occurs when thunder accompanies rainfall. Radar observers use the intensity of radar echoes to distinguish between rain showers and thunderstorms.

Straight line winds are responsible for most thunderstorm wind damages. One type of straight-line wind, the downburst, is a small area of rapidly descending air beneath a thunderstorm. A downburst can cause damage equivalent to a strong tornado and make air travel extremely hazardous.

LOCATION

Thunderstorms wind events can develop in any geographic location and are considered a common occurrence in Texas. Therefore, a thunderstorm wind event could occur at any location within the City of Austin's planning area, as these storms develop randomly and are not confined to any geographic area within the County. It is assumed that the City of Austin planning area is uniformly exposed to the threat of thunderstorms winds.

SECTION 10: THUNDERSTORM WIND

EXTENT

The extent or magnitude of a thunderstorm wind event is measured by the Beaufort Wind Scale. Table 10-1 describes the different intensities of wind in terms of speed and effects, from calm to violent and destructive.

Table 10-1. Beaufort Wind Scale¹

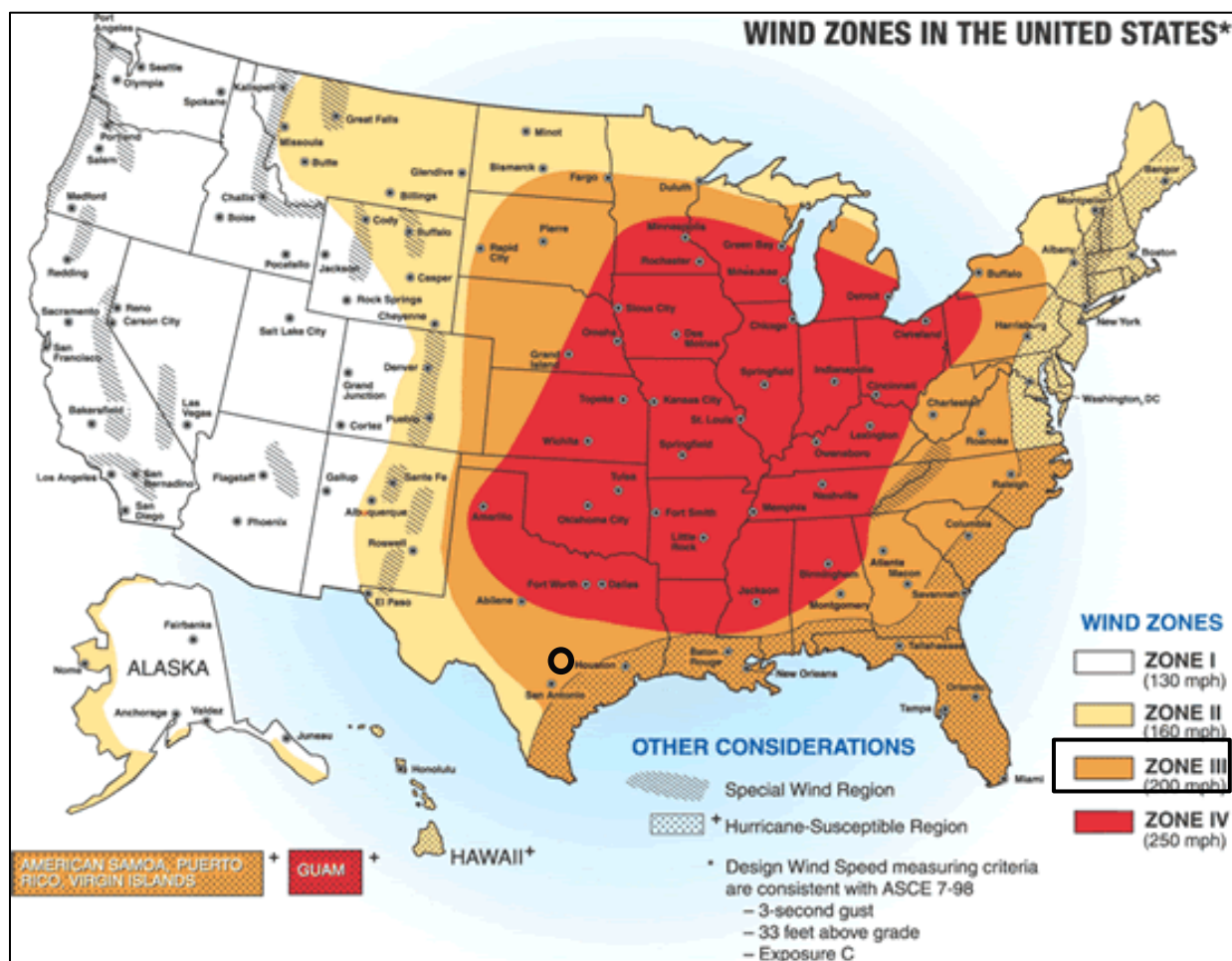
FORCE	WIND (MHP)	WMO CLASSIFICATION	APPEARANCE OF WIND EFFECTS
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-8	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	9-14	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	15-21	Moderate Breeze	Dust, leaves and loose paper lifted, small tree branches move
5	22-28	Fresh Breeze	Small trees in leaf begin to sway
6	29-36	Strong Breeze	Larger tree branches moving, whistling in wires
7	37-44	Near Gale	Whole trees moving, resistance felt walking against wind
8	45-53	Gale	Whole trees in motion, resistance felt walking against wind
9	54-62	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	63-72	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	73-83	Violent Storm	If experienced on land, widespread damage
12	84+	Hurricane	Violence and destruction

Figure 10-1 displays the wind zones as derived from NOAA.

¹ Source: World Meteorological Organization

SECTION 10: THUNDERSTORM WIND

Figure 10-1. Wind Zones in the United States²



On average, the planning area experiences two to three thunderstorm wind events every year. The planning area is in Zone III, meaning they can experience winds up to 200 mph. The City of Austin has experienced a significant wind event or an event with winds in the range of “Force 11” on the Beaufort Wind Scale with winds up to 83 mph. This is the most significant event that can be expected in the future for the planning area.

HISTORICAL OCCURRENCES

Tables 10-2, 10-3, and 10-4 depict historical occurrences of thunderstorm wind events for the City of Austin planning area according to the National Centers for Environmental Information (NCEI) data. Since January 1993, 72 thunderstorm wind events are known to have impacted the City of Austin planning area based upon NCEI records. Table 10-3 presents information on known historical events impacting the City of Austin planning area with resulting damages, injuries or fatalities. It is important to note that high wind events associated with other hazards, such as tornadoes, are not accounted for in this section.

² City of Austin is indicated by the circle.

SECTION 10: THUNDERSTORM WIND

The NCEI is a national data source organized under the National Oceanic and Atmospheric Administration. The NCEI is the largest archive available for climate data; however, it is important to note that the only incidents recorded are those that are reported to the NCEI from January 1993 through November 2019 have been factored into this risk assessment. In the tables that follow property damage estimates are not always available. Where an estimate has been provided in a table for losses, the dollar amounts have been altered to indicate the damage in 2020 dollars.

Historical thunderstorm wind data for the planning area is provided on a City-wide basis per the NCEI database.

Table 10-2. Historical Thunderstorm Wind Events with Reported Damages, 1993-2019

MAXIMUM WIND SPEED RECORDED (MPH)	NUMBER OF REPORTED EVENTS
0-30	2
31-40	1
41-50	8
51-60	40
61-70	13
71-80	1
81-90	0
91-100	0
Unknown	7

Table 10-3. Historical Thunderstorm Wind Events, 1993-2019³

JURISDICTION	DATE	TIME	MAGNITUDE (MPH)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	5/30/1993	6:59 PM	51	0	0	\$0	\$8,945
City of Austin	10/19/1993	11:25 PM	0	0	0	\$8,853	\$8,853
City of Austin	5/29/1994	10:52 PM	53	0	0	\$87,448	\$8,745
City of Austin	11/4/1994	11:55 PM	57	0	0	\$8,616	\$0
City of Austin	9/7/1995	8:00 PM	0	0	7	\$5,051,651	\$0
City of Austin	9/20/1996	8:55 PM	Unknown	0	0	\$32,696	\$0
City of Austin	4/4/1997	6:30 PM	Unknown	0	0	\$322,061	\$0

³ Only recorded events with fatalities, injuries or damages are listed. Magnitude is listed when available. Damage values are in 2020 dollars.

SECTION 10: THUNDERSTORM WIND

JURISDICTION	DATE	TIME	MAGNITUDE (MPH)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	3/7/1998	5:50 PM	Unknown	0	0	\$238,568	\$0
City of Austin	4/11/2000	11:42 PM	51	0	0	\$30,119	\$0
City of Austin	3/12/2001	1:30 AM	Unknown	0	5	\$219,612	\$0
City of Austin	9/3/2001	8:05 PM	Unknown	0	0	\$72,342	\$0
City of Austin	6/16/2002	2:00 AM	Unknown	0	0	\$71,698	\$0
City of Austin	6/26/2002	7:20 PM	Unknown	0	0	\$143,397	\$0
City of Austin	6/13/2003	3:45 PM	56	0	0	\$140,431	\$0
City of Austin	8/8/2003	3:23 PM	57	0	0	\$139,746	\$0
City of Austin	8/11/2003	7:05 PM	60	0	0	\$838,476	\$0
City of Austin	6/28/2004	4:40 PM	60	0	0	\$27,198	\$0
City of Austin	5/4/2006	9:30 PM	64	0	0	\$127,393	\$0
City of Austin	4/13/2007	8:30 PM	55	0	0	\$62,407	\$0
City of Austin	5/14/2008	11:30 PM	70	0	0	\$59,541,296	\$0
City of Austin	8/12/2009	2:55 PM	50	0	0	\$2,390	\$0
City of Austin	5/20/2011	7:10 PM	40	0	0	\$1,142	\$0
City of Austin	4/7/2014	6:35 PM	48	0	0	\$2,176	\$0
City of Austin	6/12/2014	8:45 PM	70	0	0	\$5,412	\$0
City of Austin	6/12/2014	9:05 PM	74	0	0	\$216,470	\$0
City of Austin	4/18/2015	8:30 PM	50	0	0	\$10,903	\$0
City of Austin	4/18/2015	8:30 PM	50	0	0	\$10,903	\$0
City of Austin	4/2/2017	8:19 AM	70	0	0	\$1,054,993	\$0
City of Austin	4/2/2017	8:20 AM	70	0	0	\$1,054,993	\$0
City of Austin	5/28/2017	5:55 PM	52	0	0	\$1,054	\$0
City of Austin	6/9/2019	6:42 PM	61	0	0	\$5,036	\$0
TOTALS			(Max Extent)	0	12	\$69,529,480	\$26,543

SECTION 10: THUNDERSTORM WIND

Table 10-4. Summary of Historical Thunderstorm Wind Events, 1993-2019

JURISDICTION	NUMBER OF EVENTS	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	72	74	0	12	\$69,529,480	\$26,543
TOTAL LOSSES	72	(Max Extent)	0	12	\$69,556,023	

Based on the list of historical thunderstorm wind events for the City of Austin planning area (listed above) 25 of the events have occurred since the 2016 Plan.

SIGNIFICANT EVENTS

April 2, 2017 – City of Austin

A thunderstorm produced wind gusts estimated at 75 to 80 mph that downed large trees on Point Venture near Lake Travis. In addition, several homes sustained wind damage especially those that were on the south side of the point facing Lakeway. Roofs and patios had the most damage as radar indicated winds in excess of 70 kt blowing through the area. With multiple homes damaged including water damage, estimates of monetary loss may have been as high as a million.

June 12, 2014 – City of Austin

An upper level low and surface cold front moved through South Central Texas producing thunderstorms. These storms produced a few tornadoes and damaging wind gusts across many areas of South-Central Texas. The thunderstorm produced wind gusts estimated at 60 mph that tore five-inch diameter branches off of some Lace Bark Elms.

July 15, 2012 – City of Austin

A stagnant upper air pattern of a weak trough combined with deep subtropical moisture to cause thunderstorms for several days. These storms produced isolated areas of heavy rain leading to flash flooding along with some strong winds and large hail. A thunderstorm produced wind gusts estimated at 58 mph that flipped over six boats at the Emerald Point Marina on Lake Travis.

May 14, 2008 – City of Austin

A severe thunderstorm to the southwest of the City of Austin moved northeast across the downtown area causing extensive damage from winds and large hail. Widespread damage occurred over portions of central Austin when a large severe thunderstorm rolled through the downtown area. Numerous reports of large trees and branches were down along with wind-blown hail. The hardest hit area was downtown near the neighborhoods of Tarrytown and Hyde Park, University of Texas campus, and the Interstate35 corridor just north of the river. The combination of baseball size hail and winds of 70 to 80 mph blew out building and apartment windows throughout this area. Windows on the Texas Capitol building were blown out as well. Lion's golf course and the Morris Williams course sustained damage and had to briefly close. Power was knocked off to nearly 20,000 customers. Large old oak trees were damaged, and the City of Austin spent over 2 million dollars in cleanup and response. Total monetary losses are estimated at 50 million dollars.

SECTION 10: THUNDERSTORM WIND

PROBABILITY OF FUTURE EVENTS

Most thunderstorm winds occur during the months of March, April, May, and September. Based on available records of historic events, there have been 72 events in a 27-year reporting period, which provides a probability of two to three events every year. Even though the intensity of thunderstorm wind events is not always damaging for the City of Austin planning area, the frequency of occurrence for a thunderstorm wind event is highly likely. This means that an event is probable within the next year for the City of Austin planning area.

VULNERABILITY AND IMPACT

Vulnerability is difficult to evaluate since thunderstorm wind events can occur at different strength levels, in random locations, and can create relatively narrow paths of destruction. Due to the randomness of these events, all existing and future structures and facilities in the City of Austin planning area could potentially be impacted and remain vulnerable to possible injury and property loss from strong winds.

Trees, power lines and poles, signage, manufactured housing, radio towers, concrete block walls, storage barns, windows, garbage receptacles, brick facades, and vehicles, unless reinforced, are vulnerable to thunderstorm wind events. More severe damage involves windborne debris; in some instances, patio furniture and other lawn items have been reported to have been blown around by wind and, very commonly, debris from damaged structures in turn have caused damage to other buildings not directly impacted by the event. In numerous instances roofs have been reported as having been torn off of buildings. The portable buildings typically used at schools and construction sites would be more vulnerable to thunderstorm wind events than typical site-built structures and could potentially pose a greater risk for wind-blown debris.

The US Census data indicates a total of 5,750 manufactured homes (approximately 1.4%) located in the City of Austin planning area, including all participating jurisdictions, (Table 10-5). In addition, 35.2% (approximately 142,060 structures) of the residential structures in the City of Austin planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant wind events.

Table 10-5. City of Austin Structures at Greater Risk

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
City of Austin	5,750	142,060

The following critical facilities would be vulnerable to thunderstorm wind events in the planning area:

Table 10-6. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

SECTION 10: THUNDERSTORM WIND

Impact of thunderstorms winds experienced in the City of Austin planning area has resulted in twelve injuries and no fatalities. Impact of thunderstorm wind events experienced in the City of Austin planning area would be “Limited,” meaning injuries and illnesses would be treatable with first aid, less than ten percent of property damaged or destroyed, and facilities would be shut down for 24 hours or less. Overall, the average loss estimate (in 2020 dollars) is \$69,556,023, having an approximate annual loss estimate of \$2,576,149 (Table 10-7).

Table 10-7. City of Austin Potential Annualized Losses

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$69,556,023	\$2,576,149

ASSESSMENT OF IMPACTS

Thunderstorm wind events have the potential to pose a significant risk to people and can create dangerous and difficult situations for public health and safety officials. Impacts to the planning area can include:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- During exceptionally heavy wind events, first responders may be prevented from responding to calls, as the winds may reach a speed in which their vehicles and equipment are unsafe to operate.
- Thunderstorm wind events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage often results in an increase in structure fires and carbon monoxide poisoning, as individuals attempt to cook or heat their homes with alternate, unsafe cooking or heating devices, such as grills.
- First responders are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.
- Emergency operations and services may be significantly impacted due to damaged facilities and/or loss of communications.
- Critical staff may be unable to report for duty, limiting response capabilities.
- City or county departments may be damaged, delaying response and recovery efforts for the entire community.
- Private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.

SECTION 10: THUNDERSTORM WIND

- Economic disruption negatively impacts the programs and services provided by the community due to short- and long-term loss in revenue.
- Some businesses not directly damaged by thunderstorm wind events may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Older structures built to less stringent building codes may suffer greater damage as they are typically more vulnerable to thunderstorm winds.
- Large scale wind events can have significant economic impact on the affected area, as it must now fund expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, and normal day-to-day operating expenses.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.
- Activities at locations such as Lake Travis, Walter E. Long and Lady Bird Lake attract tourism including hiking, camping, boating, and fishing throughout the year. A large thunderstorm wind event could impact recreational activities, placing visitors in imminent danger, potentially requiring emergency services or evacuations.
- Recreational areas and parks may be damaged or inaccessible due to downed trees or debris, causing temporary impacts to area businesses.

The economic and financial impacts of thunderstorm winds on the area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by the community, local businesses, and citizens will also contribute to the overall economic and financial conditions in the aftermath of any thunderstorm wind event.

SECTION 11: HAIL

Hazard Description	1
Location	1
Extent	1
Historical Occurrences	3
Significant Events	4
Probability of Future Events	5
Vulnerability and Impact.....	5
Assessment of Impacts.....	6

HAZARD DESCRIPTION



Hailstorm events are a potentially damaging outgrowth of severe thunderstorms. During the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere, and the subsequent cooling of the air mass. Frozen droplets gradually accumulate into ice crystals until they fall as precipitation that is round or irregularly shaped masses of ice typically greater than 0.75 inches in diameter. The size of hailstones is a direct result of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a by-product of heating on the Earth’s surface. Higher temperature gradients above Earth’s surface result in increased suspension time and hailstone size.

LOCATION

Hailstorms are an extension of severe thunderstorms that could potentially cause severe damage. As a result, they are not confined to any specific geographic location and can vary greatly in size, location, intensity, and duration. Therefore, the entire City of Austin planning area are equally at risk to the hazard of hail.

EXTENT

The National Weather Service (NWS) classifies a storm as “severe” if there is hail three-quarters of an inch in diameter (approximately the size of a penny) or greater, based on radar intensity or as seen by observers. The intensity category of a hailstorm depends on hail size and the potential damage it could cause, as depicted in the National Centers for Environmental Information (NCEI) Intensity Scale in Table 11-1.

SECTION 11: HAIL

Table 11-1. Hail Intensity and Magnitude¹

SIZE CODE	INTENSITY CATEGORY	SIZE (Diameter Inches)	DESCRIPTIVE TERM	TYPICAL DAMAGE
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33 – 0.60	Marble	Slight damage to plants and crops
H2	Potentially Damaging	0.60 – 0.80	Dime	Significant damage to plants and crops
H3	Severe	0.80 – 1.20	Nickel	Severe damage to plants and crops
H4	Severe	1.2 – 1.6	Quarter	Widespread glass and auto damage
H5	Destructive	1.6 – 2.0	Half Dollar	Widespread destruction of glass, roofs, and risk of injuries
H6	Destructive	2.0 – 2.4	Ping Pong Ball	Aircraft bodywork dented and brick walls pitted
H7	Very Destructive	2.4 – 3.0	Golf Ball	Severe roof damage and risk of serious injuries
H8	Very Destructive	3.0 – 3.5	Hen Egg	Severe damage to all structures
H9	Super Hailstorms	3.5 – 4.0	Tennis Ball	Extensive structural damage, could cause fatal injuries
H10	Super Hailstorms	4.0 +	Baseball	Extensive structural damage, could cause fatal injuries

The intensity scale in Table 11-1 ranges from H0 to H10, with increments of intensity or damage potential in relation to hail size (distribution and maximum), texture, fall speed, speed of storm translation, and strength of the accompanying wind. Based on available data regarding the previous occurrences for the area, the City of Austin planning area may experience hailstorms ranging from an H0 to an H8. The City of Austin can mitigate a storm from low risk or hard hail to a very destructive hailstorm with hen egg size hail that could cause severe damage to structures and could cause significant injuries. The largest hail event in the City of Austin planning area resulted in hail measuring 3.0 inches in diameter, or a H8, a Very Destructive Hailstorm. This is the worst extent the planning area can anticipate in the future.

¹ NCEI Intensity Scale, based on the TORRO Hailstorm Intensity Scale.

SECTION 11: HAIL

HISTORICAL OCCURRENCES

Historical evidence shown in Figure 11-1 demonstrates that the planning area is vulnerable to hail events overall, which typically result from severe thunderstorm activity. Historical events with reported damages, injuries, or fatalities are shown in Table 11-2. A total of 115 reported historical hail events impacted the City of Austin planning area between 1993 through November 2019 (Summary Table 11-3). These events were reported to NCEI and NOAA databases and may not represent all hail events to have occurred during the past 27 years. Only those events for the City of Austin planning area with latitude and longitude available were plotted (Figure 11-1).

Figure 11-1. Spatial Historical Hail Events, 1993-2019

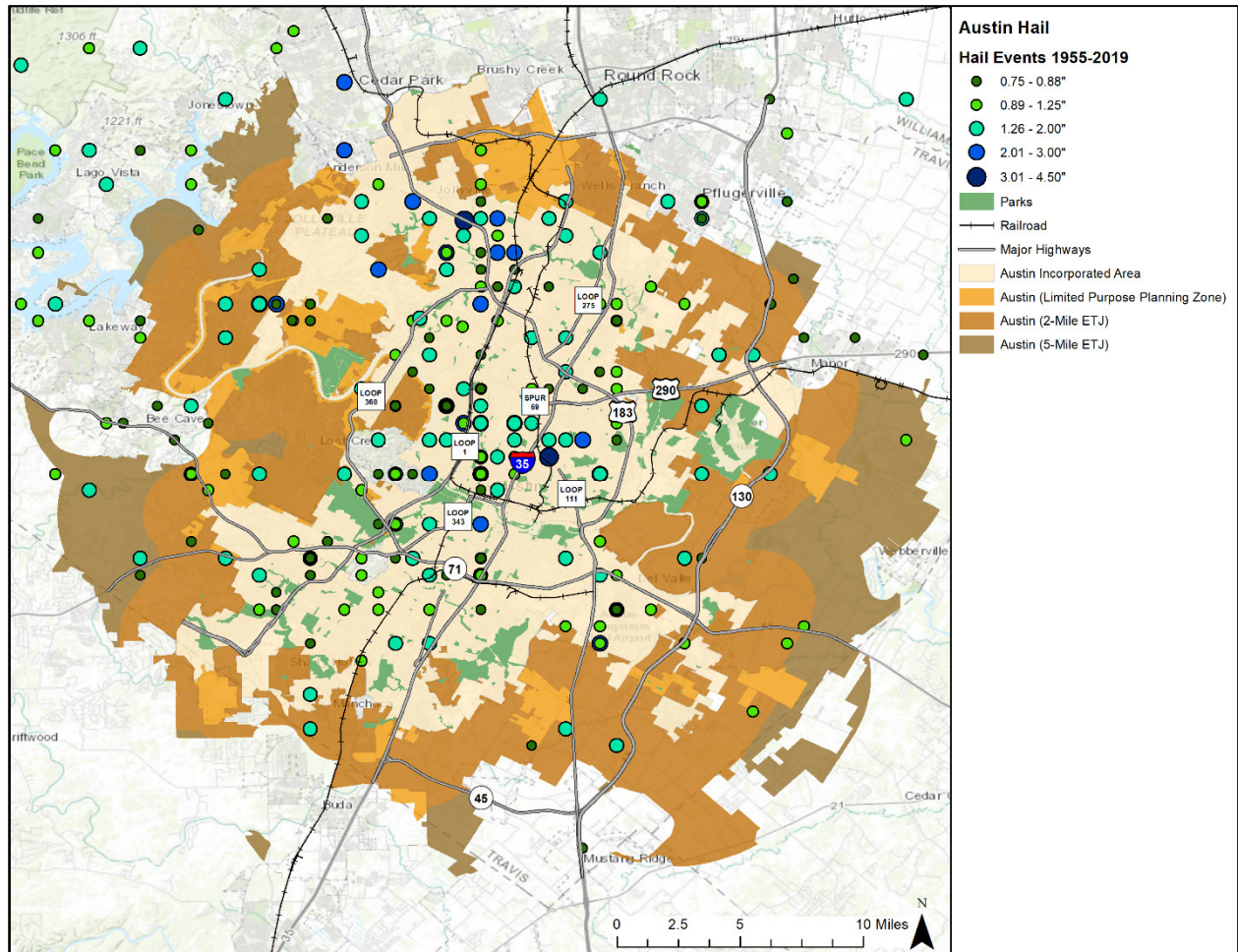


Table 11-2. Historical Hail Events, 1993-2019²

JURISDICTION	DATE	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	3/25/1993	0.75	0	0	\$0	\$8,982
City of Austin	3/25/1993	1.75	0	0	\$89,823	\$0

² Only recorded events with fatalities, injuries, and/or damages are listed.

SECTION 11: HAIL

JURISDICTION	DATE	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	3/25/1993	1.75	0	0	\$898,228	\$0
City of Austin	3/25/1993	0.88	0	0	\$0	\$8,982
City of Austin	3/25/1993	2	0	0	\$134,734,157	\$8,982
City of Austin	4/5/1994	0.75	0	0	\$875,071	\$87,507
City of Austin	10/17/1996	1.5	0	0	\$32,593	\$0
City of Austin	10/17/1996	Unknown	0	0	\$16,296	\$0
City of Austin	10/20/2002	1.75	0	0	\$711,448	\$0
City of Austin	8/11/2003	1.75	0	0	\$139,746	\$0
City of Austin	5/14/2008	2	0	0	\$119,083	\$0
City of Austin	5/14/2008	1.75	0	0	\$1,191	\$0
TOTALS		(Max Extent)	0	0	\$137,732,089	

Table 11-3. Historical Hail Events Summary, 1993-2019

JURISDICTION	NUMBER of EVENTS	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	115	3.0 inches	0	0	\$137,617,636	\$114,453

Based on the list of historical hail events for the City of Austin planning area (listed above) 10 of the events have occurred since the 2016 Plan.

SIGNIFICANT EVENTS

May 28, 2017 – City of Austin

A thunderstorm produced quarter size hail near the intersection of Burleson Rd. and McKinney Falls Pkwy. in southeastern Austin.

May 11, 2017 – City of Austin

A thunderstorm produced ping pong ball size hail near TX360 and Lakewood Dr. in northwestern Austin.

April 27, 2014 – City of Austin

A cold front pushed the dry-line ahead of it into eastern sections of South Central Texas and caused thunderstorms. Some of these storms produced large hail. In Elroy, a thunderstorm produced 1.25 inch hail that damaged a plastic patio cover.

January 24, 2012 – City of Austin

A deep upper level low pressure center brought a frontal system through Texas which caused thunderstorms across South Central Texas. These storms formed into a mesoscale convective

SECTION 11: HAIL

system and produced several tornadoes, wind damage, large hail, and heavy rain that resulted in flash flooding.

March 25, 2009 – City of Austin

A cold front stalled across South Central Texas on the morning of March 25, 2009. The subtropical jet and a mid/upper-level short wave trough pushed into the region. Convection initiated across the San Angelo County warning area in the morning and spread to the southwest. Thunderstorms reached the Edwards Plateau by early afternoon and continued moving east into the evening. Total estimated loss from this storm is around \$160 million dollars, the most ever for a hail storm in the City of Austin. The top three hail storms that have hit the City of Austin have all occurred on a March 25th. March 25, 1993 saw losses at \$125 million, and March 25, 2005 had \$100 million in losses. A thunderstorm moved through the north Austin and Round Rock area, and produced hail ranging in size from golf ball to hen egg size. NOAA received three reports of severe hail with this storm. This hail dented cars and caused minor damage to some roof shingles in the north Austin area.

May 14, 2008 – City of Austin

A severe thunderstorm to the southwest of Austin moved northeast across the downtown area causing extensive damage from winds and large hail. Golf ball to baseball size hail damaged 26 cars at the Combined Transportation, Emergency and Communications Center (CTECC).

PROBABILITY OF FUTURE EVENTS

Based on available records of historic events, 115 events in a 27-year reporting period for the City of Austin provides a probability of four to five events per year. This frequency supports a highly likely probability of future events for the City of Austin planning area.

VULNERABILITY AND IMPACT

Damage from hail approaches 1 billion dollars in the U.S. each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are most commonly damaged by hail.

Utility systems on roofs at school districts and critical facilities would be vulnerable and could be damaged. Hail could cause a significant threat to people as they could be struck by hail and falling trees and branches. Outdoor activities and events may elevate the risk to residents and visitors when a hailstorm strikes with little warning. Portable buildings typically utilized by schools and commercial sites such as construction areas would be more vulnerable to hail events than the typical site built structures.

The City of Austin planning area features mobile or manufactured home parks throughout the planning area. These parks are typically more vulnerable to hail events than typical site built structures. In addition, manufactured homes are located sporadically throughout the planning area which would also be more vulnerable. The US Census data indicates a total of 5,719 (1.5%) manufactured homes located in the City of Austin planning area including all participating jurisdictions (Table 11-4). In addition, 35.2% (approximately 142,060 structures) of the single family residential (SFR) structures in the City of Austin planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant hail events.

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Table 11-4. City of Austin Structures at Greater Risk

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
City of Austin	5,750	142,060

The following critical facilities would be vulnerable to hail events in the planning area:

Table 11-5. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

Hail has been known to cause injury to humans and occasionally has been fatal. Overall, the average loss estimate of property and crops (in 2020 dollars) is \$137,617,636, having an approximate annual loss estimate of \$5,101,188. Based on historic loss and damages, the impact of hail damages on the City of Austin planning area can be considered “Minor” meaning injuries and illnesses are possible but may not result in permanent disability, shutdown of facilities and services for more than a week, and more than ten percent of property is destroyed or experiences major damage.

Table 11-6. City of Austin Potential Annualized Losses

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATE
City of Austin	\$137,732,089	\$5,101,188

ASSESSMENT OF IMPACTS

Hail events have the potential to pose a significant risk to people and can create dangerous situations. Impacts to the planning area can include:

- Hail may create hazardous road conditions during and immediately following an event, delaying first responders from providing for or preserving public health and safety.
- Individuals and first responders who are exposed to the storm may be struck by hail, falling branches, or downed trees resulting in injuries or possible fatalities.
- Residential structures can be damaged by falling trees, which can result in physical harm to occupants.
- Large hail events will likely cause extensive roof damage to residential structures along with siding damage and broken windows, creating a spike in insurance claims and a rise in premiums.
- Automobile damage may be extensive depending on the size of the hail and length of the storm.
- Hail events can result in power outages over widespread areas increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.

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- Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- First responders are exposed to downed power lines, damaged structures, hazardous spills, and debris that often accompany hail events, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.
- Downed power lines and large debris, such as downed trees, can result in the inability of emergency response vehicles to access areas of the community.
- Hazardous road conditions may prevent critical staff from reporting for duty, limiting response capabilities.
- Economic disruption negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Some businesses not directly damaged by the hail event may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.
- Hazardous road conditions will likely lead to increases in automobile accidents, further straining emergency response capabilities.
- Depending on the severity and scale of damage caused by large hail events, damage to power transmission and distribution infrastructure can require days or weeks to repair.
- A significant hail event could significantly damage agricultural crops, resulting in extensive economic losses for the community and surrounding area.
- Hail events may injure or kill livestock and wildlife.
- A large hail event could impact the accessibility of recreational areas and parks due to extended power outages or debris clogged access roads.

The economic and financial impacts of hail will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning conducted by the community, local businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of any hail event.

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HAZARD DESCRIPTION



Tornadoes are among the most violent storms on the planet. A tornado is a rapidly rotating column of air extending between, and in contact with, a cloud and the surface of the earth. The most violent tornadoes are capable of tremendous destruction and have wind speeds of 250 miles per hour or more. In extreme cases, winds may approach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

The most powerful tornadoes are produced by “Supercell Thunderstorms.” These thunderstorms are created when horizontal wind shears (winds moving in different directions at different altitudes) begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado.

Table 12-1. Variations among Tornadoes

WEAK TORNADOES	STRONG TORNADOES	VIOLENT TORNADOES
<ul style="list-style-type: none"> 69% of all tornadoes Less than 5% of tornado deaths Lifetime 1-10+ minutes Winds less than 110 mph 	<ul style="list-style-type: none"> 29% of all tornadoes Nearly 30% of all tornado deaths May last 20 minutes or longer Winds 110 – 205 mph 	<ul style="list-style-type: none"> 2% of all tornadoes 70% of all tornado deaths Lifetime can exceed one hour Winds greater than 205 mph

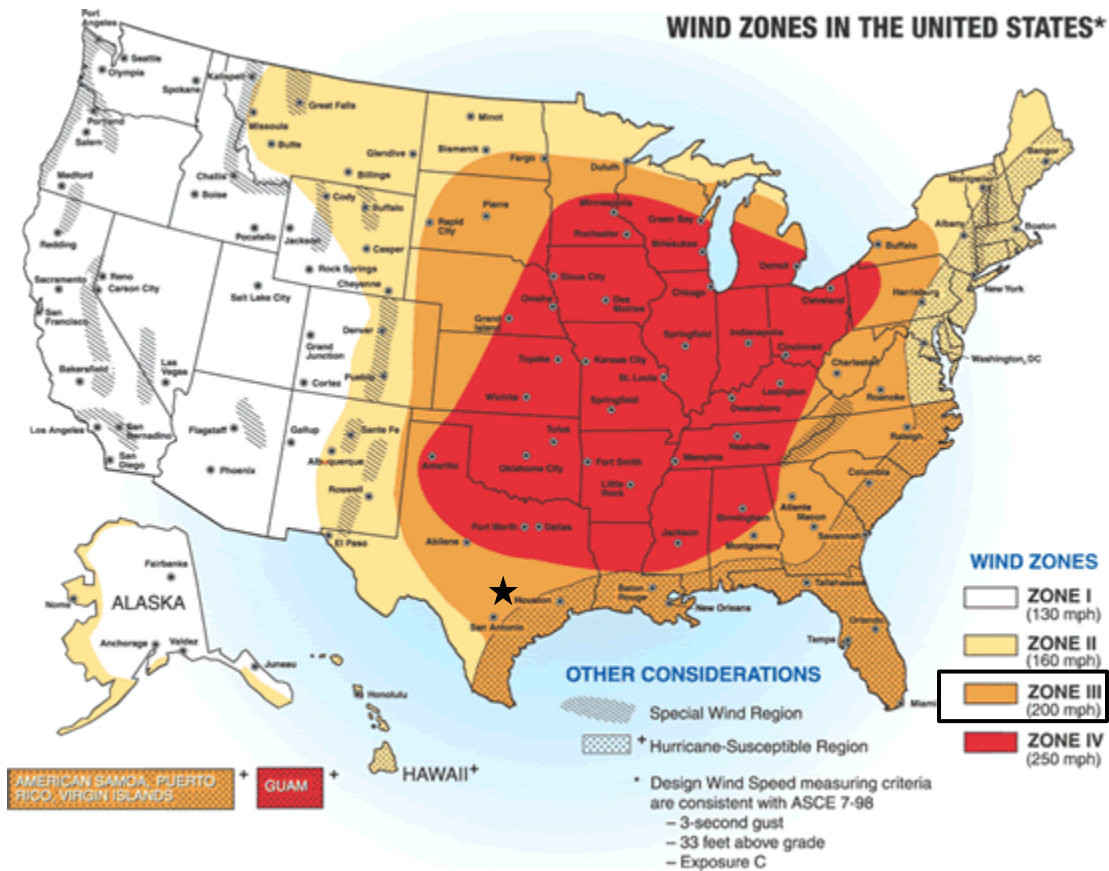
LOCATION

Tornadoes do not have any specific geographic boundary and can occur throughout the County uniformly. It is assumed that the entire City of Austin planning area is uniformly exposed to tornado

SECTION 12: TORNADO

activity. The entire City of Austin planning area is located in Wind Zone III (Figure 12-1), where tornado winds can be as high as 200 mph.

Figure 12-1. FEMA Wind Zones in the United States¹



EXTENT

The destruction caused by tornadoes ranges from light to inconceivable, depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, such as residential homes (particularly mobile homes).

¹ City of Austin is indicated by the star.

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Table 12-2. The Fujita Tornado Scale²


F-SCALE NUMBER	INTENSITY	WIND SPEED (MPH)	TYPE OF DAMAGE DONE	PERCENT OF APPRAISED STRUCTURE VALUE LOST DUE TO DAMAGE
F0	Gale Tornado	40 – 72	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.	None Estimated
F1	Moderate Tornado	73 – 112	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.	0% – 20%
F2	Significant Tornado	113 – 157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	50% – 100%
F3	Severe Tornado	158 – 206	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.	100%
F4	Devastating Tornado	207 – 260	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	100%
F5	Incredible Tornado	261 – 318	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; steel reinforced concrete badly damaged.	100%

² Source: <http://www.tornado-project.com/f-scale/f-scale.htm>

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Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (Table 12-2). Since February 2007, the Fujita Scale has been replaced by the Enhanced Fujita Scale (Table 12-3), which retains the same basic design and six strength categories as the previous scale. The newer scale reflects more refined assessments of tornado damage surveys, standardization, and damage consideration to a wider range of structures.

Table 12-3. Enhanced Fujita Scale for Tornadoes

STORM CATEGORY	DAMAGE LEVEL	3 SECOND GUST (MPH)	DESCRIPTION OF DAMAGES	PHOTO EXAMPLE
EF0	Gale	65 – 85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.	
EF1	Weak	86 – 110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; attached garages may be destroyed.	
EF2	Strong	111 – 135	Considerable damage; roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.	
EF3	Severe	136 – 165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.	
EF4	Devastating	166 – 200	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.	
EF5	Incredible	200+	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; steel reinforced concrete badly damaged.	

Both the Fujita Scale and Enhanced Fujita Scale should be referenced in reviewing previous occurrences since tornado events prior to 2007 will follow the original Fujita Scale. The largest

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magnitude reported within the planning area is an F4 on the Fujita Scale, a “Devastating Tornado.” Based on the planning areas location in Wind Zone III, the planning area could experience anywhere from an EF0 to EF5 depending on the wind speed.

The events in the City of Austin have been between EF0 and EF5 (Table 12-4). Therefore, the range of intensity that the City of Austin planning area would be expected to mitigate is a tornado event that would be a low to incredible risk, an EF0 to EF5. Historically, the strongest tornado to strike the planning area was a F4, which would be an EF5 on the Enhanced Fujita Scale. This is the strongest event the planning area can anticipate in the future.

HISTORICAL OCCURRENCES

Only reported tornadoes were factored into the Risk Assessment. It is likely that a high number of occurrences have gone unreported over the past 67 years. Historical tornado data for the planning area is provided on a county-wide basis per the NCEI database.

Figure 12-2 identifies the locations of previous occurrences in the City of Austin planning area from 1953 through November 2019. A total of 30 events have been recorded by the Storm Prediction Center (NOAA) and NCEI databases for the City of Austin planning area.

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Figure 12-2. Spatial Historical Tornado Events, 1953-2019³

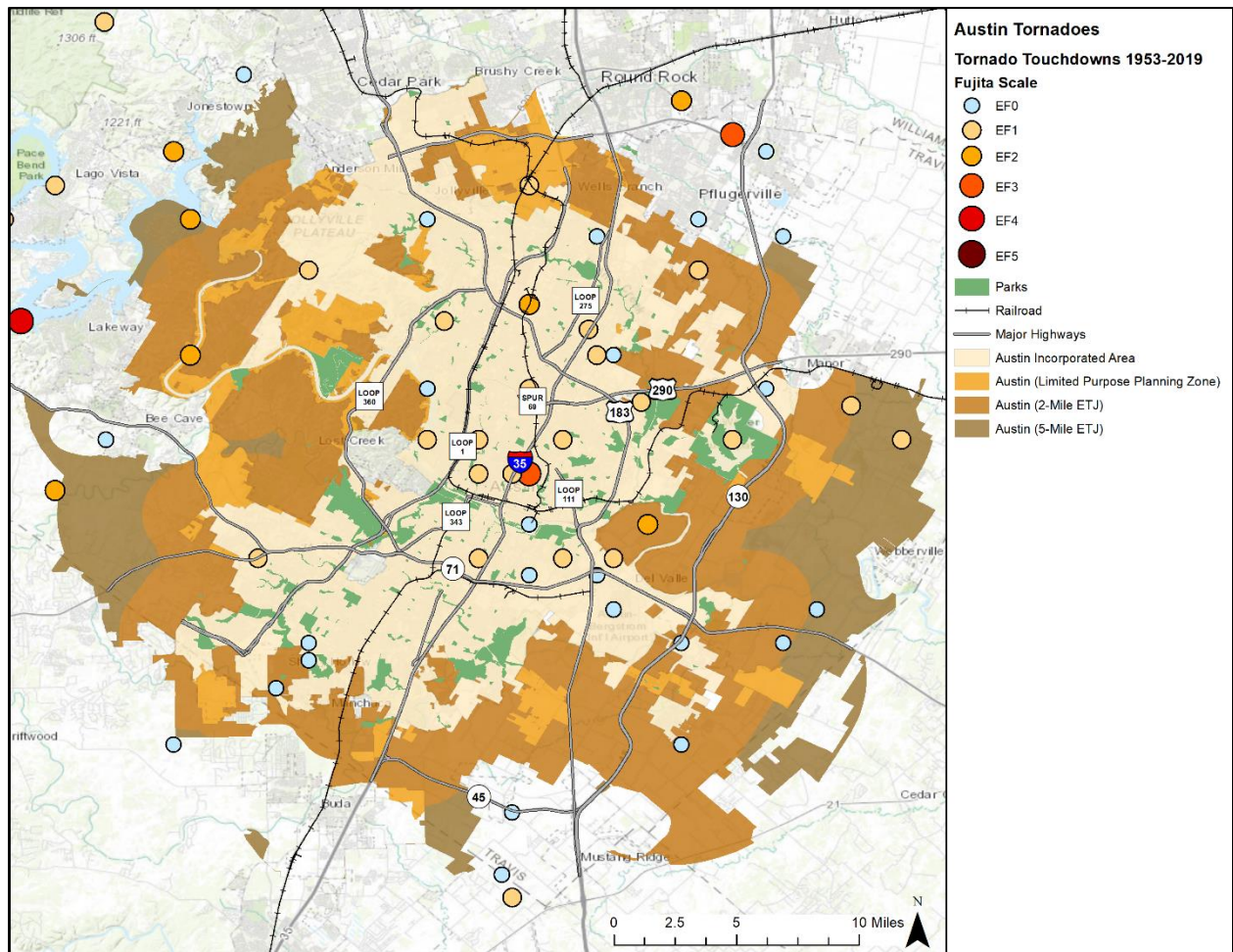


Table 12-4. Historical Tornado Events, 1953-2019⁴

JURISDICTION	DATE	TIME	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	10/23/1953	1:00 AM	F1	0	0	\$238,862	\$0
Travis County	3/31/1957	9:05 AM	F2	0	0	\$2,319,883	\$0
Travis County	3/31/1957	10:50 AM	F2	0	0	\$231,988	\$0
Travis County	3/31/1957	9:15 PM	F1	0	0	\$2,320	\$0
Travis County	4/22/1957	2:25 AM	Unknown	0	0	\$2,312	\$0
Travis County	4/24/1957	2:20 PM	F0	0	0	\$277	\$0
Travis County	5/10/1959	3:20 PM	F3	0	0	\$2,223,888	\$0

³ Source: NOAA Records

⁴ Only recorded events with fatalities, injuries or damages are listed. Magnitude is listed when available. Damage values are in 2020 dollars.

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JURISDICTION	DATE	TIME	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	7/20/1960	6:15 AM	F1	0	0	\$21,788	\$0
Travis County	5/17/1965	1:30 AM	F1	0	0	\$2,054	\$0
Travis County	9/20/1967	10:00 AM	F0	0	0	\$19,194	\$0
Travis County	9/20/1967	10:00 AM	F1	0	0	\$19,194	\$0
Travis County	9/20/1967	10:00 AM	F1	0	1	\$19,194	\$0
Travis County	9/20/1967	10:00 AM	F0	0	0	\$19,194	\$0
Travis County	9/20/1967	10:00 AM	F0	0	0	\$19,194	\$0
Travis County	9/21/1967	12:00 PM	Unknown	0	0	\$19,194	\$0
Travis County	7/4/1970	6:00 PM	F2	1	4	\$0	\$0
Travis County	8/3/1972	11:10 AM	F0	0	0	\$153,554	\$0
Travis County	1/20/1973	9:00 PM	F2	0	0	\$151,391	\$0
Travis County	3/10/1973	5:45 AM	F1	0	2	\$1,489,440	\$0
Travis County	5/9/1974	9:00 PM	F1	0	10	\$1,327,011	\$0
Travis County	5/7/1975	4:00 PM	F2	0	0	\$1,212,270	\$0
Travis County	3/5/1976	1:15 AM	F0	0	0	\$115,372	\$0
Travis County	3/30/1976	3:45 AM	F0	0	8	\$1,153,716	\$0
Travis County	4/14/1977	5:20 PM	F2	0	0	\$1,074,879	\$0
Travis County	5/2/1977	4:50 PM	Unknown	0	0	\$10,695	\$0
Travis County	4/7/1980	5:30 PM	F3	0	3	\$796,207	\$0
Travis County	8/10/1980	12:40 PM	F1	0	0	\$774,223	\$0
Travis County	8/10/1980	1:40 PM	F2	0	4	\$774,222,689	\$0
Travis County	8/10/1980	2:50 PM	F0	0	0	\$774,223	\$0
Travis County	6/13/1981	3:00 PM	F1	0	0	\$71,184	\$0
Travis County	6/22/1982	4:50 PM	F0	0	0	\$80	\$0
Travis County	5/18/1983	11:15 AM	F1	0	0	\$6,501	\$0
Travis County	9/20/1996	7:58 PM	F1	0	0	\$8,174	\$0
Travis County	5/27/1997	3:11 PM	F2	0	0	\$80,566	\$16,113
Travis County	5/27/1997	3:15 PM	F1	0	0	\$8,057	\$0

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JURISDICTION	DATE	TIME	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Travis County	5/27/1997	3:50 PM	F4	1	5	\$24,169,675	\$0
Travis County	8/29/1998	5:45 PM	F1	0	0	\$47,363	\$0
Travis County	11/15/2001	5:30 PM	F1	0	0	\$116,334	\$0
Travis County	11/15/2001	5:44 PM	F0	0	0	\$21,813	\$0
Travis County	11/15/2001	3:50 PM	F1	0	0	\$145,418	\$0
Travis County	11/15/2001	4:45 PM	F0	0	0	\$43,625	\$0
Travis County	12/23/2002	7:04 AM	F1	0	1	\$285,208	\$0
Travis County	6/8/2004	7:45 PM	F0	0	0	\$203,983	\$0
Travis County	3/25/2005	9:50 PM	F1	0	0	\$133,456	\$0
Travis County	4/2/2017	8:15 AM	EF0	0	0	\$105,499	\$0
TOTALS			(Max Extent)	2	38	\$813,861,145	\$16,113

Table 12-5. Summary of Historical Events, 1954-2018⁵

JURISDICTION	Number of Events	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
City of Austin	30	F3	0	3	\$6,564,554	\$0
Travis County	43	F4	2	35	\$807,296,588	\$16,113

Based on the list of historical tornado events for the City of Austin planning area (listed above), 6 of the events have occurred since the 2016 Plan.

SIGNIFICANT EVENTS

April 2, 2017 – City of Austin

A small tornado developed on the leading edge of squall line moving over the Lake Travis area. Many trees were blown down and damaged. A security cam video shows a developing circulation near Noack Hill at a residence. Tree damage can be seen along R O Drive toward Bee Creek. A couple of videos from citizens show a waterspout crossing Lake Travis near Bee Creek, moving east toward Point Venture. Several marinas were damaged as the small tornado crossed the lake. It is assumed the tornado came ashore near the park area of Point Venture on Whispering Hollow Drive where there is tree damage. At this point, concrete evidence of a tornado and tornado damage is lost so the path of the EF0 tornado is ended on the far west side of Point Venture. Estimated peak winds are 80 mph with a maximum width of 100 yards. The path length is estimated to be at 3 miles. Other house and roof damage was found on the south side of Point Venture but there was not enough evidence to call it tornado damage.

⁵ Damages reported in 2020 dollars.

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PROBABILITY OF FUTURE EVENTS

Tornadic storms can occur at any time of year and at any time of day, but they are typically more common in the spring months during the late afternoon and evening hours. A smaller, high frequency period can emerge in the fall during the brief transition between the warm and cold seasons. According to historical records the City of Austin can experience a tornado touchdown approximately once every year. This frequency supports a highly likely probability of future events for the City of Austin.

VULNERABILITY AND IMPACT

Because tornadoes often cross jurisdictional boundaries, all existing and future buildings, facilities, and populations in the entire City of Austin planning area are considered to be exposed to this hazard and could potentially be impacted. The damage caused by a tornado is typically a result of high wind velocity, wind-blown debris, lightning, and large hail.

The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Consequently, vulnerability of humans and property is difficult to evaluate since tornadoes form at different strengths, in random locations, and create relatively narrow paths of destruction. Although tornadoes strike at random, making all buildings vulnerable, three types of structures are more likely to suffer damage:

- Manufactured Homes;
- Homes on crawlspaces (more susceptible to lift); and
- Buildings with large spans, such as shopping malls, gymnasiums, and factories.

Tornadoes can cause a significant threat to people as they could be struck by flying debris, falling trees/branches, utility lines, and poles. Blocked roads could prevent first responders to respond to calls. Tornadoes commonly cause power outages which could cause health and safety risks to residents and visitors, as well as to patients in hospitals.

The City of Austin planning area features multiple mobile or manufactured home parks throughout the planning area. These parks are typically more vulnerable to tornado events than typical site-built structures. In addition, manufactured homes are located sporadically throughout the planning area which would also be more vulnerable. The US Census data indicates a total of 5,750 (1.4%) manufactured homes located in the City of Austin planning area (Table 12-6). In addition, 35.2% (approximately 142,060 structures) of the single family residential (SFR) structures in the entire planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant tornado events.

Table 12-6. City of Austin Structures at Greater Risk

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
City of Austin	5,750	142,060

The following critical facilities would be vulnerable to tornado events in the City of Austin:

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Table 12-7. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

The average loss estimate of property and crop is \$6,564,554 (in 2020 dollars), having an approximate annual loss estimate of \$97,978 (Table 12-8). Based on historic loss and damages, the impact of tornado on the City of Austin planning area can be considered “Minor,” with more than 10 percent of property expected to be destroyed, and critical facilities shut down for one week or more. However, with historical events with 38 injuries and 2 fatalities, the impact of tornadoes to the planning area is considered “substantial”, with multiple deaths possible depending on the size of the event.

Table 12-8. Potential Annualized Losses by Jurisdiction

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$6,564,554	\$97,978

ASSESSMENT OF IMPACTS

Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations. Often times, providing and preserving public health and safety is difficult. Impacts to the planning area can include:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Manufactured homes may suffer substantial damage as they would be more vulnerable than typical site-built structures.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- Tornadoes often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outages can result in an increase in structure fires and/or carbon monoxide poisoning as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- Tornadoes can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.
- First responders must enter the damage area shortly after the tornado passes to begin rescue operations and to organize cleanup and assessments efforts, therefore they are exposed to downed power lines, unstable and unusual debris, hazardous materials, and

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generally unsafe conditions, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.

- Emergency operations and services may be significantly impacted due to damaged facilities, loss of communications, and damaged emergency vehicles and equipment.
- City or county departments may be damaged or destroyed, delaying response and recovery efforts for the entire community.
- Private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Economic disruption negatively impacts the programs and services provided by the community due to short- and long-term loss in revenue.
- Damage to infrastructure may slow economic recovery since repairs may be extensive and lengthy.
- Some businesses not directly damaged by the tornado may be negatively impacted while roads and utilities are being restored, further slowing economic recovery.
- When the community is affected by significant property damage it is anticipated that funding would be required for infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, and normal day-to-day operating expenses.
- Displaced residents may not be able to immediately return to work, further slowing economic recovery.
- Residential structures destroyed by a tornado may not be rebuilt for years, reducing the tax base for the community.
- Large or intense tornadoes may result in a dramatic population fluctuation, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area.
- Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community and a potential increase in the unemployment rate.
- Recreation activities may be unavailable and tourism can be unappealing for years following a large tornado, devastating directly related local businesses.

The economic and financial impacts of a tornado event on the community will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by government, businesses, and citizens will contribute to the overall economic and financial conditions in the aftermath of a tornado event.

SECTION 13: EXPANSIVE SOILS

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Historical Occurrences 6
Probability of Future Events 7
Vulnerability and Impact 8

HAZARD DESCRIPTION

Expansive soils are soils and soft rocks with a relatively high percentage of clay minerals that are subject to changes in volume as they swell and shrink with changing moisture conditions. Drought conditions can cause soils to contract in response to a loss of soil moisture.

Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When these clays absorb water they increase in volume and expand. Expansions in soil of ten percent or more are not uncommon in the City of Austin planning area. The change in soil volume and resulting expansion can exert enough force on a building or other structure to cause damage.



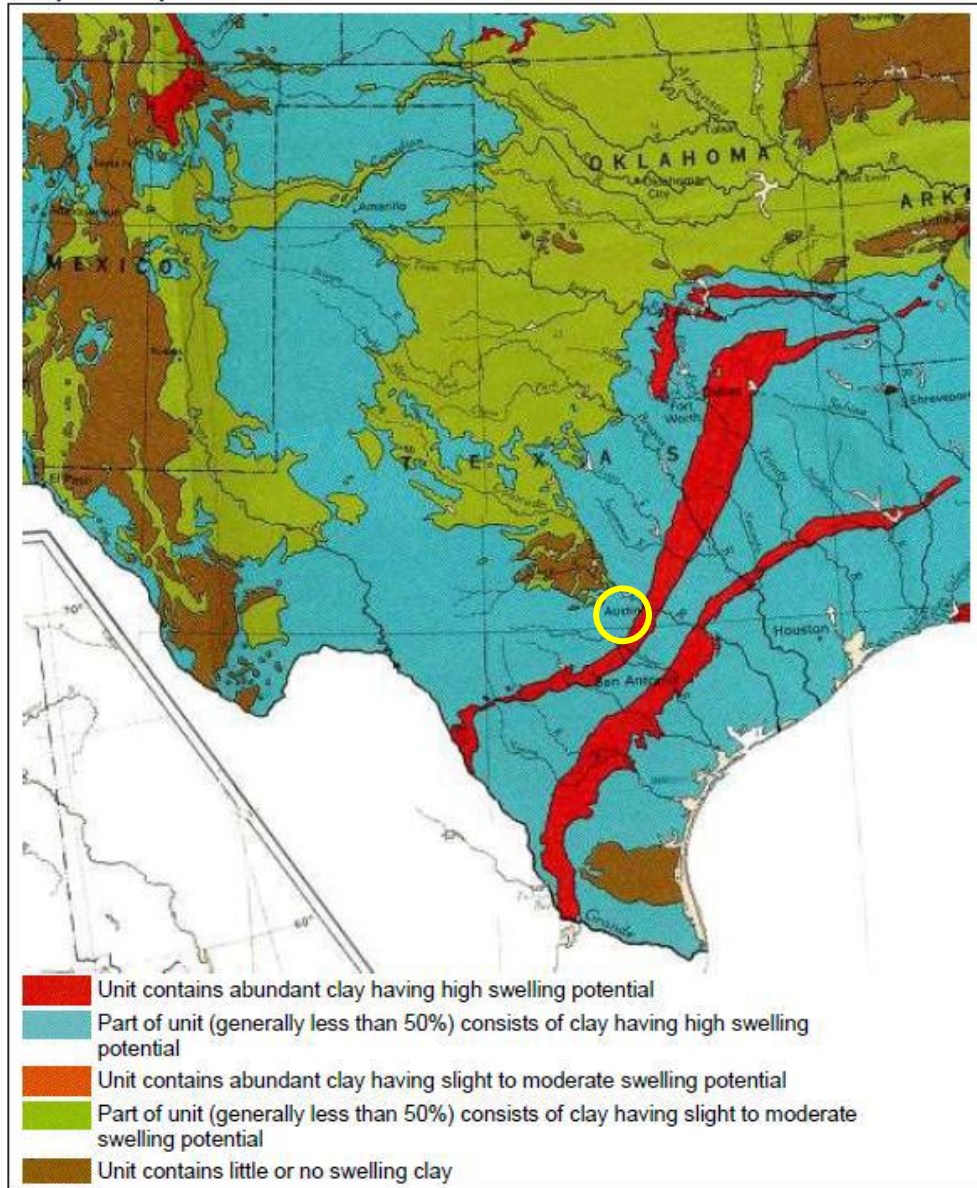
Expansive soils will also lose volume and shrink when they dry. A reduction in soil volume can affect the support to buildings or other structures and result in damaging soil subsidence. Fissures in the soil can also develop and facilitate the deep penetration of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures.

LOCATION

The City of Austin planning area may be affected by the band of expansive soils stretching from northeast Dallas, southwest through San Antonio, towards Laredo, and along an area also known as the I-35 corridor, Figure 13-1 depicts expansive soils across the State of Texas and the City of Austin planning area is identified within the yellow circle. These areas receive the most moisture and are also vulnerable to droughts, which can cause the soils to expand and contract. Figure 13-2 depicts the types of land resources in the State of Texas due to their soil types.

SECTION 13: EXPANSIVE SOILS

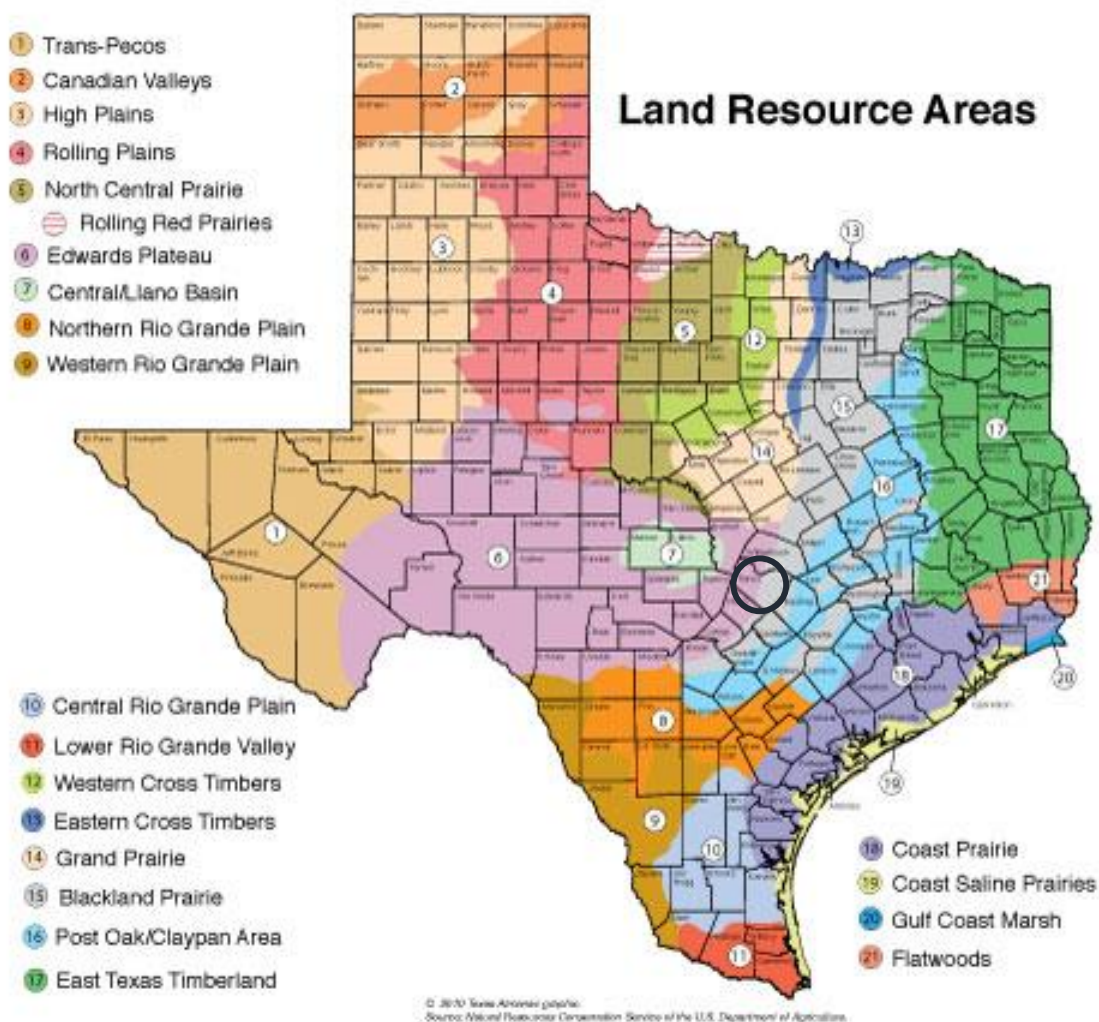
Figure 13-1. Texas Geological Survey¹



¹ Source: United States Geological Survey, <http://www.usgs.gov>

SECTION 13: EXPANSIVE SOILS

Figure 13-2. Texas Geological Survey



The City of Austin is located within the Edwards Plateau and Blackland Prairie as identified within the black circle in Figure 13-2. The entire planning area is located in an area affected by expansive soils.

Edwards Plateau: The 22.7 million acres of the Edwards Plateau are in South Central Texas east of the Trans-Pecos and west of the Blackland Prairie. Uplands are nearly level to undulating, except near large stream valleys, where the landscape is hilly with deep canyons and steep slopes. There are many cedar brakes in this area and surface drainage is rapid.

Upland soils are mostly shallow, stony, or gravelly, and consisting of dark alkaline clays and clay loams underlain by limestone. Lighter-colored soils are on steep sideslopes and deep, less-stony soils are in the valleys. Bottomland soils are mostly deep, dark-gray or brown, with alkaline loams and clays.

Raising beef cattle is the main enterprise in this region, but it is also the center of Texas' and the nation's mohair and wool production. The area provides a major deer habitat, and hunting leases

SECTION 13: EXPANSIVE SOILS

produce income. Cropland is mostly in the valleys on the deeper soils and is used mainly for growing forage crops and hay. The major soil-management concerns are brush control, large stones, low fertility, excess lime, and limited soil moisture.

Blackland Prairie: The Blackland Prairies consist of about 12.6 million acres of east-central Texas extending southwesterly from the Red River to Bexar County. There are smaller areas to the southeast. The landscape is undulating with few scattered wooded areas that are mostly in the bottomlands. Surface drainage is moderate to rapid.

Both upland and bottomland soils are deep, dark-gray to black, and consist of alkaline clays. Some soils in the western part are shallow to moderately deep over chalk. Soils on the eastern edge are typically neutral to slightly acidic, grayish clays and loams over mottled clay subsoils (sometimes called graylands). Blackland soils are known as “cracking clays” because of their high shrink-swell property and large, deep cracks that form in dry weather. The high shrink-swell property can cause serious damage to foundations, highways, and other structures; and is a safety hazard in pits and trenches.

Land use is almost equally cropland and grassland. Cotton, grain sorghums, corn, wheat, oats, and hay are grown in this area. Grassland is mostly improved pastures, with native range on the shallower and steeper soils. Water erosion, cotton root rot, soil tilth, and brush control are the major management problems.

EXTENT

The extent to which soil expansion is present in an area can be measured using the standard test method for expansive soils which has been adopted by the American Society for Testing and Materials (ASTM D-4829).² The expansion index (EI) provides an indication of swelling potential for a compacted soil.³ The EI measures volumetric swelling and is calculated by bringing a soil sample to 50 percent saturation and the multiplying the percentage of soil swelling with the fraction of soil to pass through a No. 4 sieve, and then by 100.

Table 13-1. Swelling Potential of Soils and Plasticity Index

Potential Expansion	Expansion Index
Low	0 – 15
Medium	10 – 35
High	20 – 55
Very High	35 and above

The amount and depth of potential swelling that can occur in a clay material are, to some extent, functions of the cyclical moisture content in the soil. In dryer climates where the moisture content in the soil near the ground surface is low because of evaporation, there is a greater potential for extensive swelling than the same soil in wetter climates where the variations of moisture content

² <http://www.astm.org/Standards/D4829.htm>

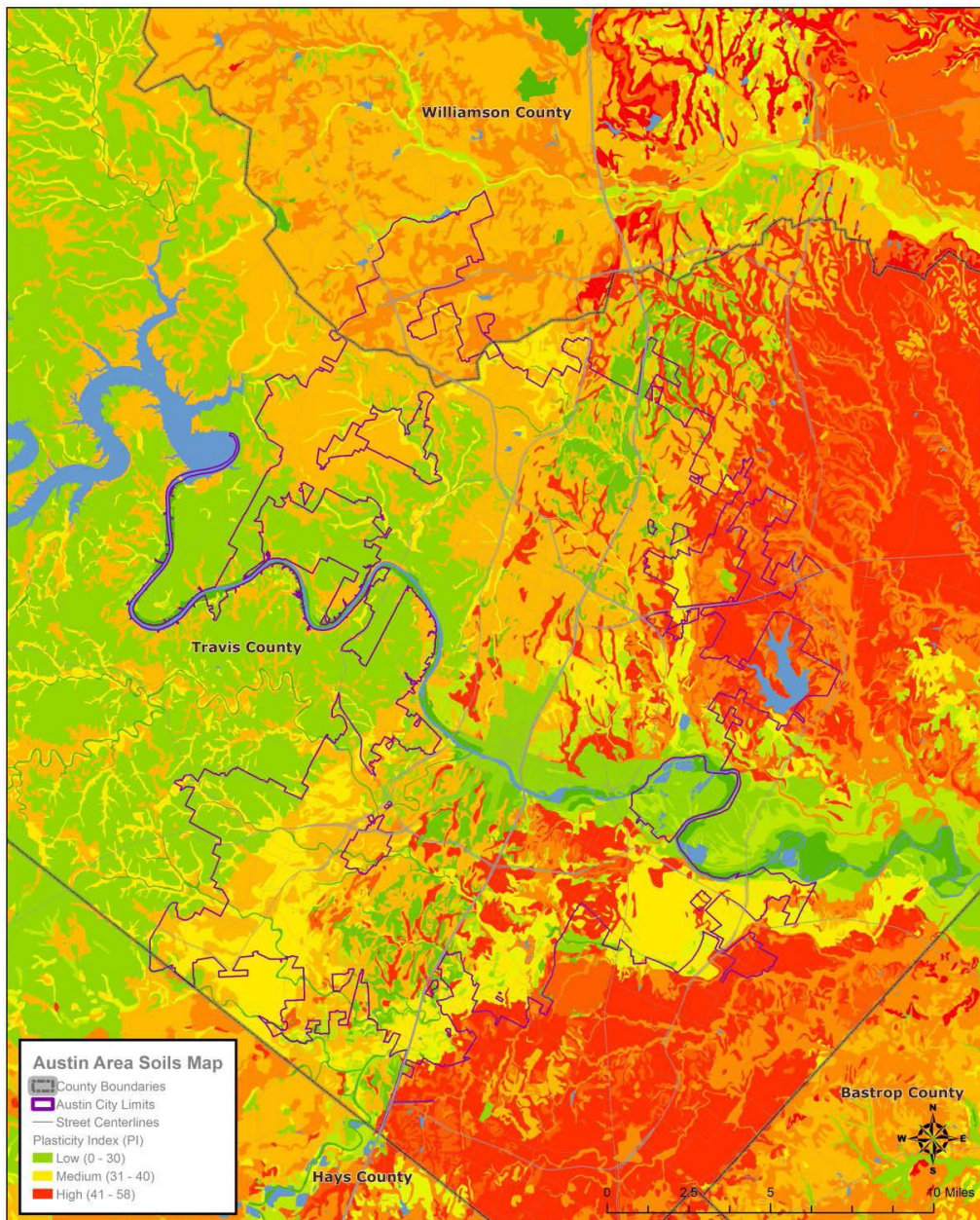
³ http://publicecodes.cyberregs.com/icod/ibc/2009f2cc/icod_ibc_2009f2cc_18_par012.htm

SECTION 13: EXPANSIVE SOILS

are not as severe. Volume changes in highly expansive soils range between seven and ten percent, however under abnormal conditions, they can reach as high as 25 percent.

The Web Soil Survey is used to measure the extent of expansive soils by measuring the type of soils and their moisture content. Figure 13-3 depicts the plasticity index of the soils in the City of Austin planning area.

Figure 13-3. Plasticity Index of Austin Area Soils ⁴



⁴ Source: National Cooperative Soil Survey

SECTION 13: EXPANSIVE SOILS

The red and orange areas shown in Figure 13-3 indicate locations with relatively higher plasticity soils, which can exhibit greater sensitivity to drought conditions. High plasticity soils are prone to shrink and swell as soil moisture changes, which can degrade pavement, causing longitudinal cracking and edge drop-off. This effect can damage foundations of buildings and homes.

HISTORICAL OCCURRENCES

Expansive soils is a condition that is native to Texas soil characteristics and cannot be documented as a time-specific event, except when it leads to structural and infrastructure damage.

The photos below represent the types of longitudinal cracking damage that expansive soils have caused in the planning area. All of the pictures feature relatively new roads that were damaged, in part, by changes in soil moisture. Roads in the City of Austin have been damaged to expansive soils in 2008, 2009, and in the summer of 2011, according to the Capital Area Metropolitan Planning Organization Risk Assessment.⁵

Extreme conditions can damage new roads, including projects still under construction. The Texas State Highway (SH) 130 tollway, under construction in 2011 in neighboring Caldwell County, suffered an estimated \$30 million in damage from cracks across several sections. In response, builders repaired cracks and also changed the substructure to create moisture barriers designed to mitigate soil moisture-related damage in the future.



Left: Photo of pavement cracks in a new Austin subdivision in 2009. Right: Longitudinal cracking on Golden Falls Drive in Travis County in 2008. Photo credit: City of Austin.

⁵ Source: CAMPO Extreme Weather Vulnerability Assessment

SECTION 13: EXPANSIVE SOILS



Photo of a severe pavement crack on Hamann Lane in Travis County in 2005. Photo credit: City of Austin.

PROBABILITY OF FUTURE EVENTS

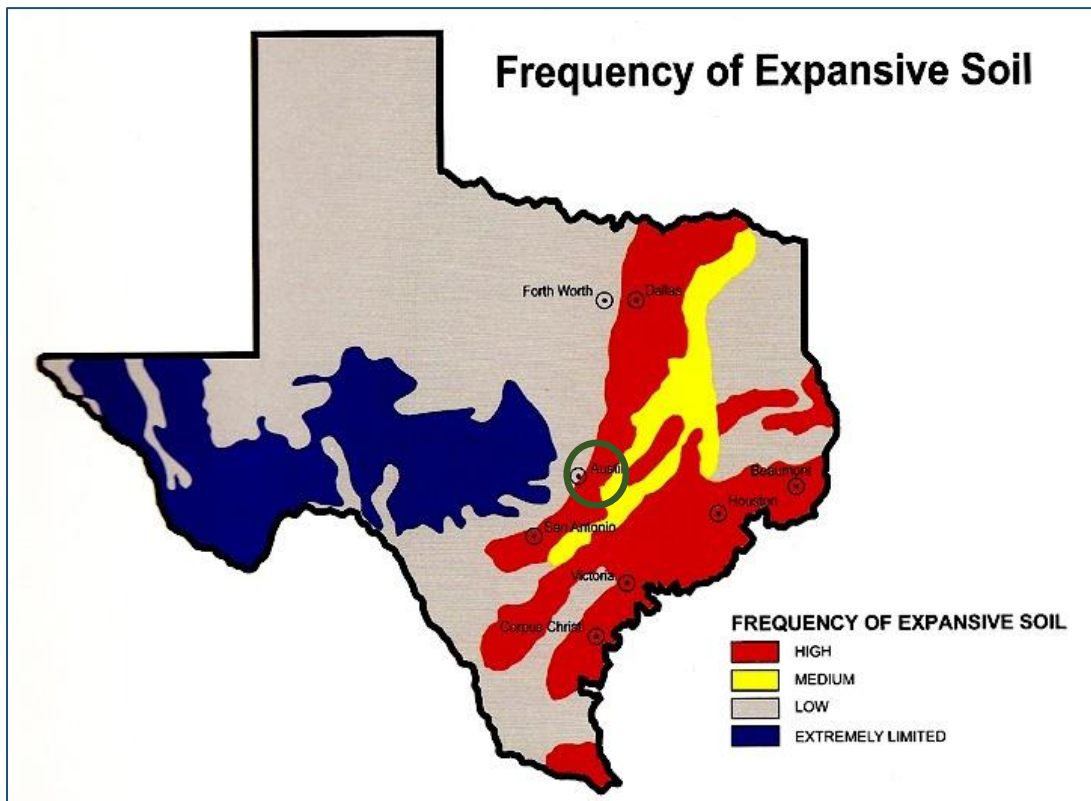
According to the CAMPO Extreme Weather Vulnerability Assessment, the MetroRail Red Line at Boggy Creek may have a high sensitivity to drought. This rating is based on the soil plasticity near the asset. The Red Line is built over some of the most expansive soils in the region, with a soil plasticity index of 55 on a scale of 0 to 58 (See Figure 13-3). This high plasticity indicates that soils could expand and contract dramatically with changes in soil moisture, and in turn damage infrastructure.

Since no other records of specific incidences of loss associated with expansive soils were found, and no specific occurrences of expansive soils were identified within the planning area, the probability of future events cannot be determined at this time. However, according to public opinion, the probability of future events of loss due to expansive soils within the planning area, is highly possible, especially when periods of drought increase throughout the planning area.

Figure 13-4 displays the frequency of expansive soil occurrences for the entire state. The City of Austin planning area is shown in the green circle and is subject to a range of frequency of expansive soils with a maximum “High” frequency.

SECTION 13: EXPANSIVE SOILS

Figure 13-4. Frequency of Expansive Soil



VULNERABILITY AND IMPACT

The effects of expansive soils are most prevalent when periods of moderate to high precipitation are followed by drought and then again by periods of rainfall. Other cases of damage result from increases in moisture volume from such sources as broken or leaking water and sewer lines. Dry clays are capable of absorbing water and will increase in volume in an amount proportional to the amount of water absorbed. Soils capable of changes in volume present a hazard to structures built over them and to the pipelines buried in them. Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings, which are usually heavy enough to counter swelling pressures. However, if constructed on wet clay, multi-story buildings may also be damaged by clay shrinkage when moisture levels are substantially reduced.



Cracked foundations and floors, jammed windows and doors, and ruptured pipelines are typical types of damage resulting from swelling soils. Damage to the upper floors of larger buildings can occur when motion in the structure is significant. All infrastructure within in the planning area are susceptible to this phenomenon.

The following critical facilities would be vulnerable to hail events in the planning area:

SECTION 13: EXPANSIVE SOILS

Table 13-2. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

The impact of expansive soils ranges from cosmetic cracks in walls to substantial foundation and structural damage that can result in a need for building demolition. Infrastructure such as pipelines can be damaged, causing increased maintenance and repairs, replacement, or damage to the point of failure. Sewer and water lines are also affected by shrink and swell soils. The movement of the soils can snap water and sewer lines, producing a minimum of temporary discomfort, and a maximum of a serious health and welfare risk.

Homeowners and public agencies that assume they cannot afford preventative measures such as more costly foundations and floor systems, often incur the largest percentage of damage and costly repairs from expanding soil. No figures are available for the total damage to homes in the planning area from expansive clays. However, several examples are known where the cost of repairs has exceeded the value of homes. Additionally, in some areas of Austin, streets and highways have required frequent and very expensive reconstruction or maintenance due to damage from expansive clay.

For the City of Austin, the most extensive damage from expansive soils can occur to bridges, highways, streets, and parking lots. The greatest damage occurs when structures are constructed when clays are dry (such as during a drought) and then subsequent soaking rains swell the clay.

SECTION 14: WINTER STORM

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Extent	3
Historical Occurrences	4
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HAZARD DESCRIPTION



A severe winter storm event is identified as a storm with snow, ice, or freezing rain. This type of storm can cause significant problems for area residents. Winter storms are associated with freezing or frozen precipitation such as freezing rain, sleet, snow, and the combined effects of winter precipitation and strong winds. Wind chill is a function of temperature and wind. Low wind chill is a product of high winds and freezing temperatures.

Winter storms that threaten the City of Austin planning area usually begin as powerful cold fronts that push south from central Canada. Although the city is at risk to ice hazards, extremely cold temperatures, and snow, the effects and frequencies of winter storm events are generally mild and short-lived. As indicated in Figure 14-1, on average, the City of Austin planning area typically experience approximately 11-17 extreme cold days a year, meaning up to 17 days are at or around freezing temperatures. During times of ice and snow accumulation, response times will increase until public works road crews are able to make major roads passable. Table 14-1 describes the types of winter storms possible to occur in the City of Austin planning area.

SECTION 14: WINTER STORM

Figure 14-1. Extreme Cold Days, 1960-2003¹

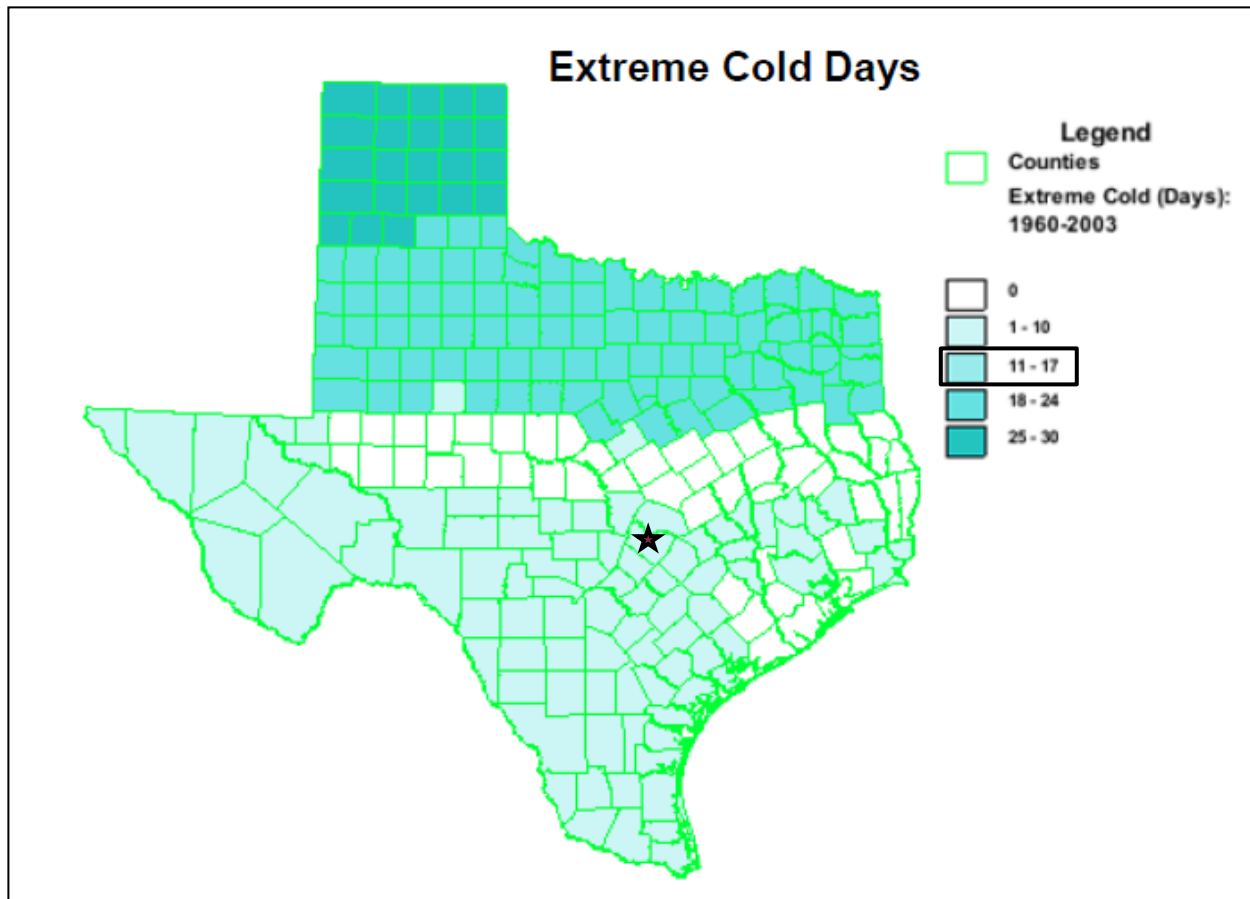


Table 14-1. Types of Winter Storms

TYPE OF WINTER STORM	DESCRIPTION
Winter Weather Advisory	This alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events.
Winter Storm Watch	Severe winter weather conditions may affect your area (freezing rain, sleet, or heavy snow may occur separately or in combination).
Winter Storm Warning	Severe winter weather conditions are imminent.
Freezing Rain or Freezing Drizzle	Rain or drizzle is likely to freeze upon impact, resulting in a coating of ice glaze on roads and all other exposed objects.
Sleet	Small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.

¹ Source: National Weather Service. City of Austin indicated by star.

SECTION 14: WINTER STORM

TYPE OF WINTER STORM	DESCRIPTION
Blizzard Warning	Sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted.
Frost/Freeze Warning	Below freezing temperatures are expected and may cause significant damage to plants, crops, and fruit trees.
Wind Chill	A strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

LOCATION

Winter storm events are not confined to specific geographic boundaries. Therefore, all existing and future buildings, facilities, and populations in the City of Austin planning area are considered to be exposed to a winter storm hazard and could potentially be impacted.

EXTENT

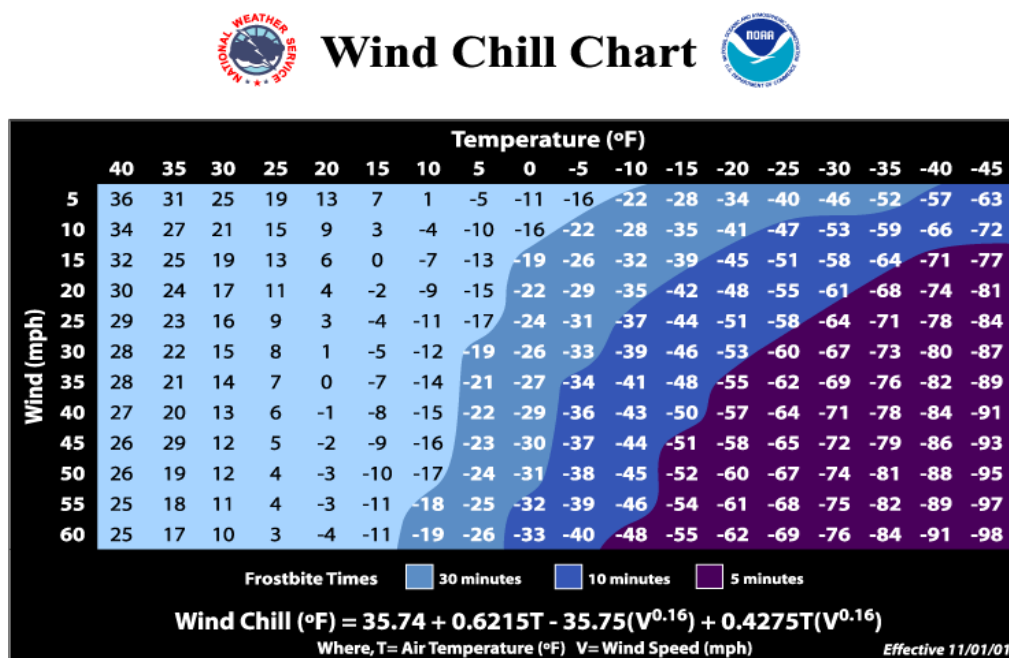
The extent or magnitude of a severe winter storm is measured in intensity based on the temperature and level of accumulations as shown in Table 14-2. Table 14-2 should be read in conjunction with the wind-chill factor described in Figure 14-2 to determine the intensity of a winter storm. The chart is not applicable when temperatures are over 50°F or winds are calm. This is an index developed by the National Weather Service.

Table 14-2. Magnitude of Severe Winter Storms

INTENSITY	TEMPERATURE RANGE (Fahrenheit)	EXTENT DESCRIPTION
Mild	40° – 50°	Winds less than 10 mph and freezing rain or light snow falling for short durations with little or no accumulations
Moderate	30° – 40°	Winds 10 – 15 mph and sleet and/or snow up to 4 inches
Significant	25° – 30°	Intense snow showers accompanied with strong gusty winds between 15 and 20 mph with significant accumulation
Extreme	20° – 25°	Wind driven snow that reduces visibility, heavy winds (between 20 to 30 mph), and sleet or ice up to 5 millimeters in diameter
Severe	Below 20°	Winds of 35 mph or more and snow and sleet greater than 4 inches

SECTION 14: WINTER STORM

Figure 14-2. Wind Chill Chart



Wind chill temperature is a measure of how cold the wind makes real air temperature feel to the human body. Since wind can dramatically accelerate heat loss from the body, a blustery 30°F day would feel just as cold as a calm day with 0°F temperatures. The City of Austin planning area has never experienced a blizzard but based on 26 previous occurrences recorded from 1996 through November 2019, it has been subject to winter storm watches, warnings, freezing rain, sleet, snow, and wind chill.

The average number of cold days is similar for the entire planning area. Therefore, the intensity or extent of a winter storm event to be mitigated for the area ranges from mild to extreme according to the definitions at Table 14-2. The City of Austin planning area can expect anywhere between 0.1 to 4.0 inches of ice and snow during a winter storm event and temperatures between 20 and 50 degrees with winds ranging from 0 to 20 mph. This is the worst that can be anticipated to mitigate against in the future for the City of Austin.

HISTORICAL OCCURRENCES

Table 14-3 shows historical occurrences for the City of Austin from 1996 through November 2019 provided by the NCEI database. There have been 26 recorded winter storm events in the City of Austin. Historical winter storm information, as provided by the NCEI, identifies winter storm activity across a multi-county forecast area for each event. The appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. Historical winter storm data for the planning area are provided on a County-wide basis per the NCEI database. Table 14-3 shows historical incident information for the planning area.

SECTION 14: WINTER STORM

Table 14-3. Historical Winter Storm Events, 1996-2019²

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE ³	CROP DAMAGE
Travis County	2/1/1996	0	0	\$0	\$0
Travis County	1/7/1997	0	0	\$0	\$0
Travis County	1/11/1997	0	0	\$0	\$0
Travis County	12/23/1998	0	0	\$0	\$0
Travis County	12/12/2000	0	0	\$0	\$0
Travis County	11/28/2001	0	0	\$0	\$0
Travis County	2/24/2003	0	0	\$0	\$0
Travis County	12/7/2005	0	0	\$0	\$0
Travis County	1/15/2007	0	0	\$2,039,135	\$0
Travis County	1/27/2009	0	0	\$0	\$0
Travis County	2/3/2011	0	0	\$0	\$0
Travis County	2/9/2011	0	0	\$0	\$0
Travis County	12/5/2013	0	0	\$0	\$0
Travis County	12/7/2013	0	0	\$0	\$0
Travis County	1/23/2014	0	0	\$0	\$0
Travis County	1/27/2014	0	0	\$0	\$0
Travis County	3/4/2014	0	0	\$0	\$0
Travis County	1/9/2015	0	0	\$0	\$0
Travis County	1/23/2015	0	0	\$0	\$0
Travis County	2/16/2015	0	0	\$0	\$0
Travis County	2/23/2015	0	0	\$0	\$0
Travis County	2/27/2015	0	0	\$0	\$0
Travis County	3/4/2015	0	0	\$0	\$0
Travis County	12/7/2017	0	0	\$0	\$0

² Values are in 2018 dollars.

³ Countywide damages have been adjusted to reflect only a percentage (26.59%) of the damages attributed to the City of Austin.

SECTION 14: WINTER STORM

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE ³	CROP DAMAGE
Travis County	1/16/2018	0	0	\$0	\$0
Travis County	11/11/2019	0	0	\$0	\$0
TOTALS		0	0	\$2,039,135	

Based on the list of historical winter storm events for the City of Austin planning area (listed above), 9 of the events have occurred since the 2016 Plan.

SIGNIFICANT EVENTS

November 12, 2019 – City of Austin

A cold front brought a shallow layer of cold air to South Central Texas. Precipitation changed to sleet, freezing rain, and snow behind the front. There were minor accumulations of ice on elevated surfaces and some roads in Travis County. There were several accidents reported in the region.

February 23, 2015 – City of Austin

A cold front brought below freezing temperatures and light precipitation. Precipitation was a mix of sleet and freezing drizzle. Sleet was first reported in Travis County and spread to Kerr and Williamson. There was some light icing on elevated surfaces.

March 4, 2015 – City of Austin

A cold front brought below freezing temperatures and light precipitation to parts of South-Central Texas. There was a mix of freezing rain, sleet, and rain over our northern counties from Kerr to Williamson. There were reports of some icy spots on roads, bridges, overpasses, and elevated surfaces. There were also reports of ice in Bexar and Val Verde Counties. No roads were closed and no accidents were reported.

March 4, 2014 – City of Austin

In the wake of a strong cold front, a shallow layer of cold air settled over South Central Texas in March 2014. An upper level trough moved across the southern plains and caused elevated thunderstorms during the evening of March 3rd. Some of these storms produced small hail. Then an isentropic upglide of warm moist air froze the precipitation during the early morning hours of the 4th. The first report of freezing rain occurred at 12:40am in Travis County. Icy bridges and overpasses were reported in Travis, Williamson, Fayette, and Caldwell Counties. In Fayette County, county offices and school openings were delayed on March 4th.

PROBABILITY OF FUTURE EVENTS

According to historical records, the planning area experiences approximately one winter storm event each year. Hence, the probability of a future winter storm event affecting the City of Austin planning area is highly likely, with a winter storm likely to occur within the next year.

VULNERABILITY AND IMPACT

During periods of extreme cold and freezing temperatures, water pipes can freeze and crack, and ice can build up on power lines, causing them to break under the weight or causing tree limbs to fall on the lines. These events can disrupt electric service for long periods.

SECTION 14: WINTER STORM

An economic impact may occur due to increased consumption of heating fuel, which can lead to energy shortages and higher prices. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

All populations, buildings, critical facilities, and infrastructure in the entire City of Austin planning area are vulnerable to severe winter events.

The following critical facilities would be vulnerable to Winter Storm events in the planning area:

Table 14-4. Critical Facilities by Jurisdiction

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

People and animals are subject to health risks from extended exposure to cold air. Elderly people are at greater risk of death from hypothermia during these events, especially in the rural areas of the county where populations are sparse, icy roads may impede travel, and there are fewer neighbors to check in on the elderly. According to the U.S. Center for Disease Control, every year hypothermia kills about 600 Americans, half of whom are 65 years of age or older. In addition, populations living below the poverty level may not be able to afford to run heat on a regular basis

Population over 65 in the entire City of Austin planning area is estimated at 8.7% of the total population or an estimated total of 81,322⁴ potentially vulnerable residents in the planning area based on age. An estimated 14.5% of the planning area population live below the poverty level (Table 14-5).

Table 14-5. Population at Greater Risk by Jurisdiction

JURISDICTION	POPULATION 65 AND OLDER	POPULATION BELOW POVERTY LEVEL
City of Austin	81,322	135,684

Historic loss, in 2020 dollars, is estimated at \$2,039,135 in damages over the 24-year recording period giving an approximate loss of \$84,964 in damages annually (Table 14-6). The potential severity of impact for the City of Austin planning area are “Limited” meaning injuries are treatable with first aid, shutdown of facilities and services for 24 hours or less, and less than 10% of property destroyed or with major damage.

Table 14-6. Potential Annualized Losses for the City of Austin

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$2,039,135	\$84,964

⁴ US Census Bureau 2018 data for City of Austin

SECTION 14: WINTER STORM

ASSESSMENT OF IMPACTS

The greatest risk from a winter storm hazard is to public health and safety. Potential impacts for the planning area may include:

- Vulnerable populations, particularly the elderly, can face serious or life-threatening health problems from exposure to extreme cold including hypothermia and frostbite.
- Loss of electric power or other heat source can result in increased potential for fire injuries or hazardous gas inhalation because residents burn candles for light or use fires or generators to stay warm.
- Response personnel, including utility workers, public works personnel, debris removal staff, tow truck operators, and other first responders, are subject to injury or illness resulting from exposure to extreme cold temperatures.
- Response personnel would be required to travel in potentially hazardous conditions, elevating the life safety risk due to accidents and potential contact with downed power lines.
- Operations or service delivery may experience impacts from electricity blackouts due to winter storms.
- Power outages are possible throughout the planning area due to downed trees and power lines and/or rolling blackouts.
- Critical facilities without emergency backup power may not be operational during power outages.
- Emergency response and service operations may be impacted by limitations on access and mobility if roadways are closed, unsafe, or obstructed.
- Hazardous road conditions will likely lead to increases in automobile accidents, further straining emergency response capabilities.
- Depending on the severity and scale of damage caused by ice and snow events, damage to power transmission and distribution infrastructure can require days or weeks to repair.
- A winter storm event could lead to tree, shrub, and plant damage or death.
- Severe cold and ice could significantly damage agricultural crops.
- Schools may be forced to shut early due to treacherous driving conditions.
- Exposed water pipes may be damaged by severe or late season winter storms at both residential and commercial structures, causing significant damages.

The economic and financial impacts of winter weather on the community will depend on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of a winter storm event.

SECTION 15: DAM FAILURE

Portions of the City of Austin Hazard Mitigation Plan are considered confidential and not for release to the public. The information in this section is covered under Privacy Act of 1974 (5 U.S.C. Section 552a).

SECTION 16: HURRICANE WIND

- Hazard Description 1
- Location 1
- Extent 1
- Historical Occurrences 2
 - Significant Events..... 4
- Probability of Future Events 5
- Vulnerability and Impact..... 5
 - Assessment of Impacts 6

HAZARD DESCRIPTION

According to the National Oceanic and Atmospheric Administration (NOAA), a hurricane is an intense tropical weather system of strong thunderstorms with well-defined surface circulation and maximum sustained winds of 74 mph or higher. In the Northern Hemisphere circulation of winds near the Earth’s surface is counterclockwise.

Hurricanes often begin as tropical depressions that intensify into tropical storms when maximum sustained winds increase to between 35 – 64 knots (39 – 73 mph). At these wind speeds, the storm becomes more organized and circular in shape and begins to resemble a hurricane. Tropical storms resulting in high winds and heavy rainfall can be equally problematic without ever becoming a hurricane and can be dangerous to people and property, resulting in high winds and heavy rainfall, as Tropical Storm Hermine did for Travis and Williamson Counties in September 2010. Once sustained winds reach or exceed 74 mph, the storm becomes a hurricane. The intensity of a land falling hurricane is expressed in categories relating wind speeds to potential damage. Tropical storm-force winds are strong enough to be dangerous to those caught in them.



LOCATION

The City of Austin planning area is located inland from the coast and is outside of the hurricane wind speed hazard areas. Thus, the City of Austin is in a low risk area for hurricane wind speeds of 90 miles per hour (mph) or less. However, the City of Austin is susceptible to the indirect threats of a hurricane, including high winds and flooding. Additionally, the City of Austin has hosted coastal area residents who evacuate during hurricane events.

EXTENT

As a hurricane develops, the barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles

SECTION 16: HURRICANE WIND

per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane.

Hurricanes are categorized according to the strength and intensity of their winds using the Saffir-Simpson Hurricane Scale (Table 16-1). A Category 1 storm has the lowest wind speeds, while a Category 5 hurricane has the highest. However, a lower category storm can inflict greater damage than higher category storms depending on where they strike, the amount of storm surge, other weather they interact with, and how slow they move.

Table 16-1. Extent Scale for Hurricanes¹

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

Based on the historical storm tracks for hurricanes and the location of the City of Austin planning area, which is outside of the hurricane wind hazard area, the average extent to be mitigated is for a Category 1 storm for the planning area.

HISTORICAL OCCURRENCES

By the time hurricanes and tropical storms have made landfall at various magnitudes (categories) in the City of Austin planning area, the storms have usually weakened to tropical storms or depressions, being near the end of their life cycle. With the storms having reduced winds, extreme rainfall is the hazard of concern. In Figure 16-1 below, hurricane tracks are reflective of their strength in the City of Austin planning area. Table 16-2 lists the storms that have tracked through the planning area. Historical hurricane data for Austin are provided on a County-wide basis per the National Center for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA) databases.

¹ Source: National Hurricane Center

SECTION 16: HURRICANE WIND

Figure 16-1. Location of Historic Storm Tracks

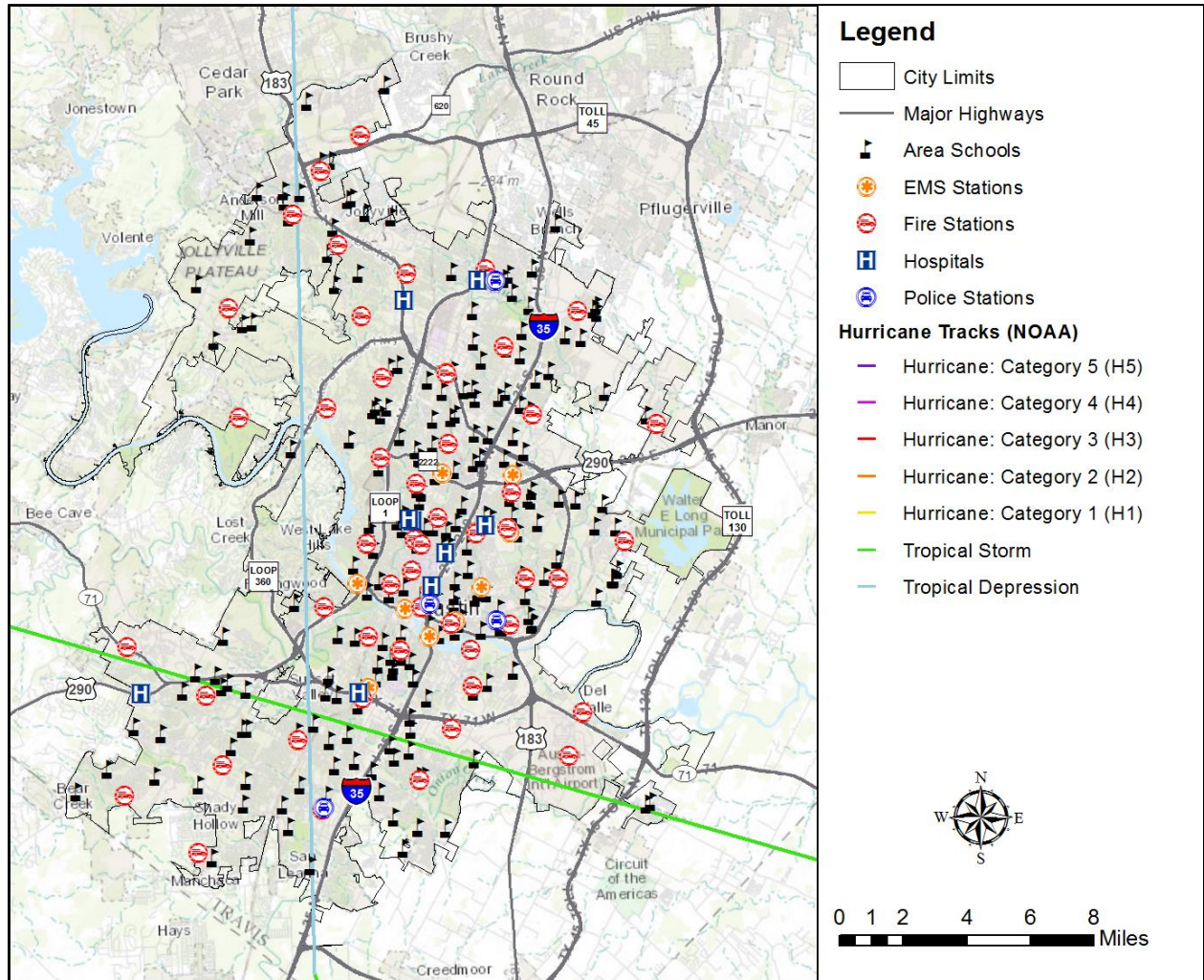


Table 16-2. Historic Storms²

YEAR	STORM NAME	CATEGORY	PROPERTY DAMAGE (2020 DOLLARS)	CROP DAMAGE (2020 DOLLARS)
1961	Carla	Category 4	\$4,302,906	\$4,302,906
1967	Beulah	Category 4	\$5,447,831	\$544,783
1968	Candy	Category 1	N/A	N/A
1970	Celia	Category 3	\$4,319,395	\$443,614
1971	Edith	Category 5	\$5,518	\$5,518
1973	Delia	Tropical Storm	N/A	N/A

² N/A means data was not available.

SECTION 16: HURRICANE WIND

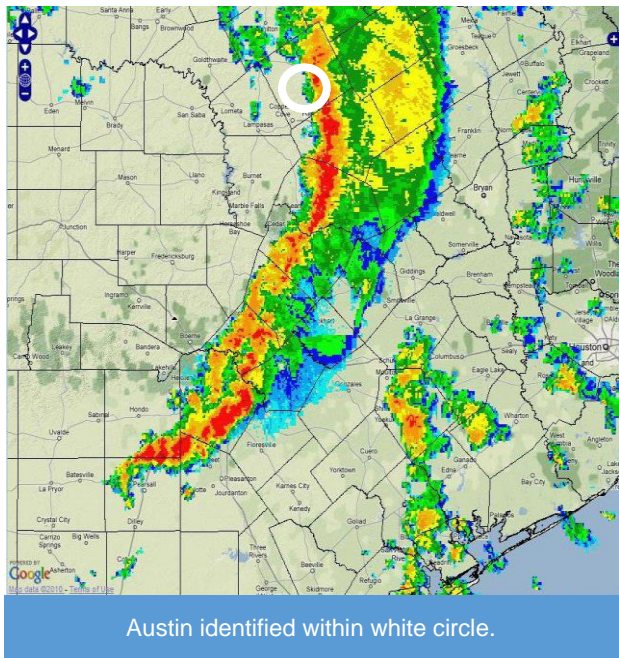
YEAR	STORM NAME	CATEGORY	PROPERTY DAMAGE (2020 DOLLARS)	CROP DAMAGE (2020 DOLLARS)
1980	Allen	Category 5	\$16,444,219	\$1,644,422
2010	Hermine	Tropical Storm	N/A	N/A
Totals:			\$30,519,868	\$6,941,242

Based on the list of historical hurricane wind events (listed above), none of the events occurred after the 2016 Plan Update.

SIGNIFICANT EVENTS

Tropical Storm Hermine, September 3-9, 2010 Travis County

On Tuesday afternoon an intense rain band developed primarily along the I-35 stretching several hundred miles from Waco to south of San Antonio due to tropical storm Hermine. Rain rates of 2-3 inches per hour were experienced in the Austin-San Antonio I-35 corridor and brought widespread flash flooding by Tuesday evening. Widespread rain totals of 5-6 inches were common along the corridor during the evening hours and the torrential rains continued over the next eight hours well past midnight early Wednesday morning. Camp Mabry in the City of Austin set a daily rainfall record on September 7, receiving 7.04 inches in a 24-hour period.³



During the overnight hours early Wednesday September 8, tropical rains continued to fall across portions of Travis and Williamson Counties. The Shoal Creek and Brushy Creek watersheds were hit hardest. Several swift water rescues were performed as creeks overflowed their banks and flooded many low water crossings. The most intense rains of 10 - 16 inches occurred over the area from central Williamson County down into northern Travis County. A National Weather Service Cooperative Observer near Lake Georgetown recorded a total of 16.37 inches from September 7 - 9 with 14.57 inches of that total coming in a 24-hour time period. Shelters were set up as homes began to flood and RV parks were evacuated along Brushy Creek. For a time, I-35 in Georgetown was shut down with witnesses saying that water was as high as the center concrete barrier.

³ The City of Austin indicated within the circle.

SECTION 16: HURRICANE WIND

PROBABILITY OF FUTURE EVENTS

Based on historical occurrences of significant hurricane wind events, the probability of future events is occasional, with a frequency of occurrence of one event every five years for the City of Austin planning area.

VULNERABILITY AND IMPACT

Hurricane-force winds can cause major damage to large areas; hence all existing buildings, facilities and populations are equally exposed and vulnerable to this hazard and could potentially be impacted. Most structures in the planning area can resist the effects of all but the most severe wind storms. The City of Austin planning area features multiple mobile or manufactured home parks throughout the planning area. These parks are typically more vulnerable to hurricane events than typical site-built structures. In addition, manufactured homes are located sporadically throughout the planning area which would also be more vulnerable. The US Census data indicates a total of 5,750 (1.4%) manufactured homes located in the City of Austin planning area (Table 16-3). In addition, 35.2% (approximately 142,060 structures) of the single family residential (SFR) structures in the entire planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more susceptible to damages during significant hurricane events.

Table 16-3. City of Austin Structures at Greater Risk

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
City of Austin ⁴	5,750	142,060

The following critical facilities would be vulnerable to hurricane events in the planning area:

Table 16-4. City of Austin Critical Facilities at Risk

JURISDICTION	CRITICAL FACILITIES
City of Austin	44 Fire Stations, 4 Police Stations, 18 Hospitals, 46 EMS Stations, and 178 School Facilities

Storm track data was available for the past 150 years; and property and crop loss data was available from 1950 to the present. Only hurricane wind events that have been reported have been factored into this Risk Assessment. It is likely that additional hurricane wind occurrences have gone unreported before and during the recording period. Table 16-5 shows the annualized losses based on historical incident information for the planning area. The average annual loss estimate for Travis County is approximately \$634,934.

⁴ County totals includes all incorporated jurisdictions and unincorporated areas.

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Table 16-5. Potential Annualized Losses by Jurisdiction

JURISDICTION	PROPERTY & CROP LOSS	ANNUAL LOSS ESTIMATES
City of Austin	\$37,461,110	\$634,934

The impact of hurricane wind events experienced in Travis County has resulted in 11 injuries and 1 fatality. Based on the level of risk and historical occurrences for hurricane winds in the City of Austin there is a “minor” severity of impact for the City of Austin planning area; meaning the shutdown of critical facilities and services could be for 1 week or less, and more than ten percent of property can be destroyed or experience major damage. However, with one fatality and multiple injuries, there could be a “Substantial” severity of impact depending on the size of the storm.

ASSESSMENT OF IMPACTS

Hurricane events have the potential to pose a significant risk to people and can create dangerous and difficult situations for public health and safety officials. The impact of climate change could produce larger, more severe hurricane events, exacerbating the current hurricane impacts. Worsening hurricane conditions can be frequently associated with a variety of impacts, including:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Driving conditions in all jurisdictions may be dangerous during a hurricane event, especially over the Causeway or other elevated bridges, elevating the risk of injury and accidents during evacuations if not timed properly.
- Additional resources may be required for emergency preparedness and response during the summer months due to increases in populations along the coast.
- Emergency evacuations may be necessary prior to a hurricane landfall, requiring emergency responders, evacuation routing and temporary shelters in the planning area.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- During hurricane landfall, first responders may be prevented from responding to calls, as the winds may reach a speed in which their vehicles and equipment are unsafe to operate.
- Hurricane events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage often results in an increase in structure fires and carbon monoxide poisoning, as individuals attempt to cook or heat their homes with alternate, unsafe cooking or heating devices, such as grills.
- Extreme hurricane events may rupture gas lines and down trees and power lines, increasing the risk of structure fires during and after a storm event.

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- Extreme hurricane events may lead to prolonged evacuations during search and rescue, and immediate recovery efforts requiring additional emergency personnel and resources to prevent entry, and protect citizens and property.
- First responders are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.
- Emergency operations and services may be significantly impacted due to damaged facilities and/or loss of communications.
- Critical staff may be unable to report for duty, limiting response capabilities.
- City or county departments may be damaged, delaying response and recovery efforts for the entire community.
- Private sector entities that the city and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Economic disruption negatively impacts the programs and services provided by the community due to short- and long-term loss in revenue.
- Some businesses not directly damaged by the hurricane may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Older structures built to less stringent building codes may suffer greater damage as they are typically more vulnerable to hurricane damage.
- Large scale hurricanes can have significant economic impact on the affected area, as it must now fund expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.

The economic and financial impacts of a hurricane on the area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by the community, local businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of any hurricane event.

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HAZARD DESCRIPTION

A cyber-attack is any type of offensive maneuver employed by individuals or organizations that targets computer information systems, infrastructures, computer networks, and personal computer devices by various means of malicious acts. The malicious act usually originates from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system.

Cyberspace and its underlying infrastructure are vulnerable to a wide range of risk including both physical and cyber threats and hazards. Sophisticated cyber actors and nation-states exploit vulnerabilities to steal information and money and can develop capabilities to disrupt, destroy, or threaten the delivery of essential services. Various crimes are perpetrated through cyberspace including the production and distribution of child pornography and child exploitation conspiracies, banking and financial fraud, intellectual property violations, and other crimes, all of which have substantial human and economic consequences.



Cyberspace is particularly difficult to secure from cyber-attack events, due to a number of factors including the ability of malicious actors to operate from anywhere in the world, the links between cyberspace and physical systems, and the difficulty of reducing vulnerabilities and consequences

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in complex cyber networks. Of growing concern is the cyber threat to critical infrastructure, which is increasingly subject to sophisticated cyber intrusions that pose new risks. As information technology becomes increasingly integrated with physical infrastructure operations, there is increased risk for wide scale or high-consequence events that could cause harm or disrupt services upon which our economy and the daily lives of millions of Americans depend. In light of the risk and potential consequences of cyber events, strengthening the security and resilience of cyberspace has become an important homeland security mission.¹

The City of Austin has enjoyed continued growth over the past 35 years. As a university town, with an educated workforce, a large number of technological companies have selected the City of Austin as their headquarters. To address the City's growth, the City of Austin has become a leader in its use of computers, networks, and the data stored on them. The City of Austin has been proactive in securing the cybersecurity assets using best practices. This section reviews the hazards to the cybersecurity assets for the City of Austin planning area.

HAZARDS

DENIAL OF SERVICE ATTACKS

A denial of service attack (DoS) is the attempt to make a computer or network resource unavailable to its intended users. A DoS attack may come from one or several computers, while a distributed denial of service attack (DDoS) will be launched from many, often thousands of computers. While a DoS attack may occur frequently and typically can be handled by the City's equipment, a DDoS attack can overload the City of Austin's network or computer resources resulting in extended downtime. Often these attacks rely on lower level network vulnerabilities.

DATA LOSS/LEAKAGE

Data loss can result from a variety of reasons, both intentional and unintentional. Data loss may result from a failure to properly backup or have disaster recovery equipment and processes, employees improperly handling sensitive data, and criminal activities such as espionage, theft, sabotage and other malicious acts.

INFRASTRUCTURE LOSS/FAILURE

Loss of computer and network resources may result from a variety of natural and human-caused disasters including tornadoes, hurricanes, and explosions due to accident, power loss, terrorism, and fire.

INSIDER THREATS

Insider threats are malicious threats to the planning area that comes from City of Austin employees, contractors, and volunteers who have access to the City's computers, networks, and data. An insider can initiate a DoS attack, leak or steal data, and sabotage the infrastructure and data.

ORGANIZED CYBERCRIME, STATE-SPONSORED HACKERS ESPIONAGE

Organized cybercrime, which may include state-sponsored cybercrime, are attacks on the City of Austin's computers, network, and data by criminal organizations. These criminals may be motivated by money or political reasons. Often these attacks are well planned out, difficult to identify due to their more limited scope, and can result in extensive damage.

¹ Source: Department of Homeland Security

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THIRD PARTY MISMANAGEMENT

Reliance on third parties for cyber services implies acceptance of the risk that the third party will properly protect the cyber resources from loss or unavailability. Hazards from the use of third parties include DoS, DDoS, data loss and leakage, infrastructure loss and failure, insider threats, and organized cybercrime.

ADVANCE PERSISTENT THREATS

An advanced persistent threat (APT) is a stealthy and continuous attack on the City of Austin over a long period of time. The "advanced" process signifies sophisticated techniques using malware to exploit vulnerabilities in systems. The "persistent" process suggests that an external command and control system is continuously monitoring and extracting data from a specific target. The "threat" process indicates human involvement in orchestrating the attack.

CIVIL DISORDER

Civil disorder may impact the cybersecurity of the planning area by directly or indirectly impacting the City of Austin's ability to support its computers, networks, and data. Civil disorder can result in the planning area not having resources due to direct impact to the computers and networks, and indirectly by limiting the resources necessary to run the computers and networks.

LOCATION

Cyberwar is deceptive, invisible to most, and fought out of sight. It takes place in cyberspace, a location that cannot be seen, touched, or felt. The physical instruments, such as computers, routers, and cables can be seen; however, these instruments interact in cyberspace, a virtual and unseen realm. Thus, the source of the hazard can extend from one part of the world to attacks on public or private sector entities in another part of the world, and the perpetrator can remain unknown in a legally provable sense. The entire City of Austin planning area can be affected by a cyber-attack.

EXTENT

Currently an official index for measuring the extent of a cyber-attack does not exist. The extent, nature, and timing of cyber-attack events are impossible to predict. There may or may not be any warning. Some cyber-attack events take a long time (weeks, months or years) to be discovered and identified.² Therefore, the City of Austin planning area is vulnerable to all types of cyber-attack, and can occur anywhere, and at any time.

The extent of damages is based on historical incidents in the City of Austin planning area which are classified as low, medium, and high; third party information regarding the impact; and if the City of Austin has experienced an occurrence of the incident.

Denial of service attacks: Low

A DoS and DDoS attack could result in an extended cyber-outage in the planning area. The outage, although impacting the daily business of the City of Austin would not have a substantial economic impact to the City.

² <http://www.ready.gov/cyber-attack>

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Data loss/leakage: High

Data loss and leakage experienced by the City of Austin could result in costly remediation efforts to ensue. For example, if personally identifiable information (PII) is leaked, the City may be required to pay for credit protection services. Since the City of Austin manages a large quantity of sensitive information, the possibility of costly remediation efforts is high.

Infrastructure loss/failure: High

Loss of a cyber-processing facility could result in very high expenses to remediate, repair, and recover from the loss.

Insider threats: Medium

Insider threats can result in substantial impacts to the organization, depending on what data the insider has accessed. The City of Austin has remediated insider threats by using the industry standard separation of duties, and performing background checks of its employees, contractors, and volunteers.

Organized cybercrime, state-sponsored hackers' espionage: High

The planning area is a target for organized criminals and state-sponsored hackers due to its political environment and the size of the organization. Due to the potential extent of attacks by organized criminals, the possibility and severity of resulting damages are great.

Third party mismanagement: Low

Since each vendor is isolated to the service it performs, the damages from one third party's mismanagement is fairly low.

Advanced persistent threats: High

The impact of an APT to the planning area can be severe because a large number of systems can be affected and the remediation of such an attack could be expensive to recover from.

Civil disorder: High

The impacts of civil disorder on cybersecurity could be extensive due to the typical physical nature of the attacks.

HISTORICAL OCCURRENCES

USA Today reported that the electric grid is attacked every four days either physically or through cyber threats. Austin's Homeland Security official expressed that the numbers of attacks are accelerating and becoming more sophisticated. The Texas Governor announced that websites belonging to state agencies have seen an increase in attempted cyberattacks coming out of Iran (about 10,000 per minute) in the days since Iranian general Qassem Soleimani was killed in a U.S. drone strike.³ While the attacks to gather data have not been successful, Austin's technology security team remains on high alert. ERCOT reportedly has a team of professionals and a series of procedures they utilized to protect the planning area systems from cyber-attacks.

Even though cyber-attack events are virtually impossible to predict, the City of Austin planning area has the potential of an occurrence happening at any time.

³ Statesman News Network, January 2020, Website: <https://www.statesman.com/news/20200110/austin-on-guard-after-texas-hit-with-increased-cyberattacks-from-iran>

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PROBABILITY OF FUTURE EVENTS

The probability of occurrence based on historical incidents at the City of Austin are classified as low, medium, and high; as well as third party information regarding the likelihood of incidents if the City has not had an occurrence of the incident.

Denial of service attacks: Medium

The planning area has daily DOS attacks which are not severe enough to cause impact to the City of Austin's service levels. Historically the City of Austin has had one DDoS attack over the last year which successfully impacted services.

Data loss/leakage: Medium

The planning area is subject to several compliance requirements which specifically address data loss and leakage. These compliance standards include but are not limited to:

- Payment Card Industry Security Standard (PCI/DSS)
- Health Insurance Portability and Accountability Act of 1996 (HIPAA)
- Criminal Justice Information Services Division (CJIS)

Historically, the City of Austin had one instance of data loss over the last year which resulted in the City having to remediate the situation.

Infrastructure loss/failure: Low

The planning area has multiple data centers which are hardened in various ways to minimize the possibility of outage. Resilience and redundancy are continuously being reviewed and addressed to reduce the risk of loss or failure. Historically, the infrastructure has had few outages that were extended.

Insider threats: Low

The planning area requires anyone who has access to the City of Austin's enterprise network and resources to have gone through a background check, which is regularly reviewed. There has never been evidence of insider attacks.

Organized cybercrime, state-sponsored hackers' espionage: Medium

Over the last five years the City of Austin had several instances of organized attack via DDoS and malware by an organization. Because the City of Austin is a large public entity, it is more prone to these types of attacks.

Third party mismanagement: Low

The City of Austin utilizes third parties for its cyber activities, and vets all contracts prior to final agreement. As part of the contractual agreements, all data are required to be stored within the U.S., and segregated from other entities' data. There has not been an instance of Third party mismanagement to date.

Advanced persistent threats: Medium

The City of Austin maintains systems which monitor symptoms of APT, and over the last year there has been one instance of an infection by malware which had a command and control system.

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Civil disorder: Low

The City of Austin has had instances of civil disorder in the past and is more subject to such events due to it being the Capital of Texas. Although this is the case in general, the City has relatively low civil disorder.

VULNERABILITY AND IMPACT

With the internet being largely open and unregulated, it leaves the planning area vulnerable to cyber-attacks and threats. The attack can be on information systems resulting in a data breach, or the spread of a virus. With the growing dependence on digital interconnectivity even a small incident may have widespread, and damaging consequences.



Transportation, public safety, and utility services are all critical, and highly dependent on information technology. The motive behind such disruptions can be driven by religious, political, other objectives.

A cyber-attack can last a few minutes to a couple of days, although large-scale events and their impacts can last much longer. Cyber-attacks differ by motive, type, vector, and perpetrator profile.

Cybersecurity involves protecting infrastructure by preventing, detecting, and responding to cyber-attack incidents. Unlike physical threats that prompt immediate action, such as “stop, drop, and roll,” in the event of a fire; cyber threats are often difficult to identify and comprehend. Among these dangers are viruses erasing entire systems, intruders breaking into systems and altering files, intruders using a computer or device to attack others, and intruders stealing confidential information. The spectrum of cyber-attack risks is limitless. Threats of cyber-attack can have wide-ranging effects on the individual, community, organizational, and national level. Risks from cyber-attack include:

- Organized cybercrime, state-sponsored hackers, and cyber espionage, which can pose national security risks to our country.
- Transportation, power, and other services may be disrupted by large scale cyber incidents, and the extent of the disruption is highly uncertain as it will be determined by many unknown factors including the target and size of the incident.
- Vulnerability to data breach and loss increases if an organization’s network is compromised, and therefore information about a company, its employees, and its customers can be at risk.
- Individually-owned devices such as computers, tablets, mobile phones, and gaming systems that connect to the Internet are vulnerable to intrusion, and therefore personal information may be at risk without proper security.⁴

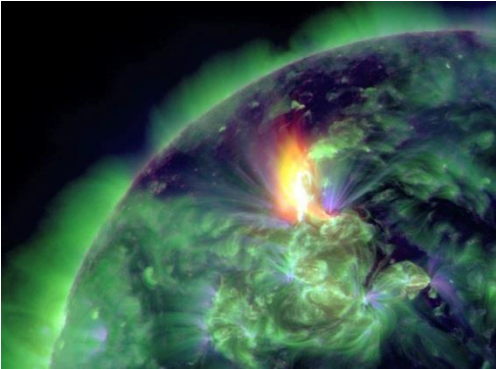
⁴ <http://www.ready.gov/cyber-attack>

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HAZARD DESCRIPTION

Technological disruptions can be caused by solar flares, geomagnetic storms, and power disruptions. A solar flare is a sudden, rapid, and intense flash of brightness observed over the sun’s surface that occurs when built-up magnetic energy from the solar atmosphere is suddenly released. Flares generally cannot pass through the Earth’s magnetosphere and atmosphere, therefore the City of Austin planning area is not vulnerable to powerful bursts of particles. However, solar flares can impact satellite and radio transmissions, cause flights to be re-routed due to changes in the Earth’s magnetic field, and cause radio blackouts due to radiation. Geomagnetic storms are a major disturbance of Earth’s magnetosphere that occur when there is a very efficient exchange of energy from solar wind into the space environment surrounding the Earth. Magnetic storms can affect the performance of equipment, upset radio communications, blackout radars, and disrupt radio navigation systems.



LOCATION

Space weather impacts various aspects of everyday life including a variety of phenomena that occur due to the variability of the sun over periods ranging from hours to years. A technological disruption can happen anywhere and at any time within the entire world, including the City of Austin planning area.

EXTENT

The National Oceanic and Atmospheric Administration (NOAA) Space Weather Scales were introduced as a way to publicly communicate the current and future space weather conditions and their possible effects on people and systems. Many of the Space Weather Prediction Center (SWPC) products describe the space environment, but few have described the effects that can be experienced as the result of environmental disturbances. The scales describe the environmental disturbances for three event types including geomagnetic storms, solar radiation storms, and radio blackouts. The scales have numbered levels, analogous to events that convey

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severity including hurricanes, tornadoes, and earthquakes. The scales identify possible effects of an event, how frequently events occur, and the intensity of the physical causes.¹

Table 18-1. Geomagnetic Storms

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
G 5	Extreme	<p>Power systems: Widespread voltage control problems and protective system problems can occur, and some grid systems may experience complete collapse or blackouts. Transformers may experience damage.</p> <p>Spacecraft operations: Problems with extensive surface charging, and orientation, uplink/downlink, and tracking satellites can occur.</p> <p>Other systems: Pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).</p>	Kp = 9	4 per cycle (4 days per cycle)
G 4	Severe	<p>Power systems: Possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid.</p> <p>Spacecraft operations: Problems with surface charging and tracking can occur, and corrections may be needed for orientation problems.</p> <p>Other systems: Induced pipeline currents can affect preventive measures, HF radio propagation is sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama</p>	Kp = 8, including a 9	100 per cycle (60 days per cycle)

¹ <http://www.swpc.noaa.gov/noaa-scales-explanation>

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SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
		and northern California (typically 45° geomagnetic lat.).		
G 3	Strong	<p>Power systems: Voltage corrections can be required, and false alarms triggered on some protection devices.</p> <p>Spacecraft operations: Surface charging can occur on satellite components, drag can increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems.</p> <p>Other systems: Intermittent satellite navigation and low-frequency radio navigation problems can occur, HF radio can be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).</p>	Kp = 7	200 per cycle (130 days per cycle)
G 2	Moderate	<p>Power systems: High-latitude power systems can experience voltage alarms, and long-duration storms can cause transformer damage.</p> <p>Spacecraft operations: Corrective actions to orientation can be required by ground control, and possible changes in drag can affect orbit predictions.</p> <p>Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).</p>	Kp = 6	600 per cycle (360 days per cycle)
G 1	Minor	<p>Power systems: Weak power grid fluctuations can occur.</p> <p>Spacecraft operations: Minor impact on satellite operations are possible.</p> <p>Other systems: Migratory animals are affected, and aurora is commonly visible at high latitudes (northern Michigan and Maine).</p>	Kp = 5	1700 per cycle (900 days per cycle)

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Table 18-2. Solar Radiation Storms

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE (Flux level of ≥ 10 MeV particles)	AVERAGE FREQUENCY (1 Cycle = 11 Years)
S 5	Extreme	<p>Biological: Unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity) occurs; and passengers and crew in high-flying aircraft at high latitudes can be exposed to radiation risk.</p> <p>Satellite operations: Satellites can be rendered useless, memory impacts can cause loss of control, serious noise in image data can occur, star-trackers may be unable to locate sources; and permanent damage to solar panels is possible.</p> <p>Other systems: Complete blackout of HF communications is possible through the polar regions, and position errors make navigation operations extremely difficult.</p>	10 ⁵	Fewer than 1 per cycle
S 4	Severe	<p>Biological: Unavoidable radiation hazard to astronauts on EVA can occur; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.</p> <p>Satellite operations: Memory device problems and noise on imaging systems can occur; star-tracker problems can cause orientation problems, and solar panel efficiency can be degraded.</p> <p>Other systems: Blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.</p>	10 ⁴	3 per cycle
S 3	Strong	<p>Biological: Radiation hazard avoidance is recommended for astronauts on EVA, and passengers and crew in high-flying aircraft at high latitudes can be exposed to radiation risk.</p> <p>Satellite operations: Single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely.</p>	10 ³	10 per cycle

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SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE (Flux level of ≥ 10 MeV particles)	AVERAGE FREQUENCY (1 Cycle = 11 Years)
		Other systems: Degraded HF radio propagation through the polar regions and navigation position errors are likely.		
S 2	Moderate	Biological: Passengers and crew in high-flying aircraft at high latitudes can be exposed to elevated radiation risk. Satellite operations: Infrequent single-event upsets are possible. Other systems: Small effects on HF propagation through the polar regions can occur, and navigation at polar cap locations can be possibly affected.	10^2	25 per cycle
S 1	Minor	Biological: None. Satellite operations: None. Other systems: Minor impacts on HF radio in the polar regions.	10	50 per cycle

Table 18-3. Radio Blackouts

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
R 5	Extreme	HF Radio: Complete HF (high frequency) radio blackout on the entire sunlit side of the Earth lasting for a number of hours can occur. This results in no HF radio contact with mariners and en route aviators in this sector. Navigation: Low-frequency navigation signals used by maritime and general aviation systems can experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours can occur on the sunlit	X20 (2×10^{-3})	Less than 1 per cycle

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SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
		side of Earth, which may spread into the night side.		
R 4	Severe	<p>HF Radio: HF radio communication blackout on most of the sunlit side of Earth can occur for one to two hours, and HF radio contact is lost during this time.</p> <p>Navigation: Outages of low-frequency navigation signals can cause increased error in positioning for one to two hours, and minor disruptions of satellite navigation are possible on the sunlit side of Earth.</p>	X10 (10 ⁻³)	8 per cycle (8 days per cycle)
R 3	Strong	<p>HF Radio: Wide area blackout of HF radio communication, and loss of radio contact for about an hour on sunlit side of Earth can occur.</p> <p>Navigation: Low-frequency navigation signals can be degraded for about an hour.</p>	X1 (10 ⁻⁴)	175 per cycle (140 days per cycle)
R 2	Moderate	<p>HF Radio: Limited blackout of HF radio communication on the sunlit side of the Earth, and loss of radio contact for tens of minutes can occur.</p> <p>Navigation: Degradation of low-frequency navigation signals for tens of minutes can occur.</p>	M5 (5 x 10 ⁻⁵)	350 per cycle (300 days per cycle)
R 1	Minor	<p>HF Radio: Weak or minor degradation of HF radio communication on the sunlit side of the Earth, and occasional loss of radio contact can occur.</p> <p>Navigation: Low-frequency navigation signals can be degraded for brief intervals.</p>	M1 (10 ⁻⁵)	2000 per cycle (950 days per cycle)

The societal and economic impacts of a geomagnetic disturbance scenario have been mapped in Figure 18-1. Texas is at a zero percent for an at-risk transformer capacity. This does not mean that Texans are safe from power-grid failure. In recent years, utilities have joined grids together to allow long-distance transmission of low-cost power to areas experiencing sudden demand.

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The Interconnectedness of the power-grid makes the system susceptible to wide-ranging "cascade failures."²

The U.S. electric grid has three main components including generation (creation of electricity), transmission (long haul transport of electricity), and distribution (shorter distances connecting the electricity to the consumer and end user). The electric grid is complex with in increasing number of connection points. The U.S. has 80,000 miles of extra-high voltage (EHV) transmission lines comprising the backbone of the transmission grid that enables the long-haul transport of electricity. EHV transformers are considered critical equipment on the transmission grid and 90 percent of consumed power passes through a high voltage transformer at some point. If EHV transformers fail, especially in large numbers, the resulting damage could be extensive.

EHV transformers are huge, weighing hundreds of tons, making them difficult to transport, and in some cases rare and specialized rail cars must be used for transport. Many of the EHV transformers installed in the U.S. are approaching or exceeding the end of their design lifetimes (approx. 30-40 years), increasing their vulnerability to failure. Although the utility industry does maintain limited spares, the ability to quickly and rapidly replace several transformers at once could be a challenge.³

² http://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather/

³ <http://www.dhs.gov/science-and-technology/power-hungry-prototyping-replacement-ehv-transformers>

SECTION 18: TECHNOLOGICAL DISRUPTION

Figure 18-1. At Risk Extra High Voltage (EHV) Transformer Capacity Map by State

FUTURE SOLUTIONS, VULNERABILITIES, AND RISKS

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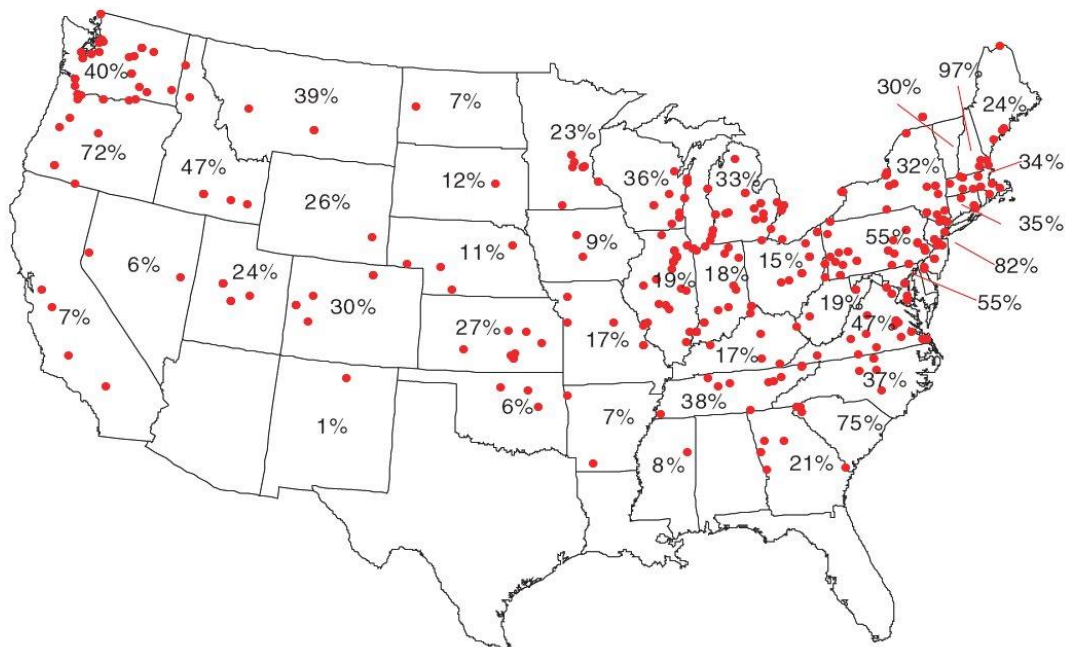


FIGURE 7.2 A map showing the at-risk EHV transformer capacity (estimated at ~365 large transformers) by state for a 4800 nT/min geomagnetic field disturbance at 50° geomagnetic latitude. Regions with high percentages of at-risk capacity could experience long-duration outages that could extend multiple years. SOURCE: J. Kappenman, Metatech Corp., “The Future: Solutions or Vulnerabilities?,” presentation to the space weather workshop, May 23, 2008.

HISTORICAL OCCURRENCES

October-November 2003

The Halloween Solar Storms were a series of solar flares and coronal mass ejections that occurred from mid-October to early November 2003, peaking around October 28–29. Satellite-based systems and communications were affected, aircraft were advised to avoid high altitudes near the Polar Regions, and a one-hour-long power outage occurred in Sweden as a result of the solar activity. Aurorae were observed at latitudes as far south as Texas and the Mediterranean countries of Europe.

The Solar and Heliospheric Observatory (SOHO) satellite failed temporarily, and the Advanced Composition Explorer was damaged by the solar activity. Numerous other spacecraft were damaged or experienced downtime. Some spacecraft were intentionally put into safe mode in order to protect sensitive equipment. Astronauts aboard the International Space Station had to stay inside the more shielded parts of the Russian Orbital Segment to protect themselves against the increased radiation levels. Both the Ulysses spacecraft which was near Jupiter at the time, and Cassini, approaching Saturn, were able to detect the emissions. In April 2004, Voyager 2 was also able to detect them as they reached the spacecraft.

These events occurred during solar cycle 23, approximately three years after its peak in 2000, which was marked by another occurrence of solar activity known as the Bastille Day Flare.

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March 9-13, 1989

The March 1989 geomagnetic storm was a severe storm that caused the collapse of Hydro-Québec's electricity transmission system. It occurred during solar cycle 22.

The storm began on Earth with extremely intense auroras at the poles. The aurora could be seen as far south as Texas and Florida. As this occurred during the Cold War, an unknown number of people worried that a nuclear first-strike might be in progress. Others considered the intense auroras to be associated with the Space Shuttle mission STS-29, which had been launched on March 13, 1989 at 9:57:00 AM. The burst caused short-wave radio interference, including the disruption of radio signals from Radio Free Europe into Russia. It was initially believed that the signals had been jammed by the Soviet government.

Through the evening of March 13, a river of charged particles and electrons in the ionosphere flowed from west to east, inducing powerful electrical currents in the ground that surged into many natural nooks and crannies.

Some satellites in polar orbits lost control for several hours. Geostationary Operational Environmental Satellite (GOES) weather satellite communications were interrupted, causing weather images to be lost. National Aeronautics and Space Administration's (NASA) Tracking and Data Relay Satellite (TDRS)-1 communication satellite recorded over 250 anomalies caused by the increased particles flowing into its sensitive electronics. The Space Shuttle Discovery was having its own problems: a sensor on one of the tanks supplying hydrogen to a fuel cell was showing unusually high pressure readings on March 13, 1989. The problem went away after the solar storm subsided.

May 13 -15, 1921

The May 1921 geomagnetic storm was a significant event caused by the impact of an extraordinarily powerful coronal mass ejection on Earth's magnetosphere. It took place May 13 through May 15, 1921 and was part of solar cycle 15. This event occurred before extensive interconnectivity of electrical systems and the general electrical dependency across infrastructures in the developed world, so the effect was restricted to certain sectors. Resulting ground currents were up to an order of magnitude greater than those of the March 1989 geomagnetic storm that blacked out large parts of northeastern North America. At the time, scientists estimated the size of the sunspot that began on May 10, 1921 and caused the storm, as being 94,000 by 21,000 miles (131,000 km by 33,800 km).

August 28-September 2, 1859

The 1859 Solar Flare is the largest magnetic explosion recorded and is referred to as the Carrington Event, named for British Astronomer Richard Carrington, who witnessed growing sunspots and documented a bright white flash that lasted about five minutes. The impacts on Earth were colorful and bright auroras were seen as far south as Hawaii and Cuba. Telegraph operators experienced sparks from telegraph equipment that started fires. Scientists predict that such an event today would be devastating to the internet, communications, and power transformers, satellites, airplanes, or any GPS guided system. Solar activity is closely monitored as the sun storms have increased since 2011. Studies have shown that a solar storm of this magnitude occurring today would likely cause widespread problems for modern civilization. The solar storm of 2012 was of similar magnitude, but it passed Earth's orbit without striking the planet.

SECTION 18: TECHNOLOGICAL DISRUPTION

PROBABILITY OF FUTURE EVENTS

Technological Disruptions are expected to continue in the near future. Solar storm activity is expected to increase and is being mapped by NASA's Solar Shield Project and NOAA's Space Weather Prediction Center to show strong currents and warn power companies to protect their systems. The entire City of Austin planning area could be affected should there be another major solar flare, dependent on location of penetration within the Earth's atmosphere.

VULNERABILITY AND IMPACT

Different types of space weather can affect different technologies at Earth. Solar flares can produce strong x-rays that degrade or block high-frequency radio waves used for radio communication during events known as Radio Blackout Storms. Solar Energetic Particles (energetic protons) can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes during Solar Radiation Storms. Space weather has been recognized as causing problems with new technology since the invention of the telegraph in the 19th century.

Besides emitting a continuous stream of plasma called the solar wind, the sun periodically releases billions of tons of matter called coronal mass ejections. These immense clouds of material, when directed toward Earth, can cause large magnetic storms in the magnetosphere and upper atmosphere. Such space weather can affect the performance and reliability of space-borne and ground-based technological systems. Coronal Mass Ejections (CME) can cause Geomagnetic Storms at Earth and induce extra currents in the ground that can degrade power grid operations.

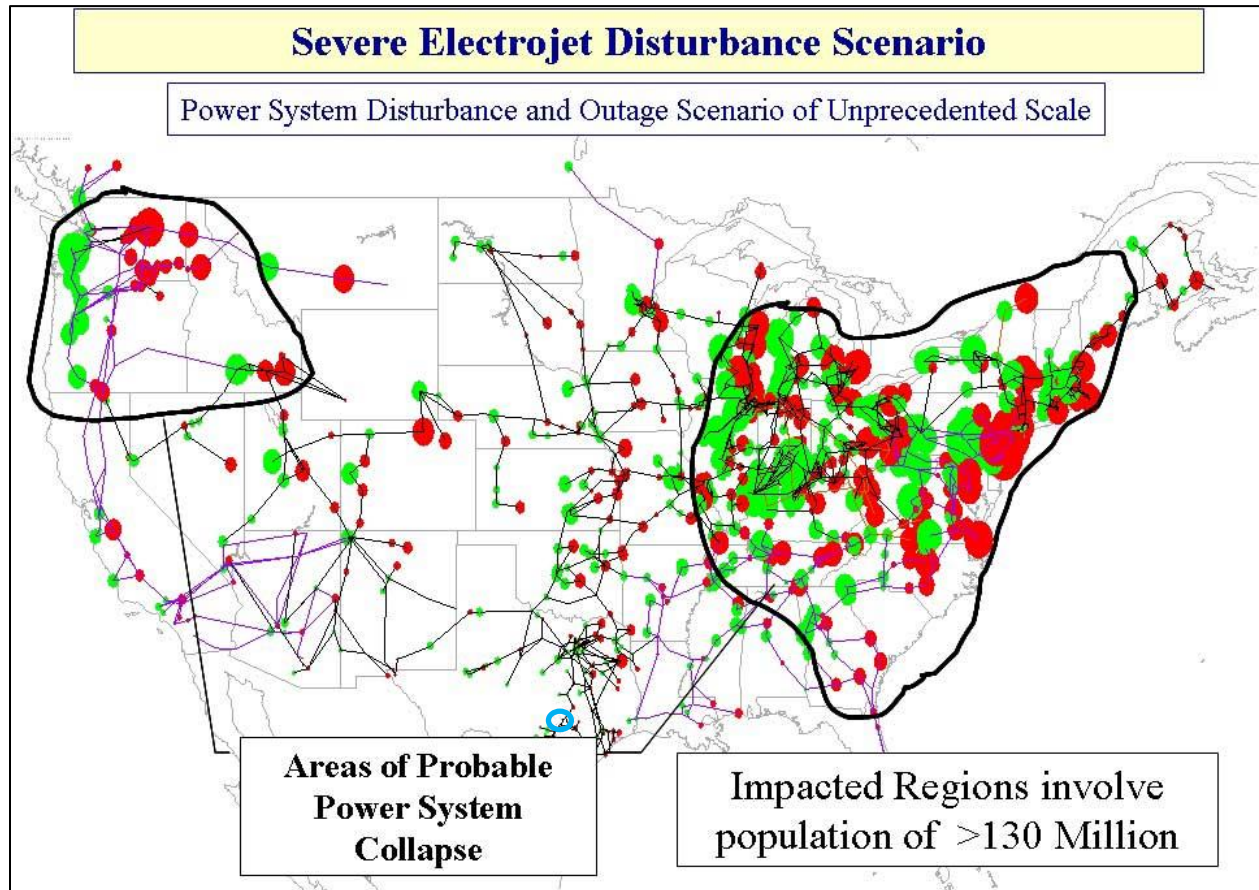
Geomagnetic storms can modify the signal from radio navigation systems (GPS and GNSS) causing degraded accuracy. Geomagnetic storms also produce the aurora. Space weather will impact people who depend on all of these technologies.

A catastrophic failure of commercial and government infrastructure in space and on the ground can be mitigated through raising public awareness, improving vulnerable infrastructure and developing advanced forecasting capabilities. Without preventive actions or plans, the trend of increased dependency on space-weather sensitive technology, could make society more vulnerable to a technological disruption event in the future.

Figure 18-2 identifies a hypothetical scenario presented by a study on potential extreme space weather events that could result in a partial, wide-spread collapse of the U.S. electric power grid with enormous consequences for the affected population. As seen in Figure 18-2, the City of Austin planning area would be affected. Improvements in space weather forecasting, public awareness and infrastructure preparedness can mitigate the potential effects of technological disruption.

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Figure 18-2. Power System Disturbance Scenario⁴



⁴ Source: NASA, Austin is indicated by the blue circle.

SECTION 19: INFECTIOUS DISEASES

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HAZARD DESCRIPTION

An infectious disease is a clinically evident disease resulting from the presence of pathogenic microbial agents. According to FEMA, infectious diseases are a major threat around the world, killing millions globally each year. Transmission of an infectious disease may occur through one or more means including physical contact with infected individuals. These infecting agents may also be transmitted through liquids, food, bodily fluids, contaminated objects, airborne inhalation, or through vector-borne dissemination.

There are three classifications of disease impacts: endemic, epidemic, and pandemic. An endemic is present at all times at a low frequency, such as chicken pox in the United States. An epidemic is a sudden severe outbreak of disease, such as the bubonic plague during Medieval Times. A pandemic is an epidemic that becomes very widespread and affects a whole region, a continent, or the world, for example the ongoing Coronavirus currently impacting every corner of the world. In recent years, fears of pandemic have risen because the globalized economy and growing population fosters large scale international travel and trade. Growing populations increase the vulnerability because more densely populated areas increase the risk of exposure to an infectious disease, allowing the disease to rapidly advance the spread of the infection.

There are many different types of infectious diseases. Due to the rise in certain diseases, the City of Austin is closely monitoring the following diseases that have affected the planning area.

CORONAVIRUS DISEASE 2019 (COVID-19)

Coronavirus disease (COVID-19) is an infectious disease caused by a recently discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate

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respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.

The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow). Many months into the COVID-19 pandemic, the coronavirus is still spreading uncontrolled through the country and throughout the world. Public health authorities including the U.S. Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommend citizens to remain six feet apart, wash hands frequently, disinfect frequently touched surfaces, and wear masks. There is a growing school of evidence that COVID-19 cases are transmitted through aerosols (sometimes referred to as airborne).

During the drafting of this plan, there were no specific vaccines or treatments for COVID-19 approved by the Food and Drug Administration (FDA). However, there are many ongoing clinical trials evaluating potential treatments. Similar to communities around the globe, the City of Austin and Travis County has been dramatically impacted by this virus with an average of 782 new confirmed cases and 7 related deaths per day at the peak of the virus surge. The economic impact of the virus has been devastating for the planning area. With no immediate relief on the horizon, economic recovery is likely to take years. The COVID-19 infection was declared a pandemic by the World Health Organization on March 11, 2020.

The CDC contains the latest information and guidance on the COVID-19 pandemic and provides recommendations on protecting citizens and reducing the spread of the disease. The most current recommendations include:

Wash your hands often

- Wash your hands often with soap and water for at least 20 seconds especially after you have been in a public place, or after blowing your nose, coughing, or sneezing.
- It's especially important to wash:
 - Before eating or preparing food
 - Before touching your face
 - After using the restroom
 - After leaving a public place
 - After blowing your nose, coughing, or sneezing
 - After handling your mask
 - After changing a diaper
 - After caring for someone sick
 - After touching animals or pets
- If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands and rub them together until they feel dry.
- Avoid touching your eyes, nose, and mouth with unwashed hands.

Avoid close contact

- Inside your home: Avoid close contact with people who are sick.
- If possible, maintain 6 feet between the person who is sick and other household members.

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- Outside your home: Put 6 feet of distance between yourself and people who don't live in your household.
- Remember that some people without symptoms may be able to spread virus.
- Stay at least 6 feet (about 2 arms' length) from other people.
- Keeping distance from others is especially important for people who are at higher risk of getting very sick.

Cover your mouth and nose with a mask when around others

- You could spread COVID-19 to others even if you do not feel sick.
- The mask is meant to protect other people in case you are infected.
- Everyone should wear a mask in public settings and when around people who don't live in your household, especially when other social distancing measures are difficult to maintain.
 - Masks should not be placed on young children under age 2, anyone who has trouble breathing, or is unconscious, incapacitated or otherwise unable to remove the mask without assistance.
- Do NOT use a mask meant for a healthcare worker. Currently, surgical masks and N95 respirators are critical supplies that should be reserved for healthcare workers and other first responders.
- Continue to keep about 6 feet between yourself and others. The mask is not a substitute for social distancing.

Cover coughs and sneezes

- Always cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow and do not spit.
- Throw used tissues in the trash.
- Immediately wash your hands with soap and water for at least 20 seconds. If soap and water are not readily available, clean your hands with a hand sanitizer that contains at least 60% alcohol.

Clean and disinfect

- Clean AND disinfect frequently touched surfaces daily. This includes tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, and sinks.
- If surfaces are dirty, clean them. Use detergent or soap and water prior to disinfection.
- Then, use a household disinfectant. Most common EPA-registered household disinfectants will work.

Monitor Your Health Daily

- Be alert for symptoms. Watch for fever, cough, shortness of breath, or other symptoms of COVID-19.
 - Especially important if you are running essential errands, going into the office or workplace, and in settings where it may be difficult to keep a physical distance of 6 feet.
- Take your temperature if symptoms develop.
 - Don't take your temperature within 30 minutes of exercising or after taking medications that could lower your temperature, like acetaminophen.

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- Follow CDC guidance if symptoms develop.

HUMAN IMMUNODEFICIENCY VIRUS

Human immunodeficiency virus (HIV) is spread through bodily fluids such as blood, semen, vaginal fluids, and breast milk. In the United States, HIV is most commonly transmitted from one person to another through unprotected anal or vaginal sex and through sharing needles or other drug paraphernalia. Transmission also can occur through transfusion of blood or its components from infected persons. In addition, a mother can pass HIV to her baby during pregnancy, during labor, or through breastfeeding. HIV infection is diagnosed by testing blood or saliva for antibodies to the virus or by directly testing for the presence of the virus. HIV damages the immune system leading to immunodeficiency; that is, the immune system is deficient in its ability to fight off infectious agents and cancer. Acquired immunodeficiency syndrome (AIDS) is the clinical stage of infection with HIV. The time from HIV infection to the development of AIDS is extremely variable ranging from less than one year to over 15 years.

The term most often used for people who are HIV positive is “person living with HIV/AIDS.”

The Centers for Disease Control and Prevention estimates that over one million persons, aged 13 years and older, are living with HIV infection. In the United States, gay, bisexual, and other men who have sex with men are considered most at risk of HIV infection.

PREVALENT FOODBORNE DISEASES

Foodborne disease is a term used to describe illnesses resulting from the consumption of contaminated foods. These diseases may be caused by bacteria, viruses, or toxins produced by these organisms. Contamination may occur during food production and preparation via inadequate sanitization, improper food handling, or holding food items at inadequate temperatures. The Centers for Disease Control and Prevention (CDC) estimate that one in six Americans, approximately 48 million people, have a foodborne illness each year.¹ Additionally, foodborne diseases kill thousands in the United States each year and cause billions of dollars in healthcare-related and industry costs annually.²

Foodborne disease rates in Travis County are significantly higher than those reported for Texas. Foodborne diseases are commonly underreported, and only a small proportion of illnesses are confirmed by laboratory testing; as a result, the higher Travis County rates could reflect an increased disease burden or a higher proportion of diseases identified and reported as compared to Texas overall.

The most common foodborne diseases reported in Travis County and Texas were Salmonellosis, Campylobacteriosis, and Shigellosis. Other forms of foodborne diseases are Cyclosporiasis, E Coli, Hepatitis A, and Listeriosis, which are listed in Table 19-2.

Commonly associated with contaminated food, water, or contact with infected animals, salmonellosis has been associated with many food items and animal exposures over the past few years. Nationally, salmonellosis is identified more frequently in children which is also the case in

¹ <http://www.cdc.gov/foodborneburden/>

² http://www.cdc.gov/WinnableBattles/FoodSafety/index.html?s_cid=fb165

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Travis County.³ Travis County has seen a steady increase in salmonellosis cases from 2006 to 2015, which follows the national trend.

Campylobacteriosis is associated with eating raw or undercooked poultry, raw milk dairy products, contaminated produce and drinking water. Travis County has seen a slow increasing trend in campylobacteriosis cases from 2005 to 2015.

Shigellosis is an illness caused by *Shigella* bacteria. It is transmitted by hand-to-mouth contact with stool (feces) from a sick person or animal, eating contaminated foods, or drinking contaminated water. Children and people who work in day care facilities are prone to contracting this disease. Other ways of contracting the disease may be through sexual practices or caring for someone who has Shigellosis; or traveling to other countries where the food/water supply is contaminated and unsafe.⁴ Cases of Shigellosis saw a dramatic increase from 2013 to 2015 in the 0-19 age bracket, which is similar to national trends during that same time frame.

PREVALENT VECTORBORNE DISEASES

WEST NILE VIRUS

West Nile virus infection is the most common vectorborne disease in the United States. In nature, West Nile virus is spread between mosquitos and birds. Infected mosquitos will infect birds while getting a blood meal. Mosquitos can become infected by feeding on infected birds. West Nile virus is primarily transmitted to humans by the bite of an infected mosquito.

Transmission also may occur through blood transfusions, organ transplants, and from mother to baby during pregnancy, delivery, or breastfeeding. Most persons with a West Nile virus infection experience a fever with headache, body aches, and joint pains. Severe symptoms in some persons include encephalitis or meningitis.

INFLUENZA A (H1N1)

In March of 2009, a novel strain of Influenza A (H1N1 or “Swine Flu”) virus was detected in Mexico and the United States. The virus has since spread worldwide.⁵ The Center for Disease Control and Prevention (CDC) estimates that from April 12, 2009 to April 10, 2020, there were over 60.8 million cases, 274,304 hospitalizations, and 12,469 deaths in the United States due to the H1N1 virus.

The most commonly reported symptoms include cough, fever, sore throat, and gastrointestinal symptoms, such as vomiting and diarrhea. Most individuals infected with H1N1 did not require hospitalization and had symptoms that lasted four days.⁶ The CDC reports that confirmed flu activity continues to decrease for the 2019-2020 season.

H5N1 AVIAN FLU (BIRD FLU)

H5N1 is a highly pathogenic avian (bird) flu virus that has caused serious outbreaks in domestic poultry in parts of Asia and the Middle East. Highly pathogenic refers to the virus’s ability to

³ Ibid

⁴ <http://www.dshs.state.tx.us/idcu/disease/shigellosis/>

⁵ World Health Organization

⁶ Carrat, F. et al. Timelines of Infection and Disease in Human Influenza: A Review of Volunteer Challenge Studies. *American Journal of Epidemiology*, 2008, 167: 775–785.

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produce disease. Although H5N1 does not usually infect humans, 861 cases of human infection with avian influenza was reported globally from January 2003 to August 2020.⁷

Most human cases of “highly pathogenic” H5N1 virus infection have occurred in people who had recent contact with sick or dead poultry that were infected with H5N1 viruses. About 60% of people infected with the virus died from their illness.

Unlike other types of flu, H5N1 usually does not spread between people.

There have been no reported infections with these viruses in birds, poultry, or people in the United States.

It is rare for humans to be infected with this virus. You cannot get infected with these viruses from properly handled and cooked poultry or eggs. However, flu viruses are constantly changing and animal flu viruses can change such that they may gain the ability to infect people easily and spread among people, causing a pandemic.

EBOLA VIRUS DISEASE (EVD)

Ebola is a viral hemorrhagic fever disease. Symptoms of Ebola may include fever, severe headache, muscle pain, vomiting, diarrhea, stomach pain, or unexplained bleeding or bruising. Symptoms may appear anywhere from 2 to 21 days after exposure to the virus, although 8 to 10 days is most common for symptoms to occur.

The 2014 Ebola outbreak was centered on three countries in West Africa. Ebola does not pose a significant risk to the United States public. There are no known cases of Ebola in the City of Austin.⁸

LOCATION

Pandemics are random and only a few happen every century. The impacts from an infectious disease event can affect all areas of the world, therefore all areas are vulnerable, as evidenced by the current COVID-19 pandemic. Since air travel and worldwide shipping have increased, it has become increasingly difficult to contain localized outbreaks as infected or exposed people travel across the globe in a matter of hours. Third world countries have fewer resources to fight disease and may be more vulnerable than more industrialized nations. In the United States, the U.S. public health system works at the federal, state and local level to monitor diseases, plan and prepare for outbreaks, and prevent epidemics where possible.

There is no distinct geographic boundary to infectious disease, therefore, it can occur throughout the City of Austin planning area.

EXTENT

The severity of a pandemic virus can be evaluated from the perspective of the individual who has been infected; or from the population level, how many complications and deaths might be

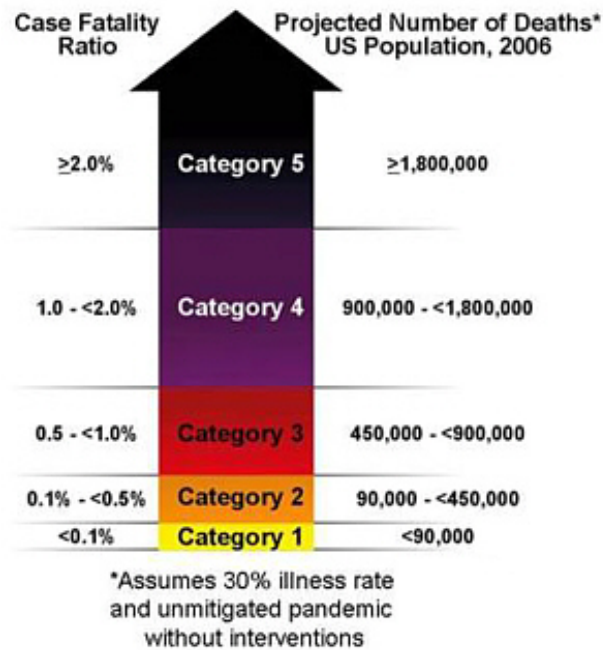
⁷ [https://www.who.int/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza/ai-20200814.pdf?sfvrsn=30d65594_68#:~:text=Globally%2C%20from%20January%202003%20to,30%20April%202019%20\(source\)](https://www.who.int/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza/ai-20200814.pdf?sfvrsn=30d65594_68#:~:text=Globally%2C%20from%20January%202003%20to,30%20April%202019%20(source))

⁸ <https://austintexas.gov/ebola>

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expected as a whole. The most common measure of severity for a pandemic virus event is the case-fatality rate (CFR) as depicted in Figure 19-1.

Figure 19-1. Case-Fatality Rate for Severity



The magnitude of a pandemic event is identified in terms of warning levels based on population. Figure 19-2 illustrates the various warning levels for pandemic. The current COVID-19 pandemic warning level is at Phase 6.

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Figure 19-2. Risk levels for Pandemic (World Health Organization)



HISTORICAL OCCURRENCES

The Austin/Travis County Health and Human Services Department has produced a 2017 Critical Health Indicators Report to illustrate health conditions and disparities in Travis County. Information in the 2017 report was primarily obtained from the United States Census Bureau, Texas Department of State Health Services, the Texas Behavioral Risk Factor Surveillance Survey, and from morbidity and mortality reports collected by the Disease Prevention and Health Promotion Division. The Critical Health Indicators Report was prepared by epidemiologists and staff in the Disease Prevention and Health Promotion Division using the most recent county, state, and national data available.⁹

The number of infectious disease cases and rates are included in Table 19-2. Rates for each year were configured using the number of cases per 100,000 total population. Rates based on fewer than 20 cases are likely to be unstable and imprecise. On average, more than 9,500 cases of infectious disease are reported annually for Travis County.

⁹ https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/CHI_Report_3.20.17.pdf

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Table 19-2. Historical Infectious Disease for Austin and Travis County, 2015 – 2016¹⁰

INFECTIOUS DISEASE	2015	2016
	Cases	Cases
AIDS	Unavailable	Unavailable
Amebiasis	25	21
Anthrax	0	0
Botulism	0	0
Brucellosis	0	0
Campylobacteriosis	235	124
Chicken Pox (Varicella)	89	50
Chlamydia	7,787	Unavailable
Cholera	0	0
Creutzfeldt-Jakob Disease	0	0
Cryptosporidiosis	36	Unavailable
Cyclosporiasis	113	25
Cysticercosis	0	1
Dengue	6	4
Diphtheria	0	0
Ehrlichiosis	0	1
Encephalitis	Unavailable	Unavailable
Encephalitis, Nonarboviral	Unavailable	Unavailable
Escherichia coli , Shiga toxin-producing (STEC)	Unavailable	Unavailable
Gonorrhea	2,431	Unavailable
Haemophilus influenzae type b, invasive	0	1

¹⁰ Source: Austin/Travis County Health & Human Services. Data for infectious disease in the planning area represents only a snapshot of reporting in 2015 and 2016. A broader range of data was unavailable during this planning process.

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INFECTIOUS DISEASE	2015	2016
	Cases	Cases
Hantavirus	0	0
Hemolytic Uremic Syndrome (HUS)	0	1
Hepatitis A, Acute	13	6
Hepatitis B, Acute	17	12
Hepatitis B, Perinatal	Unavailable	Unavailable
Hepatitis C, Acute	0	0
Hepatitis Other, Acute	Unavailable	Unavailable
HIV	Unavailable	Unavailable
Influenza-associated pediatric mortality	0	0
Legionellosis	15	5
Leishmaniasis	1	1
Listeriosis	2	0
Lyme Disease	4	3
Malaria	3	1
Measles	0	0
Meningitis, Aseptic	Unavailable	Unavailable
Meningitis, Bacterial and Other	Unavailable	Unavailable
Meningococcal Infection	3	2
Mumps	8	15
Pertussis	110	58
Plague	0	0
Poliomyelitis	0	0
Primary Amoebic Meningoencephalitis (PAM)	0	0
Q Fever, Acute	0	0
Rabies, human	0	0

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INFECTIOUS DISEASE	2015	2016
	Cases	Cases
Rubella	0	0
Salmonellosis	253	153
Shigella	435	162
Smallpox	0	0
Spotted Fever Rickettsiosis	4	1
Streptococcus, Group A	41	22
Streptococcus, Group B	74	42
Streptococcus pneumonia	85	63
Syphilis	501	Unavailable
Taeniasis	0	0
Tetanus	0	0
Trichinosis	0	0
Tuberculosis	59	Unavailable
Tularemia	0	0
Typhoid Fever	1	1
Typhus, Murine	15	21
Vancomycin- intermediate resistant Staphylococcus aureus (VISA)	2	1
Vancomycin-resistant Staphylococcus aureus (VRSA)	0	0
Vibrio Infections	4	2
West Nile Virus	0	0
Yellow Fever	0	0
Yersiniosis	3	0

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HIV AND AIDS

Table 19-3 reports the number of new HIV and AIDS cases in Travis County during 2003 through 2018. The number of cases of AIDS are those who were diagnosed in that year regardless of whether they were previously diagnosed as HIV only or if they were newly diagnosed and had already met the AIDS case definition. The annual number of new HIV diagnoses ranged from 191 to 295.

Table 19-3. Number of New HIV and AIDS Diagnoses, Travis County, Texas, 2003 – 2018¹¹

DIAGNOSIS YEAR	HIV	AIDS
2003	207	140
2004	191	136
2005	221	169
2006	223	150
2007	224	161
2008	207	148
2009	191	153
2010	195	129
2011	237	127
2012	255	112
2013	223	Unavailable
2014	242	Unavailable
2015	295	Unavailable
2016	244	Unavailable
2017	216	Unavailable
2018	205	Unavailable
Total	3,576	

INFLUENZA

During the 2019-2020 influenza season (September 29, 2019 through March 14, 2020) Influenza A was the most common type of flu circulating in Travis County. Three influenza-associated school outbreaks and five influenza-associated outbreaks at long-term care facilities have been reported so far this season in Travis County. Five influenza-associated adult deaths have been

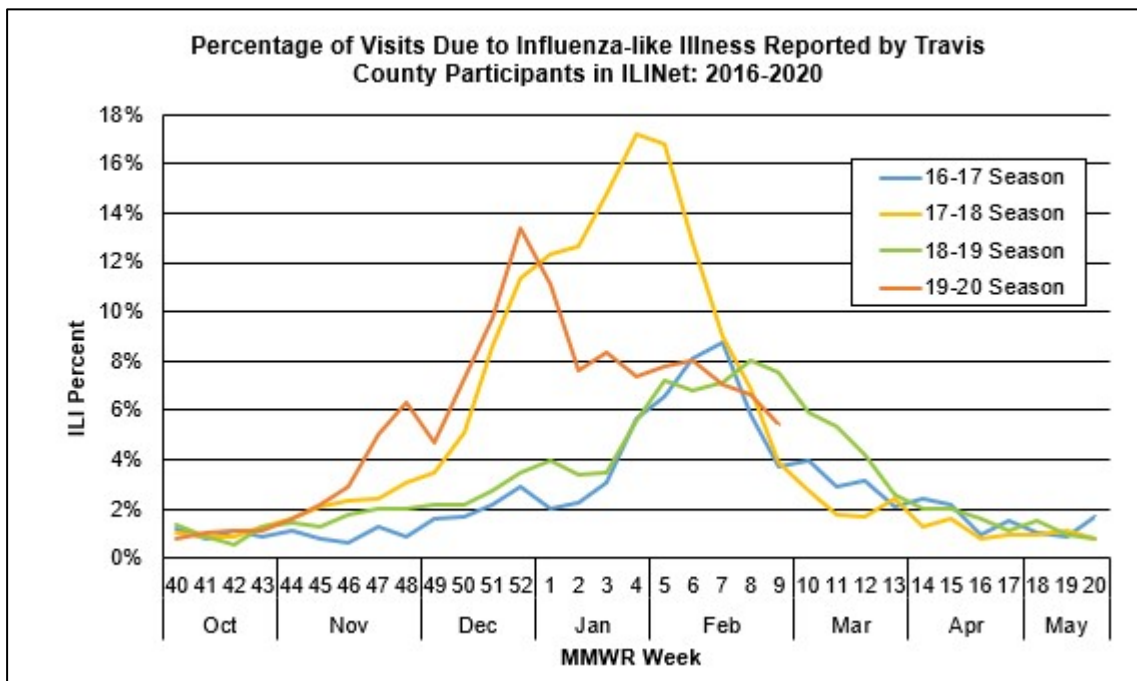
¹¹ TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services

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reported in Travis County. Fifteen influenza-associated pediatric deaths have been reported in Texas though none were reported in Travis County.¹² The CDC estimates that so far this season there have been at least 38 million flu illnesses, 390,000 hospitalizations and 23,000 deaths from flu in the United States.

During the fall 2019 influenza season, there have already been 15 associated deaths with the City of Austin and Travis County residents. Figure 19-3 illustrates the percentage of visits to Travis County hospitals for influenza-like symptoms. Figure 19-4 displays the City of Austin influenza and pneumonia mortality rate from 2010 through 2015.

Figure 19-3. Percentage of Visits Due to Influenza-like-Illness, Travis County 2016-2020¹³

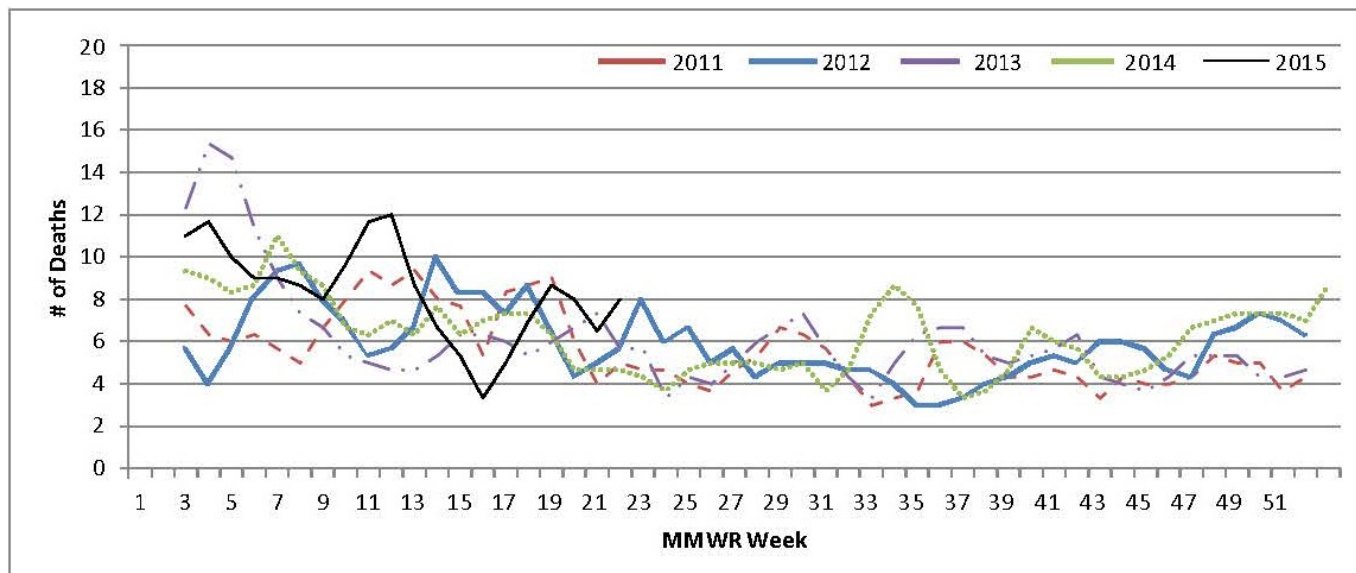


¹² <http://www.austintexas.gov/department/flu-austin-influenza>

¹³ <http://www.austintexas.gov/department/influenza>

SECTION 19: INFECTIOUS DISEASE

Figure 19-4. City of Austin Pneumonia and Influenza Mortality, 2010 – 2015¹⁴



WEST NILE VIRUS

During 2008 through 2011, only two West Nile virus cases were reported in Travis County. In 2012, the United States experienced an outbreak of West Nile virus with 5,674 cases reported.¹⁵ A total of 286 persons in the United States died due to West Nile virus in 2012.¹⁶ In 2012, over 1,800 cases were reported in Texas, with 153 of those cases occurring in Travis County causing 6 deaths. Ill persons had onset of symptoms during July through October of 2012. The initial cases had onset of illness the second week of July, 2012.

There were 379 cases of West Nile virus in Texas in 2014 causing 6 deaths. There were 6 reported cases in 2015, although none of those cases occurred in Travis County.¹⁷ In 2019, there were 30 cases reported in Texas though none of those cases were reported in Travis County. In 2020 three cases have been reported in Travis county to date.

PROBABILITY OF FUTURE EVENTS

Epidemics and pandemics have occurred in human and animal populations for thousands of years. As humans began to gather and congregate in urban areas, the potential for pandemics and epidemics increased. As trade routes became established and contact with other cities became more frequent, the potential for transmission of illnesses increased. In modern society, the ease of global travel has created a situation where viruses and bacteria can spread quickly from one continent to another.

Historical evidence shows that the population of the City of Austin is vulnerable to disease outbreak, and the probability of future infectious disease or pandemic events is possible. Local

¹⁴ Center for Disease Control and Prevention 122 Cities Mortality: <http://wonder.cdc.gov/mmwr/mmwrmort.asp>

¹⁵ Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report; 62:513-517

¹⁶ Ibid

¹⁷ <https://www.dshs.state.tx.us/news/updates.shtm>

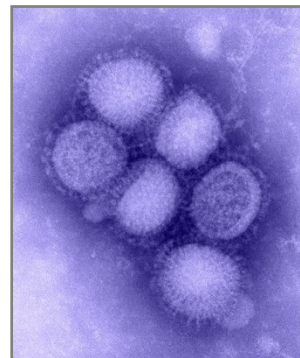
SECTION 19: INFECTIOUS DISEASE

public health officials maintain surveillance in hopes of identifying disease prominence and containing potential threats before they become epidemics. Of concern is the reduction and treatment of COVID-19.

With the current COVID-19 pandemic, the probability of an infectious disease epidemic or pandemic in the City of Austin planning area is occasional and an event has the probability of occurring once every five years. At the time this plan was being developed, the City of Austin was still suffering the impacts of the 2020 World Pandemic of COVID-19.

VULNERABILITY AND IMPACT

Estimated potential losses to the built environment are difficult to calculate because infectious disease causes little damage to the built environment and generally losses are experienced through public health response and medical costs, economic losses due to social distancing, and lost wages. Therefore, it is assumed that all buildings and facilities are exposed to disease but would experience negligible damage in the occurrence of an outbreak event. However, upkeep and maintenance of buildings and facilities would fall behind due to the high absenteeism of employees or the closing of facilities.



Critical infrastructure services, such as emergency services, utility services, water services and telecommunications can be limited by an infectious disease event. Certain strains of disease are highly infectious and can be communicable by coughing, touching, and even breathing. The City of Austin has seen a rise in West Nile Virus over the last few years. Other more prevalent diseases are Influenza and Chicken Pox (Varicella). Children within the Austin school district are most likely to begin the spread of an infectious disease in the classroom setting, based on the number of children that share a classroom together.

People at the highest risk for developing complications from infectious diseases include children younger than five, adults 65 year of age and older, and pregnant women. People who have medical conditions, such as asthma; heart disease; chronic lung disease; blood, endocrine, kidney, liver or metabolic disorders; or a weakened immune system, could experience a worsening of existing conditions.

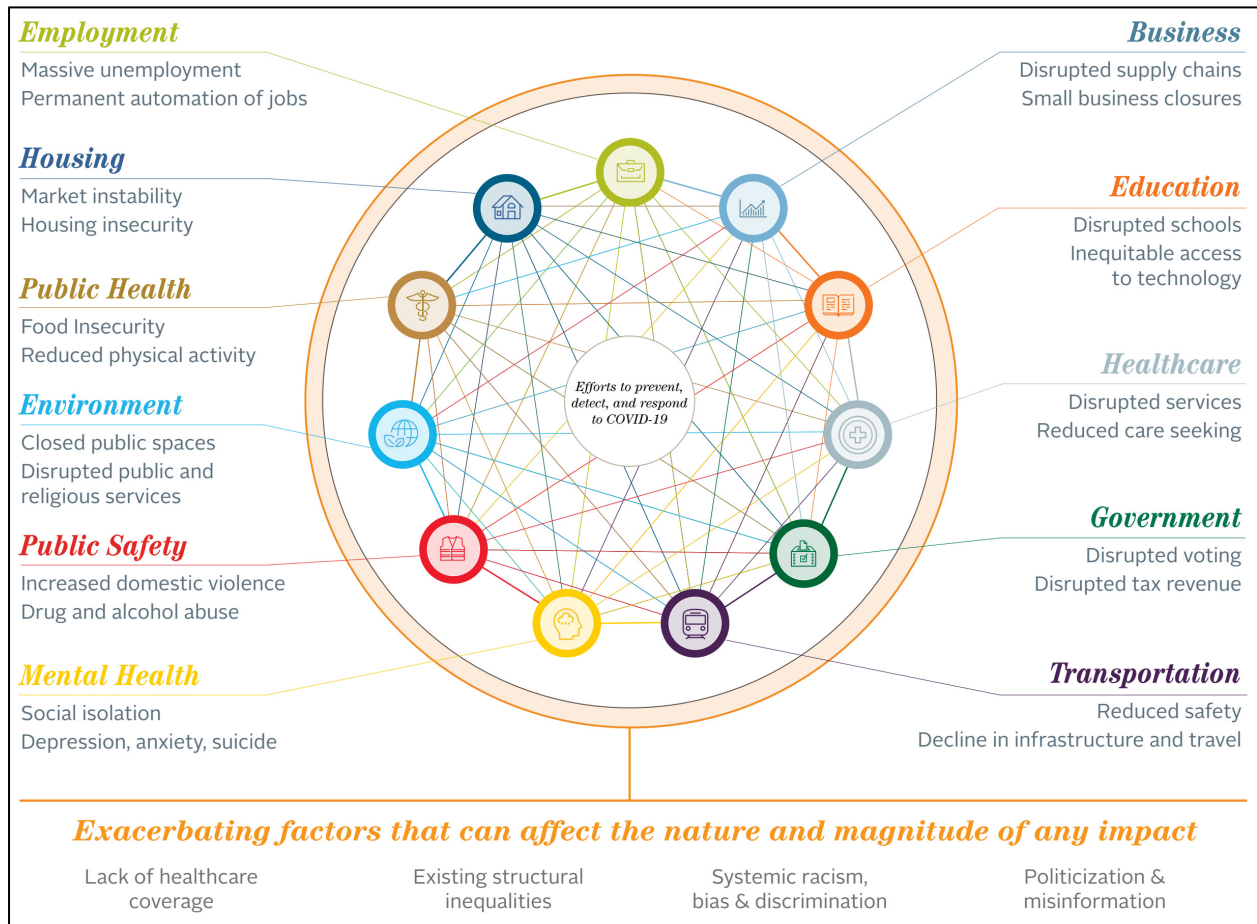
The current COVID-19 pandemic has demonstrated that the response costs to the public health sector for an outbreak, the economic impact and the impact to health as a whole for the City of Austin planning area, is “Substantial.” Multiple deaths can be expected, and the City of Austin area facilities could be shut down for at least 4 weeks. Property damage could result from high absenteeism of persons responsible for property management.

The City of Austin planning area executed a mandatory shutdown of non-essential businesses for weeks as a direct result of COVID-19. Re-opening of businesses and restaurants has been in limited measures to try and protect consumers while restarting the economy. Larger gatherings of people were limited to 50 and below and at times to 10 and below. The Austin Independent School District (ISD) closed all campuses and implemented remote learning in the spring of 2020 and for the first three weeks of the 2020-2021 school year. It is yet to be determined if schools will be able to re-open safely and remain open for in-person learning.

SECTION 19: INFECTIOUS DISEASE

The impacts of COVID-19, the mandatory shutdown, large gathering limits, ISD closures and pervasive unemployment have led to extensive secondary impacts. Figure 19-5 provides an overview of secondary impacts of COVID-19 in the United States.

Figure 19-5. Secondary Impacts of the COVID-19 Pandemic in the United States



SECTION 20: TERRORISM

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- Location 1
- Extent 2
- Historical Occurrences 2
 - Significant Events 3
- Probability of Future Events 3
- Vulnerability and Impact..... 4

HAZARD DESCRIPTION

The Federal Bureau of Investigation (FBI) categorizes terrorism in the United States as domestic terrorism, or international terrorism. Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. International terrorism involves groups or individuals whose terrorist activities are foreign-based and directed by countries or groups outside the United States, or whose activities transcend their national boundaries.

A terrorist attack event can take several forms depending on the technological means available to the terrorist, nature of the issue motivating the attack, and points of weakness of the terrorist's target. Bombing is the most frequently occurring terrorist event in the United States. A chemical or biological terrorist event is of particular concern to officials. Additionally, special training and equipment are necessary to safely manage a Weapons of Mass Destruction incident.

Biological agents are infectious microbes or toxins used to produce illness or death in people, animals or plants. Biological agents can be dispersed as aerosols or airborne particles. Terrorists may use biological agents to contaminate food or water and may be extremely difficult to detect.

Chemical agents can kill and incapacitate people, destroy livestock, and ravage crops. Some chemical agents are odorless and tasteless and are therefore difficult to detect. Chemical agents can have an immediate effect, within a few seconds to a few minutes; or a delayed effect, within several hours to several days.

The U.S. Department of Defense estimates that 26 nations may possess chemical agents and weapons, and an additional 12 may be seeking to develop them. The Central Intelligence Agency reports that at least ten countries are believed to be in possession or conducting research on biological agents for weaponization.

Terrorist events involve the application of one or more modes of harmful force to the built environment. These modes include contamination, such as chemical, biological, radiological, and nuclear hazards; energy, such as explosives, arson, and electromagnetic waves; or denial of service, such as sabotage, infrastructure breakdown, and transportation service disruption.

LOCATION

There is no distinct geographic boundary to the threat of terrorism. An event is possible throughout the City of Austin planning area.

SECTION 20: TERRORISM

Terrorists most often search for highly visible targets that can be impacted while avoiding detection. However, the motivation behind a terrorist event can be varied and the target's surrounding area is considered at risk.

EXTENT

The National Terrorism Advisory System (NTAS), issued by the U.S. Department of Homeland Security (DHS). The NTAS consists of two types of advisories: Bulletins and Alerts. DHS has added Bulletins to the advisory system to be able to communicate current developments or general trends regarding threats of terrorism. When there is specific, credible information about a terrorist threat against the United States, DHS will share an NTAS Alert with the American public when circumstances warrant doing so. The Alert may include specific information, if available, about the nature of the threat, including the geographic region, mode of transportation, or critical infrastructure potentially affected by the threat, and steps that individuals and communities can take to protect themselves and help prevent, mitigate or respond to the threat. The Alert may take one of two forms: "Elevated," if there is credible threat information, but only general information about timing and target such that it is reasonable to recommend implementation of protective measures to thwart or mitigate against an attack; or "Imminent," if the threat is credible, specific, and impending in the very near term.¹

Table 20-1. NTAS Alert Levels²

THREAT LEVEL ³	TYPES OF ADVISORIES
Elevated	Warns of a credible terrorism threat against the United States
Imminent	Warns of a credible, specific and impending terrorism threat against the United States

The Red Cross also issues Advisory System Recommendations for individuals, families, neighborhoods, schools and businesses for each alert level. These may be found at: www.redcross.org.

Heightened periods for terrorism risk are based on intelligence and other information. A potential terrorist event could devastate the community physically, economically and psychologically for many years to come. Warning time for terrorism is minimal to none. The City of Austin planning area could encounter any level of threat of terrorism as there is usually very little warning time and terrorist events are not typically foreseeable.

HISTORICAL OCCURRENCES

In 2007, the Texas Department of Public Safety, which is responsible for Homeland Security in Texas, reported that individuals with ties to Hezbollah, Hamas, and al-Qaida were arrested crossing the border from Mexico. From March 2006 to September 2007, almost 350 individuals "from terrorism-related countries" were arrested at the border.

¹ <http://www.dhs.gov/ntas-frequently-asked-questions>

² Department of Homeland Security

³ Current threat levels can be found at: http://www.dhs.gov/xinfoshare/programs/Copy_of_press_release_0046.shtm.

SECTION 20: TERRORISM

SIGNIFICANT EVENTS

March 2 - 22, 2018 – City of Austin

The Austin serial bombings occurred between March 2 and 22, 2018, mostly in Austin, Texas. In total, five package bombs exploded, killing two people and injuring another five. The suspect, 23-year-old male from Pflugerville, Texas, blew himself up inside his vehicle after he was pulled over by police, also injuring a police officer.

November 28, 2014 – City of Austin

Right-wing and anti-government extremist Larry Steven McQuilliams set a fire at the Mexican Consulate and shot towards several government buildings. Police arrived on scene and shot him dead. McQuilliams had a prior criminal history including drug possession and robbery.

June 18, 2014 – City of Austin

Rahatul Ashikim Khan of the Austin suburb of Round Rock and Michael Todd Wolfe who were residents of the City of Austin have been convicted of conspiring to provide material support to terrorists. Wolfe was sentenced in June 2015 to almost 7 years in federal prison after pleading guilty to planning to travel to the Middle East to join the al-Qaida offshoot Islamic State of Iraq and Syria, or ISIS. Rahatul Ashikim Khan was sentenced to 10 years in federal prison for attempting to provide material to support terrorists.

March 31, 2014 – City of Austin

An act of Arson was committed on the Austin ISD Cunningham Campus.

July 19, 2013 – City of Austin

A Homeland Security warning was sent out July 19, 2013 warning of “unconfirmed” possible “random terrorist attacks” that while considered “random” specified several targets, noting supposed “plans to plant back-pack style bombs on 6th street on either 8 or 9 August.”

The threat advisory claimed there were plans to “attack a school and a theological seminary in the downtown Austin area and complete the attack with operations at the Austin Bergstrom International Airport.” The “unconfirmed” warning of “random” attacks further noted a backup date, August 29th, if the 8th and 9th weren’t considered “a viable option.”

May 31, 2013 – City of Austin

An acid bomb was seized before detonation.

February 18, 2010 – City of Austin

Andrew Joseph Stack III flew his single engine plane into the Austin Texas IRS building killing himself and one IRS employee and injured 13 others. The event is considered a suicide attack. Stack left a suicide note online, comparing the IRS to Big Brother from the novel written in 1984.

April 25, 2007 – City of Austin

A bomb was left in a women's clinic in the City of Austin but failed to explode.

PROBABILITY OF FUTURE EVENTS

The type, frequency, and location of many natural hazards are identifiable and somewhat predictable because natural hazards are governed by the laws of physics and nature. However, malevolence cannot be forecast with any accuracy. Therefore, there is potential for intentional terrorist acts to occur anywhere and at any time. According to the historical incident data, a

SECTION 20: TERRORISM

terrorism incident for the City of Austin planning area is likely, with an event occurring on average once every three years.

VULNERABILITY AND IMPACT

There is no defined geographic boundary for a terrorist event. All of the population, buildings, critical facilities, infrastructure, lifelines, and hazardous materials facilities in the City of Austin planning area are considered exposed to the hazards of terrorism and could potentially be affected. Because there have been terrorist attacks within Austin all assets and facilities are potentially at risk to damages.

Terrorist events can have a “Major” severity of impact. They can cause injuries and illnesses, and result in permanent disability, complete shutdown of City of Austin area facilities for at least two weeks, and cause more than 25 percent of affected properties to be destroyed or suffer major damage.

Terrorism poses a potentially significant risk to public health and safety. Persons in the area at the time of a terrorist attack are at risk for injury or death from a variety of threats.



The chance for death, injury, and financial loss increases as population density increases. Therefore, locations in the City of Austin planning area with high population density should be considered to have the most risk.

Response personnel face similar potential impacts as the general public. Response personnel can be at increased risk of physical injury because the nature of their responsibilities may bring them closer to the hazard and secondary incendiary devices are often directed at response personnel. Additionally, response personnel can be subjected to more long-term impacts resulting from prolonged exposure to chemicals or biological weapons.

Damage from a terrorist event can either directly or indirectly impact utility infrastructure. Damage to utility infrastructure can result in a temporary loss of function for businesses in the planning area that rely on utilities for operation. Additionally, businesses can suffer interruption from closed or blocked roadways; for example, firefighters and law enforcement personnel may need to close a roadway during response and investigative operations. This could negatively impact other businesses in the area that were not otherwise damaged.

Most property, facilities, and infrastructure within the City of Austin planning area are at risk from damage or destruction from a terrorist event, including residential and commercial structures and their supporting utilities, vehicles and transportation infrastructure, and community buildings, such as hospitals, police stations, and schools. Access to community buildings can be negatively impacted by the damage to roadways or closure of roadways in or near a terrorist event due to response or investigative operations.

Due to the varied ways a terrorist event can occur, there are many potential environmental impacts. The environmental impacts associated with terrorism include, but are not limited to:

SECTION 20: TERRORISM

- Air pollution,
- soil contamination,
- water pollution and hydrologic impacts, and
- radiological contamination.

Examples of potential terrorist impacts on the environment:

- During severe drought, a terrorist group conducts an arson campaign with multiple fire-bomb attacks that result in large-scale fires throughout the area. Fire affected regions sustain losses to agriculture and forest areas.
- An intentional release of hazardous materials into soil, water, or air that leads to environmental contamination and potential changes of the ecosystem, such as habitat loss.
- Failure of control systems of major utility companies due to cyber-attack, leading to damages of critical infrastructure and consequent environmental impacts, such as uncontrolled release of chemicals into the environment, initiation of random fires, or radiological contamination.

The economic and financial impacts of a terrorist event on local government will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of a terrorist event.

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Historical Occurrences	6
Probability of Future Events	7
Vulnerability and Impact.....	8

HAZARD DESCRIPTION

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. A hazardous material (HAZMAT) incident involves a substance outside normal safe containment in sufficient concentration to pose a threat to life, property, or the environment.

Chemicals are found everywhere. They purify drinking water, increase crop production, and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use, or disposal. You and your community are at risk if a chemical is used unsafely or released in harmful amounts into the environment where you live, work, or play.

In a hazardous materials incident, solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions will directly affect how the hazard develops.

The Toxics Release Inventory (TRI) is a publicly available database from the federal Environmental Protection Agency (EPA) which contains information on toxic chemical releases and other waste management activities that are reported annually by certain covered industry groups federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to the EPA and their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; Resource Conservation and Recovery Act (RCRA) Subtitle C Treatment, Storage and Disposal (TSD) facilities; and solvent recovery services.
- Have ten or more full-time employee equivalents.
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, Bio-accumulative and Toxic (PBT) chemicals are subject to different thresholds of ten pounds, 100 pounds or 0.1 grams depending on the chemical.

LOCATION

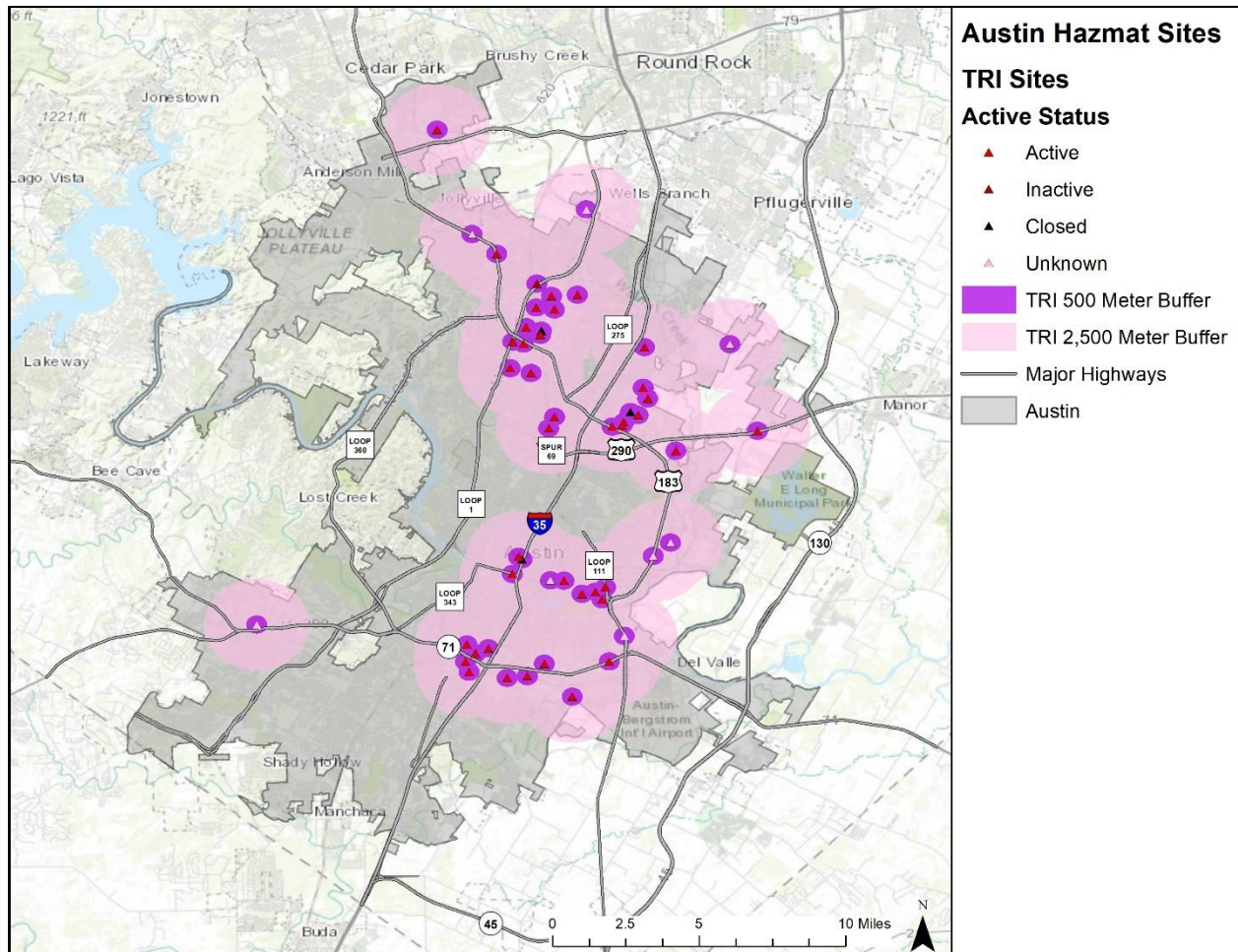
Under the Community Right-to-Know program laws upheld at the state and federal level, all facilities which store significant quantities of hazardous chemicals must share this information

SECTION 21: HAZARDOUS MATERIALS

with state and local emergency responders and planners. Facilities in Texas share this information by filing annual hazardous chemical inventories with the state, with Local Emergency Planning Committees (LEPCs), and with local fire departments.

Figure 21-1 shows the locations of available georeferenced TRI toxic sites in and around the City of Austin study area and Figure 21-2 shows the corridors are mobile hazardous materials. For fixed site analysis, only toxic sites that have georeferenced data available were analyzed and the circle buffers are drawn around each hazardous material site. Two size buffers, 500 and 2,500 meters are assumed in respect to the different levels of effect – immediate (primary) and secondary.

Figure 21-1. Fixed HazMat Analysis Locations and Buffers



SECTION 21: HAZARDOUS MATERIALS

Figure 21-2. Mobile HazMat Analysis Corridors and Buffers

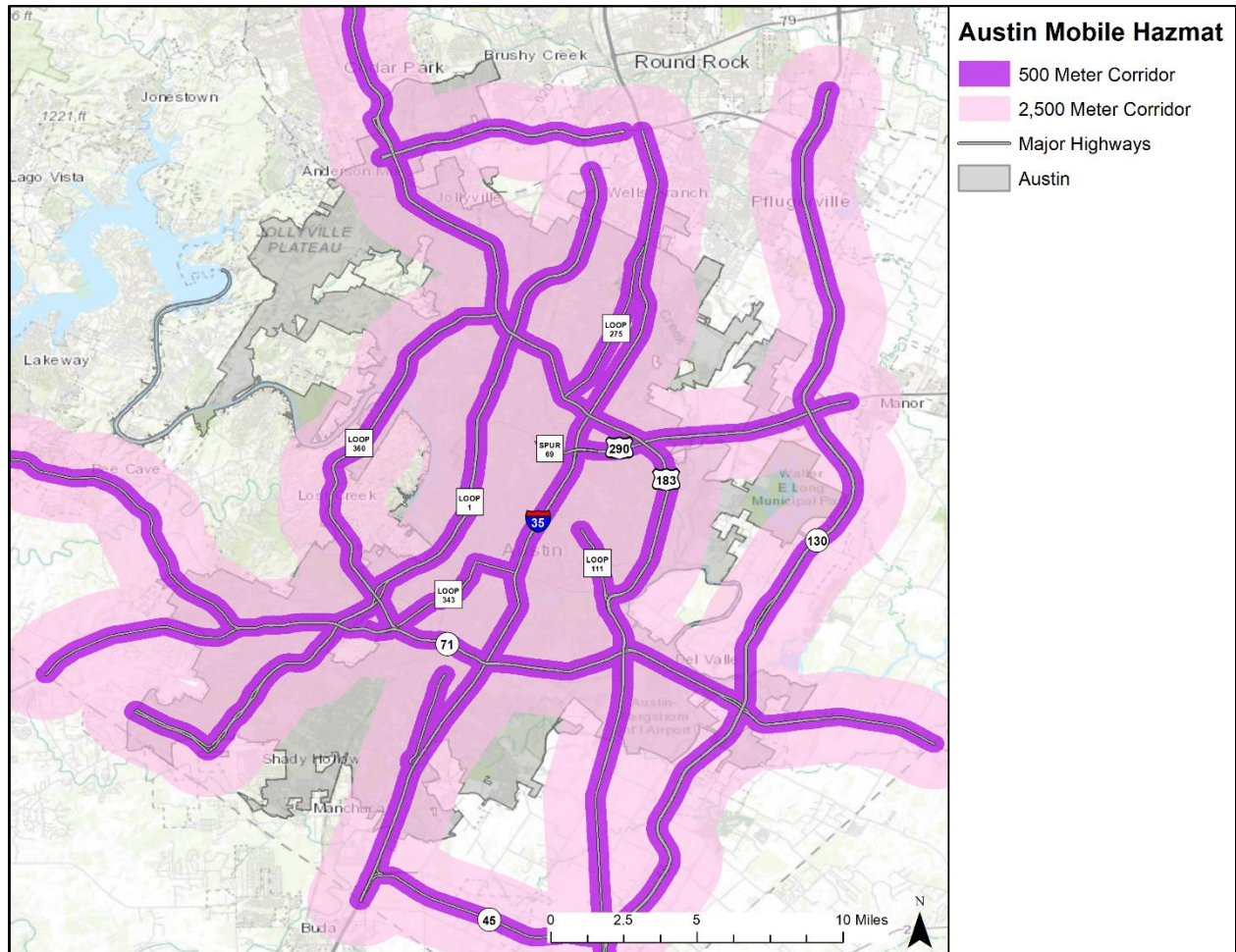


Table 21-1. TRI HazMat Facilities within Austin Area

JURISDICTION	FACILITY NAME	TOTAL RELEASES
City of Austin	3M CO-AUSTIN RESEARCH BOULEVARD SITE-78759MDYNT11705	100.27
City of Austin	ACME BRICK CO-ELGIN PLANT-78621CMBRCRTE2X	0.2001
City of Austin	AIRBORN INC-7862WRBRNN35AIR	14364
City of Austin	ASPHALT INC HAROLD GREEN-7872WSPHLT11824	0
City of Austin	AUSTIN MANUFACTURING SERVICES-7872WSTNMN4616W	23075.8
City of Austin	AUSTIN WHITE LIME CO-78727STNWH14001	404.39

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JURISDICTION	FACILITY NAME	TOTAL RELEASES
City of Austin	BAE SYSTEMS INFORMATION & ELECTRONIC SYSTEMS INTEGRATION IN-78725TRCRN6500T	3.846
City of Austin	BORDEN DAIRY CO OF TEXAS LLC-78702BRDNN71STR	71.7
City of Austin	CMC STEEL FABRICATORS INC (DBA CMC CAPITOL CITY STEEL)-78610CMCST1451S	0
City of Austin	CMC STEEL FABRICATORS INC-78666STHRN440WO	0
City of Austin	COLLINS AEROSPACE SAN MARCOS-78666HTRST2005T	0.197181
City of Austin	CONTEMPORARY PRODUCTS OF TEXAS INC-7867WCNTMP41FM1	0
City of Austin	CUSTOM CRETE - LEANDER-7864WLNDRL2544H	0
City of Austin	CUSTOM CRETE - TERRY O LANE-78745CCMFG4433T	61.44
City of Austin	DARLING INGREDIENTS INC-7860WDRLNG264FA	14.49
City of Austin	DURCON INC-7657WDRCNN26ALL	1839
City of Austin	ELGI RUBBER CO LLC-78648DRLWS5000E	20
City of Austin	ERGON ASPHALT & EMULSIONS INC - AUSTIN-7875WRGNP883NR	0
City of Austin	ERGON ASPHALT & EMULSIONS INC - MANOR-7865WRGNP13811	1154
City of Austin	FEDERAL CORRECTIONAL INSTITUTION BASTROP-7860WFDRLC1341H	827
City of Austin	FLEXTRONICS AMERICA LLC-78759SLCTR12455	1
City of Austin	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL-78724KCHPT9011J	264
City of Austin	FLINT HILLS RESOURCES CORPUS CHRISTI LLC MUSTANG RIDGE-7861WFLNTH1165E	175
City of Austin	FLORENCE HMP-7652WFLRNC11151	0
City of Austin	FORTERRA PIPE & PRECAST - AUSTIN-78702HNSNP81AIR	148
City of Austin	GEMINI - TAYLOR-76574GMNNC1610E	159
City of Austin	ICU MEDICAL FLEET SERVICES LLC - ROUND ROCK SITE-78664BBTTL2820O	51

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JURISDICTION	FACILITY NAME	TOTAL RELEASES
City of Austin	ICU MEDICAL FLEET SERVICES LLC-78728BBTTL3900H	750
City of Austin	MANOR HOT MIX PLANT-7865WMNRHT1421L	7056
City of Austin	MERIDIAN BRICK - ELGIN PLANT-78621PYNPLHWY29	237
City of Austin	NXP USA INC - ED BLUESTEIN FACILITY-78721MTRLN3501E	0
City of Austin	NXP USA INC - OAK HILL FACILITY-78735MTRLN6501W	18
City of Austin	PALM HARBOR HOMES INC-78741PLMHR830BA	366
City of Austin	PURE CASTINGS CO-7864WPRCST112EM	0
City of Austin	RAMIREZ LANE CONCRETE BATCH PLANT-78742CMXRV8900R	1
City of Austin	RTI HOT MIX FLORENCE QUARRY ASPHALT PLANT-7863WRTHTM1725C	1245
City of Austin	RTI HOT MIX MUSTANG RIDGE ASPHALT PLANT-7874WRTHTM651FM	312
City of Austin	RTI HOT MIX SOUTH ASPHALT PLANT-78610RTHTM117FM	339
City of Austin	SAMSUNG AUSTIN SEMICONDUCTOR-78754SMSNG12100	0
City of Austin	SATELLITE INDUSTRIES-7861WSTLLT1713H	60
City of Austin	SEWARD PLANT-7864WSWRDP11729	808
City of Austin	SPANSION LLC-78741DVNCD5204E	0
City of Austin	STI INTERNATIONAL-7862WSTNTR114HA	0
City of Austin	TEC/SOLOMON CORP ALLIANCE-7862WTCSLM1WCPE	0.44
City of Austin	TECO-WESTINGHOUSE MOTOR CO-78680WSTNGIH35A	22.26
City of Austin	TEXAS LEHIGH CEMENT CO LP-78610TXSLHLOOP4	0.394735
City of Austin	TXI-BASTROP READY MIX-7860WTXBST85HWY	0
City of Austin	TXI-GEORGETOWN READY MIX-7862WTXGRG61BLE	0.05

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JURISDICTION	FACILITY NAME	TOTAL RELEASES
City of Austin	TXI-GREEN READY MIX-7872WTXGRN1311H	0
City of Austin	TXI-LEANDER READY MIX-7864WTXLND391HW	676.26
City of Austin	TXI-ROUND ROCK READY MIX-78664CMXRN2412R	360.43
City of Austin	TXI-SAN MARCOS READY MIX-7866WTXSNM251NI	0
City of Austin	TXI-VOLENTE READY MIX-7872WTXVLN1221V	0
City of Austin	US ARMY NATIONAL GUARD CAMP SWIFT RANGES-78602SRMYC2SH95	0
City of Austin	WAYNE FUELING SYSTEMS-78728DRSSR3814J	13573

EXTENT

The extent of a hazardous material release will depend on whether it is from a mobile or fixed site and the size of impact. The range of intensity will vary greatly depending on the circumstances. These factors and conditions include the material, toxicity, duration of the release, and environmental conditions such as the wind and precipitation.

Hazardous materials or toxic releases can have substantial impact on communities. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. In a hazardous materials incident, solid, liquid and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions would directly affect how the hazard develops. The micro-meteorological effects on buildings and terrain can alter travel patterns and duration of agents. Shielding in the form of permanent shelter can protect people from harmful effects. Non-compliance with fire and building codes, as well as failure to maintain existing fire and containment features can substantially increase damage from a hazardous materials release. The duration of a hazardous materials incident can range from hours to days. Warning time is minimal to none.

The spatial extent of a hazardous material release is minimal or expected to affect less than 10% of people or property.

HISTORICAL OCCURRENCES

Hazardous materials are substances which if released or misused can cause death, serious injury, long-lasting health effects, and damage to structure and other properties as well as to the environment. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines.

SECTION 21: HAZARDOUS MATERIALS

It's estimated as many as 40 percent of the transport trucks moving through Central Texas and Travis County are carrying some form of hazardous materials, according to TxDOT and the Federal Highway Administration. But that's just a guess based on national trends that break down transported goods by mode: truck, rail, pipeline, water, and air.

There's data on truck traffic volume in a study done in 2015 by researchers for TxDOT. While most of the traffic is local, they counted 4,290 trucks of all kinds that could be moved off I-35 -- about 14% of overall traffic. Every normal weekday up to 226,000 vehicles traveled past I-35 and Braker Lane on their way through the Austin region, the study found.

Compared to larger centers in Texas like Houston and its fuel transportation-based economy, truck accidents involving hazardous materials are relatively rare along Austin's piece of IH-35 and surrounding commuter corridors. But they do happen. Federal Hazardous Materials Safety Administration (FHMSA) data show since 2008, 185 hazardous material incidents involving various types of dangerous truck cargo in Central Texas, most during loading or unloading.

The most dramatic happened during transit and include:

October 20, 2015

A truck and trailer was traveling west on US 290 Service Road making a left turn at the intersection of US 183 service road south bound. The driver took the turn too fast causing the load to shift in the trailer. The driver lost control of the trailer and it rolled onto its side. An approximate three-inch gash in the trailer resulted in a product release. The tanker was hauling 8,000 gallons of gasoline and all was recovered except for 660 gallons that was discharged into a storm drain. The recovered product was pumped into an empty trailer or was removed with a vacuum truck. All products on the roadway were absorbed with Oil Dri. The storm inlet was flushed with 2,500 gallons of water.

September 27, 2012

A north bound vehicle on IH-35 main lanes swerved to avoid an animal crossing the roadway. The vehicle ran off the road and rolled. During the rollover, a compartment manhole cover came loose to secondary clamp position. Approximately 2,900 gallons of gasoline flowed from the partially opened cover. First responders clamped the manhole shut prior to evacuation of the product. The remaining product was removed from the cargo tank. Environmental personnel were on the scene and began remediation work immediately. Contaminated soil was removed and replaced. The environmental clean up efforts were completed within 36 hours. During the product removal, northbound traffic was diverted to Toll 130.

March 28, 2012

Toll 130 and Maha Loop. 9,500 gallons of gasoline burned when a car slammed into a tanker truck, killing the car's driver.

October 30, 2010

US183 and MoPac. 9,500 gallons of gasoline burned when a tanker rolled off an overpass. The intense heat threatened the structure's stability.

PROBABILITY OF FUTURE EVENTS

The likelihood or future probability of occurrence of a hazardous materials release in the City of Austin planning area is Highly Likely, with an event likely occurring in the next year.

SECTION 21: HAZARDOUS MATERIALS

VULNERABILITY AND IMPACT

Based on the prevalence and geographic proximity of hazardous materials transportation routes and fixed locations, the majority of the City of Austin’s planning area is vulnerable. The risk to the population depends on a variety of factors, including type and amount of chemical released, weather conditions, prevailing winds, time of day, and season.

The environment is often vulnerable in a hazardous materials incident and can be heavily damaged by a hazardous materials incident. The particular transportation route and fixed site involved are significant factors in determining the risk to public health and safety, and will determine the number of people in proximity to the hazard. Depending on the nature of the hazardous materials incident, the public could be required to either evacuate the area or shelter in place, which will interrupt normal routines.

It is possible that a hazardous materials incident could involve a number of fatalities. It is likely that inhaled hazardous gasses may result in respiratory problems, including burning sensations in the lungs, nose, and throat. Releases that involve solids or liquids can be absorbed through the skin, and may cause burns on contact. In some instances, the threat to health and safety may not be evident for an extended period of time.

Hazardous Material Releases were included in the 2015 Plan Update, and also in this Update as toxic releases can have a substantial impact. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage.

Table 21-2. Critical Facilities Vulnerable to Hazardous Material Releases, 500 Meter Buffer

NAME	TYPE
East Sub-Station	Police Department
Station 10	EMS Station
Station 13	EMS Station
Demand 1	EMS Station
ALLAN ELEMENTARY	School
ZAVALA ELEMENTARY	School
UNIVERSITY OF TEXAS ELEMENTARY CHARTER SCHOOL	School

Table 21-2. Critical Facilities Vulnerable to Hazardous Material Releases, 2,500 Meter Buffer

NAME	TYPE
Main Headquarters	Police Department
North Austin Medical Center	Hospital
Seton Northwest Hospital	Hospital

SECTION 21: HAZARDOUS MATERIALS

NAME	TYPE
Seton Southwest Hospital	Hospital
South Austin Medical Center	Hospital
University Medical Center at Brackenridge	EMS Station
Station 01	EMS Station
Station 03	EMS Station
Station 04	EMS Station
Station 06	EMS Station
Station 07	EMS Station
Station 11	EMS Station
Station 12	EMS Station
Station 18	EMS Station
Demand 3	EMS Station
Headquarters	EMS Station
Education Development & Wellness Div	EMS Station
EMS Garage	EMS Station
HARMONY SCHOOL OF EXCELLENCE	School
TRAVIS COUNTY DAY SCHOOL	School
KIPP AUSTIN COLLEGIATE	School
THE EAST AUSTIN COLLEGE PREP ACADEMY	School
OAK MEADOWS ELEMENTARY	School
PIONEER CROSSING ELEMENTARY	School
EDEN PARK ACADEMY	School
AUSTIN CAN ACADEMY CHARTER SCHOOL	School
KIPP AUSTIN ACADEMY OF ARTS & LETTERS	School
GARCIA YOUNG MENS LEADERSHIP ACADEMY	School
HARMONY SCIENCE ACADEMY - AUSTIN	School

SECTION 21: HAZARDOUS MATERIALS

NAME	TYPE
TRAVIS COUNTY JUVENILE DETENTION CENTER	School
PHOENIX ACADEMY	School
SMALL MIDDLE	School
MCBEE ELEMENTARY	School
RODRIGUEZ ELEMENTARY	School
TEXAS EMPOWERMENT ACADEMY	School
LEADERSHIP ACADEMY	School
PLEASANT HILL ELEMENTARY	School
BATY ELEMENTARY	School
TRAVIS COUNTY STATE JAIL	School
CANYON CREEK ELEMENTARY	School
TRAVIS HIGH	School
ANDERSON HIGH	School
GARZA INDEPENDENCE HIGH	School
FULMORE MIDDLE	School
KEALING MIDDLE	School
BURNET MIDDLE	School
MARTIN MIDDLE	School
DOBIE MIDDLE	School
ALLISON ELEMENTARY	School
BLACKSHEAR ELEMENTARY	School
BROOKE ELEMENTARY	School
DAWSON ELEMENTARY	School
GOVALLE ELEMENTARY	School
METZ ELEMENTARY	School
OAK SPRINGS ELEMENTARY	School
ORTEGA ELEMENTARY	School
SANCHEZ ELEMENTARY	School

SECTION 21: HAZARDOUS MATERIALS

NAME	TYPE
ST ELMO ELEMENTARY	School
SUMMITT ELEMENTARY	School
SIMS ELEMENTARY	School
TRAVIS HEIGHTS ELEMENTARY	School
PATTON ELEMENTARY	School
PATTON ELEMENTARY	School
OAK HILL ELEMENTARY	School
BARRINGTON ELEMENTARY	School
NORMAN ELEMENTARY	School
PILLOW ELEMENTARY	School
HILL ELEMENTARY	School
GRAHAM ELEMENTARY	School
LINDER ELEMENTARY	School
HOUSTON ELEMENTARY	School
HART ELEMENTARY	School
GALINDO ELEMENTARY	School
DAVIS ELEMENTARY	School
COPPERFIELD ELEMENTARY	School
NOEL GRISHAM MIDDLE	School
CANYON VISTA MIDDLE	School
KATHY CARAWAY ELEMENTARY	School
PURPLE SAGE ELEMENTARY	School
POND SPRINGS ELEMENTARY	School
JOLLYVILLE ELEMENTARY	School
WALNUT CREEK ELEMENTARY	School
GEORGE M KOMETZKY SCHOOL	School
AUSTIN DISCOVERY SCHOOL	School
INTERNATIONAL HIGH	School

SECTION 21: HAZARDOUS MATERIALS

NAME	TYPE
KIPP AUSTIN COLLEGE PREP	School
AMERICAN YOUTHWORKS SERVICE LEARNING ACADEMY	School
EASTSIDE MEMORIAL AT JOHNSTON CAMPUS	School
HARMONY SCHOOL OF SCIENCE - AUSTIN	School
KIPP AUSTIN COMUNIDAD	School
KIPP AUSTIN CONNECTIONS ELEMENTARY	School
KIPP AUSTIN BEACON PREP	School
THE EAST AUSTIN COLLEGE PREP AT MLK	School
IDEA ALLAN COLLEGE PREP	School
PREMIER HIGH SCHOOL AT TRAVIS	School
IDEA ALLAN ACADEMY	School
DOBIE PK CENTER	School
GUERRERO THOMPSON ELEMENTARY	School
SAN JUAN DIEGO CATHOLIC HIGH SCHOOL	School
ST IGNATIUS MARTYR SCHOOL	School
CATHEDRAL SCHOOL OF ST MARY - AUSTIN	School
OUR SAVIOR LUTHERAN SCHOOL AUSTIN	School
BRENTWOOD CHRISTIAN SCHOOL	School
HOLY WORD LUTHERAN SCHOOL	School
AUSTIN MONTESSORI SCHOOL	School
COUNTRY HOME LEARNING CENTER NO 8	School
COUNTRY HOME LEARNING CENTER NO 7	School
PADRON ELEMENTARY	School
ALTERNATIVE LEARNING CENTER	School

SECTION 22: PIPELINE FAILURE

Hazard Description	1
Location	1
Extent	3
Historical Occurrences	3
Probability of Future Events	5
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HAZARD DESCRIPTION

Energy pipeline breach or pipeline failure of an oil or natural gas pipeline is a serious hazard event. An estimated 2.4 million miles of pipelines in the United States carry hazardous materials. Natural gas pipelines transport natural gas and oil. Liquid petroleum pipelines transport crude oil and refined products from crude oils, such as gasoline, home heating oil, jet fuel, kerosene, liquefied propane, ethylene, butane and petrochemical products. Oil pipelines can also transport liquefied gases, such as carbon dioxide.



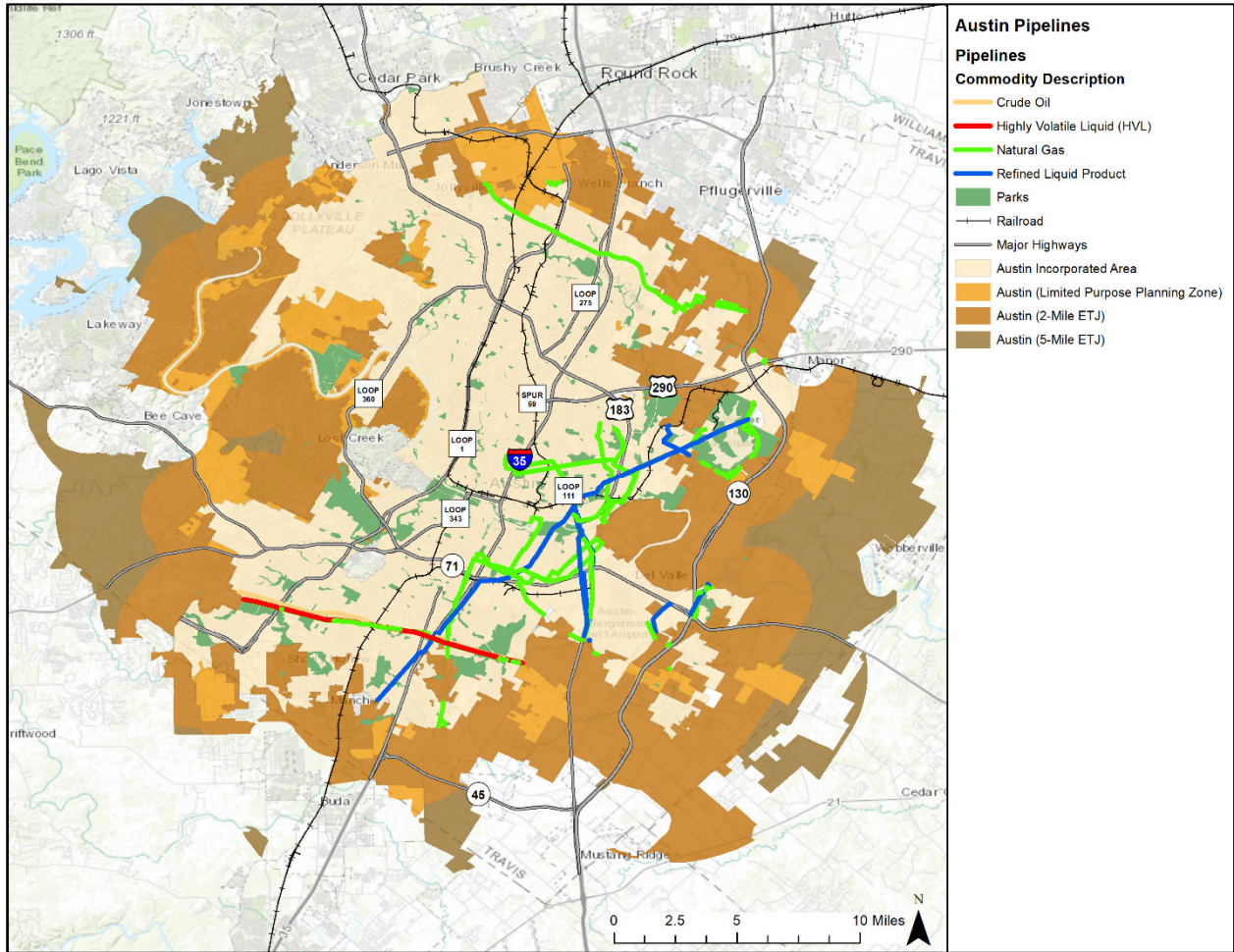
Pipeline failure is a rare occurrence and has the potential to cause extensive property damage and loss of life. Pipelines have caused fires and explosions that killed more than 200 people and injured more than 1,000 people nationwide with 50 of the injuries in Texas in the last decade.

LOCATION

Figure 22-1 shows the location of energy pipelines (gas and oil) in and around the City of Austin. Figure 22-2 shows the population density around the pipelines within the City of Austin Planning Area. If any of these energy pipelines, oil or gas, were to rupture, such an event could endanger property and lives in the immediate area (up to 500 meters for immediate [primary] impact and up to 2,500 meters for secondary impact).

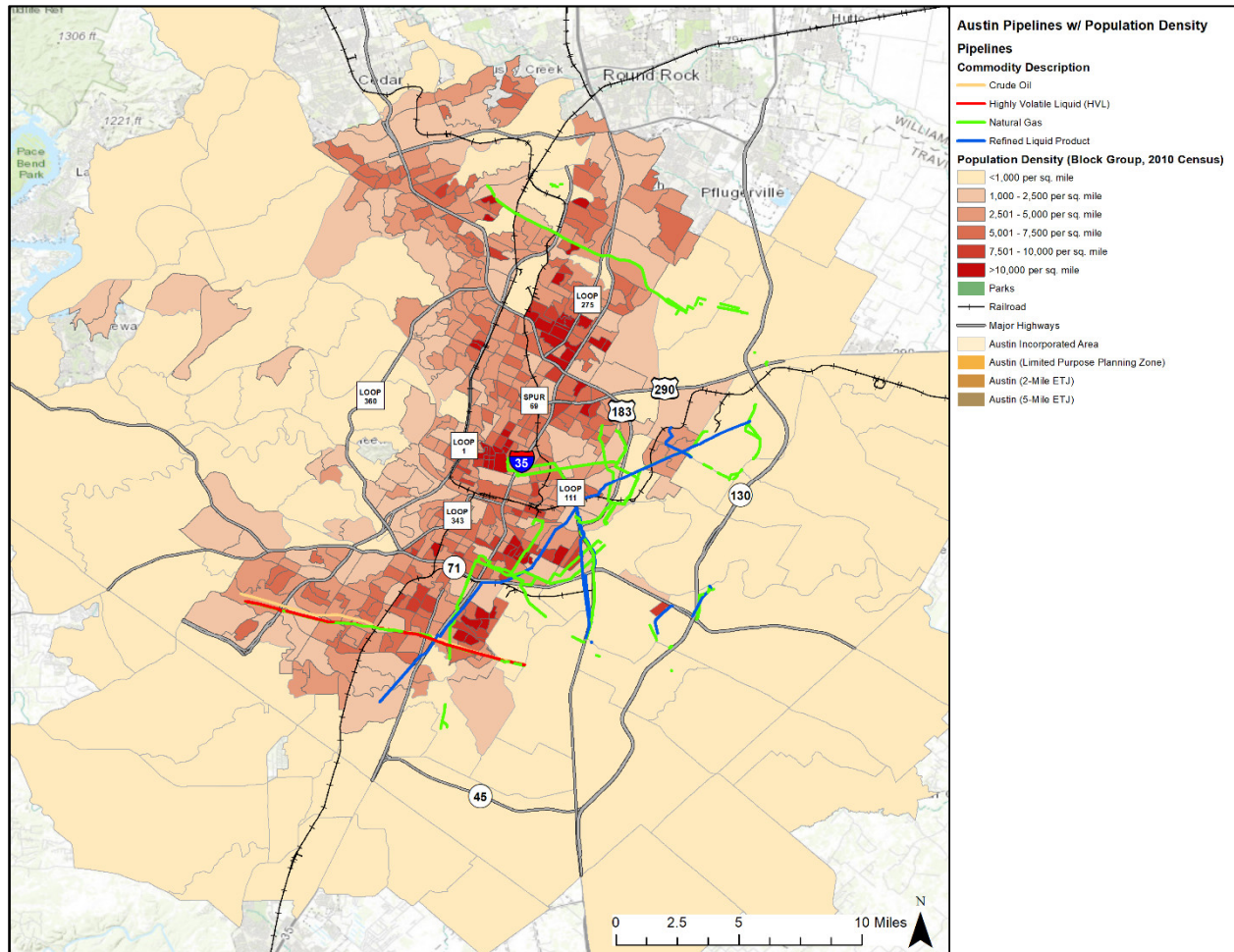
SECTION 22: PIPELINE FAILURE

Figure 22-1. Location of Pipelines in City of Austin



SECTION 22: PIPELINE FAILURE

Figure 22-2. Pipelines & Population Density within City of Austin



EXTENT

The U.S. Department of Transportation's (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA), acting through the Office of Pipeline Safety (OPS), administers the Department's national regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline. The OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Since 1986, the pipeline safety program has been funded by a user-fee assessed on a per-mile basis for all pipeline operators that OPS regulates.

The spatial extent of a fuel pipeline breach is "Minimal," expected to affect less than 10% of people and property in Austin.

HISTORICAL OCCURRENCES

Pipeline failure events can be caused by corrosion, equipment failure, damage from excavations, incorrect operation, and natural forces. Incidents are generally categorized by severity and type of affected pipeline system component.

SECTION 22: PIPELINE FAILURE

The PHMSA defines significant events as those incidents reported by pipeline operators when any of the following occur:

1. Fatality or injury requiring in-patient hospitalization;
2. \$50,000 or more in total costs, measured in 1984 dollars;
3. Highly volatile liquid releases of 5 barrels or more, or other liquid releases of 50 barrels or more; and
4. Liquid releases resulting in an unintentional fire or explosion.

The PHMSA defines a serious pipeline incident as an event involving a fatality or injury requiring in-patient hospitalization.

Table 22-1. Historical Pipeline Events, 2004 – 2019¹

LOCATION	INCIDENT DATE	TYPE	INJURIES	DEATHS	OPERATOR
City of Austin	03/05/2004	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
City of Austin	07/18/2005	Gasoline	0	0	MAGELLAN PIPELINE COMPANY, L.P.
City of Austin	01/11/2007	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
City of Austin	05/03/2007	Natural Gas	0	0	TEXAS COMMUNITY PROPANE, LTD.
City of Austin	02/02/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
City of Austin	03/05/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
City of Austin	03/17/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
City of Austin	01/09/2012	Natural Gas	1	1	TEXAS GAS SERVICE COMPANY

¹ City of Austin Planning Team is not aware of any significant pipeline events since 2014 and the PHMSA site does not list any events more recent than those listed in Table 22-1.

SECTION 22: PIPELINE FAILURE

LOCATION	INCIDENT DATE	TYPE	INJURIES	DEATHS	OPERATOR
City of Austin	12/27/2012	Propane Gas	2	1	TEXAS COMMUNITY PROPANE, LTD.
City of Austin	08/13/2013	Crude Oil	0	0	MAGELLAN PIPELINE COMPANY, LP
City of Austin	12/03/2014	Gas	0	0	TEXAS GAS SERVICE COMPANY, A DIVISION OF ONE GAS, INC.

More information on historical incidents:

- October 8, 1959. A 10-inch propane pipeline burst in Austin, Texas. 400 families had to be evacuated due to the explosion and fire hazard. Eventually, the fumes dissipated without incident. The rupture was caused by a weak section of pipe.
- February 22, 1973. In Austin, Texas, a 19-inch natural gas liquids (NGL) pipeline ruptured due to an improper weld. A passing truck appeared to set off a vapor cloud explosion and fire. Six people were killed, and 2 others injured.
- January 9, 2012. A man was killed, and another person injured, in a fiery house explosion in Austin, Texas, from a leaking 4-inch cast iron gas main installed in 1950. Gas had been smelled in the area for several weeks prior to this. Gas company crews had looked along the affected property for a leak but were unable to find it.
- August 14, 2013. A leak developed on a valve on Longhorn Pipeline in Austin, Texas during maintenance, spilling about 300 gallons of crude oil. There were no evacuations.

PROBABILITY OF FUTURE EVENTS

The likelihood or future probability of occurrence of a pipeline failure in the City of Austin is Occasional with an event probable in the next five years.

VULNERABILITY AND IMPACT

The analysis for gas pipelines is for natural gas and the analysis for oil pipelines is for natural gas liquids. The immediate and primary area of impact for both types of pipeline events is a 500-meter buffer. The secondary area of impact for both types of pipeline events is a 2,500-meter buffer. Both types of impact can inflict substantial damage on the surrounding areas. These buffer areas are depicted above, in Figure 22-2. The severity of impact depends on a variety of factors, including type of pipeline and volume released; weather conditions; prevailing winds; time

SECTION 22: PIPELINE FAILURE

of day; and presence of ignition source. Pipeline breaches have the potential to cause multiple deaths and complete shutdown of facilities for 30 days or more.

Pipelines traverse the watersheds that supplies water to the City, including those that supply water to well-dependent residents and environmentally sensitive areas such as Barton Springs and the Edwards Aquifer. A leak or spill from these pipelines could threaten neighborhoods, contaminate water supplies, or pollute environmentally sensitive land. A pipeline accident could have a major impact by causing injuries that result in death or permanent disability or completely shutting down critical facilities.

Pipeline failure can have a “Major” impact on human health and area properties. Pipeline failure events can cause injuries, illnesses, and result in permanent disability. These events can also cause facilities in the City planning area to shut down for at least two weeks and cause more than twenty-five percent of affected properties to be destroyed or suffer major damage.

SECTION 23: MITIGATION STRATEGY

- Mitigation Goals 1
- Goal 1..... 1
- Goal 2..... 1
- Goal 3..... 2
- Goal 4..... 2
- Goal 5..... 2
- Goal 6..... 3

MITIGATION GOALS

Based on the results of the risk and capability assessments, the Planning Team developed and prioritized the mitigation strategy. This involved utilizing the results of both assessments and reviewing the goals and objectives that were included in the previous 2016 Plan.

At the Mitigation Workshop in June 2020, Planning Team members reviewed the mitigation strategy from the previous 2016 Plan. The consensus among all members present was that the strategy developed for the 2016 Plan did not require changes, as it identified overall improvements to be sought in the Plan Update. The Mitigation Goal Statement is “It is the goal of the City of Austin to protect public health, safety, and welfare and to reduce losses due to hazards by identifying hazards, by minimizing exposure of citizens and property to hazards, and by increasing public awareness and involvement.”

GOAL 1

Protect public health and safety.

OBJECTIVE 1.1

Advise the public about health and safety precautions to guard against injury and loss of life from hazards.

OBJECTIVE 1.2

Maximize utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.

OBJECTIVE 1.3

Reduce the danger to, and enhance protection of, high risk areas during hazard events.

OBJECTIVE 1.4

Protect critical facilities and services.

GOAL 2

Build and support local capacity and commitment to continuously become less vulnerable to hazards.

OBJECTIVE 2.1

Build and support local partnerships to continuously become less vulnerable to hazards.

SECTION 23: MITIGATION STRATEGY



OBJECTIVE 2.2

Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.

OBJECTIVE 2.3

Build hazard mitigation concerns into county planning and budgeting processes.

GOAL 3

Increase public understanding, support, and demand for hazard mitigation.

OBJECTIVE 3.1

Heighten public awareness regarding the full range of natural and man-made hazards the public may face.

OBJECTIVE 3.2

Educate the public on actions they can take to prevent or reduce the loss of life and/or property from all hazards and increase individual efforts to respond to potential hazards.

OBJECTIVE 3.3

Publicize and encourage the adoption of appropriate hazard mitigation measures.

GOAL 4

Protect new and existing properties.

OBJECTIVE 4.1

Reduce repetitive losses to the National Flood Insurance Program (NFIP).

OBJECTIVE 4.2

Use the most cost-effective approach to protect existing buildings and public infrastructure from hazards.

OBJECTIVE 4.3

Enact and enforce regulatory measures to ensure that future development will not put people in harm's way or increase threats to existing properties.

GOAL 5

Maximize the resources for investment in hazard mitigation.

OBJECTIVE 5.1

Maximize the use of outside sources of funding.

SECTION 23: MITIGATION STRATEGY

OBJECTIVE 5.2

Maximize participation of property owners in protecting their properties.

OBJECTIVE 5.3

Maximize insurance coverage to provide financial protection against hazard events.

OBJECTIVE 5.4

Prioritize mitigation projects, based on cost-effectiveness and sites facing the greatest threat to life, health, and property.

GOAL 6

Promote growth in a sustainable manner.

OBJECTIVE 6.1

Incorporate hazard mitigation activities into long-range planning and development activities.

OBJECTIVE 6.2

Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

OBJECTIVE 6.3

Utilize regulatory approaches to prevent creation of future hazards to life and property.

SECTION 24: PREVIOUS ACTIONS

Summary 1
City of Austin..... 2

SUMMARY

Planning Team members were given copies of the previous mitigation actions submitted in the 2016 Plan at the mitigation workshop. The City of Austin reviewed the previous actions and provided an analysis as to whether the action had been completed, should be deferred as an ongoing activity, or be deleted from the Plan. The actions from the 2016 Plan are included in this section as they were written in 2016, with the exception of the “2021 Analysis” section.

SECTION 24: PREVIOUS ACTIONS

CITY OF AUSTIN

City of Austin (Past Action) – 1	
Proposed Action:	Educate FloodPro website as a tool for the public to determine if their home or property is in the 100-year floodplain. Teach communities mitigation ideas for flood-proofing their homes.
BACKGROUND INFORMATION	
Site and Location:	City of Austin
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to properties throughout City from flood; reduce risk to residents in floodplain areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	This would increase situational awareness about flood risks to homes in Austin
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	General Revenue, HMGP/CDBG/PDM Grants
Lead Agency/Department Responsible:	WPD
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 2	
Proposed Action:	Construct additional data centers to continue use of critical systems during a technological disruption.
BACKGROUND INFORMATION	
Site and Location:	To be determined
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City is exposed to extended outages due to reliance on only one data center. This data center has several exposures which could result in extended outages, causing total loss of critical systems needed for public safety.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Technological Disruption
Effect on New/Existing Buildings:	Lack of infrastructure redundancy
Priority (High, Moderate, Low):	High
Estimated Cost:	\$15-\$30 million
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2017-2020
Incorporation into Existing Plans:	Information Technology Strategy

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 3	
Proposed Action:	Move public facing services to the cloud to allow for continuity of services in the event of denial of service attacks (DOS).
BACKGROUND INFORMATION	
Site and Location:	To be determined
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City is exposed to denial of service attacks (DOS). Given that the City has limited resources (network, servers), an extended DOS attack will result in unavailability of services.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber, Terrorism, Technological Disruption
Effect on New/Existing Buildings:	Single point of attack, limited resources
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Information Technology Strategy

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 4	
Proposed Action:	Provide a Data Loss Protection System to reduce the likeliness of data loss.
BACKGROUND INFORMATION	
Site and Location:	City of Austin
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City could experience high costs to remediate data loss of Personally Identifiable Information (PII).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$750,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Information Technology Strategy

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 5	
Proposed Action:	Implement a Security Information and Event Management (SIEM) System.
BACKGROUND INFORMATION	
Site and Location:	City of Austin
Risk Reduction Benefit (Current Cost/ Losses Avoided):	A SIEM system will provide real-time analysis of security alerts generated by network hardware and applications.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber, Terrorism
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$750,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Information Technology Strategy

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 6	
Proposed Action:	Provide a backup site for workers displaced due to a disaster.
BACKGROUND INFORMATION	
Site and Location:	TBD
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City currently has very little backup sites for employees displaced due to disaster to their workspace. Contracting with a backup site vendor or providing telework options will provide the City with workspace for displaced employees.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Hazardous Materials, Terrorism, Pipeline Failure, Infectious Disease, Cyber, Technological Disruption
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000 - \$500,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 7	
Proposed Action:	Share information about threats with other entities to provide early identification of attacks on the City's technology infrastructure.
BACKGROUND INFORMATION	
Site and Location:	TBD
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Sharing threats with other entities will provide early identification of attacks on the City's technology infrastructure.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber, Terrorism, Technological Disruption
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000/yr.
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Information Technology Strategy

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 8	
Proposed Action:	Conduct heat surveillance using bio-surveillance tools to plan, prioritize and mitigate risks related to climate change; guide environmental management decisions and policy changes; establish triggers for emergency alerts.
BACKGROUND INFORMATION	
Site and Location:	Data is available for Central Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduces risk to public health and welfare.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on New/Existing Buildings:	Extreme heat can compromise the habitability of buildings with little or no insulation, no radiant barrier, and/or lacking air conditioning
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	US EPA
Lead Agency/Department Responsible:	Department of Health and Human Services
Implementation Schedule:	2016-2019
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 9	
Proposed Action:	Monitor zoonotic diseases thought to be associated with changes in weather conditions and climate change and inform the public of any changes so they can better protect themselves.
BACKGROUND INFORMATION	
Site and Location:	Austin/Travis County
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Prepare for potential increases in infectious diseases.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Infectious Diseases
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	Department of Health and Human Services
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 10	
Proposed Action:	Have a workshop on ways to retrofit historic homes to mitigate weather related hazards.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Educate residents and give them resources on how to retrofit their existing home to mitigate potential effects.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Wildfire, Dam Failure
Effect on New/Existing Buildings:	Educate residents and encourage them to implement mitigation actions on their own properties
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	City, Texas Historic Commission (Certified Local Government Grant), Preservation Austin
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2015-2020
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 11	
Proposed Action:	Survey and map historic resources within flood prone areas. Design review and site plan review can lead to new construction that is both disaster-resistant and adheres to the scale, setting, materials, and sense of place of a particular historic district. By implementing Regulatory actions (such as planning and zoning) this will provide an opportunity to ensure that future growth and development avoid or minimize risk of hazard-related damage to the historical property.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Help identify properties that already have historic designation, as well as those that are eligible, that are threatened by potential risks.
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	Identify existing historic buildings that are threatened by flooding
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	City, Texas Historic Commission (Certified Local Government Grant)
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2015-2020
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 12	
Proposed Action:	Create a grant or rebate program to encourage energy retrofitting buildings within areas that are designated as Historic to encourage energy retrofitting that is compatible to historic properties. These mitigation efforts would include integrating a fire protection system with sprinklers; retrofitting windows for cold/heat and wind resistance to include shatter-resistant glass and ensure they are properly sealed. Attach guards to AC units for hail and tornado. Replace all toilets with low-flow toilets to help preserve water, especially for drought. For expansive soils, a perimeter apron can be applied around the structure to focus on drainage-control strategies to keep the soils within an acceptable range of moisture content.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	This would help with Water Conservation and Energy Conservation as well as reduce potential property damage during extreme weather events.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Expansive Soils
Effect on New/Existing Buildings:	Encourage retrofitting of historic buildings to reduce water and energy consumption
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	City, Austin Energy
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2015-2020
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 13	
Proposed Action:	Structurally retrofit existing City of Austin facilities including, but not limited to, libraries and recreation facilities to serve as hardened shelters in the event of hazardous weather, extreme heat or winter storms.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce loss of lives, reduce cost to repair facilities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Thunderstorm Wind, Hail, Tornado, Winter Storm, Hurricane Wind, Extreme Heat
Effect on New/Existing Buildings:	This action would require new and existing City facilities to be strengthened to better resist extreme weather conditions
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	Building Services, Parks and Recreation Department (PARC), Austin Public Libraries, HSEM
Implementation Schedule:	Ongoing
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 14	
Proposed Action:	Implement mitigation strategies that would strengthen and retrofit existing, pre-identified City of Austin facilities that serve as intermediate shelters, to include replacing windows with shatter-proof glass, upgrading fire systems, reinforcing wall and foundation connections, and other mitigation activities as required.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Reduce loss of lives, reduce cost to repair facilities.
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hail, Tornado, Flood, Wildfire, Dam Failure, Hazardous Materials, Pipeline Failure
Effect on New/Existing Buildings:	This action would require new and existing City facilities to be designed to better withstand severe weather and to include redundancies such as generators
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	Building Services, Parks and Recreation Department (PARD), HSEM
Implementation Schedule:	Ongoing
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 15	
Proposed Action:	Create and implement a component of the City of Austin Business Recovery Plan that will educate private business on the hazards the City is subject to and assist them with the identification of methods to mitigate the impact of those hazards on their business. This will help educate business owners on mitigation strategies that will make their properties more hazard resistant.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Educate businesses to reduce loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Hazardous Materials, Terrorism, Pipeline Failure, Infectious Disease, Cyber, Technological Disruption
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	HSEM and Economic Development Department
Implementation Schedule:	Ongoing
Incorporation into Existing Plans:	Business Recovery Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 16	
Proposed Action:	Modify the existing structure and make improvements to allow proper draining of excess rainwater away from the facility, such as installing a French Drain, which is basically a trench filled with gravel with a perforated pipe at the bottom. The pipe and gravel are wrapped in a protective “geotextile” fabric. Moisture accumulating in the trench percolates down and enters the pipe which transports the moisture to some point of discharge.
BACKGROUND INFORMATION	
Site and Location:	EMS Station 33, 4514 James Wheat, Austin TX
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Approximately \$75,000 in damages from three past flooding episodes.
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Expansive Soils
Effect on New/Existing Buildings:	Modification of the roofing and gutters to enhance drainage capabilities
Priority (High, Moderate, Low):	High
Estimated Cost:	\$130,000
Potential Funding Sources:	HMGP, General Fund
Lead Agency/Department Responsible:	COA Public Works, Building Services, EMS
Implementation Schedule:	1 year from initiation
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 17	
Proposed Action:	Develop new pavement design criteria that addresses expansive soils to minimize damage to roadway structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting roadways with less environmental damage, lower maintenance costs, fewer repairs required, and less frequent reconstruction.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current cost is \$310,000 (HVJ Associates consultant contract value). The losses avoided would be \$61.5 million. (20-year rules in use x (20yr/65yr) lost life x 0.5 on expansive clay x50 LM/year x \$400k/LM = \$61.5 Million additional reconstruction needed).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$310,000
Potential Funding Sources:	City of Austin, Travis County, Williamson County, City of Pflugerville
Lead Agency/Department Responsible:	Austin/Travis Co/Williamson Co/Pflugerville
Implementation Schedule:	2012-2016
Incorporation into Existing Plans:	Transportation Criteria Manual

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 18	
Proposed Action:	Educate and train civil and geotechnical engineers on new pavement design criteria, specifications, and design strategies that address expansive soils to minimize damage to roadway structures from changes in soil moisture.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current cost is \$11,520. (4 hours of training x 30 hours/hour preparation for presentation x \$60/hour = \$7,200 Train staff of 24 x 4hours training x \$45/hour = \$4,320 + \$7,200 = \$11,520). Losses avoided would be \$30,750,000. (0.5 designed improperly x 20-year rules in use x (20 year/65 year) lost life x 0.5 on expansive clay x 50 LM/year new subdivisions x \$400,000/LM = \$30,750,000 additional street reconstruction needed).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$11,520
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Capital Improvements Plan, Comprehensive Land Use Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 19	
Proposed Action:	Educate and train inspectors and contractors on the new specifications and pavement design criteria to ensure proper construction of roadways. New criteria will address expansive soils to minimize damage to roadway structures from changes in soil moisture. Partner with industry groups to develop and provide a formal certification program to document successful completion of this training.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current cost is \$24,000. (4 hours of training x 20 hours of prep for presentation x \$60/hour = \$4,800 and 4 Certification programs (Asphalt, Concrete, Stabilization, Soils) x 2 weeks x 40 hour/week x \$60/hour - \$19,200). Losses avoided would be \$15,375,000. (0.25 constructed improperly x 20-year rules in use x (20 year/65 year) lost life x 0.5 on expansive clay x 50 LM/year new subdivisions x \$400,000/LM = \$15,375,000 additional street reconstruction needed).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$24,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Capital Improvements Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 20	
Proposed Action:	Develop new criteria for designing structures and slabs on expansive soils to minimize damage to structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting structures with less environmental damage, lower maintenance costs, and fewer repairs required.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current Cost: %51,200. (SBO: 8 weeks x 40 hours/week x \$60/hour = \$19,200; QMD: 2 weeks x 40 hours/week x \$200/hour (3.4 O/H rate) = \$16,000; ESD: 2 weeks x 40 hour/week x \$200/hour (3.4 O/H rate) = \$16,000). Losses Avoided: \$20,000,000. (10 year / 50 year) reduction in useful service life of structures x \$100,000,000 in City of Austin facilities built on expansive clays over next 20 years = \$20,000,000 serviceability loss (repairs/rehabilitation/replacement).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$51,200
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	2017-2018
Incorporation into Existing Plans:	Technical Criteria Manuals, Capital Improvements Plan, Comprehensive Land Use Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 21	
Proposed Action:	Implement an inspection program to inspect and evaluate scour potential for small bridge and culvert structures not inspected by the TxDOT BRINSAP (NBIS) program.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current Costs: \$117,500 (~1,000 small structures (500 culverts and 500 pipes) 1,000 x (1.5 hours field (tech) x \$35/hour + 1hour office (tech x \$35/hour + 0.5 hour office (engineer) x \$60/hour) = \$117,500). Losses Avoided: \$3,000,000. (~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation; 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair); Permanent Mitigation/Repair = \$500,000; Damage for lack of mitigation 3 x \$500,000 = \$1,500,000; Temporary emergency repairs/TCP 1 x \$500,000 = \$500,000).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Structural damage from debris and scouring
Priority (High, Moderate, Low):	High
Estimated Cost:	\$117,500
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Bridge Management Information System

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 22	
Proposed Action:	Construct scour and erosion protection of bridges and culverts with high scour potential.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	<p>Current Cost: \$2,000,000. (465 bridges x 10%+ need scour mitigation = 50 bridges; \$300,000/year scour mitigation annually in bridge maintenance; contract for 10 major bridges - \$30,000 per location for scour mitigation (major); 50 bridges x \$30,000/bridge = \$1,500,000 (mitigation/repair); ~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation (minor); 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair)).</p> <p>Losses Avoided: \$12,000,000. (Permanent Mitigation / Repair = \$1,500,000; Damage from lack of mitigation 3 x \$1,500,000 = \$4,500,000; Temp. emergency repairs/TCP 1 x \$1,500,000 = \$1,500,000; Public Inconvenience & Hazard 1 x \$1,500,000 = \$1,500,000; = \$9,000,000 bridges; Permanent Mitigation / Repair = \$500,000; Damage from lack of mitigation 3 x \$500,000 = \$1,500,000; Temp. emergency repairs/TCP 1 x \$500,000 = \$500,000; Public Inconvenience & Hazard 1 x \$500,000 = \$500,000; = \$3,000,000 culverts).</p>
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Structure and Infrastructure Projects

SECTION 24: PREVIOUS ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Structural damage from scouring and loss of substructure or foundation support
Priority (High, Moderate, Low):	High
Estimated Cost:	\$2,000,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2016-2020
Incorporation into Existing Plans:	Bridge Maintenance Programs

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 23	
Proposed Action:	Establish new rural roadway design criteria with wider paved shoulders where feasible for less potential of fire caused by vehicles or motorists and better performance of roadways on expansive soils. Additional edge protection creates longer distance to fuel sources for fire and longer moisture path to travel lanes for soil stability.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current Cost: \$36,000. (SBO: 4 weeks x 40 hour/week x \$60/hour = \$9,600; AFD: 4 weeks x 40 hour/week x \$60/hour = \$9,600; ATD: 2 weeks x 40 hour/week x \$60/hour = \$4,800; QMD: 1 week x 40 hour/week x \$200/hour (3.4 O/H rate) = \$8,000; ESD: 0.5 weeks x 40 hour/week x \$200/hour (3.4 O/H rate) = \$4,000). Losses Avoided: no data. (There is limited data on the damages resulting from wildfire and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Expansive Soils
Effect on New/Existing Buildings:	Reduce number of urban wildfires and resulting damages
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$36,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	Transportation Criteria Manual

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 24	
Proposed Action:	Initiate the adoption of the International Code Councils' Wildland Urban Interface Code or an equivalent regulatory framework, to mitigate the threat of wildfire in high risk areas of the city.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to residents and first responders, minimizes financial loss to residents and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Applies to new construction with the exception of major renovations
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	2018
Incorporation into Existing Plans:	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 25	
Proposed Action:	Develop evacuation plan for areas without adequate collector roadways and connectivity during a wildfire or other emergency events. Plan may include the mitigation of pinch points, and high ignition corridors traffic control strategies.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Benefits citizens and first responders' safety.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Potential impact on road design to include width, and right of way maintenance
Priority (High, Moderate, Low):	High
Estimated Cost:	\$137,000
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	2018
Incorporation into Existing Plans:	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 26	
Proposed Action:	Utilization of goats to mitigate fire fuels in high risk areas where the use of mechanical equipment would result in environmental impacts. Establishment of contract services for grazing in designated high-risk corridors.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Natural System Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$117,000 annually
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Office of Sustainability, PARD, AWU
Implementation Schedule:	2017
Incorporation into Existing Plans:	Austin Community Wildfire Protection Plan, Austin Invasive Species Management Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 27	
Proposed Action:	Replacement of wooden attachments to structures and installation of ember resistive ventilations systems. This project would include the replacement of existing combustible decks and fences with ignition resistant materials as well as retrofit of ventilation systems to include ember resistive components.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Reduced risk of loss of life and property.
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Retrofit of existing structure attachments and ventilation systems
Priority (High, Moderate, Low):	High
Estimated Cost:	\$30,000,000
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Travis County TNR and OEM, Office of Sustainability, PDR
Implementation Schedule:	2018
Incorporation into Existing Plans:	Austin Community Wildfire Protection Plan, Austin Fire Code

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 28	
Proposed Action:	Establish an alternate power supply at Austin Police Department station so law enforcement can continue to operate in an emergency that effects the city’s power grid.
BACKGROUND INFORMATION	
Site and Location:	Austin Police Department – 715 E 8 th St., Austin, TX 78791
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Continue essential services to residents.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Flood, Cyber, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	Continue to provide essential services
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	HMGP, other grants
Lead Agency/Department Responsible:	Austin Police Department
Implementation Schedule:	2017
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 29	
Proposed Action:	Establish an alternate power supply at the City of Austin Public Safety Training Center (PSTC) so emergency services can continue to operate in an emergency that affects the city’s power grid. This will include a generator and an Uninterrupted Power Supply (UPS).
BACKGROUND INFORMATION	
Site and Location:	Public Safety Training Center – 4800 Shaw Lane, Austin, TX 78744
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Continue essential services to residents.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Cyber, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	Continue to provide essential services
Priority (High, Moderate, Low):	High
Estimated Cost:	TBD
Potential Funding Sources:	HMGP, other grants
Lead Agency/Department Responsible:	Austin Police Department
Implementation Schedule:	2017
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 30	
Proposed Action:	Develop a safe room program to retrofit residences in order to protect against a tornado or hurricane wind event.
BACKGROUND INFORMATION	
Site and Location:	To be determined
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Hurricane Wind
Effect on New/Existing Buildings:	This action would strengthen existing buildings and residences by making them more resistant to damage from tornadoes and hurricane winds
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$6,000 per safe room
Potential Funding Sources:	Federal Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	To be implemented after receipt of funds
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 31	
Proposed Action:	Conduct public awareness campaign for realtors, insurance agents, lenders, surveyors and other professionals on benefits of flood insurance under the National Flood Insurance Program (NFIP).
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. The NFIP benefits those who have purchased flood insurance for their homes. More training is needed regarding policies for agents, lenders and other professionals.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	This action would reduce the impact of flooding for existing and new structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff Time
Potential Funding Sources:	General Revenue
Lead Agency/Department Responsible:	Partner with other associations and groups currently providing NFIP training
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 32	
Proposed Action:	Increase public awareness regarding the National Flood Insurance Program (NFIP) and Preferred Risk Policy by holding educational forums for residents outside of the Special Flood Hazard Area (SFHA).
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. Flood insurance provides protection to those who have purchased flood insurance for their homes. Over 30% of NFIP claims occur outside of the SFHA.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	This action would result in stronger buildings if citizens purchased flood insurance
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$5,000 per year
Potential Funding Sources:	Grants and general revenue
Lead Agency/Department Responsible:	HSEM – partnering with organizations providing free NFIP training where available
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 33	
Proposed Action:	Install perimeter lighting at Tom Miller, Decker and Longhorn Dams. Perimeter lighting will ensure visibility so that proper action can be taken, including alerting the community, especially if there is a dam failure or potential breach.
BACKGROUND INFORMATION	
Site and Location:	Tom Miller Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250°N, 97.714°W
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city has not experienced a major dam failure since the early 1930s. Perimeter lighting would help increase security at the above locations.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Terrorism
Effect on New/Existing Buildings:	Prevent flood damage to existing structures within the inundation area for each dam
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 34	
Proposed Action:	Strengthen access restrictions at Tom Miller, Decker and Longhorn Dams.
BACKGROUND INFORMATION	
Site and Location:	Tom Miller Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250°N, 97.714°W
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Although the last major dam failure occurrence for the City was the result of a flood in the 1930s, access restrictions are necessary in light of concerns for terrorism since 9/11.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on New/Existing Buildings:	Prevent flood damage to existing structures within the inundation area for each dam
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 35	
Proposed Action:	Purchase communication equipment for uniform communication capability among first responders in the event of a pipeline failure or hazardous material spill.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city does not have radio equipment that would be safe to use to communicate nearby a hazardous material release or pipeline failure. Technology is currently available for radios that would allow for communication even in a volatile environment.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Hazardous Material Release, Terrorism
Effect on New/Existing Buildings:	This action enhances communicability between responders and does not directly impact new/existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	TBD
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	2016-2017 with replacements as needed
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 36	
Proposed Action:	Increase public awareness of the dangers of pipeline failure through the Pipeline Safety Trust, a NFP Public charity in order to promote fuel transportation safety.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Terrorism
Effect on New/Existing Buildings:	This action does not directly affect new/existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 37	
Proposed Action:	Create a neighborhood and community plan, including drills and exercises to educate the public regarding the location of pipelines and actions to take in the event of a hazardous material spill.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city has experienced few man-caused events, but citizens should be aware of procedures and locations of hazardous areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Hazardous Material Release
Effect on New/Existing Buildings:	This action primarily concerns protecting lives instead of directly effecting buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Minimal cost as partnering opportunities are available
Potential Funding Sources:	General Revenue and grants where available
Lead Agency/Department Responsible:	Austin Fire Department; Watershed Protection and Development Services
Implementation Schedule:	2016
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 38	
Proposed Action:	Create and implement an Extreme Event Recovery Plan that includes a Social Capital component. The plan would be based on expert knowledge in this area and would share best practices with a variety of urban change makers.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Post disaster relief to reduce long-term stressors for vulnerable communities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	HUD
Lead Agency/Department Responsible:	ATCHHSD
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	CHA/CHIP

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 39	
Proposed Action:	As the next step of the CHA/CHIP, Austin/Travis County Health and Human Services Department will initiate Building Resilience Against Climate Effects (BRACE), a CDC developed framework that allows public health departments put complex atmospheric science and climate projections into their mitigation, planning and response activities.
BACKGROUND INFORMATION	
Site and Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Health effects related to climate
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Infectious Diseases, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	CDC
Lead Agency/Department Responsible:	ATCHHSD
Implementation Schedule:	2016-2017
Incorporation into Existing Plans:	CHA/CHIP

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 24: PREVIOUS ACTIONS

City of Austin (Past Action) – 40	
Proposed Action:	Conduct public education to promote Xeriscaping of vegetation that requires little water for times of drought when water resources are low.
BACKGROUND INFORMATION	
Site and Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of wildfire, fire fuels, loss of life and property, conservation of water.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought
Effect on New/Existing Buildings:	Extensive impact on existing and new structures
Priority (High, Moderate, Low):	High
Estimated Cost:	\$25,000
Potential Funding Sources:	DHS, FEMA
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	By 2018
Incorporation into Existing Plans:	Emergency Operations Plan

2021 ANALYSIS
Defer Action – Action will be included in the 2021 Plan Update.

SECTION 25: MITIGATION ACTIONS

Summary	1
City of Austin.....	3

SUMMARY

As discussed in Section 2, at the mitigation workshop the planning team and stakeholders met to develop mitigation actions for each of the natural hazards included in the Plan. Each of the actions in this section were prioritized based on the Federal Emergency Management Agency’s (FEMA) Social, Technical, Administrative, Political, Legal, Economic, and Environmental [STAPLE(E)] criteria necessary for the implementation of each action. As a result of this exercise, an overall priority was assigned to each mitigation action.

As part of the economic evaluation of the STAPLE(E) analysis, jurisdictions analyzed each action in terms of the overall costs, measuring whether the potential benefit to be gained from the action outweighed costs associated with it. As a result of this exercise, priority was assigned to each mitigation action by marking them as High (H), Moderate (M), or Low (L). An action that is ranked as “High” indicates that the action will be implemented as soon as funding is received. A “Moderate” action is one that may not be implemented right away depending on the cost and number of citizens served by the action. Actions ranked as “Low” indicate that they will not be implemented without first seeking grant funding and after “High” and “Moderate” actions have been completed.

All mitigation actions created by Planning Team members are presented in this section in the form of Mitigation Action Worksheets. More than one hazard is sometimes listed for an action, if appropriate. Actions presented in this section represent a comprehensive range of mitigation actions per current State and FEMA Guidelines, including two actions per hazard and of two different types.

It is important to note that when the term, “Human Caused Hazards” is included in this section that includes the following hazard events: Cyber Attack, Hazardous Materials, Infectious Disease, Pipeline Failure, Technological Disruption, and Terrorism.

SECTION 25: MITIGATION ACTIONS

Table 25-1. City of Austin Mitigation Action Matrix

MITIGATION ACTION MATRIX					
Actions presented in this matrix represent a comprehensive range and minimum number of required mitigation actions per current State and FEMA Guidelines, including two actions per hazard and of two different types.					
CITY OF AUSTIN: MITIGATION ACTION MATRIX					
HAZARDS	Types of Action:				
	LOCAL PLANS / REGULATIONS	STRUCTURE / INFRASTRUCTURE	NATURAL SYSTEMS PROTECTION	EDUCATION & AWARENESS	PREPAREDNESS / RESPONSE / OTHER
Flood	12	23	3	21	
Drought	2	6	1	7	
Wildfire	7	12	2	9	
Extreme Heat	3	13	1	8	
Lightning		5	1	4	
Thunderstorm Wind	2	9	1	8	
Hail	2	11	1	6	
Tornado	2	12	1	6	
Expansive Soils	5	5		6	
Winter Storm	2	12	1	6	
Dam Failure	2	9		7	1
Hurricane Wind	2	11	1	7	
Cyber Attack	2	14		6	
Technological Disruption	2	14		6	
Infectious Disease	1	3		6	
Terrorism	3	15		8	
Hazardous Materials	2	4	1	8	
Pipeline Failure	2	4	1	9	

SECTION 25: MITIGATION ACTIONS

CITY OF AUSTIN

City of Austin – Action #1	
Proposed Action:	Implement education and awareness program utilizing media, social media, bulletins, flyers, etc. to educate citizens of hazards that can threaten the area and mitigation measures to reduce injuries, fatalities, and property damages.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Promote hazard awareness and protect citizens from potential injuries and damages.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Drought, Extreme Heat, Expansive Soils, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm, Human Caused Hazards
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$50,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Emergency Management
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #2	
Proposed Action:	Harden/retrofit critical facilities to hazard-resistant levels.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City of Austin critical facilities
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce damages at critical facilities; Ensure continuity of critical services during and after event; Reduce risk of injury to emergency and critical personnel.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Extreme Heat, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm
Effect on New/Existing Buildings:	Reduce risk to existing structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$10,000,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Public Works
Implementation Schedule:	Within 24-36 months of plan adoption
Incorporation into Existing Plans:	Emergency Management Plan; Capital Improvement Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #3	
Proposed Action:	Restrict future development in high risk areas.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of damages to new structures and infrastructure through building restrictions in high risk areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Wildfire, Dam Failure
Effect on New/Existing Buildings:	Reduce risk to new structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$5,000
Potential Funding Sources:	Local Funds
Lead Agency/Department Responsible:	Austin Service Center
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Local Building Codes/Ordinances

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #4	
Proposed Action:	Acquire and install generators with hard wired quick connections at all critical facilities, lift stations and pump stations
BACKGROUND INFORMATION	
Jurisdiction/Location:	City of Austin critical facilities, lift stations, and pump stations
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Provide power for critical facilities during power outages and ensure continuity of critical services.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Extreme Heat, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$5,000,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Public Works
Implementation Schedule:	Within 24-36 months of plan adoption
Incorporation into Existing Plans:	Emergency Management Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #5	
Proposed Action:	Upgrade critical facilities to include drought mitigation measures and expansive soils protection such as greywater reuse systems, drought tolerant landscaping, installation of a sprinkler system with regular watering schedule and installation of French drains where high plasticity soils are indicated.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City of Austin critical facilities
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce damages at critical facilities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought, Expansive Soils
Effect on New/Existing Buildings:	Reduce risk to existing and new structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$250,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Public Works
Implementation Schedule:	Within 24-36 months of plan adoption
Incorporation into Existing Plans:	Capital Improvement Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #6	
Proposed Action:	Develop a regional cybersecurity group and support structure to facilitate information sharing, maintain threat awareness, and increase collaboration amongst Austin-Metropolitan area stakeholders.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including Austin-Metropolitan area stakeholders
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Sharing information with entities in the Austin Metropolitan area and across industries will increase threat awareness and insight to potential patterns of cyberattacks.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$200,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	6 months from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
Implementation schedule is duration based on start date set after funding. Cost estimates include support personnel and facilitation expenses.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #7	
Proposed Action:	Provide awareness and training focused on management of sensitive data to City employees.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	By increasing awareness about management of sensitive data, the city could reduce likelihood of unintended data exposure, avoiding high costs of remediation due to exposure of Sensitive Personally Identifiable Information (PII) and/or other regulated data.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$500,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	1 year from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
Implementation schedule is duration based on start date set after funding.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #8	
Proposed Action:	Increase protection and monitoring of automated systems to include Internet of Things (IoT), Industrial Controls Systems (ICS), and Supervisory Control and Data Acquisition (AW SCADA)
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	By implementing increased protection and monitoring for automated systems, the City can increase the dependability of automated systems that provide critical services to residents and visitors. Increasing this capability increases the City's ability to offer Smart Cities services.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$15,000,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	5 years from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
Integration with City IT Service providers and strategic plans is needed for implementation. Implementation schedule is duration based on start date set after funding.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #9	
Proposed Action:	Flood Early Warning System Maintenance and replacement of existing instrumentation and installation of additional signage, flashing lights, gate arms, float switches, cameras, and associated telemetry and data management equipment at flood-prone areas. Radio telemetry enhancement may include upgrade of radio tower facilities and equipment or the installation of a new tower facility.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide at low water crossings and flood prone areas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Instrumentation and warning lights at roadway crossings and low areas that are subject to flooding increases the situational awareness of drivers and reduces the number of potential flood assist requests from drivers that cross these areas. This reduces the risk to life for both drivers and first responders and decreases the likelihood of damaged vehicles.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$200,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Potential additions starting in 2021
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #10	
Proposed Action:	Flood Early Warning System Maintenance and replacement of existing instrumentation and installation of additional rainfall and stream stage gauges and associated telemetry and data management equipment.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	These gauges provide information that assists in the identification of ongoing and potential flooding and improves the accuracy of the gauge-adjusted rainfall data used for or predictive flood modeling. This allows us to close low water crossings and evacuate areas as needed to reduce the risk to life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Potential additions starting in 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #11	
Proposed Action:	Flood Early Warning System Enhancement and/or replacement of the SCADA and Human-Machine Interface (HMI) systems that allow the FEWS group to monitor and operate the City's flood warning systems.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The improved SCADA and HMI systems allow for more efficient operation of our warning systems in flood-prone areas and low water crossings. This helps to reduce the risk to life and property at these areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$300,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 to 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #12	
Proposed Action:	Flood Early Warning System Enhancement and/or replacement of the existing Common Operating Picture situational awareness web-based tools and associated real-time flood and flood inundation modeling and gauge-adjusted radar rainfall data.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The Common Operating Picture and predictive models provide advance warning of potential flooding that allows City crews to close roads and evacuate areas as necessary. This reduces the risk to life and property in flood-prone areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$200,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2022 to 2024
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #13	
Proposed Action:	Flood Early Warning System Enhancement of the existing www.ATXfloods.com website for low water crossing closure information and low water crossing cameras. The site will be enhanced to provide additional functionality for partner jurisdictions and additional operation enhancements and data management and retrieval functionality.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including adjacent municipalities and counties
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The website provides flooding situational awareness for motorists and for residents in areas near low water crossing cameras. Knowledge of at-risk crossings and flood-prone areas reduces the risk to life and property for travelers.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$200,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2020 through 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #14	
Proposed Action:	<p>Flood Early Warning System Education and Outreach</p> <ul style="list-style-type: none"> • Prepare and broadcast of flood warning messaging in advance of anticipated flood events (Turn Around Don't Drown messaging). • Prepare educational material for outreach to community groups and conduct training as requested with this material. The material will include guidance on how to use the various available situational awareness tools (ATXfloods, LCRA Hydromet, National Weather Service, etc.) and will provide a general overview of the City's FEWS operations. • Prepare a tabletop exercise based on a past flood event for use in emergency management training with other departments and with other regional partners.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including adjacent municipalities and counties
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Outreach increases the awareness of residents to flood risks and provides information to reduce the risk to life and property during floods.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$200,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Specific items starting in 2021
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #15	
Proposed Action:	Floodplain Management Perform floodplain study updates to incorporate Atlas 14-based rainfall data, identify flood risks, inform the community about flood risk, and provide modeling and mapping tools for use in the evaluation and planning of flood risk reduction projects.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including adjacent municipalities and counties
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Accurate identification of flood risk is critical for education of the public and the prioritization and planning of flood risk reduction projects. The floodplain models and mapping produced through this action will greatly facilitate the Departments outreach and planning efforts.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Potentially adds properties and structures to the mapped floodplains and will impact flood insurance requirements
Priority (High, Moderate, Low):	High
Estimated Cost:	\$15,000,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2020 through 2024
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #16	
Proposed Action:	Floodplain Management Enhancement and expansion of City's www.ATXFloodPro.com web-based tool for floodplain information and outreach. Enhancements may include incorporation of updated floodplain study, addition of new, functionality and improvements to the existing data creation and management tools for the web application.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	An understanding of flood risk is key for residents to protect themselves from flood risk and flood damage. The information provided by the FloodPro tool allows residents to know their flood risk when purchasing a property and helps them understand what steps to take to protect their property (flood insurance, flood proofing, design modifications, etc.).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Identifies flood risk for buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	General revenue, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 to 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #17	
Proposed Action:	<p>Floodplain Management – Education and Outreach</p> <ul style="list-style-type: none"> Continue to conduct an outreach program to inform the public about the increased flood risks based on new Atlas 14 rainfall data. Include outreach to inform the public about the results of our floodplain study updates and inform the public about aspects of the National Flood Insurance Program (NFIP) related to new studies (newly unmapped areas, uncertified levees, etc.). Continue to conduct public awareness campaigns for realtors, insurance agents, lenders, surveyors and other professionals on the City’s flood risk regulations and the benefits of flood insurance under the National Flood Insurance Program (NFIP). Promote increased public awareness regarding the National Flood Insurance Program (NFIP) and flood insurance policies by conducting a mail-out campaign and holding educational forums for residents in and adjacent to flood-prone areas.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including adjacent municipalities and counties
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Awareness of flood risk and an understanding of flood insurance provide two of the best ways to avoid flood damage and to protect residents from the cost of flood damage. Flood insurance enables property owners to recover more quickly and fully from a flood event.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	General revenue, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 through 2022 with continuing outreach thereafter
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #18	
Proposed Action:	<p>Floodplain Management – Education and Outreach</p> <ul style="list-style-type: none"> • Develop floodplain review manuals and training programs for staff in the Development Service and Watershed Protection Departments that are responsible for review of development regulations for adherence to the City’s floodplain regulations. • Develop a training program for City inspectors to instruct them in the requirements of the City’s floodplain regulations and implement updates to the City’s permit tracking system to help ensure that all requirements of the City’s floodplain regulations are carried out through the construction process and that elevation certificates are produced when required.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Increased education of City review and inspection staff will help to ensure that new buildings are built in accordance with the City’s floodplain regulations and ensure that all required documentation is provided. This significantly reduces the risk of flooding for new buildings and ensures that data required for participation in the NFIP and CRS is collected.
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Ensure that new buildings and remodels meet the City's floodplain regulations
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 through 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #19	
Proposed Action:	Floodplain Management Revisit and update floodplain and drainage regulations in the City's Land Development Code and Drainage Criteria manual. The City is in the process of a comprehensive Code update. This action will be performed both in concert with the citywide effort and as potential code and criteria improvements are identified.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Improvements to code and criteria help to ensure that new construction is as safe from flood risk as possible and that losses to flood damage are minimized or eliminated for new construction.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Ensures that new or remodeled buildings are as safe from flood risk as possible. May slightly increase the cost of construction.
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	General revenue, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Ongoing
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #20	
Proposed Action:	<p>Floodplain Management – Post-Disaster Mitigation</p> <p>Enhance the City’s readiness to carry out post-disaster flood recovery and mitigation efforts. Examples include: Coordination with other departments to refine the damage assessment and post-flood recovery permitting processes.</p> <p>Prepare materials to provide impacted residents with information on requirements for rebuilding including requirements for mold abatement, lead-based paint, asbestos mitigation, and the permitting process for rebuilding flood damaged properties.</p>
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	<p>Many mitigation opportunities arise in the immediate aftermath of a flood disaster. However often as residents start to rebuild in the immediate aftermath of a flood, they are unaware of requirements relating to permitting, inspections, and other related issues. Having prepared information available for distribution in affected areas will provide valuable information and help ensure that property owners and their contractors rebuild safely.</p>
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Education and Awareness

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Ensures that repairs to flood damaged building meet the City's floodplain regulatory requirements. May slightly increase the cost of repairs.
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 through 2023
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan
COMMENTS	

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #21	
Proposed Action:	Regional Stormwater Management Program (RSMP) - Develop a web-based RSMP map viewer that will facilitate initial feasibility requests for participation in the RSMP, identify areas that are not appropriate for RSMP participation, identify areas where participation through construction of improvements is desired, and facilitate the processing and data management associated with RSMP cases.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Facilitates management of the RSMP and helps to pre-screen applications where RSMP participation is not appropriate. Streamlining of RSMP participation ensures that new development does not cause increased flooding impacts, facilitates construction of improvements that reduce flood risk, and facilitates collections of RSMP funds for construction of other flood risk reduction projects.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Facilitates projects to reduce flood risk to new/existing buildings
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	2021 through 2022
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #22	
Proposed Action:	Collection of LiDAR, aerial photography, planimetric, and tree canopy data on a regular interval.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide, including surrounding area
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Regular collection of these datasets facilitates the update of floodplain models to better reflect existing conditions, provide accurate data for detailed modeling of localized flood areas, allow for accurate calculation of impervious cover for the City's drainage utility fee, and facilitate evaluation of riparian habitat health.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Facilitates design and regulation of new/existing buildings
Priority (High, Moderate, Low):	High
Estimated Cost:	\$300,000 every 2 to 4 years
Potential Funding Sources:	General revenue, Grants, Partners
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Regular collection schedule (2-years for aerials and planimetrics, 4-years for LiDAR)
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #23	
Proposed Action:	Improve the City’s Community Rating System (CRS) rating through the creation and update of plans for outreach, flood risk mitigation, and open space/natural area purchase and management.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce flood insurance premiums for local residents; Reduce flood risk and build resiliency.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to new and existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$10,000
Potential Funding Sources:	Local Funds (staff time)
Lead Agency/Department Responsible:	Local Floodplain Administrator
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Floodplain Management Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #24	
Proposed Action:	Construct flood control and access improvements, including floodwalls and levees, to protect and provide access to the 605 megawatt Austin Energy Sand Hill Energy Center (SHEC) and the 75 million gallons per day Austin Water South Austin Regional (SAR) Wastewater Treatment Plant during 100-year flood events.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas; Northeast of the intersection of State Highway 130 and State High 71 along Fallwell Lane.
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	<p>Current cost of project: \$60 million, primarily comprised of new, extended, and raised levees and floodwalls.</p> <p>Losses avoided: \$176 million.</p> <p>Flood modeling using the latest precipitation values from the National Weather Service indicate that both plants would be inundated by a 100-year flood event, and the sole access road to both plants would flood, preventing access and affecting operation of the two plants, both of which are major infrastructure plants for the City of Austin.</p> <p>The current insurance/book values for SHEC and SAR are \$360 million and \$343 million, respectively, totaling \$703 million. With inundation of both plants, projected damage of 25% of the value of the two plants would be \$176 million.</p> <p>On-duty personnel would be exposed to flood conditions with the only road access to the plants cut off.</p> <p>Under flood conditions, both plants would be inoperable, and unable to generate electricity or treat wastewater. SAR represents half the wastewater treatment plant capacity of the City of Austin, and SHEC represents 23% of the base load power capacity.</p>
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Structure and Infrastructure Projects

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$50 million
Potential Funding Sources:	City of Austin, Texas Water Development Board, U.S. Federal Emergency Management Agency, U.S. Department of Housing and Urban Development
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	Within 48 months of plan adoption
Incorporation into Existing Plans:	Austin Energy, Austin Water, Watershed Protection

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #25	
Proposed Action:	Increase resiliency of digital services through implementation of security controls.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	By implementing security controls like load balancing of systems through content distributed networks (CDN) and other cloud services, the city can continue to offer critical services during online attacks such as denial of service/distributed denial of service (DoS/DDoS).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$12,000,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	3 years from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
Integration with City IT Service providers and strategic plans is needed for implementation. Implementation schedule is duration based on start date set after funding.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #26	
Proposed Action:	Provide a Data Loss Prevention (DLP) and Information Protection solution.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	By reducing the likeliness of data loss, the city would avoid high costs of remediation due to exposure of Sensitive Personally Identifiable Information (PII) and/or other regulated data.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$7,000,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	3 years from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
In addition to reducing cost of cybersecurity incident response for data loss, the action could reduce costs necessary for notification and continued monitoring of affected individuals. Implementation schedule is duration based on start date set after funding. Cost estimates include \$5M for implementation and \$2M annual run rate.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #27	
Proposed Action:	Implement a Security Information and Event Management (SIEM) solution.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	A SIEM solution provides aggregation and real-time analysis of system activities and generates cybersecurity alerts for incident responders, lessening response time and minimizing incident scope.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$10,000,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office; Communications & Technology Management
Implementation Schedule:	Within 36-48 months of plan adoption
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
Implementation schedule is duration based on start date set after funding. Cost estimates include SIEM and log aggregation licensing for multiple domains. \$4M for implementation and \$6M annual run rate.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #28	
Proposed Action:	Increase sharing of threat intelligence with other local government entities
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Increased sharing of threat intelligence between entities will provide early identification of attacks on the City's technology infrastructure.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$2,000,000
Potential Funding Sources:	Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP)
Lead Agency/Department Responsible:	Information Security Office
Implementation Schedule:	2 years from start date
Incorporation into Existing Plans:	City of Austin Information Security Strategic Plan

COMMENTS
This activity is in addition to ongoing participation in the various relevant Information Sharing and Analysis Centers (ISAC). Implementation schedule is duration based on start date set after funding.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #29	
Proposed Action:	Camera installation at High Hazard dams.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Multiple locations – high hazard dams
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Increase risk assessment capabilities
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$500,000
Potential Funding Sources:	DUF
Lead Agency/Department Responsible:	WPD, AW
Implementation Schedule:	Within 24-36 months of plan adoption
Incorporation into Existing Plans:	EAP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #30	
Proposed Action:	Education and Outreach for Cleanup Activities: Prepare an educational campaign to alert the public of hazards and behavior changes needed in light of a cleanup associated by toxins in a waterbody, whether naturally occurring or a result of a spill. Actions might include signage, social media, advertising, flyers, community meetings or other educational efforts.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Promote hazard awareness and protect citizens from potential injuries and damages.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hurricane Wind, Flood, Hazardous Materials, Pipeline Failure
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$15,000
Potential Funding Sources:	Local Funds, State and FEMA Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	With 24-36 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #31	
Proposed Action:	Emergency maintenance repair contracts in the event an immediate dam repair is needed that internal crews can't complete.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Multiple dam locations
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce recovery time.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations - Preparedness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$10,000,000
Potential Funding Sources:	DUF
Lead Agency/Department Responsible:	WPD, AW
Implementation Schedule:	Within 24-36 months of plan adoption
Incorporation into Existing Plans:	EAP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #32	
Proposed Action:	Stabilize and protect streambanks damaged by scour.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Sites throughout the City where bank scouring threatens habitable structures, businesses or City infrastructure where the banks are subject to accelerated scour due to embankment instability, hydromodification or loss of vegetation
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to habitable structures, businesses or City infrastructure.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce damages to existing infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$25,000,000
Potential Funding Sources:	Drainage Utility, Bonds, Grants
Lead Agency/Department Responsible:	Watershed Protection Dept
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	Drainage Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #33	
Proposed Action:	Education and Outreach for Homeless: Prepare an educational campaign to raise awareness of flood hazards among people experiencing homelessness.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce injuries and loss of life.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$25,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #34	
Proposed Action:	Education and Outreach: Prepare an educational campaign to raise awareness of flooding, hazards associated with low water crossings, floodplains and floodplain mapping, flood safety and preparation, flood proofing, flood insurance, benefits of natural riparian areas and floodplains and erosion hazards that may include advertising, social media, mailings, community meetings, educational programs for children and flyers.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Promote hazard awareness and protect citizens from potential injuries and damages.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$5,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #35	
Proposed Action:	Spill Cleanup Activities: Remediate a major hazardous material spill to a waterway. Actions typically include spill containment, recovery, disposal, and environmental restoration.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Mitigating impacts from illicit discharges to Austin waterways preserves natural aquatic resources which provide ecological function, recreation, drinking water and associated economic benefits.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials, Pipeline Failure
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$10,000,000
Potential Funding Sources:	Drainage Utility Fund revenues, Grants
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Spill remediation occurs as needed
Incorporation into Existing Plans:	Emergency Operations Plan, Continuity of Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #36	
Proposed Action:	Storm Drain Improvements: Upgrade storm drain systems including storm drainpipes, inlets, junction boxes and outfalls to reduce risk of localized flooding of buildings, structures, roadways, and yards.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduces the risk of flooding and reducing the risk of injury or loss of life and reducing the risk of property damage.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	3 to 30 Million
Potential Funding Sources:	Drainage Utility Fund, Bonds
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	Drainage Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #37	
Proposed Action:	Storm Drain Inspections: Inspect storm drains to assess age and condition and determine maintenance requirements. Inspection documents are used in the City’s asset Management system as a tool to determine preventative maintenance to avoid storm drain collapse and resulting damage to roads and structures.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduces the risk of flooding and reducing the risk of injury or loss of life and reducing the risk of property damage.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	Drainage Utility Fund, Bonds
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	Drainage Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #38	
Proposed Action:	Storm Drainpipe and inlet cleaning. Remove debris and sediment from critical portions of storm drain system to prevent reduction in storm drain capacity that causes increased localized flood risk.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduces the risk of flooding and reducing the risk of injury or loss of life and reducing the risk of property damage.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$3-30 Million
Potential Funding Sources:	Drainage Utility Fund, Bonds
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	Drainage Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #39	
Proposed Action:	Construct or acquire one or more disaster shelters that can be utilized to house evacuees during local events or remote evacuations. Equip these shelters and other existing shelters so that they can be rapidly utilized in any type of emergency. Ensure that shelters are ADA compliant and are located to serve the whole community. These new shelters would become the primary shelters during an emergency. Other existing facilities would provide backup capabilities.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Various locations around the City of Austin
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current shelters such as convention facilities and schools have multiple priorities. Use of these facilities may have revenue and critical infrastructure/essential services impact. This will increase sheltering capability and capacity, while minimizing impact on these other critical facilities. Facilities may be utilized for other non-essential purposes on a routine basis for maximum utilization of the resource.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hail, Tornado, Flood, Wildfire, Extreme Heat, Hurricane Wind, Dam Failure, Winter Storm, Human Caused Hazards
Effect on New/Existing Buildings:	Reduces the impact of sheltering on existing critical infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$65,000,000
Potential Funding Sources:	HMGP, HUD, State and Federal
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	Begin planning 2021 or when funds are available
Incorporation into Existing Plans:	EOP, Shelter Hub Plan

COMMENTS
Target would include a 5,000 person minimum shelter capacity in new shelters and 15,000 in existing shelters.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #40	
Proposed Action:	Implement projects from WPD’s five-year CIP to address flooding and associated water quality and erosion issues. See attached CIP list appendix G.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide – Multiple actions as listed in Appendix G
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to structures, infrastructure and citizens through various drainage improvements, flood control projects and watershed management projects.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Education and Awareness Local Plans and Regulations Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce or eliminate the impacts on new and existing structures and infrastructure
Priority (High, Moderate, Low):	High
Estimated Cost:	\$742 Million
Potential Funding Sources:	DUF, Bond, Grant
Lead Agency/Department Responsible:	Watershed Protection Department
Implementation Schedule:	5-year CIP plan: Within the five-year planning cycle upon plan adoption
Incorporation into Existing Plans:	Drainage Plan, Capital Improvement Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #41	
Proposed Action:	Hazard Training. Provide climate and weather hazard identification, response, and safety training to City of Austin staff, especially staff working outside.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City of Austin staff
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk through education and awareness.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Drought, Extreme Heat, Expansive Soils, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm, Human Caused Hazards
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	Grant funding
Lead Agency/Department Responsible:	Human Resources, Department Safety Groups
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	Climate Resilience Action Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #42	
Proposed Action:	Building Update. Upgrade aging building systems based on current code requirements, conditions assessments and energy/water audits at critical community facilities, including recreation centers, neighborhood centers, and libraries.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City Facilities
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to existing structures; Reduce water consumption.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought, Extreme Heat, Winter Storm
Effect on New/Existing Buildings:	Reduce Risk for Existing Structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$1,000,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Parks and Recreation, Austin Public Health, Austin Public Libraries
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	Capital Improvement Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #43	
Proposed Action:	Community Evacuations. Establish and update emergency evacuation routes and procedures for communities prone to extreme flooding and wildfire events. Study ingress/egress to and from flood and wildfire-prone neighborhoods and identify potential safety hubs for residents.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to citizens and emergency responders.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Flood, Wildfire
Effect on New/Existing Buildings:	Could need update to new/existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Homeland Security and Emergency Management, Watershed Protection, Austin Fire Department
Implementation Schedule:	Within 36 Months of Plan Adoption
Incorporation into Existing Plans:	Emergency Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #44	
Proposed Action:	Network Node Hardening. Investigate network node locations and create a catalog of information on backup power and cooling capabilities for each. Identify opportunities to improve weatherization and mitigate flood impacts.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Harden communications.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Flood, Winter Storm
Effect on New/Existing Buildings:	Reduce risk to existing facilities
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$250,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Communications and Technology Management
Implementation Schedule:	2020-2030
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #45	
Proposed Action:	Financial Impacts. Evaluate the risk of financial impact of having major utility facilities offline for a prolonged period of time during / after major weather events.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide major utility facilities
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Improved risk assessment.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Drought, Extreme Heat, Expansive Soils, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm, Human Caused Hazards
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	\$25,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Energy
Implementation Schedule:	With 48 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #46	
Proposed Action:	Urban Forest Canopy. Building on the Austin Forest Climate Vulnerability Assessment, develop an urban forest climate change adaptation strategy for the Austin area.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk through improved planning and mitigation strategies.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought, Extreme Heat, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$150,000
Potential Funding Sources:	Local Funds, State and Local Grants
Lead Agency/Department Responsible:	Development Services
Implementation Schedule:	Within 48 months of plan adoption
Incorporation into Existing Plans:	Climate Resilience Action Plan

COMMENTS
This effort will utilize/incorporate AW's Wildlands fire risk assessment and mitigation efforts

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #47	
Proposed Action:	Safety of outdoor staff. Evaluate work schedules and safety policies for City of Austin staff working outside during extreme heat days, poor air quality days, and other climate-related health risk days. Establish cross-departmental best practices.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City of Austin staff
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to employees' health.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Wildfire, Flood
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	\$25,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Human Resources, Department Safety Groups
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	Human Resource plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #48	
Proposed Action:	Wildfire Risk Mitigation for Radios and Radio Infrastructure. Determine which radio towers are at risk for wildfire and implement mitigation options.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Improve/harden communications; Reduce risk to citizens; Ensure continuity of services.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Reduce risk to existing communication infrastructure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$250,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Communications and Technology Management, Austin Fire Department
Implementation Schedule:	Within 48 months of plan adoption
Incorporation into Existing Plans:	CWPP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #49	
Proposed Action:	Passive Survivability. Develop Passive Survivability Guidelines for capital projects in areas projected to be impacted by climate hazards.
BACKGROUND INFORMATION	
Jurisdiction/Location:	City Facilities
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to new structures through improved construction techniques.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm
Effect on New/Existing Buildings:	Reduce risk to new structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$50,000
Potential Funding Sources:	Current Budget, State and Federal Grants
Lead Agency/Department Responsible:	Austin Energy Green Building
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #50	
Proposed Action:	Resilience Hubs. Co-locate new community facilities in low- to moderate-income areas lacking access to City facilities and services. Ensure new facilities have the capacity to serve as disaster response hubs during emergencies and as community centers offering needed City services and resources for the surrounding community.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Improve disaster response and recovery in vulnerable populations.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Drought, Extreme Heat, Expansive Soils, Flood, Hail, Hurricane Wind, Lightning, Thunderstorm Wind, Tornado, Wildfire, Winter Storm, Human Caused Hazards
Effect on New/Existing Buildings:	Reduce Risk to New Buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$1,000,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Parks and Recreation, Austin Public Health, Austin Public Libraries
Implementation Schedule:	Within 48 months of plan adoption
Incorporation into Existing Plans:	Capital Improvement Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #51	
Proposed Action:	Smoke Mapping. Create a real-time fire/smoke occurrence map similar to ATXFlood.com to provide jurisdictions with the tools necessary to more quickly and effectively communicate about wildfire smoke events. Prototype: https://1x65ua.axshare.com/#g=1&p=home&c=1
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to structures and citizens due to wildfire.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$150,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Office of Sustainability and Austin Fire Department
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	CWPP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #52	
Proposed Action:	Water Supply Impacts. Continue to study potential climate impacts on Austin's water supply in collaboration with the Water Utility Climate Alliance, regional climate agencies, and climate scientists.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce water consumption through improved planning.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought, Extreme Heat, Flood, Wildfire
Effect on New/Existing Buildings:	Reduce risk to existing infrastructure
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$50,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Austin Water
Implementation Schedule:	Within 48 hours of plan adoption
Incorporation into Existing Plans:	Land, Water and Transportation Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #53	
Proposed Action:	Educate FloodPro website as a tool for the public to determine if their home or property is in the 100 year floodplain. Teach communities mitigation ideas for flood-proofing their homes.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to properties throughout City from flood; reduce risk to residents in floodplain areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Reduce risk to existing structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$25,000
Potential Funding Sources:	General Revenue, HMGP/CDBG/PDM Grants
Lead Agency/Department Responsible:	WPD
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #54	
Proposed Action:	Construct additional data centers to continue use of critical systems during a technological disruption.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City is exposed to extended outages due to reliance on only one data center. This data center has several exposures which could result in extended outages, causing total loss of critical systems needed for public safety.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Technological Disruption
Effect on New/Existing Buildings:	Lack of infrastructure redundancy
Priority (High, Moderate, Low):	High
Estimated Cost:	\$15-\$30 million
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	2021 to 2024
Incorporation into Existing Plans:	Information Technology Strategy

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #55	
Proposed Action:	Move public facing services to the cloud to allow for continuity of services in the event of denial of service attacks (DOS).
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City is exposed to denial of service attacks (DOS). Given that the City has limited resources (network, servers), an extended DOS attack will result in unavailability of services.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Terrorism, Technological Disruption
Effect on New/Existing Buildings:	Single point of attack, limited resources
Priority (High, Moderate, Low):	High
Estimated Cost:	\$25,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Information Technology Strategy

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #56	
Proposed Action:	Provide a Data Loss Protection System to reduce the likeliness of data loss.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City could experience high costs to remediate data loss of Personally Identifiable Information (PII).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$750,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Information Technology Strategy

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #57	
Proposed Action:	Air Quality Sensors. Expand localized monitoring through a network of stationary and/or mobile monitors. Seek funding opportunities to install low-cost sensors across the city and work with local experts, open source software and off-the-shelf hardware to create affordable air quality monitors. Sensors could be tied to Bluetooth connected cellphones and WiFi signals and used for outdoor or indoor air quality monitoring. Engagement and outreach efforts for this should be co-led with community organizers.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide – vulnerable populations
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to health of vulnerable citizens
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Drought
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$250,000
Potential Funding Sources:	HMGP, Local Funds, Other State and Federal Grants
Lead Agency/Department Responsible:	Office of Sustainability
Implementation Schedule:	Within 36-48 months of plan adoption
Incorporation into Existing Plans:	Climate Resiliency Action Plan

COMMENTS
This action will evaluate and consider including “odor sensors” to inform and respond to odor complaints.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #58	
Proposed Action:	Provide a backup site for workers displaced due to a disaster.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Alternate City location to be determined
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The City currently has very little backup sites for employees displaced due to disaster to their workspace. Contracting with a backup site vendor or providing telework options will provide the City with workspace for displaced employees.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Lightning, Human Caused Hazards
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000 - \$500,000
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #59	
Proposed Action:	Share information about threats with other entities to provide early identification of attacks on the City's technology infrastructure.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Sharing threats with other entities will provide early identification of attacks on the City's technology infrastructure.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Cyber Attack, Terrorism, Technological Disruption
Effect on New/Existing Buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000/yr.
Potential Funding Sources:	HMGP, Homeland Security grants
Lead Agency/Department Responsible:	Communications & Technology Management
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Information Technology Strategy

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #60	
Proposed Action:	Conduct heat surveillance using bio-surveillance tools to plan, prioritize and mitigate risks related to climate change; guide environmental management decisions and policy changes; establish triggers for emergency alerts.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduces risk to public health and welfare.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on New/Existing Buildings:	Extreme heat can compromise the habitability of buildings with little or no insulation, no radiant barrier, and/or lacking air conditioning
Priority (High, Moderate, Low):	High
Estimated Cost:	\$250,000
Potential Funding Sources:	US EPA
Lead Agency/Department Responsible:	Department of Health and Human Services
Implementation Schedule:	Within 24 to 48 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS
Data is available for Central Texas.

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #61	
Proposed Action:	Monitor zoonotic diseases thought to be associated with changes in weather conditions and climate change, and inform the public of any changes so they can better protect themselves.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin/Travis County
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Prepare for potential increases in infectious diseases.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Infectious Diseases
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	Department of Health and Human Services
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #62	
Proposed Action:	Have a workshop on ways to retrofit historic homes to mitigate weather related hazards.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Educate residents and give them resources on how to retrofit their existing home to mitigate potential effects.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Wildfire, Dam Failure
Effect on New/Existing Buildings:	Educate residents and encourage them to implement mitigation actions on their own properties
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$10,000
Potential Funding Sources:	City, Texas Historic Commission (Certified Local Government Grant), Preservation Austin
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2020 through 2025
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #63	
Proposed Action:	Survey and map historic resources within flood prone areas. Design review and site plan review can lead to new construction that is both disaster-resistant and adheres to the scale, setting, materials, and sense of place of a particular historic district. By implementing Regulatory actions (such as planning and zoning) this will provide an opportunity to ensure that future growth and development avoid or minimize risk of hazard-related damage to the historical property.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Help identify properties that already have historic designation, as well as those that are eligible, that are threatened by potential risks.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	Identify existing historic buildings that are threatened by flooding
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$500,000
Potential Funding Sources:	City, Texas Historic Commission (Certified Local Government Grant)
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2020 through 2025
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #64	
Proposed Action:	Create a grant or rebate program to encourage energy retrofitting buildings within areas that are designated as Historic to encourage energy retrofitting that is compatible to historic properties. These mitigation efforts would include integrating a fire protection system with sprinklers; retrofitting windows for cold/ heat and wind resistance to include shatter-resistant glass and ensure they are properly sealed. Attach guards to AC units for hail and tornado. Replace all toilets with low-flow toilets to help preserve water, especially for drought. For expansive soils, a perimeter apron can be applied around the structure to focus on drainage-control strategies to keep the soils within an acceptable range of moisture content.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	This would help with Water Conservation and Energy Conservation as well as reduce potential property damage during extreme weather events.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Expansive Soils
Effect on New/Existing Buildings:	Encourage retrofitting of historic buildings to reduce water and energy consumption
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$1,000,000
Potential Funding Sources:	City, Austin Energy
Lead Agency/Department Responsible:	Planning and Zoning, Historic Preservation
Implementation Schedule:	2020 through 2025
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #65	
Proposed Action:	Structurally retrofit existing City of Austin facilities including, but not limited to, libraries and recreation facilities to serve as hardened shelters in the event of hazardous weather, extreme heat or winter storms.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce loss of lives, reduce cost to repair facilities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Thunderstorm Wind, Hail, Tornado, Winter Storm, Hurricane Wind, Extreme Heat
Effect on New/Existing Buildings:	This action would require new and existing City facilities to be strengthened to better resist extreme weather conditions
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$5,000,000
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	Building Services, Parks and Recreation Department (PARD), Austin Public Libraries, HSEM
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #66	
Proposed Action:	Implement mitigation strategies that would strengthen and retrofit existing, pre-identified City of Austin facilities that serve as intermediate shelters, to include replacing windows with shatter-proof glass, upgrading fire systems, reinforcing wall and foundation connections, and other mitigation activities as required.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce loss of lives, reduce cost to repair facilities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hail, Tornado, Flood, Wildfire, Dam Failure, Hazardous Materials, Pipeline Failure
Effect on New/Existing Buildings:	This action would require new and existing City facilities to be designed to better withstand severe weather and to include redundancies such as generators
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$5,000,000
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	Building Services, Parks and Recreation Department (PARD), HSEM
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #67	
Proposed Action:	Create and implement a component of the City of Austin Business Recovery Plan that will educate private business on the hazards the City is subject to and assist them with the identification of methods to mitigate the impact of those hazards on their business. This will help educate business owners on mitigation strategies that will make their properties more hazard resistant.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Educate businesses to reduce loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Lightning, Human Caused Hazards
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$20,000
Potential Funding Sources:	Federal/State grants and general revenue
Lead Agency/Department Responsible:	HSEM and Economic Development Department
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Business Recovery Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #68	
Proposed Action:	Modify the existing structure and make improvements to allow proper draining of excess rainwater away from the facility, such as installing a French Drain, which is basically a trench filled with gravel with a perforated pipe at the bottom. The pipe and gravel are wrapped in a protective “geotextile” fabric. Moisture accumulating in the trench percolates down and enters the pipe which transports the moisture to some point of discharge.
BACKGROUND INFORMATION	
Jurisdiction/Location:	EMS Station 33, 4514 James Wheat, Austin TX
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Approximately \$75,000 in damages from three past flooding episodes.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Expansive Soils
Effect on New/Existing Buildings:	Modification of the roofing and gutters to enhance drainage capabilities
Priority (High, Moderate, Low):	High
Estimated Cost:	\$130,000
Potential Funding Sources:	HMGP, General Fund
Lead Agency/Department Responsible:	COA Public Works, Building Services, EMS
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #69	
Proposed Action:	Develop new pavement design criteria that addresses expansive soils to minimize damage to roadway structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting roadways with less environmental damage, lower maintenance costs, fewer repairs required, and less frequent reconstruction.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current cost is \$310,000 (HVJ Associates consultant contract value). The losses avoided would be \$61.5 million. (20 year rules in use x (20yr/65yr) lost life x 0.5 on expansive clay x50 LM/year x \$400k/LM = \$61.5 Million additional reconstruction needed).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$310,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Austin/Travis Co/Williamson Co/Pflugerville
Implementation Schedule:	Within 24 months of plan adoption
Incorporation into Existing Plans:	Transportation Criteria Manual

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #70	
Proposed Action:	Educate and train civil and geotechnical engineers on new pavement design criteria, specifications, and design strategies that address expansive soils to minimize damage to roadway structures from changes in soil moisture.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current cost is \$11,520. (4 hours of training x 30 hours/hour preparation for presentation x \$60/hour = \$7,200 Train staff of 24 x 4hours training x \$45/hour = \$4,320 + \$7,200 = \$11,520). Losses avoided would be \$30,750,000. (0.5 designed improperly x 20 year rules in use x (20 year/65 year) lost life x 0.5 on expansive clay x 50 LM/year new subdivisions x \$400,000/LM = \$30,750,000 additional street reconstruction needed).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$11,520
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Capital Improvements Plan, Comprehensive Land Use Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #71	
Proposed Action:	Educate and train inspectors and contractors on the new specifications and pavement design criteria to ensure proper construction of roadways. New criteria will address expansive soils to minimize damage to roadway structures from changes in soil moisture. Partner with industry groups to develop and provide a formal certification program to document successful completion of this training.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current cost is \$24,000. (4 hours of training x 20 hours of prep for presentation x \$60/hour = \$4,800 and 4 Certification programs (Asphalt, Concrete, Stabilization, Soils) x 2 weeks x 40 hour/week x \$60/hour - \$19,200). Losses avoided would be \$15,375,000. (0.25 constructed improperly x 20 year rules in use x (20 year/65 year) lost life x 0.5 on expansive clay x 50 LM/year new subdivisions x \$400,000/LM = \$15,375,000 additional street reconstruction needed).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$24,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Capital Improvements Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #72	
Proposed Action:	Develop new criteria for designing structures and slabs on expansive soils to minimize damage to structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting structures with less environmental damage, lower maintenance costs, and fewer repairs required.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current Cost: %51,200. (SBO: 8 weeks x 40 hours/week x \$60/hour = \$19,200; QMD: 2 weeks x 40 hours/week x \$200/hour (3.4 O/H rate) = \$16,000; ESD: 2 weeks x 40 hour/week x \$200/hour (3.4 O/H rate) = \$16,000). Losses Avoided: \$20,000,000. (10 year / 50 year) reduction in useful service life of structures x \$100,000,000 in City of Austin facilities built on expansive clays over next 20 years = \$20,000,000 serviceability loss (repairs/rehabilitation/replacement).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Expansive Soils
Effect on New/Existing Buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$51,200
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works
Implementation Schedule:	Within 36 to 48 months of plan adoption
Incorporation into Existing Plans:	Technical Criteria Manuals, Capital Improvements Plan, Comprehensive Land Use Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #73	
Proposed Action:	Implement an inspection program to inspect and evaluate scour potential for small bridge and culvert structures not inspected by the TxDOT BRINSAP (NBIS) program.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Current Costs: \$117,500 (~1,000 small structures (500 culverts and 500 pipes) 1,000 x (1.5 hours field (tech) x \$35/hour + 1hour office (tech x \$35/hour + 0.5 hour office (engineer) x \$60/hour) = \$117,500). Losses Avoided: \$3,000,000. (~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation; 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair); Permanent Mitigation/Repair = \$500,000; Damage for lack of mitigation 3 x \$500,000 = \$1,500,000; Temporary emergency repairs/TCP 1 x \$500,000 = \$500,000).
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Structural damage from debris and scouring
Priority (High, Moderate, Low):	High
Estimated Cost:	\$117,500
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Bridge Management Information System

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #74	
Proposed Action:	Construct scour and erosion protection of bridges and culverts with high scour potential.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	<p>Current Cost: \$2,000,000. (465 bridges x 10%+ need scour mitigation = 50 bridges; \$300,000/year scour mitigation annually in bridge maintenance; contract for 10 major bridges - \$30,000 per location for scour mitigation (major); 50 bridges x \$30,000/bridge = \$1,500,000 (mitigation/repair); ~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation (minor); 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair)).</p> <p>Losses Avoided: \$12,000,000. (Permanent Mitigation / Repair = \$1,500,000; Damage from lack of mitigation 3 x \$1,500,000 = \$4,500,000; Temp. emergency repairs/TCP 1 x \$1,500,000 = \$1,500,000; Public Inconvenience & Hazard 1 x \$1,500,000 = \$1,500,000; = \$9,000,000 bridges; Permanent Mitigation / Repair = \$500,000; Damage from lack of mitigation 3 x \$500,000 = \$1,500,000; Temp. emergency repairs/TCP 1 x \$500,000 = \$500,000; Public Inconvenience & Hazard 1 x \$500,000 = \$500,000; = \$3,000,000 culverts).</p>
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

SECTION 25: MITIGATION ACTIONS

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on New/Existing Buildings:	Structural damage from scouring and loss of substructure or foundation support
Priority (High, Moderate, Low):	High
Estimated Cost:	\$2,000,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	2020 through 2025
Incorporation into Existing Plans:	Bridge Maintenance Programs

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #75	
Proposed Action:	Establish new rural roadway design criteria with wider paved shoulders where feasible for less potential of fire caused by vehicles or motorists and better performance of roadways on expansive soils. Additional edge protection creates longer distance to fuel sources for fire and longer moisture path to travel lanes for soil stability.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (<i>Current Cost/ Losses Avoided</i>):	Current Cost: \$36,000. (SBO: 4 weeks x 40 hour/week x \$60/hour = \$9,600; AFD: 4 weeks x 40 hour/week x \$60/hour = \$9,600; ATD: 2 weeks x 40 hour/week x \$60/hour = \$4,800; QMD: 1 week x 40 hour/week x \$200/hour (3.4 O/H rate) = \$8,000; ESD: 0.5 weeks x 40 hour/week x \$200/hour (3.4 O/H rate) = \$4,000). Losses Avoided: no data. (There is limited data on the damages resulting from wildfire and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high).
Type of Action (<i>Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness</i>)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Expansive Soils
Effect on New/Existing Buildings:	Reduce number of urban wildfires and resulting damages
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$36,000
Potential Funding Sources:	City of Austin
Lead Agency/Department Responsible:	Public Works Department
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	Transportation Criteria Manual

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #76	
Proposed Action:	Initiate the adoption of the International Code Councils' Wildland Urban Interface Code or an equivalent regulatory framework, to mitigate the threat of wildfire in high risk areas of the city.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to residents and first responders, minimizes financial loss to residents and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Applies to new construction with the exception of major renovations
Priority (High, Moderate, Low):	High
Estimated Cost:	\$100,000
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #77	
Proposed Action:	Develop evacuation plan for areas without adequate collector roadways and connectivity during a wildfire or other emergency events. Plan may include the mitigation of pinch points, and high ignition corridors traffic control strategies.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Benefits citizens and first responders' safety.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Potential impact on road design to include width, and right of way maintenance
Priority (High, Moderate, Low):	High
Estimated Cost:	\$137,000
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #78	
Proposed Action:	Utilization of goats to mitigate fire fuels in high risk areas where the use of mechanical equipment would result in environmental impacts. Establishment of contract services for grazing in designated high risk corridors.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Natural System Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	\$117,000 annually
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Office of Sustainability, PARD, AWU
Implementation Schedule:	Within 24 months of plan adoption
Incorporation into Existing Plans:	Austin Community Wildfire Protection Plan, Austin Invasive Species Management Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #79	
Proposed Action:	Replacement of wooden attachments to structures and installation of ember resistive ventilations systems. This project would include the replacement of existing combustible decks and fences with ignition resistant materials as well as retrofit of ventilation systems to include ember resistive components.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduced risk of loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on New/Existing Buildings:	Retrofit of existing structure attachments and ventilation systems
Priority (High, Moderate, Low):	High
Estimated Cost:	\$30,000,000
Potential Funding Sources:	Local Funds, Inspections, In-Kind
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Travis County TNR and OEM, Office of Sustainability, PDR
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	Austin Community Wildfire Protection Plan, Austin Fire Code

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #80	
Proposed Action:	Establish an alternate power supply at Austin Police Department station so law enforcement can continue to operate in an emergency that effects the city’s power grid.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin Police Department – 715 E 8 th St., Austin, TX 78791
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Continue essential services to residents.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Flood, Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	Continue to provide essential services
Priority (High, Moderate, Low):	High
Estimated Cost:	\$300,000
Potential Funding Sources:	HMGP, other grants
Lead Agency/Department Responsible:	Austin Police Department
Implementation Schedule:	Within 24 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #81	
Proposed Action:	Establish an alternate power supply at the City of Austin Public Safety Training Center (PSTC) so emergency services can continue to operate in an emergency that affects the city’s power grid. This will include a generator and an Uninterrupted Power Supply (UPS).
BACKGROUND INFORMATION	
Jurisdiction/Location:	Public Safety Training Center – 4800 Shaw Lane, Austin, TX 78744
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Continue essential services to residents.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Cyber Attack, Technological Disruption, Terrorism
Effect on New/Existing Buildings:	Continue to provide essential services
Priority (High, Moderate, Low):	High
Estimated Cost:	\$300,000
Potential Funding Sources:	HMGP, other grants
Lead Agency/Department Responsible:	Austin Police Department
Implementation Schedule:	Within 24 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #82	
Proposed Action:	Develop a safe room program to retrofit residences in order to protect against a tornado or hurricane wind event.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Hurricane Wind
Effect on New/Existing Buildings:	This action would strengthen existing buildings and residences by making them more resistant to damage from tornadoes and hurricane winds
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$6,000 per safe room
Potential Funding Sources:	Federal Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	To be implemented after receipt of funds
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #83	
Proposed Action:	Conduct public awareness campaign for realtors, insurance agents, lenders, surveyors and other professionals on benefits of flood insurance under the National Flood Insurance Program (NFIP).
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. The NFIP benefits those who have purchased flood insurance for their homes. More training is needed regarding policies for agents, lenders and other professionals.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	This action would reduce the impact of flooding for existing and new structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff Time
Potential Funding Sources:	General Revenue
Lead Agency/Department Responsible:	Partner with other associations and groups currently providing NFIP training
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #84	
Proposed Action:	Increase public awareness regarding the National Flood Insurance Program (NFIP) and Preferred Risk Policy by holding educational forums for residents outside of the Special Flood Hazard Area (SFHA).
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. Flood insurance provides protection to those who have purchased flood insurance for their homes. Over 30% of NFIP claims occur outside of the SFHA.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Thunderstorm Wind
Effect on New/Existing Buildings:	This action would result in stronger buildings if citizens purchased flood insurance
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$5,000 per year
Potential Funding Sources:	Grants and general revenue
Lead Agency/Department Responsible:	HSEM – partnering with organizations providing free NFIP training where available
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #85	
Proposed Action:	Install perimeter lighting at Tom Miller, Decker and Longhorn Dams. Perimeter lighting will ensure visibility so that proper action can be taken, including alerting the community, especially if there is a dam failure or potential breach.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Tom Miller Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250°N, 97.714°W
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city has not experienced a major dam failure since the early 1930s. Perimeter lighting would help increase security at the above locations.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Dam Failure, Terrorism
Effect on New/Existing Buildings:	Prevent flood damage to existing structures within the inundation area for each dam
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$50,000
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #86	
Proposed Action:	Strengthen access restrictions at Tom Miller, Decker and Longhorn Dams.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Tom Miller Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250°N, 97.714°W
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Although the last major dam failure occurrence for the City was the result of a flood in the 1930s, access restrictions are necessary in light of concerns for terrorism since 9/11.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on New/Existing Buildings:	Prevent flood damage to existing structures within the inundation area for each dam
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #87	
Proposed Action:	Purchase communication equipment for uniform communication capability among first responders in the event of a pipeline failure or hazardous material spill.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city does not have radio equipment that would be safe to use to communicate nearby a hazardous material release or pipeline failure. Technology is currently available for radios that would allow for communication even in a volatile environment.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Hazardous Materials, Terrorism
Effect on New/Existing Buildings:	This action enhances communicability between responders and does not directly impact new/existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$50,000
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	Within 12 to 24 months of plan adoption, with replacements as needed
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #88	
Proposed Action:	Increase public awareness of the dangers of pipeline failure through the Pipeline Safety Trust, a NFP Public charity in order to promote fuel transportation safety.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of loss of life and property.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Terrorism
Effect on New/Existing Buildings:	This action does not directly affect new/existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Staff time
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	HSEM
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #89	
Proposed Action:	Create a neighborhood and community plan, including drills and exercises to educate the public regarding the location of pipelines and actions to take in the event of a hazardous material spill.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	The city has experienced few man-caused events, but citizens should be aware of procedures and locations of hazardous areas.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Pipeline Failure, Hazardous Materials
Effect on New/Existing Buildings:	This action primarily concerns protecting lives instead of directly effecting buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Minimal cost as partnering opportunities are available
Potential Funding Sources:	General Revenue and grants where available
Lead Agency/Department Responsible:	Austin Fire Department; Watershed Protection and Development Services
Implementation Schedule:	Within 12 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #90	
Proposed Action:	Create and implement an Extreme Event Recovery Plan that includes a Social Capital component. The plan would be based on expert knowledge in this area and would share best practices with a variety of urban change makers.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Post disaster relief to reduce long-term stressors for vulnerable communities.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber Attack, Technological Disruption
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	HUD
Lead Agency/Department Responsible:	ATCHHSD
Implementation Schedule:	Within 12 to 24 months of plan adoption
Incorporation into Existing Plans:	CHA/CHIP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #91	
Proposed Action:	As the next step of the CHA/CHIP, Austin/Travis County Health and Human Services Department will initiate Building Resilience Against Climate Effects (BRACE), a CDC developed framework that allows public health departments put complex atmospheric science and climate projections into their mitigation, planning and response activities.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Austin, Texas; Travis County, Texas
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Health effects related to climate
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Infectious Diseases, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber Attack, Technological Disruption
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	\$100,000
Potential Funding Sources:	CDC
Lead Agency/Department Responsible:	ATCHHSD
Implementation Schedule:	Within 24 to 36 months of plan adoption
Incorporation into Existing Plans:	CHA/CHIP

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #92	
Proposed Action:	Conduct public education to promote Xeriscaping of vegetation that requires little water for times of drought when water resources are low.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk of wildfire, fire fuels, loss of life and property, conservation of water.
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought
Effect on New/Existing Buildings:	Extensive impact on existing and new structures
Priority (High, Moderate, Low):	High
Estimated Cost:	\$25,000
Potential Funding Sources:	DHS, FEMA
Lead Agency/Department Responsible:	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
Implementation Schedule:	Within 36 months of plan adoption
Incorporation into Existing Plans:	Emergency Operations Plan

COMMENTS

SECTION 25: MITIGATION ACTIONS

City of Austin – Action #93	
Proposed Action:	Heat Mapping. Coordinate local volunteers to help collect environmental data about the hottest and coolest places in our region during a heat wave. Data collected by volunteers during the joint one-day heat mapping campaign will be used to develop temperature maps of the Austin and help address heat-related vulnerabilities across the region.
BACKGROUND INFORMATION	
Jurisdiction/Location:	Citywide
Risk Reduction Benefit (Current Cost/ Losses Avoided):	Reduce risk to vulnerable populations; Enhanced risk assessment
Type of Action (Local Plans and Regulations, Structure and Infrastructure projects, Natural System Protection, or Education and Awareness)	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on New/Existing Buildings:	Extensive impact on existing and new structures
Priority (High, Moderate, Low):	Low
Estimated Cost:	\$10,000
Potential Funding Sources:	Local Funds, State and Federal Grants
Lead Agency/Department Responsible:	Office of Sustainability
Implementation Schedule:	Within 12-24 months of plan adoption
Incorporation into Existing Plans:	N/A

COMMENTS

SECTION 26: PLAN MAINTENANCE

Plan Maintenance Procedures 1

Incorporation 1

 Process of Incorporation 1

Monitoring and Evaluation 3

 Monitoring 3

 Evaluation 4

Updating 4

 Plan Amendments 4

 Five (5) Year Review 5

Continued Public Involvement 5

PLAN MAINTENANCE PROCEDURES

The following is an explanation of how the City of Austin and the general public will be involved in implementing, evaluating, and enhancing the Plan over time. The sustained hazard mitigation planning process consists of four main parts:

- Incorporation
- Monitoring and Evaluation
- Updating
- Continued Public Involvement

INCORPORATION

The City of Austin will be responsible for further development and implementation of mitigation actions. Each action has been assigned to a specific department within the City. The following describes the process by which the City of Austin will incorporate elements of the mitigation plan into other planning mechanisms.

PROCESS OF INCORPORATION

Once the Plan is adopted, the City of Austin will implement actions based on priority and the availability of funding. The City currently implements policies and programs to reduce loss of life and property damage from hazards. The mitigation actions developed for this Plan Update enhance this ongoing effort and will be implemented through other program mechanisms where possible.

The potential funding sources listed for each identified action may be used when the city seeks funds to implement actions. An implementation time period or a specific implementation date has been assigned to each action as an incentive for completing each task and gauging whether actions are implemented in a timely manner.

The City of Austin will integrate implementation of their mitigation actions with other plans and policies such as construction standards and emergency management plans, and ensure that

SECTION 26: PLAN MAINTENANCE

these actions, or proposed projects, are reflected in other planning efforts. Coordinating and integrating components of other plans and policies into goals and objectives of the Plan will further maximize funding and provide possible cost-sharing of key projects, thereby reducing loss of lives and property, and mitigating hazards affecting the area.

Upon formal adoption of the Plan Update, planning team members from each city department will work to integrate the hazard mitigation strategies into other plans and codes as they are developed. Participating team members will conduct periodic reviews of plans and policies (once per year at a minimum) and analyze the need for amendments in light of the approved Plan Update. The planning team will review all comprehensive land use plans, capital improvement plans, annual budget reviews, emergency operations or management plans, transportation plans, and any building codes to guide and control development. Departments will ensure that capital improvement planning in the future will also contribute to the goals of this hazard mitigation Plan Update, in order to reduce the long-term risk to life and property from all hazards. Within 1 year of formal adoption of the hazard mitigation Plan Update, existing planning mechanisms will be reviewed.

The City of Austin will review and revise, as necessary, the long-range goals and objectives in strategic plan and budgets to ensure that they are consistent with this mitigation action plan. Additionally, the City will work to advance the goals of this hazard mitigation plan through its routine, ongoing, long-range planning, budgeting, and work processes.

Table 26-1. Methods of Incorporation of the Plan

Planning Mechanism	Incorporation of Plan
Grant Applications	The Plan Update will be evaluated by the City of Austin when grant funding is sought for mitigation projects. If a project is not in the Plan Update, an amendment may be necessary to include the action in the Plan Update.
Annual Budget Review	Various departments and key personnel that participated in the planning process for the City of Austin will review the Plan Update and mitigation actions therein when conducting their annual budget review. Allowances will be made in accordance with grant applications sought and mitigation actions that will be undertaken per the implementation schedule of the specific action.
Regulatory Plans	Currently, the City of Austin has regulatory plans in place, such as Emergency Management Plans, Continuity of Operations Plans, Land Use Plans, and Evacuation Plans. The Plan Update will be consulted when City departments review or revise their current regulatory planning mechanisms or in the development of regulatory plans that are not currently in place.

SECTION 26: PLAN MAINTENANCE

Planning Mechanism	Incorporation of Plan
Capital Improvement Plan	The City of Austin has a Capital Improvement Plan (CIP) in place. Prior to any revisions to the CIP, City departments will review the risk assessment and mitigation strategy sections of the HMAP, as limiting public spending in hazardous zones is one of the most effective long-term mitigation actions available to local governments.
Floodplain Management Plan	Floodplain management plans include preventative and corrective actions to address the flood hazard. Therefore, the actions for flooding and information found in Section 5 of this Plan Update discussing the people and property at risk to flood will be reviewed and revised when the City of Austin updates their management plans or develops new plans.

MONITORING AND EVALUATION

Periodic revisions of the Plan Update are required to ensure that goals, objectives, and mitigation actions are kept current. Revisions may be required to ensure the Plan Update is in compliance with federal and state statutes and regulations. This section outlines the procedures for completing Plan revisions, updates, and review. Table 26-2 indicates the department and title of the party responsible for Plan monitoring, updating, and review of the Plan. Monitoring, evaluating and updating the plan include the planning process, hazard risk assessment and the mitigation strategies and actions as they are written in the plan. In the paragraphs below when the plan is mentioned it is to include the hazard risk assessment and mitigation actions.

Table 26-2. Team Members Responsible for Plan Monitoring, Evaluation, Updating, and Review of the Plan

DEPARTMENT	TITLE
Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
Office of Homeland Security & Emergency Management	Director
Office of Homeland Security & Emergency Management	Program Manager
Office of Homeland Security & Emergency Management	Assistant Director

MONITORING

Designated Planning Team members are responsible for monitoring, updating, and reviewing the Plan Update, as shown in Table 26-2. Individuals holding the title listed in Table 26-2 will be responsible for monitoring the Plan Update on an annual basis. Plan monitoring includes reviewing the Plan and incorporating other existing planning mechanisms that relate or support goals and objectives of the Plan; monitoring the incorporation of the Plan into future updates of

SECTION 26: PLAN MAINTENANCE

other existing planning mechanisms as appropriate; monitoring team members to maintain updated contact information and ensure availability throughout the planning cycle; reviewing mitigation actions submitted and coordinating with various City departments to determine if mitigation actions need to be re-evaluated and updated; evaluating the hazards that pose a risk to the planning area and updating the risk assessment when warranted; evaluating and updating the Plan as necessary; and monitoring plan maintenance to ensure that the process described is being followed, on an annual basis, throughout the planning process. The Planning Team will develop a brief report that identifies policies and actions in the plan that have been successfully implemented and any changes in the implementation process needed for continued success. Team meetings for monitoring the plan will include a sign-in sheet to record attendance and a written summary of meeting notes will report the particulars involved in developing an action into a project. In addition to the annual monitoring, the Plan will be similarly reviewed immediately after extreme weather events including but not limited to state and federally declared disasters.

EVALUATION

As part of the evaluation process, the Planning Team will assess changes in risk; determine whether the implementation of mitigation actions is on schedule; determine whether there are any implementation problems, such as technical, political, legal, or coordination issues; and identify changes in land development or programs that affect mitigation priorities for each respective department or organization.

The Planning Team will meet on an annual basis to evaluate the Plan, identify any needed changes, and assess the effectiveness of the plan achieving its stated purpose and goals. The Team Lead, along with key team members (Table 26-2) will evaluate the team participants in the last planning cycle to determine if additional participants can contribute further areas of expertise during the current planning cycle and future updates. The team will evaluate the number of mitigation actions implemented along with the loss-reduction associated with each action. Actions that have not been implemented will be evaluated to determine if any social, political or financial barriers are impeding implementation and if any changes are necessary to improve the viability of an action. The team will evaluate changes in land development and/or programs that affect mitigation priorities in their respective areas of authority. This annual evaluation process will include an annual meeting with a sign-in sheet to record attendance and a brief report that identifies any changes that may be necessary. In addition, the Plan will be similarly evaluated immediately after extreme weather events including but not limited to state and federally declared disasters.

UPDATING

PLAN AMENDMENTS

At any time, minor technical changes may be made to update the City of Austin Hazard Mitigation Plan Update. Material changes to mitigation actions or major changes in the overall direction of the Plan Update or the policies contained within it must be subject to formal adoption by the City.

The City will review proposed amendments and vote to accept, reject, or amend the proposed change. Upon ratification, the amendment will be transmitted to the Texas Division of Emergency Management (TDEM) for review and forwarding to FEMA for final approval of amendment.

SECTION 26: PLAN MAINTENANCE

In determining whether to recommend approval or denial of a Plan Update amendment request, the City will consider the following factors:

- Errors or omissions made in the identification of issues or needs during the preparation of the Plan Update;
- New issues or needs that were not adequately addressed in the Plan Update; and
- Changes in information, data, or assumptions from those on which the Plan Update was based.

FIVE (5) YEAR REVIEW

The Plan will be thoroughly reviewed by the Planning Team at the end of 3 years from the approval date to determine whether there have been significant changes in the planning area that necessitate changes in the types of mitigation actions proposed. Factors that may affect the content of the Plan include new development in identified hazard areas, increased exposure to hazards, disaster declarations, an increase or decrease in capability to address hazards, and changes to federal or state legislation.

The Plan review process provides the City an opportunity to evaluate mitigation actions that have been successful, identify losses avoided due to the implementation of specific mitigation measures, and address mitigation actions that may not have been successfully implemented as assigned.

It is recommended that the full Planning Team (Section 2, Table 2-2) meet to review the Plan at the end of 3 years because grant funds may be necessary for the development of a 5-year update. Reviewing planning grant options in advance of the 5-year Plan update deadline is recommended considering the timelines for grant and planning cycles can be in excess of a year.

Following the Plan review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and Plan amendment process outlined herein. Upon completion of the review, update, and amendment process, the revised Plan will be submitted to TDEM for final review and approval in coordination with the Federal Emergency Management Agency (FEMA).

CONTINUED PUBLIC INVOLVEMENT

Public input was an integral part of the preparation of this Plan and will continue to be essential for Plan updates. The Public will be directly involved in the implementation, monitoring and evaluation. Changes or suggestions to improve or update the Plan will provide opportunities for additional public input.

The public can review the Plan Update on the City of Austin's website, and provide comment via email. Notification that the Plan Update is available for review and comment will be made via social media outlets.

The Planning Team may also designate voluntary citizens from the City or willing stakeholder members from the private sector businesses that were involved in the Plan's development to provide feedback on an annual basis. It is important that stakeholders and the immediate community maintain a vested interest in preserving the functionality of the planning area as it pertains to the overall goals of the mitigation plan. The Planning team is responsible for notifying stakeholders and community members on an annual basis, and maintaining the Plan.

SECTION 26: PLAN MAINTENANCE

Media, including local newspapers and radio stations, will be used to notify the public of any maintenance or periodic review activities during the implementation, monitoring, and evaluation phases. Additionally, local news media will be contacted to cover information regarding Plan updates, status of grant applications, and project implementation. Local and social media outlets, such as Facebook and Twitter, will keep the public and stakeholders apprised of potential opportunities to fund and implement mitigation projects identified in the Plan Update. Social media outlets have been successful in communicating in the past and will continue to be utilized to not only inform the public of progress but utilized to create public awareness of activities and the need for their involvement going forward.

APPENDIX A: PLANNING TEAM

Planning Team Members	1
Stakeholders	3

PLANNING TEAM MEMBERS

The City of Austin Plan Update 2021 (Plan or Plan Update), was organized using a direct representative model. An Executive Planning Team from the City of Austin, shown in Table A-1, was formed to coordinate planning efforts and request input and participation in the planning process. Table A-2 reflects the Advisory Planning Team, consisting of additional representatives from city departments that participated throughout the planning process. Table A-3 is comprised of stakeholders who were invited to provide Plan Update input. Public outreach efforts and meeting documentation is provided in Appendix E.

Table A-1. Executive Planning Team

DEPARTMENT	TITLE
Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
Office of Homeland Security & Emergency Management	Director
Office of Homeland Security & Emergency Management	Program Manager
Office of Homeland Security & Emergency Management	Assistant Director
Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
Office of Homeland Security & Emergency Management	Accountant
Office of Homeland Security & Emergency Management	Public Information & Marketing Program Manager
Office of Homeland Security & Emergency Management	Community Preparedness Program Coordinator

Table A-2. Advisory Planning Team

DEPARTMENT	TITLE
Austin Code Department	Assistant Director
Austin Fire Department	Fire Chief
Austin Fire Department	Fire Chief

APPENDIX A: PLANNING TEAM

DEPARTMENT	TITLE
Austin Police Department	Police Chief
Austin Police Department	Senior Police Officer Emergency Management Unit
Austin Police Department	Emergency Plans Officer
Austin Police Department	Emergency Plans Officer
Austin / Travis County Emergency Medical Services	Division Chief – Emergency Management
Austin / Travis County Health & Human Services Department	Chief Epidemiologist
Austin / Travis County Health & Human Services Department	Program Manager Epidemiology
Austin Water	Emergency Manager
Austin Water	Utility Emergency Management Coordinator
Communications & Technology Management	Chief Information Security Officer
Communications & Technology Management	Chief Information Officer
Communications & Technology Management	Chief of IT Operations
Communications & Technology Management	Information Security Architect
Emergency Medical Services	Division Chief
Equity Office	Chief Equity Officer
Equity Office	Business Process Specialist
Fleet Services	Assistant Director
Fleet Services	Division Manager
Office of Sustainability	Environmental Conservation Program Manager
Travis County Office of Emergency Management	Chief Emergency Management Coordinator
Watershed Protection Department	Floodplain Coordinator

APPENDIX A: PLANNING TEAM

STAKEHOLDERS

The following groups listed in Table A-3 represent a list of organizations invited to stakeholder meetings, public meetings, and workshops throughout the planning process and include: non-profit organizations, private businesses, universities, and legislators. The public were also invited to participate via e-mail throughout the planning process. Many of the invited organizations and stakeholders participated and were integral to providing comments and data for the Plan Update. For a list of attendees at meetings, please see Appendix E¹.

Table A-3. Stakeholders

AGENCY	TITLE
Ascension Seton Hospital	Project Coordinator, Emergency Disaster Preparedness
Austin Area Legislators (Senators and Representatives)	Intergovernmental Relations Officer
Austin Area Legislators	Intergovernmental Relations Deputy Officer
Austin Community College (ACC)	Emergency Management, Department Chair
Austin Community College (ACC)	District Police Chief
Austin Independent School District (AISD)	Superintendent
Capital Area Council of Governments (CAPCOG)	Director, Homeland Security
Capital Area Council of Governments (CAPCOG)	Homeland Security Planning Coordinator
Capital Area Metropolitan Planning Organization (CAMPO)	Planner
Capital Area Metropolitan Planning Organization (CAMPO)	Executive Director
Capital Area Trauma Regional Advisory Council (CATRAC)	Executive Director
Capital Metro	Chief Operations Officer
Capital Metro	VP Risk Management and Safety
Hays County EMC	Interim Director Emergency Services
Integral Care (Austin/Travis County)	Practice Administrator, Crisis

¹ Information contained in Appendix E is exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX A: PLANNING TEAM

AGENCY	TITLE
Integral Care (Austin/Travis County)	Facilities Director
Integral Care (Austin/Travis County)	Facilities Manager
Red Cross	Disaster Services Manager
Red Cross	Red Cross Disaster Program Specialist
St. Edward's University	Emergency Management, Department Chair
TDEM	Planner
Travis County EMC	Chief Emergency Management Coordinator
Travis County Medical Society	Chief Operations Officer
University of Texas	Director, Office of Emergency Preparedness
Williamson County EMC	Director / Emergency Management Coordinator

APPENDIX B: PUBLIC SURVEY RESULTS

Overview	1
Public Survey Results	2

OVERVIEW

The City of Austin prepared a public survey that requested public opinion on a wide range of questions relating to natural hazards. The survey was made available on the City of Austin’s website, Facebook posts, and Twitter. This survey link was also distributed at public meetings and stakeholder events throughout the planning process.

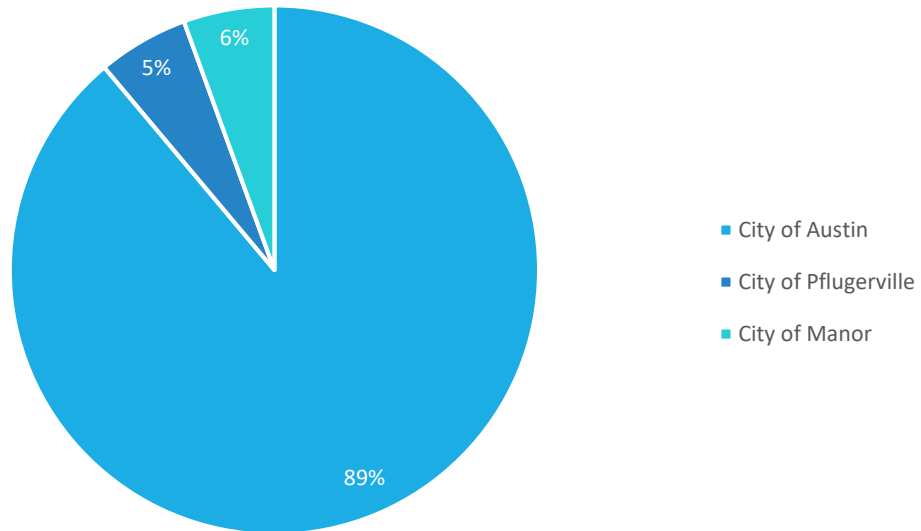
A total of 18 surveys were collected, the results of which are analyzed in Appendix B. The purpose of the survey was twofold: 1) to solicit public input during the planning process, and 2) to help the City identify any potential actions or problem areas.

The following survey results depict the percentage of responses for each answer. Similar responses have been summarized for questions that did not provide a multiple-choice answer or that required an explanation.

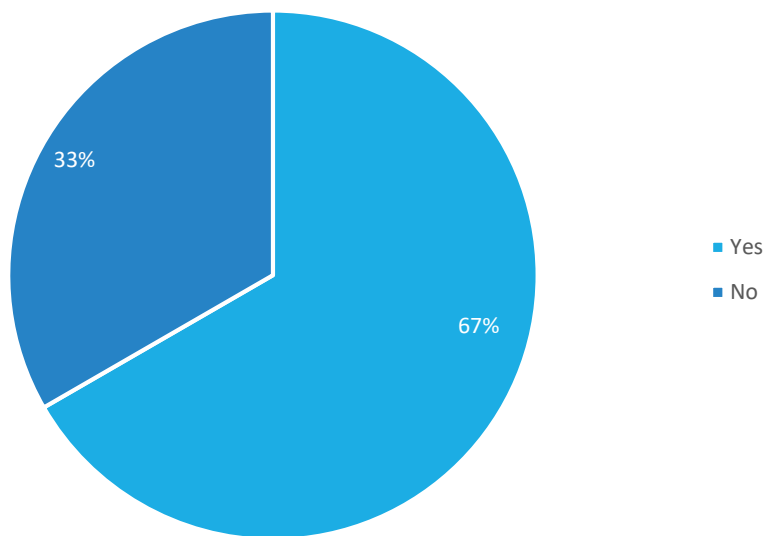
APPENDIX B: PUBLIC SURVEY RESULTS

PUBLIC SURVEY RESULTS

1. Please state the jurisdiction (city or community) where you reside.¹



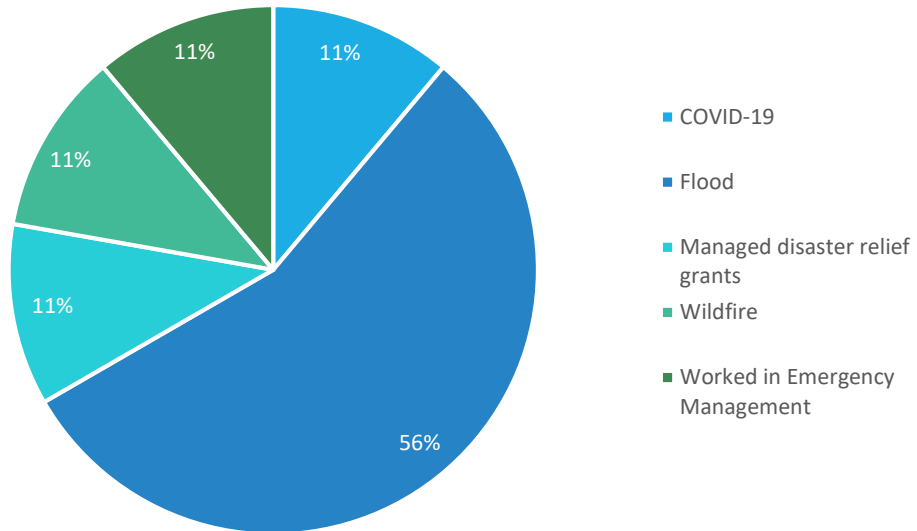
2. Have you ever experienced or been impacted by a disaster?



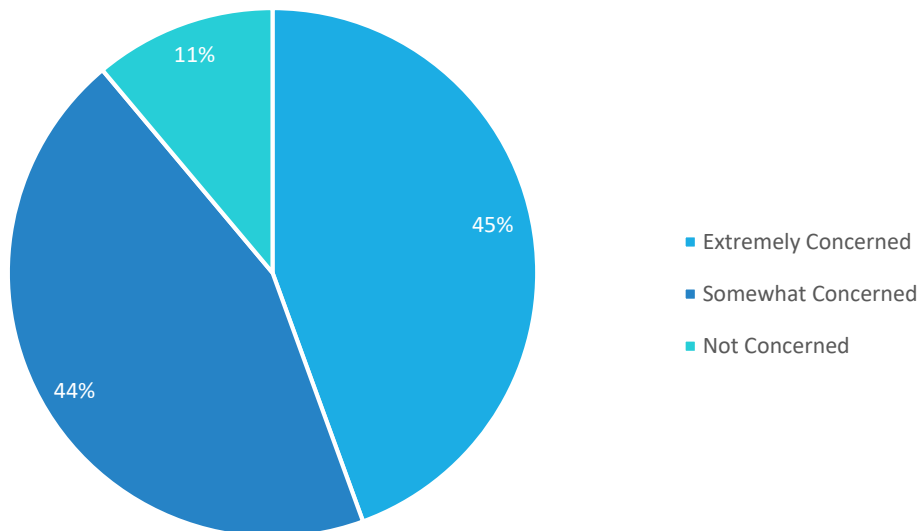
¹ The cities of Pflugerville and Manor are suburbs of the City of Austin. As the respondents may work within the City of Austin, their responses to the survey were included.

APPENDIX B: PUBLIC SURVEY RESULTS

3. If you answered "YES" to Question #2, please explain.

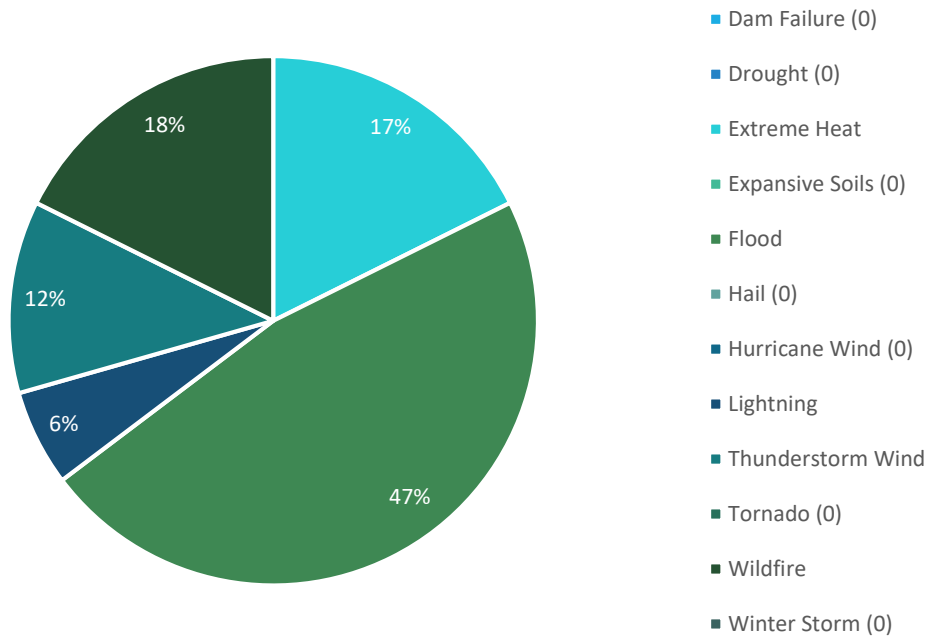


4. How concerned are you about the possibility of your community being impacted by a disaster?

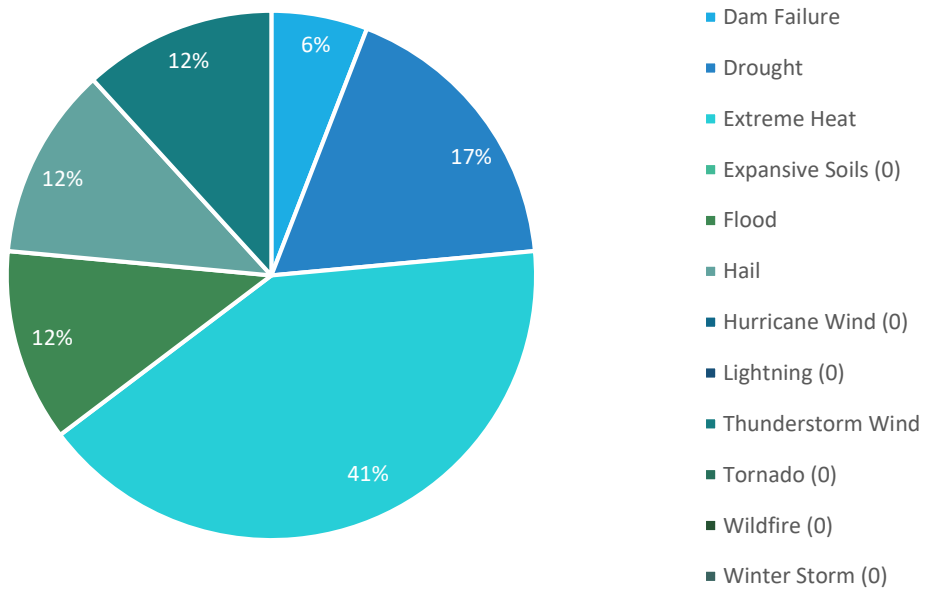


APPENDIX B: PUBLIC SURVEY RESULTS

5. Please select the one hazard you think is the highest threat to your neighborhood:

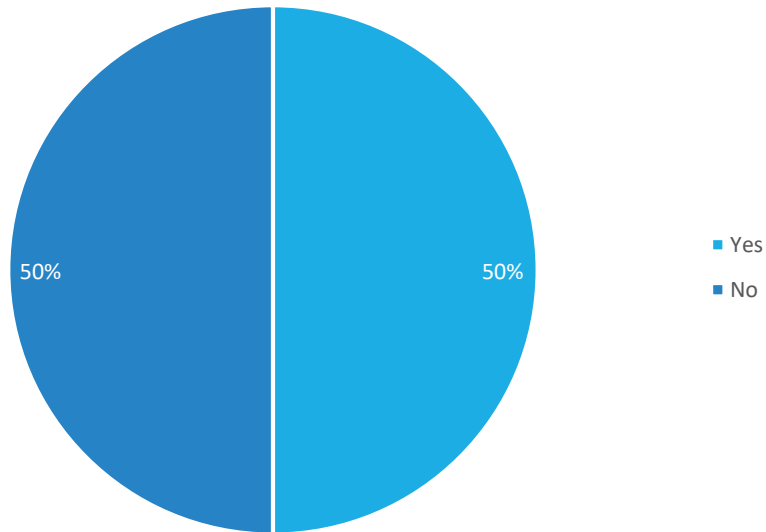


6. Please select the one hazard you think is the second highest threat to your neighborhood:

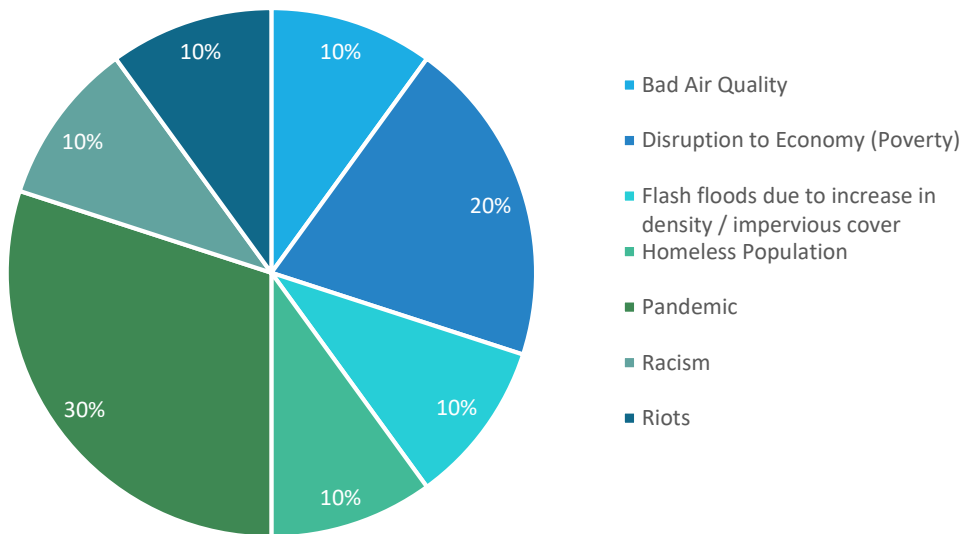


APPENDIX B: PUBLIC SURVEY RESULTS

7. Are there hazards not listed above that you think is a wide-scale threat to your neighborhood?

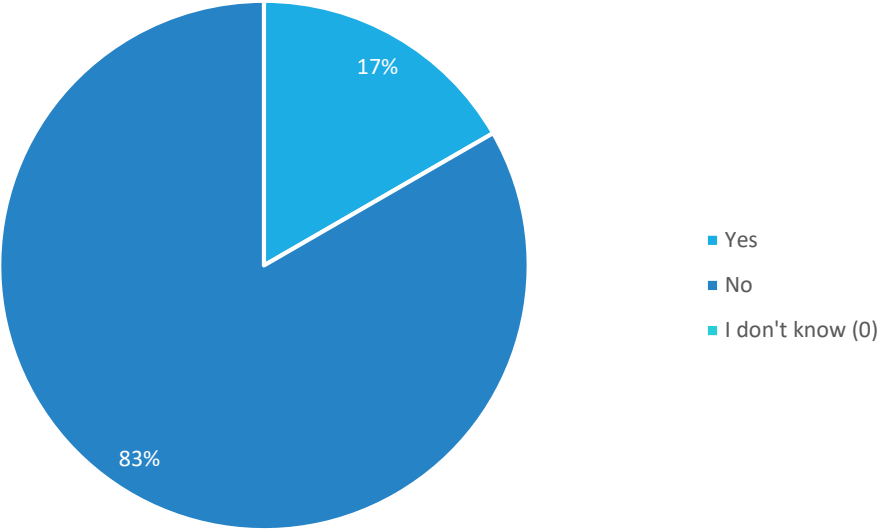


8. If you answered "YES" to Question #7, please explain.

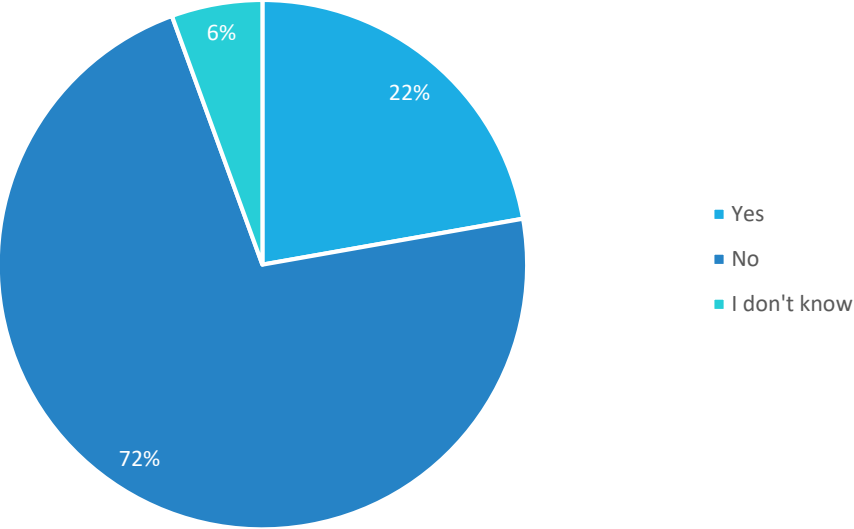


APPENDIX B: PUBLIC SURVEY RESULTS

9. Is your home located in a floodplain?

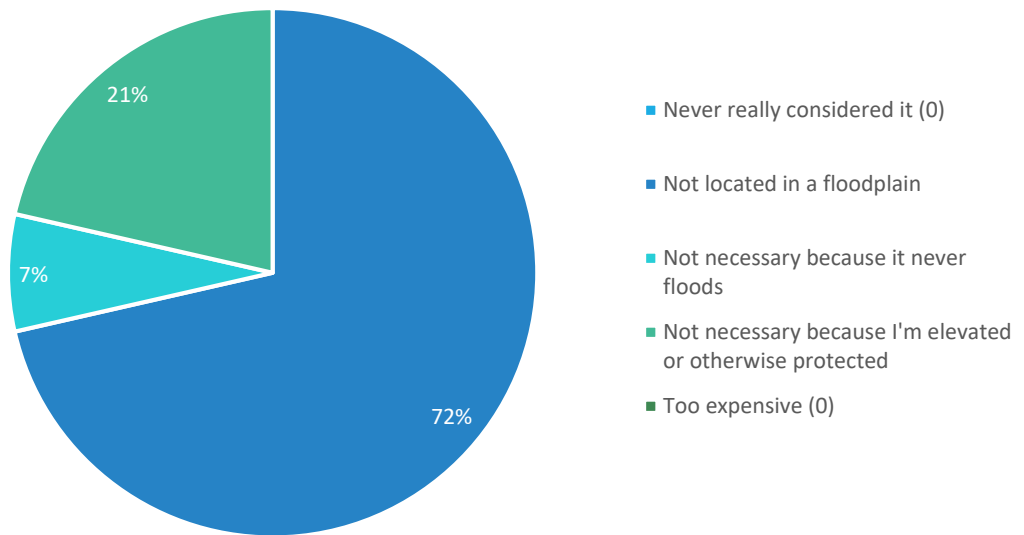


10. Do you have flood insurance?

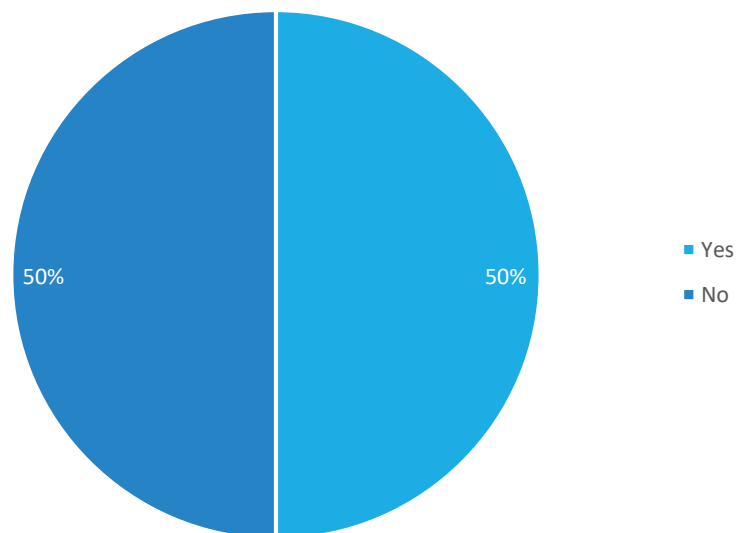


APPENDIX B: PUBLIC SURVEY RESULTS

11. If you do not have flood insurance, why not?

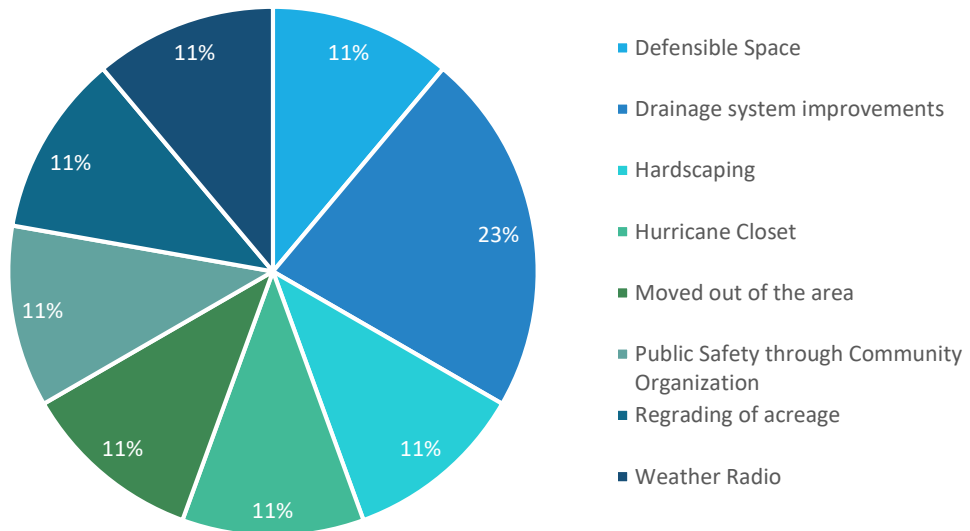


12. Have you taken any actions to make your home or neighborhood more resistant to hazards?

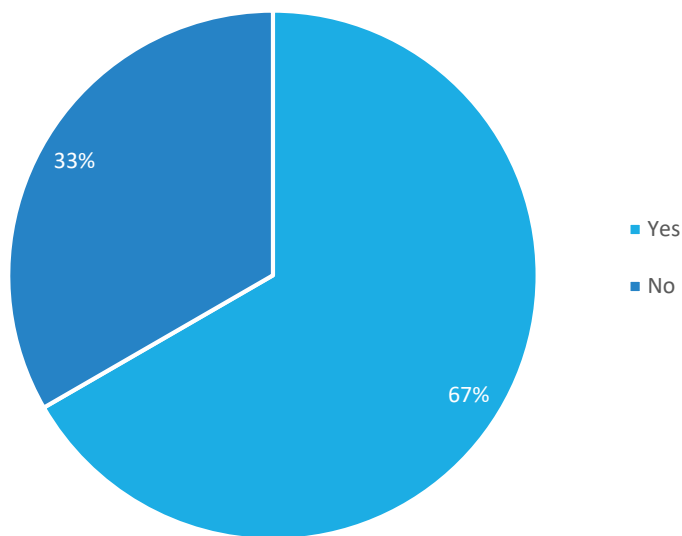


APPENDIX B: PUBLIC SURVEY RESULTS

13. If you answered "YES" to Question #12, please explain.

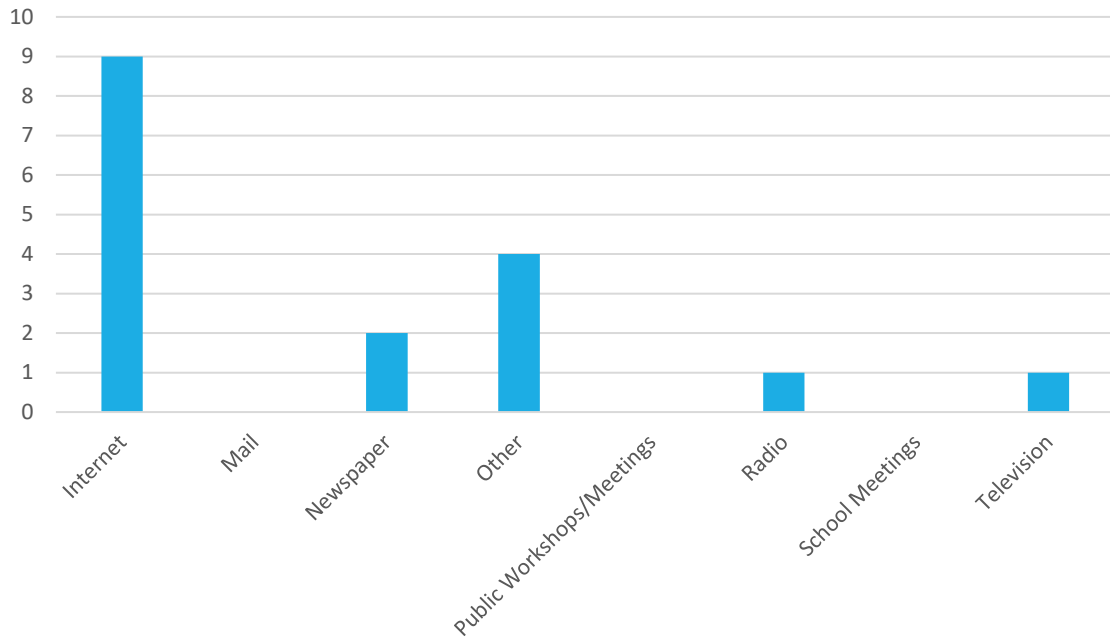


14. Are you interested in making your home or neighborhood more resistant to hazards?

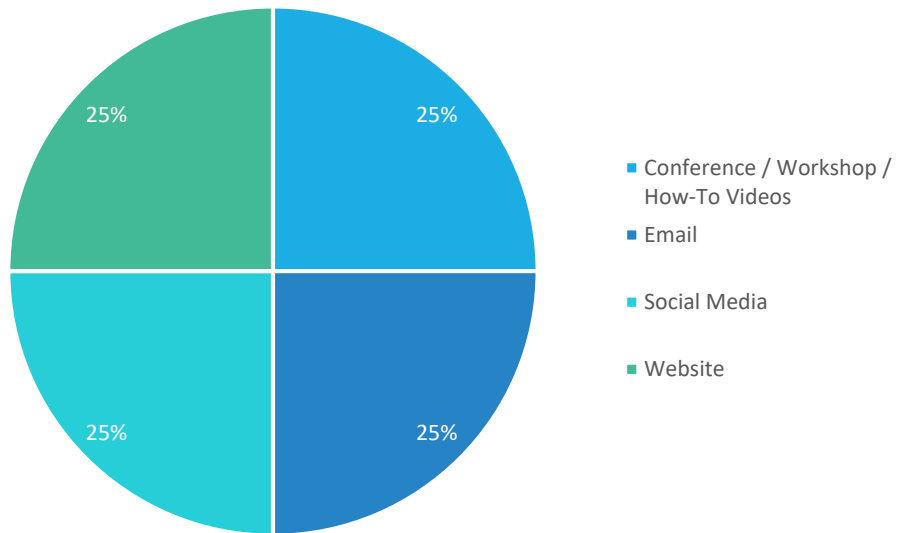


APPENDIX B: PUBLIC SURVEY RESULTS

15. What is the most effective way for you to receive information about how to make your home and neighborhood more resistant to hazards?

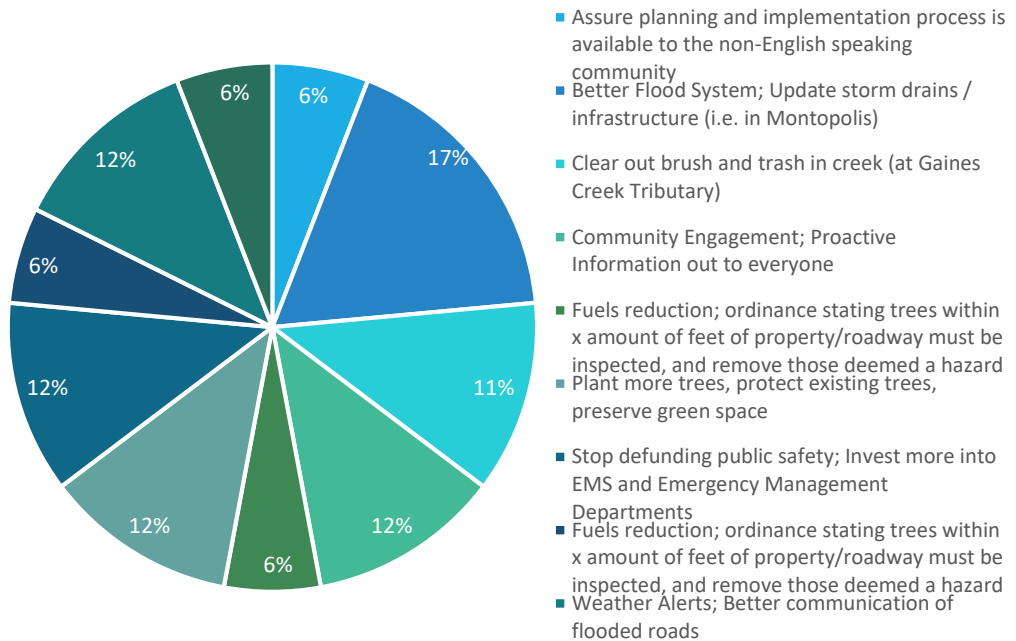


16. If you answered "Other" to Question #15, please explain.

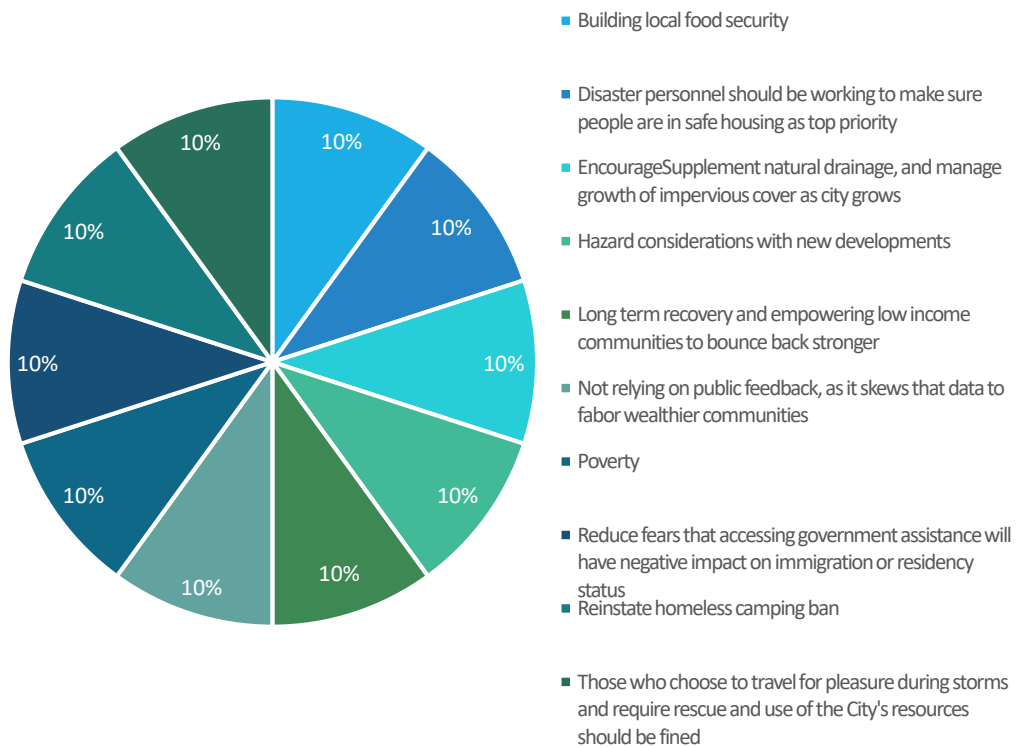


APPENDIX B: PUBLIC SURVEY RESULTS

17. In your opinion, what are some steps your local government could take to reduce or eliminate the risk of future hazard damages in your neighborhood?

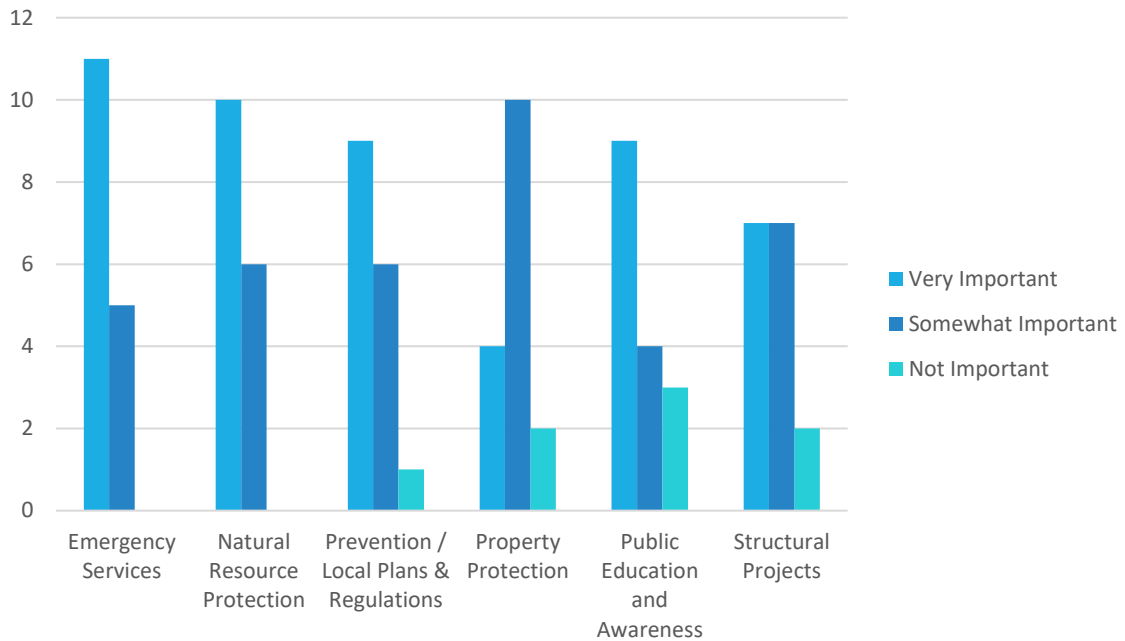


18. Are there any other issues regarding the reduction of risk and loss associated with hazards or disasters in the community that you think are important?



APPENDIX B: PUBLIC SURVEY RESULTS

19. A number of community-wide activities can reduce the risk from hazards. In general, these activities fall into one of the following six broad categories. Please tell us how important you think each one is for your community to consider pursuing.



Emergency Services - Actions that protect people and property during and immediately after a hazard event. Examples include warning systems, evacuation planning, emergency response training, and protection of critical facilities or systems.

Natural Resource Protection - Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. Examples include floodplain protection, habitat preservation, slope stabilization, riparian buffers, and forest management.

Prevention / Local Plans & Regulations - Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning and zoning, building codes, open space preservation, and floodplain regulations.

Property Protection - Actions that involve the modification of existing buildings to protect them from a hazard or removal from the hazard area. Examples include acquisition, relocation, elevation, structural retrofits, and storm shutters.

Public Education and Awareness - Actions to inform citizens about hazards and techniques they can use to protect themselves and their property. Examples include outreach projects, school education programs, library materials, and demonstration events.

Structural Projects - Actions intended to lessen the impact of a hazard by modifying the natural progression of the hazard. Examples include dams, levees, seawalls detention / retention basins, channel modification, retaining walls, and storm sewers.

APPENDIX C: CRITICAL FACILITIES

Appendix C is For **Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX D: DAM LOCATIONS

Appendix D is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX E: MEETING DOCUMENTATION

Appendix E is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX F: CAPABILITY ASSESSMENT

Appendix F is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX G: WPD 5-YEAR PROJECT LIST

Appendix G is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

APPENDIX H: CLIMATE RESILIENCE ACTION PLAN

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RESOLUTION NO. 20210610-017

WHEREAS, natural hazards in the City of Austin historically have caused significant damage, including losses of lives and property; and,

WHEREAS, in response to natural disasters and the Federal Disaster Mitigation Act (DMA) of 2000, the City of Austin developed a Hazard Mitigation Action Plan (HMAP), approved by the Federal Emergency Management Agency (FEMA) in 2004; and,

WHEREAS, the DMA and FEMA require communities to update their approved HMAP every five years to be eligible for the full range of pre-disaster and post-disaster federal funding for mitigation purposes; and,

WHEREAS, the City of Austin has assessed the community's potential risks and hazards and has updated the HMAP in 2010 and 2016 after its original adoption in 2004; and,

WHEREAS, FEMA has approved this year's Plan Update and adoption by the City of Austin is necessary to request pre- and post-disaster federal funding; and,

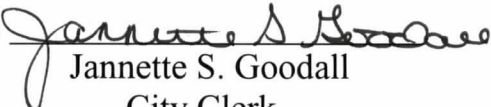
WHEREAS, the Plan Update outlines mitigation goals and objectives and identifies risk reduction strategies and actions for hazards that threaten the community; **NOW, THEREFORE**,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

1. The City of Austin's Hazard Mitigation Plan Update is approved in its entirety;

2. The City of Austin will pursue available funding opportunities for implementation of the proposals designated therein, and will, upon receipt of such funding or other necessary resources, seek to implement the actions contained in the mitigation strategies;
3. The City of Austin agrees to take such other action as may be reasonably necessary to carry out the objectives of the Plan Update and report on progress as required by FEMA and the Texas Division of Emergency Management (TDEM);
4. The City of Austin will continue to update disaster mitigation strategies between this adoption and the next planned update five years from now to ensure a more disaster resilient community.

ADOPTED: June 10, 2021

ATTEST: 
Jannette S. Goodall
City Clerk